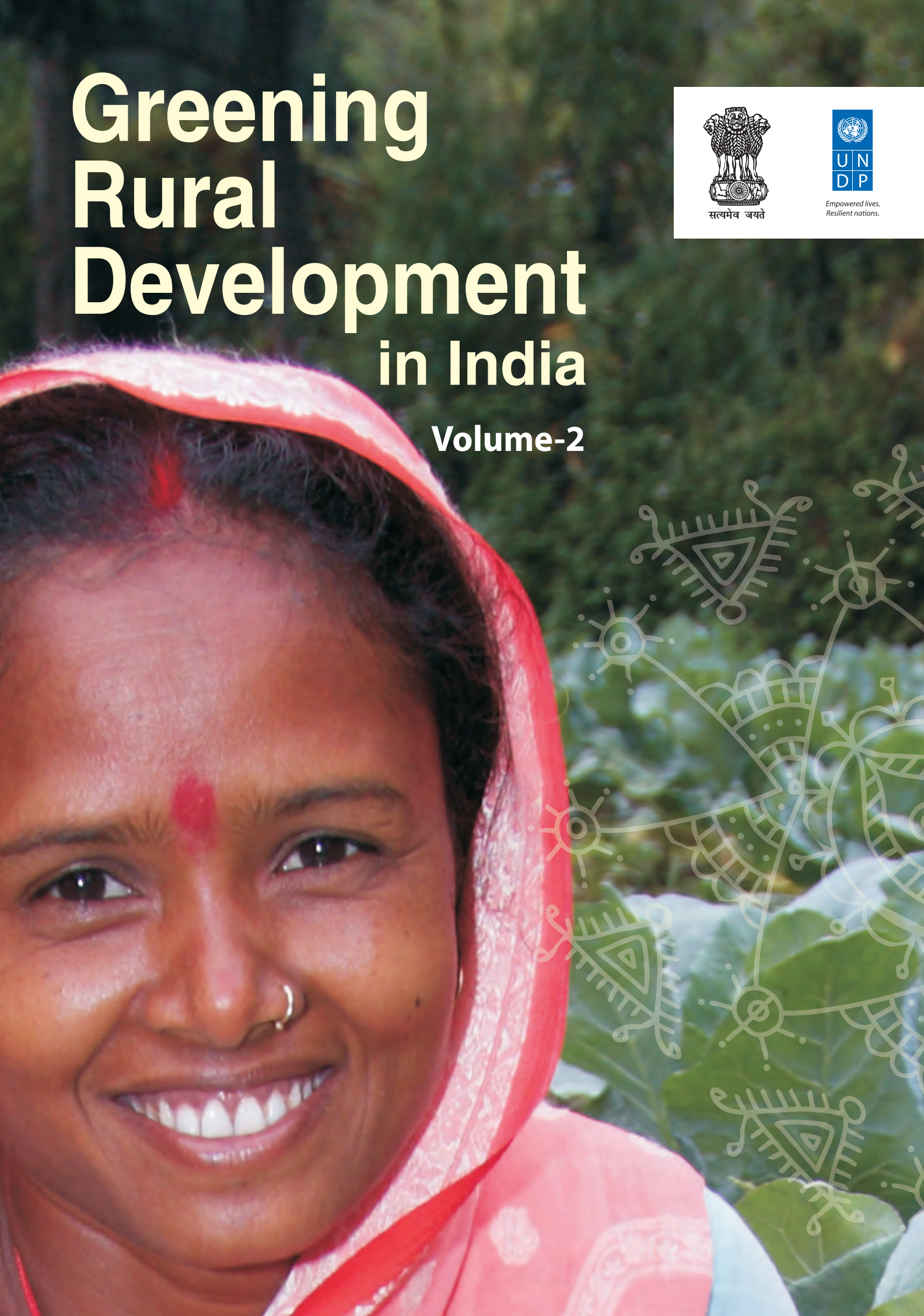
Greening Rural Development in India

Volume-2



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Greening Rural Development

Vol. 2

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Prepared by

N H Ravindranath and Indu K Murthy

Centre for Sustainable Technologies
Indian Institute of Science
Bangalore – 560 012

GREENING OF MGNREGS

1. Introduction

The Mahatma Gandhi National Rural Employment Guarantee Act aims at enhancing the livelihood security of people in rural areas. It guarantees hundred days of wage-employment in a financial year to a rural household whose adult members volunteer to do unskilled manual work. The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) is a very important rural development programme and has multiple goals; providing guaranteed employment and wages is the most critical element of the programme. Greening rural development is necessary to address poverty and ensure sustained development. Large investments in MGNREGS leading to conservation and regeneration of natural resources (such as soil, water and forests) and sustaining crop, livestock and forest production could contribute to sustained employment and livelihood generation in rural areas. In the context of greening MGNREGS, the focus should be on "conserving natural resources and sustaining production systems in rural areas". In this report, the terms natural resources, production systems, green outcomes or environmental/ecosystems services are used to refer to the following and are generally limited in scope.

- Natural resources include : soil, cropland, grazing land, common lands, forests, streams, surface water bodies, and groundwater
- Production systems include : crop, livestock, agro-forestry, forest, and fisheries
- Green outcomes/Environmental or Ecosystem services refers to delivery of services or outcomes leading to conservation and restoration of natural resources and sustained production systems (crop, livestock and forest)

This report aims at exploring the evidence, potential and options for greening MGNREGS. MGNREGS is one of the largest employment guarantee and social security programmes in the world. Preliminary evidence is emerging from a few studies, which show that MGNREGS is already generating green outcomes (Tiwari et al., 2011 and MoRD, 2012). Investment in MGNREGS has the potential to lead to green outcomes, sustained employment and livelihood generation. In this context, the report aims to address the following:

i) Describe the rationale and scope for greening MGNREGS

ii) Assess the evidence of green outcomes from MGNREGS works

iii) Present an approach for greening MGNREGS

iv) Suggest a strategy for promoting, enhancing and monitoring green outcomes from MGNREGS

2. MGNREGS : Features in the Context of Greening

The Mahatma Gandhi National Rural Employment Guarantee Act, 2005 was notified on 7 September 2005. The mandate of the Act is to provide 100 days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work. All details regarding MGNREGS can be obtained from http://nrega.nic.in/netnrega/home.aspx.

The key features of MGNREGS include:

- Bottom-up, people-centred, demand-driven, self-selecting, rights-based programme
- Provision of work is triggered by the demand for work by wage-seekers
- Provision of a legal guarantee of wage employment
- Planning at the local level is the basis of implementation; panchayats are key players

- Monitoring of all works and applications are carried out by gram sabhas; contractors are strictly not employed
- Legal provisions for allowances and compensation both in cases of failure to provide work on demand and delays in payment of work undertaken

The Act was initially notified in 200 districts in the first phase with effect from February 2006 and, subsequently extended to an additional 130 districts during 2007-08. The remaining districts were notified with effect from 1 April 2008. Thus, today MGNREGS covers the entire country with the exception of districts that have a 100 percent urban population. Of the nine identified areas of works under the MGNREGS during Phase I, seven focused on water and soil conservation:

i) Water conservation and water harvesting

ii) Drought proofing (including afforestation and tree plantation)

iii) Irrigation canals (including micro and minor irrigation works)

iv) Provision of irrigation facility to land owned by households belonging to Scheduled Castes and Scheduled Tribes or to beneficiaries of land reforms or that of beneficiaries under the Indira Awas Yojana of the Government of India

v) Renovation of traditional water bodies (including desilting of tanks)

vi) Land development

vii) Flood control and protection works (including drainage in water-logged areas)

viii) Rural connectivity to provide all-weather access

ix) Any other work, which may be notified by the Central Government in consultation with the State Government

Additional works have been identified for Phase II of MGNREGS that include : rice cultivation using the system of rice intensification, soil conservation activities, production of manure and bio-pesticides, construction of seed-storage bins and shelters for cattle and poultry; developmental works such as rural water supply and sanitation, area-focused activities like fish-drying yards and storm-water drains for coastal areas.

2.1 Rationale for Greening MGNREGS

As the largest employment and livelihood generation programme in the world. MGNREGS requires conservation, reclamation of natural resources and sustained production systems. Greening MGNREGS is needed because:

- Investment in MGNREGS is large and this can be channelled into enhancing the quality and productivity of production systems and natural resources. This could help achieve other MGNREGS goals such as water security and drought proofing in addition to sustained employment generation, which are mandated in the Act.
- MGNREGS could provide multiple local and global green outcomes or environmental services (see table 1). Greening could lead to increased area under crops, irrigation and cropping intensity, leading to increased crop production and processing of increased annual and horticultural crops, thus generating additional employment. Furthermore, MGNREGS works under land development and drought proofing including land reclamation, agro-forestry and afforestation could further lead to increased production of fruits, Non-Timber Forest Products (NTFPs) and grass, in turn leading to increased incomes and livelihood.

- It could increase crop, livestock, forest and horticulture production through increasing the productive capacity of cropland, grassland and forest land and generate sustained employment. This could potentially make investment in MGNREGS in the long-term redundant.
- Greening MGNREGS leads to increased efficiency or productivity of land (e.g. increased soil fertility) and more rain water (irrigation water availability for rainfed crops and groundwater recharge).
- It has the potential to reduce the vulnerability of crop production systems and rural communities to climate risks and increase their resilience (e.g. through improved soil fertility and water holding capacity, increased irrigation, agro-forestry and grassland reclamation can increase, diversification and sustained crop production and employment).
- There is also the potential to promote equity. For instance, implementation of MGNREGS works on community resources such as streams, irrigation tanks and forests can generate employment opportunities and access to water, products and services to the landless and poor.
- Greening MGNREGS can deliver global environmental benefits such as carbon sequestration to mitigate climate change (e.g. land development leading to afforestation or agro-forestry or increased soil organic matter).

Table1: Potential Green Outcomes and Environmental Services from MGNREGS

MGNREGS Works	Local Environmental Services	Regional and Global Environmental Services	Green Outcomes
Water conservation and harvesting	1. Groundwater recharge 2. Soil moisture retention and protection 3. Flood control (reduced risk) 4. Provisioning irrigation 5. Drinking water supply 6. Improved soil quality	Protection of river basins, regional flood control	Leads to increased water availability on a sustainable basis, leading to better crop productivity.
Irrigation provisioning and improvement	1. Provisioning of irrigation for crops 2. Increased crop production	Carbon sequestration in soil	Leads to increased water availability and irrigation, improved soil fertility, improved soil water holding capacity, increased area under crops and cropping intensity, which in turn could lead to increased and sustained food production.
Renovation of traditional water bodies	1. Improved water storage capacity 2. Irrigation water availability 3. Groundwater recharge 4. Soil quality improvement 5. Increased crop production	Carbon sequestration in soil and biomass	Leads to increased water availability for irrigation, in turn leads to better crop and forest productivity and biomass availability.
Land development	1. Land reclaimed for agriculture and grazing 2. Improved irrigation availability, hence agriculture and livelihood improvement	Halting land degradation and desertification	Potential to generate increased crop, livestock and forest production, indirectly leading to increased employment and income generation on a sustainable basis.

Drought proofing	1. Soil moisture retention 2. Soil protection (erosion control) 3. Soil quality (nutrient cycling) 5. Biomass and NTFP production	Carbon sequestration, biodiversity conservation and land reclamation	Leads to increased water availability for crop production, thereby reducing the vulnerability of crop production to rainfall deficit or drought. Also leads to production of non-timber forest products in case of afforestation, providing alternate livelihoods, which in turn will reduce the vulnerability due to crop failures.
Flood control	1. Groundwater recharge 2. Soil moisture retention and protection	Regional flood control	Leads to increased water availability and in turn crop productivity.

3. MGNREGS and Green Outcomes: Evidence from the Field

Though MGNREGS is such a large programme and over six years old, an evaluation of what has worked, how and why is lacking (CSE, 2011). MGNREGS works have shown to improve or help in conserving the resource base, but rarely has there been an attempt to quantify these (Tiwari et al., 2011; MoRD, 2012). However, budgetary support has been increasing for public works programmes despite any attempts to estimate or analyse the impact these programmes have had; particularly an appraisal of the assets created, or their maintenance (CSE, 2011). A focus on assets creation is relevant to local needs and could be used to create sustainable livelihoods or as CSE (2011) concluded "facilitate the use of ecology for economy".

3.1. Green Outcomes from MGNREGS Works

The activities under MGNREGS works are largely linked to water, soil and land and thus have the potential to impact these natural resources positively or negatively, affecting their ability to provide green outcomes as well as impact production systems. Natural resources such as cropland, grassland, forests and water sources (streams and groundwater) are known to be subjected to degradation and loss. There is a need to understand the impacts of MGNREGS works on natural resources, production systems and their vulnerability to climate risks. In this section, we review and summarise the evidence available on the impact of MGNREGS works on generating green outcomes.

Impact of MGNREGS Works on Water Availability for Irrigation

Since MGNREGS began, over 50 percent of the activities carried out have been related to water through works such as water conservation, flood control, irrigation, drought proofing, renovation of traditional water bodies and micro-irrigation.

A study by Tiwari et al. (2011) in Chitradurga district of Karnataka reports that check dams built under MGNREGS have improved water percolation by 1,000-2,800 cubic metres a year, thereby improving the groundwater recharge by 24 percent in the watershed. Similarly, desilting, has led to about 30 to 77 percent increase in groundwater levels. This, in turn, has increased the area under irrigation.

A discussion paper by UNDP (2010) concluded that assets created under MGNREGS have been conducive to the geographical-ecological environment and have contributed towards natural resource regeneration. According to this report, 78.6 percent of the respondents agreed that MGNREGS has led to increased water availability and a positive impact on agriculture through improved access to irrigation. This has led to crop diversification and farmers have been able to switch from single to double crop cultivation. Furthermore, an increase in the net irrigated area in sample districts has been reported; around 55 percent of the respondents reported an increase in crop area of about 150 ha. The study notes

that Sidhi, in Madhya Pradesh, a predominantly hilly terrain with significant forest cover, has been able to address its problem of water resources management and poor access to groundwater sources through MGNREGS. Construction of ponds, tanks and wells on Scheduled Castes & Scheduled Tribes (SC&ST) land through MGNREGS has led to improved irrigation facilities.

A study by the Madhya Pradesh Institute of Social Science Research (2011) reports that about 74 percent of beneficiaries in five districts of Madhya Pradesh have stated that dug wells under MGNREGS have increased the irrigated area and saved crops from water scarcity. In Khargone district of Madhya Pradesh, an increase in duration of surface water level flow and availability by an additional two to three months and a subsequent increase of 400 ha of irrigated area was reported to be the impact of desilting and check dam construction (MoRD, 2012).

Kareemulla et al. (2009) report that in the drought-prone district of Anantpur, Andhra Pradesh, 76 percent of the surveyed water conservation structures were being used for irrigation, water conservation and groundwater recharge.

A study by Verma (2011) in Rajasthan assessing the impact of stone bunds (anaicuts) in Rajasthan reports enhanced groundwater recharge and subsequent increase in water levels by 10 to 40 feet, as a result of construction of wells. The study also reports about 26 ha being irrigated as a result of this MGNREGS activity. Verma (2011) also reports the promotion of commercial crops such as ginger and sugarcane as a result of renovation and construction of ponds under MGNREGS that led to increased water availability in Kerala.

A sample perception-based survey of 200 households in Maharashtra reports an increase in groundwater level as a result of MGNREGS activities as conveyed by about 40 percent of the respondents (UNDP, 2010).

The Centre for Research in Rural and Industrial Development (CRRID) conducted a study to assess the impacts of MGNREGS in three districts of Haryana, Himachal Pradesh and Punjab (CRRID, 2009). An average of 46 percent respondents from these three districts reported that MGNREGS activities such as land development, which includes land levelling, terracing and bunding, provided benefits to small and marginal farmers in the region, besides providing employment. Similar reports are available from several other districts, notably from Andhra Pradesh, Kerala, Madhya Pradesh, Rajasthan and Tamil Nadu where local innovations have emerged from converging MGNREGS works with other development works.

Impact of MGNREGS Works on Agriculture

Cropping pattern: Impact on water availability as a result of MGNREGS works has implications for agriculture, in its cropping pattern, intensity and productivity.

In Madhya Pradesh, the implementation of the Kapildhara scheme – a convergence between MGNREGS, agriculture and horticulture departments - has led to perennial water availability across the agricultural seasons in about 70 percent of the cases across Betul, Jhabua, Rajgarh, Sidhi, Betul, Jhabua and Shivpuri districts. In Ujjain and Dhar districts, an increase of about 26 and 19 percent has been reported respectively, while in Chhindwara and Panna districts, the increase is still higher at 35 and 30 percent, respectively. The extended and increased availability of groundwater for irrigation has resulted in changes in cropping patterns and increased crop area in Sidhi district (IIFM, 2010). Fifty-five percent of sampled households reported an increase in crop area of about 150 ha, and 56 percent reported crop diversification with increased water availability.

The Indian School of Women's Studies Development (ISWSD, 2006) conducted an assessment of MGNREGS in Karnataka (Bidar and Davangere districts), Kerala (Palakkad and Wayanad districts), Uttar Pradesh (Mirzapur and Gorakhpur districts) and Jharkhand (Godda and Saraikela Kharsawan districts). This study reports that works under MGNREGS have stabilised existing cropping cycles through the timely provision of water as well as increased gross cropped area by retaining enough soil moisture and irrigation water for a second or even a third crop.

Crop productivity: MGNREGS works could contribute to increased crop productivity from improved irrigation and soil fertility and land development.

In Betul and Mandla districts of Madhya Pradesh, crop yield increased by 1.5-3 tons/ha for irrigated kharif crops and by 0.7-1.5 tons/ha in rainfed areas (Babu and Reddy, 2011). Similar trends of increased crop productivity are reported from a few panchayats of Haryana, Himachal Pradesh and Punjab where a 75 percent increase in Sirmaur and 62 percent increase in Sirsa have been recorded, after MGNREGS works (Bassi et al., 2011).

Renovation of micro-canals under MGNREGS contributed to improved irrigation and a corresponding increase in crop productivity by 6-15 percent (Verma, 2011) in Bihar while in Kerala, ponds utilised as secondary sources of irrigation in addition to wells, bore wells and canals led to increased rice and coconut yields.

In a study of 640 households in four districts of Madhya Pradesh and Rajasthan, a positive growth rate in agricultural productivity of 1-12 percent was reported in three districts. The impact is reported to be directly attributable to water-related MGNREGS works and structures (UNDP, 2010).

With improved irrigation resulting from improved groundwater recharge and percolation as a result of MGNREGS works, agricultural productivity is likely to increase. Such impacts have been reported from studies conducted in Andhra Pradesh, Chhattisgarh, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh and Punjab (MoRD, 2012).

Impact of MGNREGS Works on Soil Quality and Carbon Sequestration

The Chitradurga study by Tiwari et al. (2011) concludes that silt application on cropland has led to a two to three fold increase in organic carbon content in cropland soils. Similar impact was also reported from Chittoor in Andhra Pradesh, where silt application on about 14,568 ha of degraded land led to improved soil fertility in terms of soil nutrients (UNDP, 2010). The study by Tiwari et al. (2011) has also projected a large increase in carbon stocks in afforested areas in select villages of Chitradurga district.

Vulnerability Reduction to Climate Risks Through MGNREGS

Tiwari et al. (2011) based their vulnerability assessment on the following indices:

i) Water vulnerability index: In two of the study villages, there was significant reduction in water vulnerability as a result of check dam construction and desilting of tanks under MGNREGS.

ii) Agriculture vulnerability index: Improved water resources, increase in irrigated area and silt addition to cropland contributed to significant reduction in vulnerability of agriculture to climate variability.

iii) Livelihood vulnerability index: Significant reduction in livelihood vulnerability was reported in the villages studied as a result of employment and additional income generation because of MGNREGS activities.

iv) Overall vulnerability index: No negative impact as a result of MGNREGS activities was reported from any of the study villages. Positive impacts are significant in a few while it was not so visible in others.

A perception-based study by CSE (2008) in Sidhi and Nuapada districts of Madhya Pradesh reported 79 percent and 15 percent of respondents attributing increase in water availability to reduction in vulnerability of production systems to climate variability.

Water-related MGNREGS works such as water conservation, water harvesting and desilting of tanks that lead to improved water storage, percolation and groundwater recharge are most critical to reducing vulnerability.

There is limited evidence on the environmental implications of rural employment generation schemes from outside India. Employment generation schemes and rural development programmes implemented in other countries have shown to improve agricultural productivity and regenerate natural resources,

thus improving the environment substantially. For example, the main objectives of the Food for Work scheme implemented in Ethiopia include rehabilitation of forests, grazing and agricultural lands, through land terracing, tree plantation and other improvements to farmers' own land. Activities are designed to increase future crop yields by reducing land degradation, and thereby improving food security (IDS, 1999).

3.2. Factors Contributing to Delivery of Green Outcomes

As seen from various aforementioned studies, factors contributing to the delivery of environmental services and green outcomes include :

- Focus of MGNREGS works on natural resources such as streams and irrigation tanks
- Targeted focus of MGNREGS works on community resources such as streams, irrigation tanks, community-degraded and grazing lands and forests
- Bottom-up decision making process by gram sabha and gram panchayat

However, so far there have been no dedicated efforts to generate green outcomes, though green outcomes often accrue as an added benefit of the employment generation programme.

3.3. Limitations of MGNREGS Implementation : Approach and Procedures in Delivering Green Outcomes

The general focus of MGNREGS has been to create 100 days of employment for all those who demand work. There is limited evidence of the consideration of green outcomes in selecting MGNREGS works as well as monitoring its impacts. Some of the limitations are :

- Lack of information on natural resources, and its status at the village level and factors contributing to degradation of natural resources
- Decision making by gram sabha based on limited knowledge or information on status of natural resources, suitability of MGNREGS works and implications for natural resources, food production systems, biodiversity and employment
- Lack of training and capacity to generate access, interpret and use information, knowledge and technological options in decision-making
- Lack of information and access to technical information and good practices (such as soil and water conservation, biodiversity promotion and conservation, etc.)
- No monitoring and information flow to gram panchayats and gram sabhas regarding the status of natural resources
- Lack of maintenance of the structures created under MGNREGS, and delivery of desired outputs, including green outcomes
- Lack of guidelines aimed at generating or enhancing green outcomes synergistically with employment generation

4. Criteria for Enhanced Delivery of Green Outcomes from MGNREGS Works

4.1. What greening MGNREGS should not be?

MGNREGS is a rights-based programme, different from the other developmental programmes designed at the national, state or district levels. It is also implemented through a target approach, with a dedicated annual budget allocation and a large administrative setup. There is a need for recognizing what MGNREGS should not be before defining the principles of what MGNREGS should be :

Box 1: What MGNREGS should not be?

I. Not a top-down programme such as watershed development where interventions are driven by development administrators or technologists with large bureaucracy and organizational structure

II. Not guided by stringent centralized guidelines and norms

III. Should not focus on physical infrastructure such as roads, bridges and buildings with exceptions

IV. Should not support only construction of structures, excluding its maintenance (e.g. check dams and forests)

V. Should not lead to degradation of natural resources (e.g. increasing soil erosion)

VI. Should not be target-oriented with fixed activities, budget and timelines

VII. Districts and Panchayats should not be burdened with achieving green outcomes or overloaded with the existing guidelines and norms

4.2. Criteria for Greening MGNREGS

Principles of any approach or strategy to generate green outcomes from MGNREGS works would require multiple elements consisting of institutional arrangements, technical and financial inputs, and delivery of socio-economic benefits accruing from them. The most important element of greening is that it should lead to *conservation of natural resources and sustaining production systems*, ultimately leading to sustained employment and livelihoods. However, there are some additional elements required to ensure green outcomes and they are presented below:

i) **Provide Access to Information:** Information needs include; extent, status and trends of soil, water and forest resources; factors contributing to degradation of natural resources, impacts of MGNREGS works. Providing access to knowledge and information on village resources, MGNREGS works, impacts on food production, water supply, etc., and factors determining such impacts can assist communities in making the right selection of works, leading to conservation of natural resources and sustaining production systems.

ii) **Technical Inputs:** Technical inputs could include engineering drawings for construction of an irrigation tank, check dam, and soil conservation structures. These may be required for some activities, to ensure delivery of benefits, such as a check dam at an appropriate location and scale for conserving soil and storing water.

iii) **Monitoring, Evaluation and Feedback to Decision-making:** This includes assessment of green outcomes such as conservation of soil, water and biodiversity; groundwater status, enhanced soil structure and fertility. M&E of green outcomes helps in making mid-course correction as well as improved maintenance of the structures or forests, leading to green outcomes such as conservation of water, soil and biodiversity.

5. Approach and Steps for Greening MGNREGS

MGNREGS works have shown to generate green outcomes according to the evidence from a few small-scale field studies (Tiwari et al., 2010; CRRID, 2009, MoRD, 2012). MGNREGS is a large programme implemented across thousands of villages and thus it is not clear if MGNREGS is delivering green outcomes everywhere. Further, there is a need for enhancing green outcomes and avoiding any negative impacts on environment; local or global. The approach to generating green outcomes should include the elements of criteria discussed in Section 5.2., and should avoid elements listed in Box 1. The following approach is suggested for generating and enhancing green outcomes from MGNREGS works without compromising on the unique features of MGNREGS.

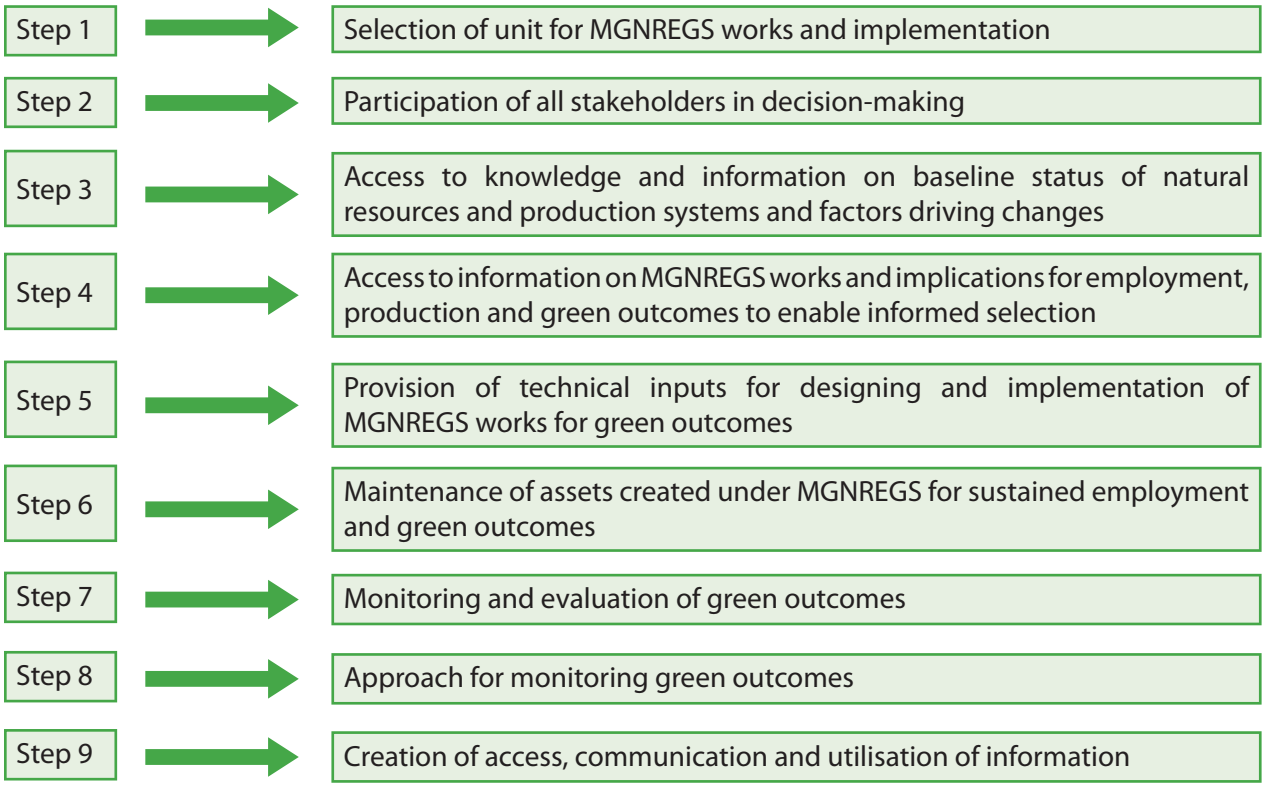


Figure 1: Approach and steps for generating green outcomes from MGNREGS works

The approach to greening should be based on some of the principles derived from four foundational approaches as suggested by MoRD (2012a) and integrated natural resource management principles.

i) Watershed development

ii) Sustainable groundwater management

iii) Flood protection and drainage management

iv) Creation of sustainable livelihoods

However, **MGNREGS should not become a programme that is top-down, guideline driven requiring large technical inputs and participation of technical bureaucracy**, as in the case of watershed programmes.

Steps 1 and 2 are already enshrined in the current guidelines for implementation of MGNREGS. Here we detail additional steps to ensure delivery of green outcomes.

Step 3: ***Access to knowledge and information on baseline status of natural resources and production systems and factors driving change***

The information and data required on natural resources and production systems that would facilitate selection of MGNREGS works and delivery of economic benefits and green outcomes is presented in Table 2.

Table 2: Illustration of knowledge and information required

Context	Natural Resource and Production Systems	Information Required
Natural Resource	Land-use systems	Map of extent and spatial spread and trends of area under different land uses; cropland, grazing land, forest land, etc.
	Cropland soil	Extent, soil structure (sand, silt, clay), soil fertility (organic matter and nitrogen), slope, soil erosion, area irrigated, agro-forestry systems
	Water bodies	Sources, extent, groundwater level, storage capacity of tank, seasonality of water availability, siltation level of water bodies
	Grazing land	Extent, slope, soil erosion, soil fertility, vegetation status, grass availability
	Forest	Extent, species composition, biodiversity, biomass stock, growth rate, flow of products
Production System	Crop production	Crops grown, crop yields, seasonality, crop intensity, crops irrigated
	Livestock production	Composition, breeds, products (milk and meat), yield, grass availability from grazing land and fodder from cropland
	Forest production	Forest products, collection, utilisation, seasonality
	Fisheries	Composition, yield, seasonality

Information and data is required to:

- Take decisions on the type of MGNREGS works to be undertaken. For example, data on declining groundwater table or silting of water bodies and soil erosion would help prioritise MGNREGS interventions aimed at conserving soil and moisture. Similarly, data on shortage of fuelwood for cooking and grass for livestock would enable decisions on improving forest and grassland resources. Further, spatial maps of land use trends over the years may show encroachment of irrigation tank area or community forests or grasslands, which may enable selection of MGNREGS works aimed at restoration of irrigation tanks and forest area.
- Establish a baseline or a benchmark for MGNREGS interventions.
- Monitor the impacts of MGNREGS works and interventions.
- Assist in decisions on maintenance of structures created.

Step 4: *Access to information on MGNREGS works and implications for employment, production and green outcomes to enable informed selection*

In Step 3, the utility of information on the status of natural resources and production systems in guiding selection of MGNREGS works is presented. There is a need for additional information on MGNREGS works and implications of implementation of works with regard to:

1. ***Employment generation potential:*** How many person-days of employment will be generated by the work or for a given level of investment and in which season?
2. ***Implications for natural resource and production systems***
   - Which natural resource or production system will be addressed by the work?
   - What will be the impact on natural resources or production systems?

3. ***Information on traditional and modern technical practices for generating green outcomes:*** There is a need to prepare educational materials such as brochures, posters and computer graphics to provide information to panchayats and gram sabha on the potential of different MGNREGS works to deliver green outcomes. It is important to recognize the green outcome potential of:
   - Traditional practices of soil and water conservation, crop cultivation and forestry, etc.
   - Modern technologies and practices of soil and water conservation, crop cultivation and forestry, etc.

Step 5: ***Provision of technical inputs for designing and implementation of MGNREGS works for green outcomes***

Not all MGNREGS works or interventions would require external technical inputs from development departments such as agriculture, irrigation, and forestry. It is desirable to minimize dependence on external technical inputs. However, technical inputs may be required for designing, implementation and maintenance of structures aimed largely at soil and water conservation and enhancing water storage capacity. Technical inputs will enable making decisions on selection of activity appropriate to the location, placement of the structure, and its physical dimension and scale. Technically correct design would lead to optimal reduction in soil erosion, maximised capacity for water storage, and enhanced groundwater recharge. Standard packages or models may have to be developed, since the staff at the panchayats may lack the technical expertise.

Step 6: ***Maintenance of assets created under MGNREGS for sustained employment and green outcomes***

The assets created require maintenance to deliver green outcomes or even economic benefits in a sustained manner. Even forests or plantations need to be protected and managed from grazing, fire and drought for survival, growth and sustained flow of benefits.

The maintenance component should become an integral part of all MGNREGS works involving creation of physical assets or forestry to ensure sustained employment and green outcomes. Incorporation of the maintenance component should take place at the time of selection of MGNREGS works as outlined in Step 3. Maintenance of some of the structures may require technical inputs as detailed in Step 5.

Step 7: Monitoring and Evaluation of Green Outcomes

Monitoring would require developing a baseline status of the natural resources and production systems, as well as assessment of the status of assets created under MGNREGS and its impact on MGNREGS works. Monitoring is critical to learn lessons and be able to make corrections if needed, apart from assessing the impacts on rural communities and effectiveness of the programme. Monitoring is a periodic process which should be initiated with the creation of a baseline, before the implementation of the MGNREGS works and periodic assessment of progress, status and impacts.

Why monitor?: Monitoring and evaluation of assets created under MGNREGS would facilitate gram panchayats, gram sabha and MGNREGS administrators in:

- Ensuring that appropriate design parameters are employed in construction of structures
- Improved maintenance of structures are created and forests raised
- Ensuring completion of structures are as per design plan and any mid-course correction
- Assessment of performance, impacts of MGNREGS works (for example, increased crop yields, increased drinking water availability, improved grass and fuelwood availability) and assessment of green outcomes
- Avoiding negative impacts such as increased soil erosion, depletion of groundwater and loss of biodiversity
- Generate experience for future MGNREGS works selection and implementation

What to monitor?:

- Implementation process and phasing
- Extent of works completed (e.g., area planted, height of the check dam, etc.)
- Status of the structure or survival rate of trees planted
- Status of natural resources such as irrigation tank, groundwater level, forest, grassland, etc.
- Benefits derived or impact of the works
  - Additional area brought under crops, change in cropping intensity, increase in area irrigated, improvement in dairy cattle/sheep/goats
  - Green outcomes such as enhanced groundwater recharge, improvement in biodiversity, increased water storage capacity in tanks, improved soil fertility (organic matter), carbon sequestration, etc.
  - Employment generated

Criteria for selecting green outcomes for monitoring: In a village/panchayat, large number of works will be implemented. Each work potentially provides one or multiple green outcomes. For example, land development can lead to soil conservation, water conservation, biodiversity conservation, carbon sequestration, etc. It is not economical or technically feasible to monitor all the green outcomes for a given work or multiple works in a village. Thus there is a need to select key works and green outcomes for monitoring, based on the following criteria:

- Utility for management and decision-making (e.g. degrading natural resource requiring maintenance or sharing of irrigation water)
- Importance of MGNREGS work implemented for crop production or water supply or grazing, etc.
- Scale of the work (e.g. check dam size or area afforested); avoid small-scale works
- Importance of natural resource (e.g. soil or water) or production system (e.g. rainfed or irrigated or livestock) for the village community
- Technical capacity needed for monitoring the outcome (soil organic matter requiring laboratory chemical analysis)
- Cost involved (e.g. high cost - soil structure: sand, silt, clay or low cost - survival rates of tree species)

Table 3: Green Outcomes and Key Indicators that could be Monitored for Different MGNREGS Works

MGNREGS Works	Green Outcomes	Key Indicators
Water conservation and harvesting	1. Ground water recharge 2. Soil moisture retention and protection (erosion control) 3. Flood control (reduced risk) 4. Provisioning irrigation 5. Drinking water and soil quality (nutrient cycling)	Groundwater aquifer recharge Soil organic matter
Irrigation provisioning and improvement	1. Provisioning of irrigation 2. Improved agriculture and livelihoods 3. Increased crop production	Crop-yield variability
Renovation of traditional water bodies	1. Improved storage capacity 2. Irrigation availability 3. Groundwater recharge 4. Soil quality (nutrient cycling) 5. Biomass production and crop production	Groundwater aquifer recharge

Land development	1. Land reclaimed for agriculture 2. Improved irrigation availability, leading to agriculture and livelihood improvement 3. Carbon sequestration in soil 4. biodiversity conservation	Soil organic matter Biomass and soil carbon stock
Drought proofing	1. Soil moisture retention 2. Protection (erosion control) 3. Soil quality (nutrient cycling) 4. Flood control (reduced risk) 5. Biomass production (fuelwood) 6. Local climate regulation 7. Agro-forestry 8. Biodiversity conservation	Biomass and soil carbon production Vulnerability Index

Step 8 :

The following table presents a step-wise approach for monitoring green outcomes. Methods for monitoring the green outcomes and metrics selected are not discussed, since standard textbook methods are available for monitoring soil, water, forest and crop-related metrics.

Table 4: Approach and Steps for Monitoring

Steps in monitoring	Description or Details	Additional information
Step 1: Selection of region or location for monitoring	Select a village or panchayat as it is the unit for implementing MGNREGS works	Ideal to conduct monitoring in all villages
Step 2: Establish baseline	Develop baseline for the selected village, its natural resources and production systems	Field studies are needed
Step 3: Selection of MGNREGS works for monitoring	Select MGNREGS works depending on scale of implementation or importance to the communities or natural resources	It is desirable to select all the works for monitoring but may not be economically feasible
Step 4: Identify green outcomes for the selected MGNREGS works	***Local:*** soil conservation, water conservation, biodiversity conservation, irrigation, etc.	- Select all green outcomes delivered by MGNREGS works in the selected village - Alternatively select key green outcomes, considering cost
	Global: carbon sequestration, vulnerability reduction to climate risks, halting desertification	- Carbon sequestration in soil requires long-term monitoring at a frequency of once in five years - Vulnerability reduction can be measured indirectly (e.g., through increased groundwater availability, soil fertility)
Step 5: Identification of green metrics	**Physical:** Soil structure, SOM, water storage, water depth	Cost and technical capacity needed could be considered in selecting indicators
	Biological: Species regenerated, cropping systems, livestock composition	
	Socio-economic: Sustained crop yield, grass availability	

Step 6: Selection of methods	PRA, HH survey, Focus Group Discussion, soil sampling, vegetation measurement, groundwater measurement	- Monitoring requires multiple methods. Methods depend on the indicator selected - Standard text book methods and rapid methods are available - Cost could be a consideration in selecting the methods
Step 7: Identification of institutions and training	Panchayat staff, school teacher, college teachers, NGOs, department staff, Self-Help Groups	- PRA, HH survey, focus group discussions could be conducted by members of the village/panchayat or NGOs with some training - Measurement of soil organic matter, groundwater depth and biomass stock requires technical expertise
Step 8: Establishment of baseline	Conduct field studies at the beginning of the project and develop a baseline on status of natural resources and production systems	Baseline/benchmark is needed to assess impacts of MGNREGS works
Step 9: Status/performance/ impact monitoring	Requires conducting periodic studies using different methods	Frequency of monitoring varies with indicators. E.g., soil carbon - once in 5 years; area irrigated
Step 10: Analysis, interpretation and data storage, and generation of periodic status and/or impact reports	Data collected using different methods need to be analysed to prepare maps, tables and charts indicating the baseline and project situation	- Analysis methods could include simple arithmetic calculations to laboratory analysis (e.g., SOM) to use of equations (e.g., biomass) - Monitoring will be over a number of years and impact will be visible over these years, thus requiring data storage to enable comparison across years
Step 11: Feedback of findings to stakeholders	Stakeholders include Gram sabhas, gram panchayats, rural development departments	Information or data or maps regarding the baseline or project performance would assist in: planning maintenance, planning expansion of the project, decision-making on MGNREGS works selection, identifying beneficiaries

Step 9 : Creation access, communication and utilization of information

The main purpose of monitoring is to assist in enhancing the performance and impact of MGNREGS works. The information, data and maps generated for the baseline as well as the project performance is required for the following:

- Decision-making on maintenance of structures created or forest raised
- Selection of MGNREGS works or completion of the works already initiated
- Prioritisation of environmental or economic objectives of MGNREGS works
- Mid-course correction in the implementation of the works, if needed
- Identifying beneficiaries of different MGNREGS works and improving targeting

Information on baseline situation, project performance, and impacts could be shared in the following manner:

- Preparation of maps of land - systems or locations of the MGNREGS works to identify beneficiaries and spatial spread of activity for display in the panchayat office
- Collection and presentation of photographs depicting status of resources or structures or impact after MGNREGS works intervention, e.g., forest regeneration
- Preparation of charts indicating the status of resources or impact after the MGNREGS works intervention, e.g., SOM content before and after, groundwater level before and after, area irrigated before and after
- Preparation of booklets or short reports in local languages for distribution among stakeholders
- Presentations to gram sabhas and panchayats using photographs, charts, maps and slides
- Computer graphics, models and videos

6. Incentives for Enhancing Green Outcomes

MGNREGS is a bottom-up process where local communities namely gram panchayat and gram sabha make decisions on the activities to be selected and implemented. Local communities have a choice or a menu of works to select from. Some works such as check dams may provide multiple green outcomes whereas road construction may not generate any significant green outcome. The question here is what incentives and guidelines would drive generation of higher levels of green outcomes. Incentives are required to deliver green outcomes through:

- Creating access to knowledge and information on the status of natural resources and production systems and the implications of different MGNREGS works.
- Selecting an appropriate MGNREGS work which delivers green outcome as well as other socio-economic benefits (such as a check dam or a planted forest)
  - Green outcomes can be maximised by selecting works which lead to conservation and regeneration of natural resources (such as soil, water and forest)
  - Green outcomes can be enhanced by focusing on community natural resources leading to multiple benefits and multiple beneficiaries.
- Proper implementation and completion of MGNREGS works selected (such as completion of a check dam or planting of a forest with protection measures).
- Maintenance and monitoring of the structure created.

Incentives and disincentives may be necessary to ensure delivery of higher levels of green outcomes.

What incentives : Incentives could be in the form of monetary or non-monetary benefits. Monetary benefits could include direct monetary contribution towards improvement of any community assets or infrastructure in the village. Non-monetary benefits could include provision of infrastructure benefits, such as improved ICT facilities water supply for school, electricity supply for community facilities, improved cooking stoves and biogas. ***The most important incentive that could lead to delivery of higher levels of benefits, in particular green benefits, could be generation of information and knowledge and creating access to this knowledge and information to the local communities through the use of ICT.*** However, it will be difficult to suggest which incentives should to be provided for which works and the resulting impact.

Criteria for monetary and non-monetary incentives: The criteria for providing incentives should be based on the natural resources addressed and any sustainable impact on the natural resource or production system. Using appropriate green metrics, the impact could be quantified to determine provision of incentives. A committee consisting of the district administrator, an NGO representative and a research scientist could evaluate the green outcomes.

When to provide incentives: The timing of provision of incentives is also critical. Some MGNREGS works generate benefits immediately such as de-silting of tanks leading to increased water storage capacity or activities generating benefits in the long-term such as planting forests or a percolation tank. Incentive could be provided after realisation of the green outcomes.

To whom should incentives be provided: The incentives should be provided only to community institutions (e.g. self help groups, village cooperatives, schools) and of course to gram panchayats. There must be a budgetary provision for providing incentives.

7. Strategy for Greening MGNREGS

Green outcomes are critical for sustaining MGNREGS goals of generating employment, livelihoods, poverty alleviation, etc. **Studies have shown that generation of employment and green outcome is generally complementary and more importantly potentially synergistic.** However, there is a need for dedicated mechanisms or arrangements to generate or enhance green outcomes. This may require institutional arrangements, technical and institutional capacity development, generation and access to information and enhanced community empowerment and participation, which are detailed in the following sections. Before considering a strategy for greening MGNREGS, it is necessary to recognize how MGNREGS should not become a *top-down programme* or be focused on '*physical infrastructure*' but on natural resources and their conservation, and enhancement of their productive capacity.

Recommendations and operational guidelines:

The greening concept is built into MGNREGS, since the works are linked to land (soil) and water, whose conservation and regeneration generates green outcomes. *The key issue is how to enhance, deliver and monitor green outcomes.* Generation of green outcomes could potentially lead to sustained natural resources, production systems and employment generation. However, there is a need for a dedicated strategy to promote and enhance the delivery of green outcomes, both local and global, through greening of MGNREGS, synergistically with socio-economic benefits (see Figure 2).

1. ***Recognition, incorporation, mainstreaming and communication of importance of green outcomes for sustaining employment and livelihoods*** **is necessary from the highest policy-making level to assist states, districts and panchayats to mainstream green outcomes synergistically with employment and livelihood enhancement.**
    - Incorporate or mainstream the green outcome concept into MGNREGS guidelines at national and state levels
    - Communicate greening concept to states and districts
    - Demonstrate the synergistic feature of green outcomes and sustained employment and livelihood generation through pilot projects and case studies
    - Generate empirical evidence on synergy between green outcomes and sustained employment/ livelihoods
2. ***Development and communication of guidelines at the national and state levels for operationalising the strategy for generating or enhancing green outcomes*** **to enable designing MGNREGS programmes and implementation arrangements to deliver green outcomes.**
    - Develop guidelines on "Greening MGNREGS" to assist states and districts in designing institutional arrangements for information generation and communication to decision-making bodies
    - Involve agricultural scientists, ecologists, social scientists, NGOs and MGNREGS administrators in developing the "Greening MGNREGS" guidelines
    - Carry out field testing and pilot demonstration of the "Greening MGNREGS" guidelines in select panchayats to learn lessons to improve the guidelines

- Communicate "Greening MGNREGS" guidelines to all the stakeholders at state, district, *taluk* and panchayat levels. The guidelines should be simple, easy to follow and implement, and should not be a burden on the panchayats or district-level administrators.

3. ***Identification of information needs for generating and monitoring green outcomes, methods and toolkits for generating, monitoring, and communicating information*** **is necessary to assist district and panchayat level institutions to generate and use the information in decision-making processes.**
   - Constitute an experts committee to identify information needs for assisting decision-making bodies (gram sabha/gram panchayat/district rural development agencies) in promoting and monitoring of green outcomes
   - Develop methods and toolkits for assisting the institutions tasked with generating and synthesising information for operationalising "Greening MGNREGS"
     – *describing what, when and how to measure, monitor, record, analyse, synthesise and communicate information*
   - Field test the methods and toolkits in pilot panchayats
   - Translate the methods and toolkits to local languages and communicate them to district rural development departments, panchayats and institutions identified for generating information
4. ***Identification of institutions and capacity development*** **for generation, communication and utilisation of information for promoting the concept of "Greening MGNREGS".**
   - ***State Coordinating Agency*** for implementing pilot projects, coordinating the work of District Coordinating Agencies with technical assistance, testing guidelines, methods, toolkits and ICT for greening of MGNREGS.
   - ***District Coordinating Agency:*** identify an agency in each district to coordinate and synthesise information generation, communication and its utilisation. This agency is similar to the District Technical Committee along with the District Programme Coordinator, suggested by the Review Committee of MoRD (2012a). **Utilise an existing institution rather than creats a new one.**
     – *Existing institutions; research institute, a science college, Krishi Vigyana Kendra, NGOs*
   - ***Panchayat-level Institution:*** (similar to Cluster-Level Facilitation Team suggested by the Review Committee of MoRD (MoRD, 2012a)) for conducting field studies, PRA, focus-group discussions, observations and measurement and for periodic monitoring and analysis of data, and preparation of charts and maps
     – *Existing institutions; science college, NGO, high school, research institute*
   - ***Organise Training Programmes at the District Level:*** for the District Coordinating Agency and panchayat-level institutions in conducting field studies, synthesising information and its communication. The guidelines, methods and toolkits prepared should be used and communicated to these agencies.

It is necessary to ensure that the state, district and panchayat level institutions' role is limited to information generation, communicating information, training and capacity building. These institutions should not formulate works and activities to be selected or implemented at the village level.

5. ***Technical assistance*** **may be required for designing, implementation, maintenance and monitoring of a few MGNREGS works.** Not all MGNREGS works may require technical assistance, for example desilting, silt application to cropland, agro-forestry and land development. Technical assistance is required for activities such as check dams, irrigation canal development, percolation tanks and other soil water conservation structures. Technical assistance involves:
   - Provision of design parameters for the structures
   - Placement of the structures

- Maintenance of the structures
- Conducting field studies and synthesis of these results using the metrics and methods
- Use of ICT for communication for access to and sharing of information and knowledge

It is important to ensure that the bulk of MGNREGS works do not require external technical inputs and bureaucracy.

6. ***ICT for green outcomes where* generation and communication of information is a continuous process wherein information, data, charts, maps are prepared on the status of natural resources or green outcomes of the MGNREGS works, and communicated to the gram sabhas and gram panchayats on an annual basis.**
   - Conduct training and capacity building for district and panchayat-level institutions
   - Provide methods, guidelines and toolkits and any field instrumentation such as measuring tapes, measuring scale, and data recording formats
   - Provide minimum basic infrastructure such as computers and desks at the panchayat, school, college or NGO
   - Establish a district Coordinating Agency to monitor and assist the panchayat-level institutions in conducting studies and synthesising their findings
7. ***ICT-enabled informed decision-making process at the* gram sabha and gram panchayat level is critical for utilising information in decision making to ensure MGNREGS works that deliver higher and multiple green outcomes are selected, implemented, maintained and monitored.** This would involve:
   - Selecting MGNREGS works that deliver green outcomes synergistically with employment generation
   - Ensuring proper implementation and maintenance of MGNREGS works
   - Ensuring monitoring of the status of natural resources and impacts of MGNREGS works, in particular green outcomes
   - Creating access to available information, data and maps such as:
     - i) Google maps of the village forest or irrigation tank, etc., ii) Village Resource Centre of ISRO (land and water resource management information), iii) Bhoosampada of NRSC (land use, land cover, water bodies, and vegetation maps).
8. ***Selection of MGNREGS works focused on natural resources and community assets* that deliver multiple benefits.** This is necessary to ensure delivery of green outcomes also benefiting the poor and for promotion of equity.
   - Generate and supply standard brochures, charts, maps, posters/computer graphics about green impact or implications of each MGNREGS work to enable informed selection of works
   - Presentation of information/maps/charts/computer graphics about the status of natural resource and production systems at gram sabha meetings to enable informed selection of works.
   - Educate communities about traditional practices which have the potential to generate green outcomes, some of which may not be in practice anymore, and about the potential of modern technical practices to generate higher levels of green outcomes.
   - Selection of MGNREGS works with a preference for conservation and enhancement of natural resources such as soil, water and forests. These have potential to generate sustained production and employment, especially for the poor. Further, regeneration of natural resources can have a multiplier effect on production as well as employment generation.

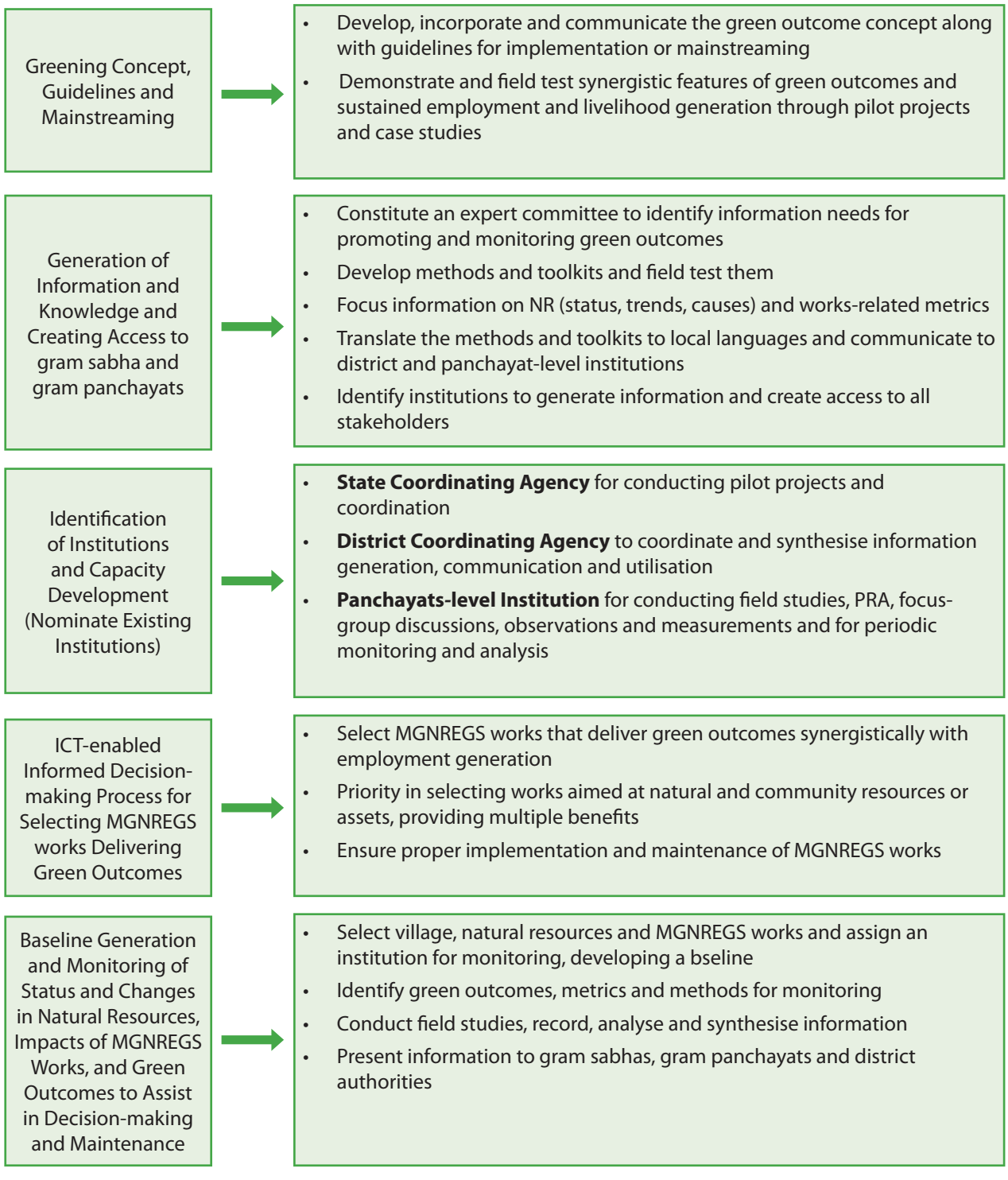
- Selection and implementation of MGNREGS works should preferably be on community resources such as streams, irrigation tanks, grazing land and forests so that the benefits accrue to a large number of local stakeholders.
- If the decision is to implement MGNREGS works on private land, belonging to certain categories of communities, the aim should be to conserve and reclaim natural resources such as cropland soil and groundwater for sustained flow of benefits.

9. ***Baseline generation and monitoring*** **of status and changes in natural resources, impacts of MGNREGS works, and green outcomes is critical for decision-making on MGNREGS works, maintenance of the structure, and ensuring the delivery of socio-economic as well as environmental outcomes.** The District Coordinating Agency should undertake the following functions with respect to monitoring:
   - Select the village, natural resource and MGNREGS works and assign a panchayat-level institution for monitoring
   - Identify green outcomes, metrics and methods for monitoring
   - Assess or monitor the metrics using the institutional arrangements namely District Coordinating Agency and the panchayat-level institution for:
     - generating the baseline for the metric selected
     - project impact assessment post-implementation of MGNREGS works
   - Record, analyse, synthesise information and data periodically
   - Present the information to the gram sabhas, gram panchayats and district authorities
   - Feed information from monitoring process into decision-making process at panchayat as well as district levels

10. ***Implementation of pilot projects to demonstrate*** **synergy between green outcomes and sustained employment generation, in particular measurable green outcomes, institutional arrangements for information generation, monitoring, maintenance, cost-effectiveness of "Greening of MGNREGS", methods, toolkits and guidelines for information generation, synthesis and communication to relevant stakeholders.** The strategy for implementation of pilot projects could involve the following:
   - Select one panchayat in each district for demonstration of the concept of greening MGNREGS
   - Nominate a State Coordination Agency to coordinate, implement and monitor the pilot projects in one selected panchayat of each district in the state
   - Conduct capacity-building programmes for planning, designing, implementation and monitoring of pilot projects
   - Finance the pilot demonstration projects
   - Coordinate implementation, monitoring and reporting of the pilot projects.

11. ***Financing institutional arrangements and incentives*** for ensuring green outcomes through informed decision-making (based on information, knowledge and data generated from field studies and observations), maintenance and monitoring. Budget allocation may be required for the following:
   - Developing guidelines, methods and toolkits
   - Conducting pilot projects to demonstrate green outcomes
   - Supporting state, district and panchayat-level institutions for providing support to gram panchayats with knowledge, information and data for informed decision-making to promote green outcomes
   - Undertake training and capacity building and coordination at the state and district levels
   - Providing financial incentives to gram panchayats and villages for delivering green outcomes.

Figure 2: Summary of Recommendations for Greening MGNREGS



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Greening Aajeevika Programme (NRLM)

AstadPastakia (NTFP sector)
A Ravindra (Agriculture and allied sectors)
Manoj Mishra (Non-farm sector)

September 2012

For
United Nations Development Programme, India
New Delhi

Greening Aajeevika Programme (NRLM)

I Introduction: Key Elements of NRLM[i]

The Swarnajayanti Grameen Swarojgar Yojana (SGSY) programme of the Ministry of Rural Development (MoRD) which was implemented for a whole decade (1999-2009) proved beyond doubt that the poor need to be organised and their capacities built if they are to successfully access various governmental services and tap opportunities for employment and self-employment. Based on several reviews and inputs from experts, the programme metamorphosed into the NRLM and quickly emerged as one of the most ambitious programmes undertaken by the Ministry. NRLM builds on the core strengths of the SGSY and incorporates the important lessons from large-scale experiences in the country.

The Mission seeks to target the seven crore rural BPL families on a priority basis, particularly the 4.5 crore households that are still to be organised under SHGs. NRLM endeavours, through its dedicated sensitive-support structures and organisations at various levels, to reach out to all BPL households in the country. The Mission aims to alleviate poverty through building their capacities, financial muscle and access, through placement in jobs, and nurturing them into remunerative self-employment and enterprises. The institutions of the poor would gradually take charge of supporting their members being in control of their livelihoods and lives. The most vulnerable communities/ individuals such as the PVTGs, widows, pensioners, scheduled caste etc. would be given the highest priority in the Mission.

Box 1.1

Mission Statement:

"To reduce poverty by enabling the poor households to access gainful self-employment and skilled wage employment opportunities resulting in appreciable improvement in their livelihoods on a *sustainable basis*, through building strong and *sustainable grassroots institutions* of the poor."

Guiding Principles:

i) Poor have a strong desire to come out of poverty and they have innate capabilities.

ii) Social mobilisation and building strong institutions of the poor is critical for unleashing their innate capabilities.

iii) An external, dedicated and sensitive support structure is required to induce social mobilisation, institution building and empowerment.

Core Values:

Inclusion of the poorest, transparency and accountability in all processes and institutions, ownership of the poor and their involvement in all stages, community self-reliance and self-dependence are some of the core values espoused in the mission document.

Two most important features of the programme include a) Sustainability and b) Flexibility.

Sustainability:

As stated in the mission statement, sustainability is at the core of the NRLM programme. Past experiences have shown that sustainable livelihoods cannot be accomplished without ensuring both environmental and institutional sustainability. This strong orientation is visible in its planning and implementation of various livelihood schemes for different segments of the rural poor. Much of this is rooted in the past experience of the present leadership[ii] and therefore augers well for the greening of the programme.

Flexibility:

Aajeevika's flexibility is the reason why there are no 'guidelines'. Each state is free to set up its own form of implementation structure and develop its own plans for implementation. However, after an extensive consultative process with civil society, researchers and others, the MoRD brought out a 'Framework for Implementation' document, which serves as a guide for the state implementing institutions.

Most of the states have either just set up their implementation structure or have just completed their state-level implementation plans. The plans are expected to be not only demand driven, but also dynamic. This is because NRLM recognises and values the iterative nature of the process. This is an opportune moment to introduce the idea of 'greening' in these state-level plans and institutions.

Components of the Programme:

As per the framework document, NRLM works on the basis of three pillars:

a) enhancing and expanding existing livelihood options for the poor;

b) building skills for the job market outside

c) nurturing self-employment and entrepreneurship

However, these three pillars can only stand on a foundation of social capital of the poor. Hence, mobilising communities for SHGs and various aggregate forms of people's institutions becomes a core activity of NRLM. Dedicated support structures build and strengthen the institutional platforms of the poor. These platforms, with the support of their built-up human and social capital, offer a variety of livelihoods services to their members (see Figure 1).

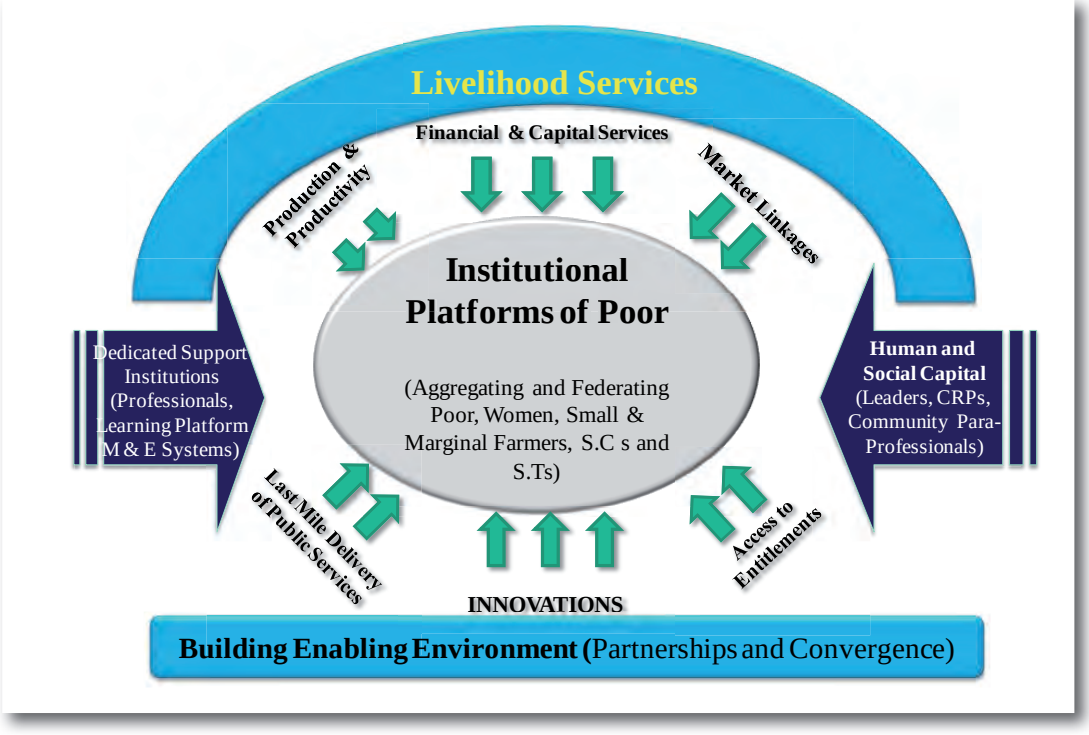


Figure 1: Key Components of NRLM

These services include financial and capital services, production and productivity enhancement services that include technology, knowledge, skills and inputs, and market linkages etc. The interested rural BPL youth would be offered skills development after counseling and matching their aptitude with the job requirements, and placed in jobs that are remunerative. Self-employed and entrepreneurial oriented poor would be provided skills and financial linkages and nurtured to establish and grow with micro-

enterprises for products and services in demand. Creating an enabling environment for the poor to access their rights and entitlements, public services and innovations is also an integral part of the Mission. This process of institutionalisation reduces transaction costs to the individual members, makes their livelihoods more viable and accelerates their journey out of poverty.

II Greening NRLM

Defining greening in the context of NRLM

In as much as the livelihoods of rural poor are largely dependent on natural resources, greening of NRLM must imply:

> "Promoting/strengthening the culture of conserving natural resources and utilising them in a sustainable[iii] way"

In recent years new approaches to livelihood promotion have evolved, which underline the ecological concept of 'carrying capacity'. Developing pro-poor value chains, leveraging technology to create value-added products from local resources and developing non-farm and service sectors in rural areas are among the most important of these. Therefore, greening of NRLM would also include:

> 'Promoting efforts to diversify the local economy by adding value to local produce through processing, creating pro-poor value chains, and developing non-farm and service sectors'

Again, it is well known that processing involves investments in machinery, consumption of energy and creation of wastes. Hence, while diversifying the economy, care should be taken to adopt clean technology, extract resources in a sustainable way and minimise negative externalities on the environment and on society. The notion of greening NRLM must also include:

> 'Efforts at greening existing and proposed supply/value chains that adopt clean technology, renewable energy, minimise waste and use natural resources in a sustainable way'

In summary all NRLM livelihood promotion activities must ensure that the net environmental impacts (whether local or global) are positive. There should be a continuous striving to minimise the negative environmental externalities and opt for technologies that are either benign or positive in their impacts on the environment.

Opportunities for Greening the Programme

A priori, a number of components of the programme (see Figure 1) offer opportunities for greening. In the production technology component, one can ensure that the rates of NTFP extraction do not exceed the rates of replenishment/rejuvenation of the resource concerned. The way to accomplish this would become more clearer after a look at the best practices available in India and elsewhere in the world. In the area of marketing, one can consider establishing standards for sustainable harvest from the wilderness and its certification, which is greatly valued by consumers in some industrialised countries where awareness about environmental issues is higher. Coupled with fair-trade certification and collective marketing, the poor tribal harvester can hope to substantially increase his/her price realisation. Other areas of intervention could be in creating a level playing field for the local green entrepreneurs who try to market NTFP with value addition. Providing fiscal incentives for grassroots eco-preneurs would also go a long way in stimulating NTFP livelihoods. The present study with its emphasis on best practices helps to concretise these suggestions and generate additional ideas that the MoEF could consider while trying to create green NTFP-based livelihoods.

While looking at opportunities for greening NRLM, the flagship programme of the MoRD, it was decided to examine separately three important sectors that affect the lives and livelihoods of the rural poor the most:

a) Non-timber forest produce (NTFP)

b) Agriculture and allied activities (such as animal husbandry, fisheries etc.)

c) Non-farm

This paper synthesises the findings of three researchers who worked separately on each of the above mentioned sectors. Certain aspects of NRLM such as employment generation and skill building are not addressed separately but are covered indirectly in the sectoral studies.

III Environmental Analysis

As mentioned in Section I, NRLM is presently in the take-off stage and therefore it would be premature to make an assessment of environmental impacts. As a proxy, we have looked for evidence of direct or indirect inclusion of green initiatives in a) framework for implementation document b) state annual plans drawn up by individual state implementing agencies and c) multi-state initiatives planned by NRLM at the center.

Framework for implementation

As mentioned earlier, the Mission already has a strong sustainability component. This could be made more explicit in the framework for implementation document by including a few words in the sections on guiding principles and core values as well.

Guiding Principles:

– "Environmental stewardship and sustainable harvest/NRM are central for ensuring sustainability of livelihoods of rural poor."

Core Values:

– "Respect for nature and its stewardship to ensure sustainable livelihoods for present as well as future generations."

It is in the "innovations" component of the programme that the document makes specific references to environmental sustainability by citing examples of organic and non-chemical agriculture and greening of value chains. The framework document could be substantially revised by including such direct references in other important components of the Mission as well, especially in "production and productivity", "market linkages" and "building-enabling environment". These could be drawn largely from the recommendations of this study provided in the last section.

Proposed Multi-state NTFP Projects Under MKSP

The NRLM has been leveraging the MKSP (*Mahila Kisan Sashaktikaran Pariyojana*) for livelihoods-related to sustainable agriculture and allied sectors. In 2011 NRLM spent INR 200 crores on the project, focusing on empowerment of women farmers through community-managed sustainable agriculture. Here non-chemical and organic farming as well as conservation of valuable natural resources were emphasised. The project also focused on removal of drudgery for women. Based on this experience, NRLM plans on launching initiatives for sustainable livelihoods in other sectors such as dairy, NTFP, fisheries etc.

In a recent initiative NRLM invited proposals from various institutions including NGOs and private sector companies to develop NTFP-based livelihoods for the poor. It identified six main sub-sectors to initiate multi-state projects for the development of NTFPs. These sub-sectors *include lac, medicinal plants and herbs, gum, tasar, bamboo andnon edible oil seeds*. MKSP received the project proposals from various institutions covering 1.15 lakh tribal families in the states of Andhra Pradesh (AP), Bihar, Chhattisgarh,

Jharkhand, Madhya Pradesh (MP), Maharashtra, Odisha and West Bengal. These project proposals are currently being assessed after which they will be sanctioned for implementation.

Table 3.1 provides details of the key partner institutions, the expected increase in income and the key sub-sector issues that will need to be tackled in each of these projects. The use of primitive technology and unscientific, often unsustainable harvesting is reportedly one of the major issues to be tackled. If this project succeeds in developing sustainable harvest protocols and in propagating these protocols amongst target communities, it would certainly lead to greening of these value chains at the primary production level.

Table 3.1: Multistate NTFP Proposals Submitted to MKSP

Commo-dity	States	No. of Tribal Families	Partner NGOs	Market Players	Increase in Income	Sub-Sector Issues
Lac	Jharkhand	16,000	Udyogini	Manoharilal DM Shellac Pvt Ltd Parvati Lac Udyog	INR 30k to 1lakh per family	• Demand much higher than supply: Lac processing units lying idle and importing from Thailand) • Production problem: Brood Lac Management • Pest attack • Working capital Management • Simple tools/ technology
	Odisha	To be worked out	RCDC partners; CCN			
	Chattisgarh	4000	BAIF			
	AP	30,00	CCN, Kovel, SERP			
Medicinal Plants/ Herbs	Odisha	5000	FRLHT, CCD Network, Sambandh, VRF, Kovel	Dabur India Pvt Ltd Himalaya Health care Natural Remedies Pvt Ltd	INR 5000 per family?	• Unscientific collection which kills plants • Collection should be in adherence to Biodiversity Act • Health security intervention needed using tribal knowledge
	Chattisgarh					
	MP					
	AP					
Gum	AP	12000	VRF, SERP, SRUJAN	Laxmi Enterprise	INR 20-30k per family	• Production is issue • Unscientific harvesting • Regeneration of gum trees
	Chattisgarh	8000				
	MP	4000				
	Maharastra	1000				
Tasar	Jharkhand	3850	BAIF Kovel		INR 30k per family	• Production is key issue • Tasar seed availability • Host tree availability • Primitive technology • Climate change • Narrow product range • Developing value chain
	Bihar	1237				
	WB	3600				
	Odisha	4070				
	Chattisgarh	4057				
	MP	4185				
	AP	4069				
	Maharastra	3901				
Bamboo	Odisha	4000		ITC Agarbatti	INR150-200 per person day	Bamboo cultivation is crucial ITC is ready to invest INR 12crore for Agarbatti Rolling Machines
	AP	3000				
5 Commo-dities	**8 states**	**1.15 lakh families**				

IV Proposals for Greening NRLM : NTFP-based Livelihoods

1.0 Scale and Scope of Augmenting Livelihoods in NTFP Sector[iv]:

Traditionally Non Timber Forest Products (NTFPs) refer to all biological materials other than timber extracted from natural forests for human and animal use and have both consumptive and exchange value. Globally NTFP are defined as "forest products consisting of goods of biological origin other than wood, derived from forest, other wood land and trees outside forests".

NTFP[v] is one of India's largest un-organised sectors with a business turnover of INR 60,000 m. Medicinal plants represent one of the important sub-sectors within NTFP. Of the 7000 plants used in the Indian medicine system, 960 have been recorded in trade and 178 are traded in high volumes - quantities exceeding 100 MT per year. According to a study, the total annual demand of botanical raw drugs in the country for the year 2005-06 was estimated at 3,19,500 MT worth INR10,690 m.

Nearly 75 per cent of NTFPs produced are collected from Andhra Pradesh, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra and Odisha. It is estimated that 275 million poor rural people in India (27 percent of the total population) depend on NTFPs for at least part of their subsistence and cash livelihoods. This dependency is particularly intense for half of India's 89 million tribal people, the most disadvantaged section of society, who live in forest fringe areas. NTFP contributes about 20-40 percent of the annual income of forest dwellers, mostly disadvantaged and landless communities with a dominant population of tribals. It provides them critical subsistence during the lean seasons, particularly for primitive tribal groups such as hunter gatherers, and the landless. Most of the products are collected and used/sold by women, so it has a strong linkage to women's financial empowerment in the forest-fringe areas.

NTFPs have a tremendous potential to involve local collectors for establishing micro, small and medium enterprises through clear tenured rights, better collection methods, financial support, capacity development, and infrastructure and institutional support in the near future. With these efforts there is a potential to create large scale employment opportunities. This would help reduce poverty and increased empowerment, particularly, of women, tribal and poor people of the poorest and most backward districts of the country. The Sal seed case has demonstrated how R&D supplemented with favourable policy environment can revolutionalize the commercial fate of the NTFP collectors. Besides food security, NTFPs also provide for a big opportunity to establish eco-friendly, and small to medium enterprises at the local level.

Table A1.1: List of Potential NTFPs for Enterprise Development

Sl no	Zone	Potential NTFPs
1	North Himalaya	Tejpatta, Jatamanshi, Tulsi, Jhula (Lichens), Kutki, Texus (Thun), Chirata, Reetha, Moss ghash, Pine resin, Picrorhizakurrooa (Kutki)
2	North-East	Broom grass (Thysanolyna maxima), Bamboo*, Phrynium leaf, Tejpatta, Orchids, Acqularia sp. (Agar), Ashoka bark, Cinchona, Taxusbaccata, Swertiachirata, Litseaglutinosa, Andrographispaniculata (Kalmeg), Cane (Calamus spp.), Parkiaspeciosa (tree bean)
3	Central India	Tendu leaf*, Sal leaves, Chironji*, Lac*, Tamarind, Sabai grass, Kalmegh, Mahua seed* and flower*, Sal seeds*, Siali leaves, Anola*, Kullu gum*, Hill broom grass, Salai gum, Litseaglutinosa (Maida bark), Arrowroot (Curcuma angustifolia), Rauvolfiaserpentine, Honey*
4	South	Cinnamon bark, Mahagli (Decalepsis spp.), Karanj seeds*, Tamarind*, Bauhinia vahlii (Siali leaf or Mahulpatta), Sandal oil (Santalum album), Garciniaindica (Kokam), Asparagus racemosus (satawar)
5	Western India	Tendu leaf, Bael, Buchananialanzan (Chronji), Boswelliaserratagum, Guggal gum (Commiphorawightii), Bahera*, Harra*, Chrota seed* (Cassia tora), Mahua flower, seed oil

*Items suggested by the Haque committee for MSP, along with neem seed

Source: Planning Commission Sub Group II on NTFP, 2011

However, the NTFP sector was neglected for decades and considered Minor Forest Produce. This despite the fact that monopoly rights over several such NTFPs/MFPs fetched a good income for the Forest Department. After the ban on green felling, income from NTFPs formed a major share of the in the total income of the Department, also once income from timber decreased, in many states. In spite of this, conventional approaches of forest management focused largely on timber with only secondary attention paid to NTFP development. Working plans remained confined, at best, to elaborate prescriptions for bamboo along with few tit bits on other NTFPs.

The sub-group on NTFP under the Planning Commission Working Group on Natural Resource Management discussed the issues, challenges, potential, and scope for developing the NTFP sector. Several strategies were recommended for implementation in the XII Plan with a total budget of INR 6590 crores. It expects to generate approximately 10 crore workdays of employment in the XII Plan and about 2 crore workdays per annum thereafter in a sustainable manner, helping promote a green GDP and contributing to the fulfillment of Millennium Development Goals.

Global Trends and Influences:

The impact of globalisation and liberalisation on the NTFP sector in India has been mixed. While it increased the scope of accessing NTFP-based international markets coinciding more or less with an increasing global demand for natural products, it also increased competition with more emphasis on quality control and resource conservation (which is how certification became an important necessity).

With most of the raw drugs being sourced from the wild, global demand further accelerated the unsustainable exploitation of some species like *Taxusbaccata*[vi], and *Swertiachirayita*. At the same time the CITES treaty restricted the export of highly procured but endangered species like *Rauvolfiaserpentina*[vii]. On the other hand, synthetic substitutes adversely affected the domestic and export trade of many NTFPs such as lac.

2. Current NTFP-related Policies and Programmes[viii]

2.1 National Level

Presently there is no single NTFP policy at the national level. There are however, several Acts , policies, or administrative orders like JFM resolutions which partially address NTFPs in reference to their ownership, benefit sharing, monopoly, transit rules, tax,conservation need etc. at national level and at state level too.

Some of the policy concerns and specific issues in this regard include: inadequate/insecure rights of collectors; incompatible access regulation systems; inadequate benefit sharing mechanism; incompatible tax structure, and absence of commodity-specific and region-specific solutions, etc. In the absence of a comprehensive national/central policy/approach, contradictory legal provisions still prevail while differential state regimes create some of the biggest limitations, which the sector's healthy growth. Bamboo, for instance, is classified as a 'minor forest produce' in the Forest Rights Act, 2006 whereas the Indian Forest Act, 1927 treats it at par with timber. Despite, former Minister of Environment, Mr. Jairam Ramesh's efforts to remove this discrepancy through dialogue with the State Forest Departments, the issue remains unresolved. The recent bill to amend the Forest Act of 1927 did not include this amendment (Mahapatra, 16 May 2012). Similarly,PESA 1996, gives ownership rights to local communities over NTFPs whereas the regime created under the Wildlife Protection Act does not.

Recently the Planning Commission approved a plan of the Ministry of Tribal Affairs (MOTA) to introduce a minimum support price mechanism for 13 items of NTFP. These NTFPs include tendu, bamboo, mahua flower, mahua seeds, sal leaves, sal seeds, lac, chironji, myrobalan, wild honey, tamarind, gum and karanj. The plan is based on the recommendations of two committees, one headed by agricultural economist, T.Haque (see Box A2.1) and another by Planning Commission Secretary Sudha Pillai (Livelihoods.net.in, June 01, 2012). It could be in NRLMs interest to coordinate with MOTA for the smooth implementation of the proposed plan.

Box A2.1: Haque Committee Recommendations to Provide MSP for Select NTFPs

Barring a few nationalised ones, most NTFPs are traded freely in the market. Middlemen buy from those belonging to tribal communities and sell to the end-users. The gatherers are often not aware of the market price. The Left and other political and human rights organisations have been fighting for tribal rights, demanding ownership and a minimum support price for NTFPs. The Ministry of Panchayati Raj had set up a committee under the chairmanship of T Haque on the "Ownership, Price Fixation, Value Addition and Marketing of Minor Forest Produce." The committee submitted a report on 11 May 2011. It suggested that a Central Price Fixation Commission be set up to determine minimum support prices for 14 economically important minor forest produce. The 14 MFPs were: bamboo, tendu leaf, tamarind, mahuwa flower, mahuwa seed, sal seed, myrobalan, chironji, lac, gum karaya, honey, and seeds of karanja, neem and puwad.

The Commission should consist of one chairperson and three other members whose mandate would be to fix the MSP as a benchmark and set up quality standards for certification of forest produce. The Commission, it is suggested, should also be responsible for formulating guidelines, monitoring and evaluating the scheme for providing MSP. The proposed agency would fix the price for each crop season after in-depth consultation with the ministries of Tribal Affairs, Panchayati Raj and Environment as well as tribal leaders. The minimum price should be based on considerations such as the labour time involved in collecting the forest produce, prevailing wage rate, transport cost and market price and demand-supply analysis. The existing minimum wages under MGNREGS or in the agriculture sector, whichever is higher, should form an important criterion in fixing MSP.

Source: Haque Committee (2011)

Apart from the above policies, the Government of India (GoI) has initiated several sectoral programmes and institutions with varying outcomes[ix]. Some of the important ones are listed below:

- National Biodiversity Authority (NBA) – since 2006
- Tribal Cooperative Marketing Development Federation of India Limited (TRIFED) – since 1987
- National Medicinal Plants Board (NMPB) – since 2000
- National Mission on Medicinal Plants (NMMP) - XI Five-Year Plan
- National Mission on Bamboo Technology and Trade (NMBTT) - X Five-Year Plan
- National Mission on Bamboo Applications (NMBA) - X Five-Year Plan

2.2 State Level

Joint Forest Management Scheme:

Over the past two decades, the Forest Departments of various states in India have initiated the Joint Forest Management (JFM) scheme, where Forest Protection Committees (FPCs) constituted from among local communities have been set up to protect the forests. In return, these communities get access to the forests to meet their legitimate needs of fuel-wood, fodder and NTFPs and a pre-determined share in the harvest of timber and bamboo.

The JFM scheme has been implemented in more than 17 million hectares through 84,632 FPCs (Basu, 18th Commonwealth Forest Conference, 2010). All NTFPs barring few nationalised products like tendu leaves, sal seeds etc. are available to people free of royalty in all states. On an average 40 percent of the sites showed improvement in regeneration owing to protection against biotic pressures, fires and illicit felling. On an average high plant density was observed in regeneration at 70 percent sites. Studies show that the performance varies from state to state (Murali, Murthy and Ravindranath, 2002). This performance could be improved significantly through assisted natural regeneration (ANR) as shown in the case of Andhra Pradesh and Madhya Pradesh.

Nationalisation of NTFPs:

States have their own policies on NTFPs though it is informal in most states. State procurement agencies (corporations/ federations) play an important role in certain NTFPs that are nationalised. Nationalised NTFPs are those whose procurement (purchase from the gathers/collectors) and sale (to private merchandisers, exporters) can be done only through designated state agencies. In effect, states exercise monopoly over these NTFPs, thereby restricting their free trade in open markets.

Table A2.2: List of Nationalised NTFPs

No.	State	Nationalised NTFP
1	Andhra Pradesh	bamboo, tendu leaves and 25 other NTFPs
2	Chhattisgarh	bamboo, tendu leaves, sal seed, myrobalans, gums of kullu, dhawda, khair and babool
3	Gujarat	bamboo, tendu leaves, mahua flower, mahua seed, gum karaya and other miscellaneous gums
4	Maharashtra	bamboo, tenu leaves, apta leaves and other 33 NTFPs
5	Madhya Pradesh	bamboo, tendu leaves, sal seed, kullu gum and lac resin
6	Rajasthan	bamboo, tendu Leaves
7	Orissa	bamboo, tendu leaves
8	Himachal Pradesh	-
9	Jharkhand	tendu leaves

Source: Haque Committee Report, 2011

The nationalisation of NTFPs, was done in different states in various years from the 1960s to the early eighties. Nationalisation of the NTFP was done for the upliftment of the poor, so that they could get a fair price for the produce. But it has affected their lives adversely. It reduces the number of legal buyers, chokes the free flow of goods, and delays payment to the gatherers, as government agencies find it difficult to make prompt payment. This has resulted in illegal marketing of the produces (Haque Committee, 2011). In Rajasthan, the Rajasthan Scheduled Tribe Area Development Cooperative Corporation Ltd., Udaipur, buys *TholiMusli*, a medicinal herb at INR 250-400 per kg, though it could easily get anything from INR 500-1000 per kg in the open market. Similarly, the Corporation pays only INR 18 per kg for honey as against the market price of INR 50 per kg. Thus nationalisation has not been of any help to the gatherers (Saxena, 1999). In Maharashtra, 33 nationalised NTFPs are sold by gatherers in the open market illegally because private traders give very high returns as compared to the state corporation (MSCTDC) (Haque Committee, 2011).

Under these circumstances the policy of nationalisation of NTFPs, needs to be reconsidered.

Self-help Movement and NTFPs:

Both government and non-government agencies have attempted to promote collectives of primary collectors in the form of SHGs, self-help cooperatives, and producer companies. Despite their limited impact on the financial front, these institutions have given the NTFP collectors (who are mostly women) a new identity and self-confidence. They need more support and enabling mechanisms to grow financially.

3.0 NTFP-based Sustainable Livelihoods: A Theoretical Framework

Tribal communities dependent on NTFPs harvest them for either subsistence or to sell in the market. In areas where communities are still largely dependent on NTFPs, the proportion of harvest for subsistence is about 70 percent[x] while the rest is sold to local traders or other outsiders. It has been observed that in majority of the cases traditional methods and norms of harvest are sustainable as it is based on

indigenous knowledge of the species developed over several generations. Since the local people are keen to maintain the natural resource base to serve future generations of their community, they follow these norms as part of their culture.

With the increasing demand for NTFPs from non-forest areas of India and abroad, the pressure for these extraction for markets has been mounting. With increasing commercial pressure for unsustainable rates of extraction, there has been a corresponding increase in the break down of traditional norms and methods of harvest. This has led to unsustainable extraction of several commercial species pushing them towards the brink of extinction. Often government policies of providing access to private contractors and companies have accelerated the pace of unsustainable extraction. There is an urgent need to strengthen traditional norms and institutions of sustainable harvest while at the same time introduce new methods and protocols for sustainable harvest of commercial species for wider markets.

However, the state of forests and resultant stock of NTFPs are also dependent on other stakeholders. Chief among these is the Forest Department which controls the access of forests to local populations as well as contractors and private companies. It decides on the conservation measures, including silvicultural operations, best suited to a particular forest and develops the working plans for plantation as well as harvest of trees and minor forest produce. Hence the participation of state governments as well as State Forest Departments in any NTFP intervention becomes important. There are already a number of governmental schemes targeted towards the development of certain NTFPs with a view to strengthen rural livelihoods as seen in the previous section. However, in the absence of an overall policy as well as an overall institution to champion the cause of NTFP livelihoods, the progress made in this sector is way below its actual potential.

Government policies should be targeted at both the above mentioned plantation and harvesting cycles so as to facilitate:

a) Conservation of forest resources,

b) Sustainable use of these resources

c) Development of value-added products and value chains over which primary producers have greater control

While much work is needed to create enabling policies, government agencies, non-government development agencies and research institutions will have to come together to ensure that eco-friendly technology and corresponding social capital is brought in place.

Eco-friendly technology will be needed for:

i) In-situ and ex-situ conservation of NTFP species

ii) Sustainable harvest of wild species

iii) Cultivation of NTFP species

iv) Development of value-added products using sustainable production processes

The ideal way to develop this technology would be to create mutual respect, understanding and dialogue between scientists working in formal institutions and local experts with their indigenous knowledge. A few NGOs have started working in this direction as elaborated in the next section.

Local institutions will be critical in ensuring sustainability of resource management as these institutions will control the collective behavior of its members. Traditional norms of sustainable harvest will need to be reinforced and reintroduced in today's institutions. NRLM offers an ideal opportunity to do this as it is already working towards the empowerment of local institutions with new knowledge, technology and systems of democratic decision-making. Figure A4.1 summarises this agenda for sustainable NTFP management and how it could be accomplished.

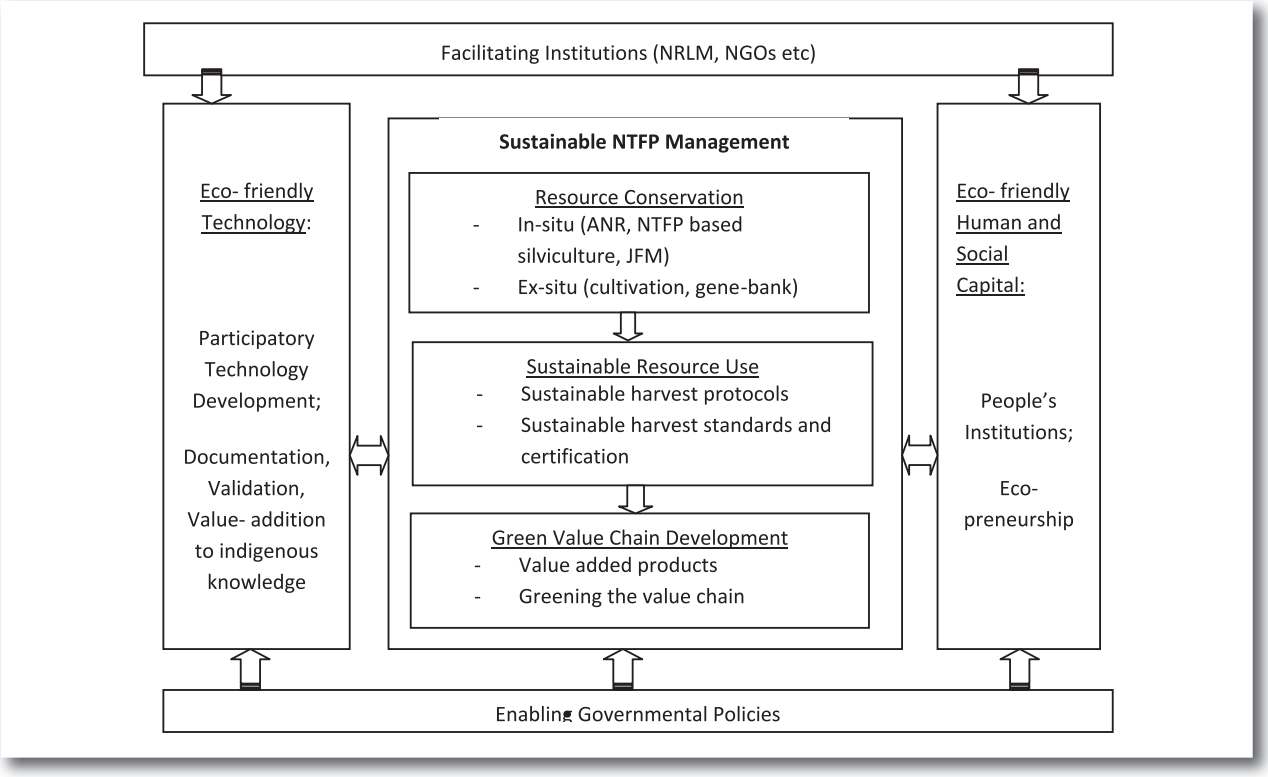


Figure A 4.1: Agenda for Sustainable NTFP Livelihood Development

4.0 Proposals for Greening of NTFP-based Livelihoods

4.1 Resource Conservation

Resource conservation strategies for biodiversity and NTFP species can broadly be classified into two groups:

a) *In-situ conservation* – includes silvicultural practices keeping NTFP species in the main focus rather than timber species, aided natural regeneration and forest protection by local communities as is practiced under JFM Schemes in India and Community Forest Management schemes in some other countries.

b) *Ex-situ conservation* – includes cultivation of NTFP species as regular crops or within the canopy of plantations, maintenance of gene banks with the help of tissue culture – especially for endangered species.

In-situ Conservation

The objective of in-situ conservation is to protect and enable natural regeneration of species in their natural habitat.

Forest Protection and ANR:

While FPC activities started with simple protection of degraded forest lands, in at least a few places, assisted natural regeneration (ANR) has been taken up. ANR refers to a simple low-cost forest restoration method that can effectively convert deforested lands from degraded vegetation to more productive forests. The method aims to accelerate, rather than replace natural succession processes by removing or reducing barriers to natural forest regeneration such as soil degradation, competition with weedy

species, and recurring disturbances (e.g., fire, grazing, and wood harvesting). Compared to conventional reforestation methods involving planting of tree seedlings, ANR offers significant cost advantages because it reduces or eliminates the costs associated with propagating, raising, and planting seedlings (Shano, Cadaweng and Durst, 2007). For a discussion on sequential steps used to implement ANR see Kathleen et al., (1999), in Forestry Administration, Cambodia Tree Seed project, (2005).

FPCs (in Adhra Pradesh and Madhya Pradesh) are involved in creating and maintaining fire lines by cleaning them regularly and in putting out forest fires. This has resulted in good regeneration in hitherto vulnerable areas. JFM was adapted as a strategy for improvement and development of degraded forest land. Between 1995 and 2001, the number of community-based forest protection committees increased from 171 to 6602. By 2001, 1,660,000 hectares of forest lands were under FPCs. These degraded forests were closed for facilitating the coppice and seed-based regeneration. Only about 5-10 percent expenditure was required for plantation establishment. Natural re-growth is faster which has yielded many NTFPs (Community Forest Management Support Project 2000 for South-east Asia, 2002).

Box A4.1: Regeneration of Bamboo forest in Dosatnagar, Andhra Pradesh, Using ANR

In Dosatnagar, ground fires and grazing threatened to suppress the natural regeneration of bamboo. So in 1995 the community formed a FPC to restore it. In addition to protection, in 1997 the community began treating the bamboo by mounding earth around the regenerating bamboo clumps and digging water pits next to the plant. The cost of the treatment was INR 3600 per hectare. The annual production of poles after seven years was estimated at 5000/ha worth INR 1.5 lakhs.

Source: Community Forest Management Support Project 2000 for South-east Asia, 2002

NTFP-based Silviculture:

With growing realisation of the value of NTFP species for biodiversity and ecological services as well as for subsistence of local tribal communities, the time is right to remove the bias against NTFPs in silvicultural practices. However, not many examples are available for NTFP-based silviculture in the country. This is an aspect that needs to be explored in more depth with senior forest officials. However, the case of chirpine tree litter management in Uttarakhand (see Box A4.2) provides insights into the potential ecological benefits of such silviculture as opposed to conventional timber-based silviculture.

Ex-situ Conservation

Presently, many NGOs are working towards ex-situ conservation of NTFPs. Cultivation of NTFP species, especially medicinal plants, is an important though indirect way of promoting ex-situ conservation. In addition, gene banks and tissue culture technology are being utilised to conserve RET species. The latter is extremely important from the viewpoint of conservation of species. A few NGOs such as Sahyadri Genes, Kolhapur, are doing useful work in conservation of endangered species. However, it is the job of specialised institutions like the National Bureau of Plant Genetic Resources, Botanical Survey of India, and Department of Bio-technology and therefore is excluded from the discussion here.

Box A4.2: NTFP-based Silviculture: Case of Chirpine Forest, Uttarakhand

In the Himalayan province of Uttarkhand, forest fires caused by the burning of pine-needle and leaf litter, is a serious problem in 2500 kms of pine forests. The total amount of litter fall ranges from 1,000 to 8,000 kg/ha per year depending on the density and maturity of the crop. Avani, an NGO based in this area, demonstrated on pilot scale the adoption of gasifier technology for electricity generation. It is now in the process of setting up a commercial unit of 120 k-watts. The project helps to generate employment for the poor who get paid wages for collection of the litter while effectively addressing the problem of forest-fire.

Source: Personal communication with Mr. Ravi Chopra

NRLM may like to influence the agenda of these institutions by asking them to focus on certain species, which have implications for livelihoods of the poor.

Cultivation of NTFPs:

Medicinal plants offer the best prospects as many of them can be propagated and cultivated as cash crops. A few examples are discussed here. The case of alternative host plantations for lac cultivation, which makes it economically more attractive, is also discussed.

1. Ex-situ conservation and use of medicinal plants for local health care:

The Foundation for Revitalisation of Local Health Traditions (FRLHT) is coordinating a Danish Aid-supported and a Government of India-sponsored project for the conservation of medicinal plants in the southern states of Karnataka, Kerala and Tamil Nadu. It is the most comprehensive programme in India for in-situ and ex-situ conservation of medicinal plants. The ex-situ conservation programme comprises the establishment of a chain of 15 ethno-medicinal forest gardens called Medicinal Plant Conservation Parks (MPCPs). The MPCPs will conserve all plant species traditionally used by the ethnic communities of southern India and will act as live repositories of the natural and cultural history of the region in which they are located. They will also be the learning and documentation centres for local folk practitioners (Shankar and Majumdar, FRLHT, Accessed on June, 6, 2012).

This pioneering work resulted in several significant conservation outcomes. Noteworthy among these was a notable shift in the conservation priorities of the forestry sector. Forest managers started admitting the need for broadening the conservation priorities so as to cover the hitherto ignored medicinal plants. From the conventional timber-focused or wildlife-focused conservation attempts, the priorities slowly got expanded to include medicinal plants too (Somashekhar, 2011).Other impacts included shedding light on many grey areas associated with adulterants and substitutes of different medicinal plants, dynamics of demand, supply and trade of medicinal plants, creation of databases and herbarium on medicinal plants etc. (ibid.).

M S Swaminathan Research Foundation (MSSRF) has similarly been engaged with nine tribal communities viz. *Paroja, Bonda, Kandha, Kandha, Saura, Gadaba, Bhumia, Bhatra, Gond* of Jeypore, Odisha in ex-situ conservation of medicinal plants. This organisation has been promoting traditional tribal practices by establishing tribe-wise Healer's Associations for the *Bhumia, Bonda and Parola* tribes. These associations prepare and administer herbal drugs (such as decoction of night jasmine, neem and tinospora) to their tribal communities (M.S Swaminathan Research Foundation's website, 2012). Other examples of building upon traditional knowledge to revitalise primary health care include the work of Karuna Trust in Karnataka and Sambandh in Odisha. Karuna trust has trained local healers to run 20 PHCs in its project area while Sabandh has promoted a producer company of 1500 traditional healers to produce traditional medicine.

Meanwhile, the Uttarakhand Gramya Vikas Samiti established in 2003 is promoting the cultivation of various medicinal and aromatic plants (MAPs) such as kuth, kutki, asparagus, rosemary, large cardamom, aloe vera, lemon grass etc. under the IFAD promoted Ajeevika Programme by the Uttarakhand State Government. By 2010 it had organised 529 demonstrations for cultivation of MAPs and nursery-raising covering 3796 households. (Uttarakhand Gramya Vikas Samiti, Annual Report, 2010).

2. Lac Production on Quick Plantations of Alternative Host

International Mass Awareness Programme (IMAP) has implemented a programme on lac cultivation in 15 villages of the Chandrakona block of Paschim Medinipur on a pilot scale. IMAP introduced a new host plant *Flemingiasemialata*. Unlike traditional host plants like Kusum, Palas and Ber, that take a long time to attain maturity, *semialata* attains maturity within a year and is ready for inoculation of lac insects. This enables farmers to take up lac cultivation like any regular agricultural cash crop. Moreover, this plant grows easily on arid soil (Bhattacharya, 2010). The intervention was made possible with the help of technical knowledge and training from the Indian Institute of Natural Resins and Gums, Ranchi.

4.2 Sustainable Resource Use

Recent years have witnessed a dramatic increase in commercial pressures for NTFPs leading to unsustainable rates of extraction. Several species with medicinal properties have been pushed to the verge of extinction as discussed earlier. There is an urgent need to develop scientific, sustainable harvest protocols and ensure their implementation. Establishment of standards and certification for sustainable management of wild produce would also go a long way in ensuring sustainable resource use while providing assurances to the discerning consumer. These two aspects are discussed in more detail here :

i) Sustainable harvest protocols

ii) Standards and certification

Sustainable Harvest Protocols

The renowned ethno-botanist Nancy Turner has defined 'sustainable NTFP harvesting' as:

> *"... harvesting plants, parts of plants, and fungi using techniques and in quantities that do not impact the long- term productivity and viability of populations, species or their ecosystems, so that they are available in the same quantities for use by future generations."*

Various countries have created sustainable harvesting guidelines according to their weather, location and market demands. They have included the best time and methods of harvesting major species related to their countries (see for example A Harvester's Handbook: *A Guide to Commercial Non-timber Forest Products in British Columbia* by Cocksedge and Schroeder, 2006). Lack of knowledge about the complex interrelationships between species, their modes of regeneration etc. can often become a cause for non-sustainable exploitation of the resource. The following thumb rules adopted in British Columbia are worth taking note of (Cocksedge and Schroeder, 2006):

- Be aware of the ecosystem: Some plants, such as mosses, harbour or feed entire communities of plant and animal organisms.
- Never harvest large amounts of any plant from one area: The rule of thumb is to harvest no more than 25 percent of a plant or its foliage from a site. If there are very few plants in an area, refrain from harvesting.
- Doing whole plant extraction: Harvest only in areas which are slated for development – such as road development – where the plants would likely not survive the disturbance.

Scotland's Sustainable Forest Harvest project identified basic principles of sustainable harvest, which are of universal appeal (Scotland Reforesting website, accessed May, 2012). It has also published three sets of harvesting codes for wild mushroom (2003), bulb collection (2007) and moss collection (2007). These codes provide guidelines on what, where and how to collect NTFPs from the wildness or forests (ibid).

In India, the work on developing sustainable harvest protocols is in its nascent stage. Dr. K.P. Rao, NIRD, has developed protocols of sustainable harvest for about 20 NTFPs[xi]. Six of these have been developed for the distance education cell at NIRD and include important NTFPs like gum karaya, lac, honey, tamarind and tasar.

The importance of adopting scientific, sustainable harvest protocols can be gauged from the case of gum karaya in Andhra Pradesh. The indigenous people used un-scientific methods for harvesting and processing gum karaya. Some of these destructive practices included : making multiple blazes on a single tree, collecting gum even from immature trees, making big blazes, using inappropriate tools like axe for blazing, using un-cleaned cloth bags, aluminium containers and large leaves for carrying the gum home. The collected gum was sun-dried on the ground directly and even heated on the fire during monsoon. These improper processed gums were sold to traders or the Girijan Cooperation Corporation (GCC). Such gum fetched a poor price for the collectors. A joint intervention by Kovel Foundation, GCC and the Andhra Pradesh government was instrumental in promoting scientific harvesting of the gum, leading to dramatic changes in price realisation while ensuring sustainability of the resource base (Panda, 2010, Kovel Foundation, Exchange Programme, India, 2012).

Box A4.3: Gum Karaya Value Chain Development in Andhra Pradesh (AP)

Kovel Foundation is the apex body of 250 Associations of Girijan Gum Pickers (GGPAs) across Andhra Pradesh. It developed scientific methods of tapping, collection, transportation, handling, cleaning, grading, drying and storage of gum karaya. Its improved tool kit consists of sickle, polythene liners, forceps, bamboo basket and bamboo mat (for collection and drying). Kovel Foundation collaborated with 60 botanists including Dr. K. P. Rao of NIRD, to develop sustainable harvesting protocols and scientific post-harvesting methods. Hundreds of educated tribal youth known as Village Liaison Workers (VLWs) were also trained.

The Girijan Cooperative Corporation (GCC) is a public sector undertaking of the Government of Andhra Pradesh established in 1956 working for the improvement of the socio-economic status of tribals in the State. It is vested with monopoly rights over NTFPs including gum karaya. Collaboration between Kovel Foundation and GCC has created a tremendous impact on the production, processing and marketing of gum karaya. Today its brand 'Girijan Gum', enjoys a high reputation in the international market and fetches good returns for the primary collectors. Primary producers earn in the range of Rs. 5,000 to 8,000 per annum (prices fo 2007-08).

The AP forest department also contributed to this effort by facilitating the formation of *Vana Samarakashana Samitis* to protect the forests. The intervention resulted in a five-fold increase in the price realised by the primary producer. The price of grade 1 gum karaya which was INR 30 per kg in 1990 increased to INR 170 per kg in 2007-08. This has resulted in business worth of INR 70 million in 2007-08 compared to Rs 35 million five years ago.

Source: Panda, 2010 and Kovel Foundation, 2012

Standards and Certification

Even where protocols for sustainable harvest are developed and implemented, consumers are often skeptical about claims made by producers and suppliers. Here, establishment of standards and certification of processes provides the necessary assurances to consumers and the public at large. Certification also proves to be an effective marketing tool for suppliers and producers. It helps to differentiate their produce in the market and thereby claim a higher price. Certification is often associated with cumbersome and lengthy procedures and high costs, which marginal producers with low or zero literacy would find difficult to deal with. A few examples of group certification (MYKAPS in organic cotton, Keystone Foundation for honey and bee-wax) have shown that this constraint can be overcome provided the farmers have the backing of a strong support institution.

Standards applicable to non-timber forest products have been developed in the areas of organic forest management, fair-trade, quality control and sustainable harvest. For examples of standards that apply to NTFPs refer to Pierce and Laird (2003). The widely used international certification systems that offer consumer labeling of NTFPs include (Mallet, 1999):

- Forest Stewardship Council (FSC)
- The International Federation of OrganicAgriculture Movements (IFOAM)
- Fairtrade LabellingOrganisation International (FLO)
- FairWild Foundation

Among these, Fair-Wild Foundation established in 2008 is the most recent. It promotes sustainable use of produce collected from the wild with a fair deal for all those involved in the supply chain. FairWild has opened a chapter in India as well. While individual organisations can get accredited for certification, governmental institutions can partner with FairWild on issues of CITES, Integration into legal frameworks, national biodiversity and resource management strategies (*Fair-Wild Foundation* website accessed May 2012).

In India, the Indian Institute of Forest Management developed the forest certification guidelines in 2007. It has included a chapter on the NTFP certification (Yadav, Kotwal, and Menaria, 2007).There are various other certification systems for certain NTFPs in particular countries such as, Keystone Foundation in India (see Box A4.4), Certified Naturally Grown in USA, BIO Cert in Indonesia etc.

Box A4.4: Keystone Foundation: Group Certification System for Sustainable Harvest

Keystone Foundation, an NGO involved since 1995 in providing organic guarantee and marketing support to indigenous communities in the Nilgiris, has focused its attention on honey and other NTFPs. It developed a value chain for honey and bee wax by promoting sustainable harvesting methods, establishing a processing unit, adding value the product at the primary and secondary processing stages, branding and certifying the produce.

The tribal communities of the Nilgiris used indigenous skill in harvesting honey from rock bees (Apisdorsta) from steep rock cliffs. But due to a lack of knowledge about filtering, the product collected had impurities, fetching a poor price. Hence, Keystone Foundation introduced simple techniques such as estimating the right time and method for harvesting honey, filtering out impurities and reducing the water content in honey. The four layer honey filter developed by the in-house product development expert was useful in protecting the nutrient quality of honey. Product diversification and product innovation is an important feature of the Keystone Foundation's intervention. It developed several value added products from bee-wax, such as candles, lip balms, pain balms and soap, etc.

Participatory Guarantee System

Unlike prevailing 'third–party' certifications, Keystone Foundation adopted a system of "truthful labeling". This label puts the onus of providing product guarantee on the organisation, which represents the public face of the intervention. The certification is based on Participatory Guarantee System of IOFAM. In 1999, Keystone launched its first `Green Shop' in the local town. By 2006, two more shops were opened in townships nearby.

Source: Website of Keystone Foundation, accessed June 8, 2012, Dhananjaya and Umesh Rao, 2010 and John M., 2008

4.3 Value-addition and Value-chain Development

Given that NTFP resources are finite, one has to constantly think of ways of applying new technology and new ways of organising supply chains so that the "carrying capacity" of the resource increases significantly. This can be done in two ways:

a) New product development

b) Developing pro-poor, green value chains.

Value-added Products

Value addition of NTFPs helps in developing new markets for these products, creating new livelihood opportunities and fetching a better price for the primary producer. Examples of two sub-sectors; i.e.; mahua and and bamboo.

Value-added mahua products:

The mahua sub-sector can be transformed with the help of new products developed with eco-friendly technology by small ecopreneurs at the village level. Mahua flowers, which have been used traditionally as daily food, alcoholic beverages or as cattle feed, are now being used for making higher valued products like jam and jelly (Patel and Naik, 2010). Studies on the nutritive value of mahua cleary show

its superiority when compared to fruits like apples and bananas (ibid). The next step is to promote local entrepreneurship around these new products. NGOs such as Srujan, (see Box A4.5) Vasundara, etc. are working towards the development of value-added products from mahua and in promoting local ecoprenerushiip.

Box A4.5: SRUJAN: Promoting Group Entrepreneurship around Value-added Products

SRUJAN, an NGO based in Nagpur, helped women SHGs in Yavatmal district of Maharashtra to build their capacity to manufacture non-alcoholic, value-added products (such as squash, jam, jelly, syrup, and spread, two types of pickles, *mahuachikki*, and *mahuamanuka*) from mahua flowers. SRUJAN also encouraged the SHGs to collect mahua flowers and set up a mahua bank.

After securing the licence to trade in mahua flowers, the SHGs were linked to Laxmi Narayan Institute of Technology, Nagpur, which provided the necessary training for preparing these products. Since then, it has marketed these products in nearby cities like Nagpur, Amravati and Yavatmal. To date, they have made transactions worth INR 4.5 lakhs and earned a profit of INR 55,000/- in less than two years. The group further plans to increase its turnover to above INR ten lakhs and increase their profit margins through effective marketing.

Source: Srujan Nagpur, 2010, accessed through Oxfam India's website, May 2012.

In a similar intervention in Odisha, Vasundhara, an NGO, took the help of the Orissa University for Agriculture Technology (OUAT) to train villagers of Ma Panthei Mahila Cooperative to produce mahua jam and jelly. Vasundhara has also developed several new products from mahua seed, viz. laundry soap, additive to ghee, lubricating grease, candle, bathing oil in jute industry, stearic acid and fatty alcohols. This unique initiative of the women's groups has also been taken up by the women's cooperatives at Kuchinda and Barkote blocks of Sambalpur, Sundargarh and Deogarh districts of Odisha. So far 38 primary cooperatives have been promoted. Their collective sales turnover is about INR 4 million (Vasundhara's website, accessed June 2012).

Value-added bamboo products

Availability of industrial wood from natural forests has been on the decline for many years now, creating a raw material crisis for the wood-based panel industry in the country. The National Forest Policy 1988 lays emphasis on the development of wood substitutes. Bamboo is a fast growing renewable resource. Compared with wood, bamboo has a higher strength/weight ratio and can be a good substitute for wood. Indian Plywood Industries Research and Training Institute a premier research institute of the MOEF, GoI, in the field of composites based on wood has developed environmentally sustainable technologies for making plywood like sheet materials from bamboo. It has taken this forward to developing pre-fabricated houses that are modular in construction, environmentally sustainable, culturally acceptable and affordable (Center for Bamboo Development, IPIRTI website, accessed May 2012). Some of the value-added products developed by the institute include bamboo mat board, bamboo mat corrugated sheet, bamboo laminate, matchsticks, molded tray etc. (IPIRTI website, accessed 2010).

Prof. M.P. Ranjan (ex-NID), who has spent several years working to build the capacity of tribal artisans in Tripura, has developed processes and tools for small-scale production of knock-down furniture made entirely out of bamboo. He has designed over 400 products that can be manufactured by clusters of artisans and sold to urban markets at a premium through their own producer companies (Ranjan M P, n.d.).

Value-chain Development of NTFPs

The NTFP market is mostly unorganised (except for few items like tendupatta or bamboo) and uncertainty in market demand makes it difficult for the tribal communities to survive with only one or two items.

Lack of value addition (like cleaning and grading) at the primary level causes the primary supplier to lose a substantial part of the possible income. Producers face a financial crisis as a result of low market price for their poor quality produce. Hence in order to survive and secure their livelihood they often end up harvesting more than is good for the sustainability of the resource.

It is in this context that value-chain development assumes importance. Value-chain development for NTFPs includes processes of aggregation, primary and secondary processing, grading, branding and certification. This results in better price realisation through collective-marketing strategies. It also generates new livelihoods for the poor in processing activities and increases the share of the poor in the end price of the value-added product. Various NGOs in India are working in the NTFP sector to develop pro-poor value chains.

Table A4.2: Examples of Pro-poor Value Chains in NTFP sector

Agency	Subsector	Location	Reference
Kovel Foundation	Gum karaya	Andhra Pradesh	Box A4.3
Keystone Foundation	Wild Honey	Tamil Nadu	Box A4.4
PRADAN	Tasar Silk	Jharkhand	Acharya in, Pastakia, 2011
Vasundhara	Mahua	Odisha	Organisational website (accessed June 2012)

Box A4.3 shows how value-chain development in gum karaya resulted in the primary producer realising a five-fold increase in the price of his produce over a decade of intervention. The tasar silk value chain created assured livelihoods for over 10,000 marginal producers over a period of two decades. Approximately about 75 percent of the end price is realised by marginal producers and/or their institutions. In 2008, these institutions produced and sold fabric worth INR 26 million and yarn worth INR 14 million. All four categories of marginal producers in the chain experienced an increase in their annual income ranging from 58-242 percent (Acharya in, Pastakia, 2011).

Greening of Pro-poor Value Chains

Development workers and institutions have woken up to the idea of promoting pro-poor value chains in different sectors because of their tremendous potential to generate new livelihoods for the poor at different nodes of the value chain. This approach also enables institutions of the poor to control the value chain and command a fair share of the end price. While planning such interventions, if agencies make an extra effort to explore opportunities for greening the value chain they would be able to make these livelihoods more sustainable (see Table A4.3).

PRADAN has promoted such a greening initiative. While PRADAN's accomplishment is remarkable and shows how value-chain development can be done in the NTFP sector on a fairly large scale, it also provides an opportunity to show also how value and supply chains can be made green. The table below shows which nodes are already green and what opportunities remain to make it greener. In this case the opportunities identified are: a) introducing eco-dyes, b) exploring alternate energy source at reeling units and c) finding alternate ways to produce yarns that do not entail killing of larvae within the cocoon. A similar format can be used to assess supply chains and identify greening opportunities.

Table A4.3: Socio-economic and Environmental Impacts in the Tasar Silk Value Chain

Socio-economic Impacts	Tasar Silk Value Chain	Environmental Impacts
Employment generation for the landless and poor	Host Plants conservation and cultivation Natural Forests + Asan Plantations (1250 ha) ↓	Positive impacts due to carbon sequestration, etc.

	Basic Seed production by Grainage entrepreneurs with inputs from CSB	
Demystification of science – empowerment of tribal youth; Economic self-reliance;	DFL Production by > 300 grainage entrepreneurs	
Stabilisation of cocoon production; Shift in attitude from superstition to scientific approach; Women too can now join cocoon rearing	Cocoon Production *Tasar Vikas Samitis* of 300-350 producers each; Using new POP	Protection of trees and forests reinforced
Drudgery of women using traditional methods removed; Efficiency greatly improved; Empowerment of women reelers	Yarn Production By MBTs at cluster level; 30 women reelers per center: >60 centers using new technology; Federated into MASUTA Producer company	- Killing of larvae with hot water treatment (can explore non-violent methods without affecting production) - Scope for use of alternative source of energy at reeling units
	Fabric Production Eco-tasar Silk Pvt Ltd: Majority holding by MASUTA; Outsourcing of weaving, dyeing, finishing; Marketing subsidiary of MASUTA	Scope to introduce eco-dyes
>10,000 poor families gainfully employed; 75% of terminal price controlled by poor and their institutions; INR 26 m/yr fabric, INR 14 m/yr yarn sold (2008)	Markets Domestic high-end urban markets; Export markets for sarees, stoles, scarves etc.	

V Recommendations for Greening of NRLM: NTFP-based Livelihoods

NTFP being one of the largest unorganised sectors with about 100 million tribal people depending on it for their livelihoods, offers a huge potential for alleviating rural poverty. Sustainable management of NTFPs starting from the natural resource base to the development of value chains with eco-friendly technology holds the key to generating sustainable livelihoods for the poor in this sector. Since 70 percent of the produce collected by tribals in interior forest areas is used for home consumption, it is important to undertake initiatives also for such non-commercial species.

A recent report (September 2011) of an expert committee of the Planning Commission on NTFPs studied all important aspects for developing this sector in a sustainable way and made a number of useful suggestions. Chief amongst these was to establish a dedicated support institution of status and capacity corresponding to that of NDDB in the dairy sector. TRIFED is already working as a national support agency in the NTFP sector. However it has so far not been able to make a major impact. An independent assessment needs to be made to see whether the institution could be upgraded and provided with the right kind of leadership to make the necessary impact. While creating a new agency one would need to ensure that there is no duplication of agenda with existing institutions like TRIFED and National Medicinal Plant Board etc. As a principle, the commercial, developmental and welfare functions should be vested in separate institutions (e.g. in the dairy sector, the cooperative structure looks after the commercial functions while the developmental function is taken care of by NDDB and the welfare function is looked after by Tribhuvandas Foundation).

The Planning Commission report has also identified potential NTFPs for enterprise development separately for five eco-zones of the country. However there is a need to develop economic incentives for eco-preneurship in the NTFP sector.

The committee's recommendations are in many ways similar to the ones made in this report, although the methods deployed to arrive at these conclusions may be different. Also, the present report has an exclusive focus on identifying opportunities for greening NTFP-based livelihood interventions.

Opportunities for Greening NTFP Livelihoods

The recommendations are based on the analysis of good practices presented in this report and uses NRLM's existing framework of implementation. Table 5.1 provides recommendations for various components of the NRLM drawing implications for greening of the NTFP-based livelihood activities. Examples of good practices are shown in *italics*.

The recommendations are provided separately for commercial NTFPs and non-commercial (subsistence) NTFPs (although it is quite possible that with the availability of new technology and development of new value-added products, many NTFPs may move from the second to the first category). A few suggestions are common to both categories. The table also includes precise indicators that could be used to monitor the progress made for each recommendation.

Table 5.1: Recommendations for Promoting Sustainable Livelihoods through NRLM

Sl No	Programme Component	Recommendations	Implications for Sustainability	Monitoring Indicators
A	***Recommendations for Commercial NTFPs***			
1	Production and Productivity	Organise awareness campaigns and build capacity of primary producers for adoption of protocols for sustainable harvest of NTFPs *Example: Kovel Foundation (gum karaya)*	Sustainable resource use	- Number of new protocols for sustainable harvest developed - Number and proportion of collectors adopting new protocols
2	Production and Productivity	Organise awareness campaigns and build capacity of primary producers for cultivation of NTFPs *Example: Gramya, Uttarakhand (MAPs)*	Sustainable resource use and resource conservation	- As above
3	Human and Social Capital	Substitute contractor system with people's institutions for scientific NTFP harvest and collective marketing *Example: Kovel Foundation (gum karaya)* *Masuta Producers Company (tasar silk)*	Sustainable resource use	- Number of SHGs and aggregate PIs adopting sustainable harvest and collective marketing
4	Market linkages	- Provide incentives for group certification programmes for sustainable harvest (only in presence of strong support institution) - Collaborate with FairWild Foundation to develop a national strategy *Example: Keystone Foundation (honey and bee-wax)*	Sustainable resource use	- Number of group certification projects supported - Number and proportion of collectors securing certification increased or decreased? - Percentage increase in producers getting certified

5	Innovations	Identify suitable research institutions and commission specific research on value-added products *Example: Vasundhara (mahua flowers and seed)* *Srujan (mahua flowers)* *IPIRTI (bamboo)*	Greening value and supply chains	- Number of new value-added products developed - Number of PIs taking up production and collective marketing of such products
6	Innovations	Commission research on methods for cultivating MAPs and other NTFPs with commercial value *FRLHT (medicinal plants)* *IINRG (semialata lac)*	Ex-situ resource conservation	- Number of POPs developed for cultivation of new MAPs - Number and proportion of farmers adopting the technology
7	Building Enabling Environment	- Collaborate with Ministry of Tribal Affairs to implement MSP schemes for NTFPs as proposed by Haque committee - Link MSP with sustainable harvest standards.	Sustainable resource use	- Institutional mechanism in place for fixing and implementing MSP - Number and proportion of cultivators/collectors benefitted/year
8	Building Enabling Environment	Develop protocols for conducting EIA of NTFP value chains and supply chains	Greening value and supply chains.	- Number and quality of protocols developed
9	Building Enabling Environment	Rationalise storage, transit and trading rules for group enterprise of the poor and for ecopreneurs	Greening value and supply chains	- Number and effectiveness of incentives developed to promote eco-preneurship in NTFP sector
B	***Recommendations for Subsistence NTFPs***			
10	Partnerships and Convergence	- Document, validate, value add and leverage indigenous knowledge about NTFPs; - Create linkages between formal researchers and local experts and facilitate Participatory Technology Development (PTD) to solve local problems of health, nutrition, livelihoods etc. *Sambandh (medicinal and other NTFPs)*	Sustainable resource use and resource conservation	- Number of PTD projects initiated facilitated - Number of species for which indigenous knowledge documented and validated - Number of instances of PTD that solved local problems
12	Partnerships and Convergence	Develop local system of Primary Health Care (PHC) based on indigenous knowledge and modern science; *Karuna Trust (medicinal plants)*	Sustainable resource use and resource conservation	- Number and effectiveness of indigenous knowledge-based PHCs in operation
13	Human and Social Capital	Leverage local beliefs and norms for conservation of biodiversity in all modern people's institutions such as CIGs, SHGs, producer companies etc. *PRADAN (tasar silk)*	Sustainable resource use and resource conservation	- Number and proportion of training programmes which emphasise sustainability beliefs and norms

14	Production and Productivity	Promote Ethno-Medical Forest gardens at community level *FRLHT (MAPs)* *MSSRF (MAPs)*	Resource conservation impact	- Number and acerage of ethno-medical gardens promoted
C	***Common Recommendations for Commercial and Subsistence NTFPs***			
15	Productivity	Develop sustainable harvest protocols for many more NTFPs – e.g. over 175 MAPs of high commercial value *NIRD (gum karaya and 19 other NTFPs)*	Sustainable resource use and resource conservation	- Number of protocols for sustainable harvest developed
16	Human and Social Capital	- Emphasise environmental sustainability values in all training programmes - Make these values explicit in Mission statement and framework for implementation documents	Sustainable resource use and resource conservation	- Number and proportion of training programmes which emphasise sustainability beliefs and norms
17	Building Enabling Environment	Create state-level team of experts to examine forest working plans (FWP) and identify the opportunity for NTFP-based silviculture *Uttaranchal (Chirpine litter management)*	Resource conservation	- Number of state-level teams formed to examine working plans - Number of opportunities for NTFP-based silviculture identified and implemented
18	Production and Productivity	Support institutions like Botanical Survey of India to create GIS-based database on inventories of NTFPs at zonal level	Resource Conservation	- Number and proportion of zones with GIS-based database created
19	Production and Productivity	Create zonal monitoring committees consisting of representatives of FD, people's institutions, civil society, research institutions, ISRSO, NRLM.	Resource conservation and sustainable resource use	- Number of zonal monitoring committees created and functional
20	Human and Social Capital	Strengthen JFM Programme by providing support for watch and ward, social fencing, ANR, and sustainable harvest protocols *Dostanagar (bamboo regeneration)*	Sustainable resource use and resource conservation	- Number and proportion of FPCs supported

[i]This section is largely drawn from the 'Mission Document' and the 'Framework for Implementation' documents available on NRLM's official website, accessed May 2012.

[ii]Mr. T. Vijay Kumar, the present CEO of the Mission is widely acknowledged for this vast experience of over 16 years in promoting sustainable livelihoods in the state of Andhra Pradesh. He was instrumental in promoting non-chemical farming through the institutions of SERP. He was also instrumental in promoting sustainable value chain development of NTFPs (particularly gum karaya) through the Kovel Foundation, Girijan Cooperative Corporation and State Forest Department. The present minister Jayram Ramesh's penchant for protecting the natural environment in all developmental activities is also well known.

[iii]The World Commission on Environment and Development (WCED) also known as the Brundtland Commission (1987) popularised a short-hand definition of sustainable development which emphasised utilising resources for the present generation without compromising on the needs of future generations.

[iv]This section is drawn from the report of Sub-Group IIon "NTFP and their Sustainable Management in the XII five-Year Plan" submitted to the Planning Commission in September 2011.

[v]When referred to as a sector the term used is Non-timber Forest Produce. Otherwise it is commonly referred to as "Non-timber Forest Products".

[vi]Taxusbaccata L., Himalayan yew, locally known as *'Thuner'* in various parts of the Western Himalaya, has great economic and medicinal values. Due to its excessive collection for use in anti-tumour and anti-cancer drugs, the population of this species has been reduced to such an extent that it is now declared an RET species (Prohit et. al , 2001).

[vii]Also known as *Sarpgandha*, it is a medicinal plant of immense value in both Western and Indian medical systems. Widely used for treatment of hypertension in recent years, the plant has been over exploited and pushed to the status of endangered species (Alatar et. al, 2012).

[viii]Except where otherwise stated the section is adopted from the report by Planning Commission's Sub-group II on NTFP Management for XII Five-Year Plan.

[ix]For a discussion on the performance of these institutions and the outcomes of the missions, refer to the longer version of this paper.

[x]As reported by participants in a regional workshop organised by UNDP and RCDC at Bhubaneshwar on 10-11 January 2012.

[xi]Personal Communication, May 2012.

VI. Proposals for Greening NRLM: Agriculture-based Livelihoods[1]

1. Background

'In this section, agriculture is used within the limited scope of crop cultivation and livestock encompassing its dependence on common property lands and fisheries in local water bodies as in the context of production systems accessible for the poor.

The exploration is also set within the framework of the National Rural Livelihoods Mission and its programme *Mahila Kisan Sashaktikaran Pariyojana* (MKSP), which has sustainable agriculture as a core area of focus.

This section explores various experiences across the country on diverse themes from varied agro-geographies; responses from UNDP's Solution Exchange are also reviewed. The suggestions made here have evolved from this backdrop.

1.1 Agro-ecological Context of NRLM

The Environment Assessment and Environment Management Framework document[2] provides the agro-ecological context of the NRLM districts. The NRLM districts have the following broad characteristics:

1. The districts are in varied agro-ecologies ranging from the stressed ecosystems in the Arid regions in the West to un-tapped bio-potential in sub-humid regions of the East; the length of growing period ranging from as low as 90 days in Rajasthan to 270 days in West Bengal. With the exception of West Bengal and, to some extent, Bihar, rest of the agro-geography is characterised by stressed ecosystems in one way or another.
2. The ratio of common lands including forests, commons and private fallows (*de facto* commons), and seasonal fallows to net sown area is higher in several of the project districts with the exception of UP, West Bengal and Bihar. Agriculture and livestock systems in several of these areas are not only embedded into each other but also, are highly integrated into their commons and forest landscapes with strong cyclical flows of inputs and products across the systems. While livestock are heavily dependent on crop residue, grazing lands and forest, agriculture is dependent on livestock for soil nutrients and additional income, and on forests for maintaining water resources.
3. Land degradation, looming groundwater crisis, undulating topographies, low development of irrigation, predominance of rainfed agriculture resulting in high vulnerability to failures in rainfall and its distribution are some of the features characteristic of the agro-ecological regions of NRLM.
4. Substantial parts of the NRLM landscape are also passing through an agrarian crisis where distress among farmers is widespread for variety of reasons. The crisis is much deeper in the rainfed areas of Vidarbha and Telangana (parts of Karnataka), among others.
5. Meanwhile, several of the agro-ecological landscapes of the NRLM districts show immense potential – despite the relatively under-developed rainfed agriculture (still showing potential for growth), availability of common lands (forests, commons, private fallows and seasonal fallows) in vast measure, predominance of meat-animals in the livestock that survive on grazing in such commons with very low external inputs, medium to high rainfall in several of the districts, etc.

[1]Sections VI and VII on agriculture based livelihoods have been authored by A Ravindra

[2]GoI (2011)

1.2 Implications for Livelihoods:

In essence, these agricultural landscapes have many opportunities as challenges. The key aspect of agriculture (including livestock and fisheries) in this area is the **integration** of crop cultivation, livestock raising and even fisheries with the common pool natural resources. Such integration is on three accounts:

a) ***Product/ input flows*** from the common natural resources into private production systems (grazing livestock providing nutrition to soils for crop cultivation and other soil nutrition cycles). Degrading commons will have a negative impact on the 'privately' operated/ owned production systems.

b) ***Buffering livelihoods*** to tide over adversities such as droughts – sale of livestock assets as a survival mechanism in times of adversities- these seasonal scarcities in many cases are a recurring phenomenon.

c) ***Primitive capital accumulation*** or asset building essential for growth in livelihoods of poor takes place mostly from livestock dependent on common natural resources.

1.3 Strategic Areas for 'Greening' :

1. This integration of livelihoods of the poor with the landscapes beyond their own privately-owned agricultural lands can be the lynchpin in the entire strategy for achieving greening objectives within NRLM.

   Water bodies, grazing lands and groundwater, however, are mostly in the commons regime. Even if one creates private access (for e.g., to groundwater) to these resources, life-cycle of benefits from such investments is highly dependent on actions of others who share the resource.

2. In addition, much of the land owned by the poor or given to them as a part of land reforms are marginal lands with undulating topography, poor soil and often in the upper reaches of watersheds heavily prone to degradation. Ecological restoration of these private lands and soil, in itself, contributes substantially to greening while increasing productivity.

   Thus, a combination of actions on privately - owned land and on natural resources on which production systems of the poor depend (but are not in their direct control of poor) are two strategic areas for NRLM. These will have direct impact on the poor and on ecological restoration.

3. Can the poor can effect and/or benefit from large-scale shifts to 'greening' of agriculture production systems of non-poor?

   Large-scale mechanisation and increasing use of chemical inputs can negatively affect wage labour. Such processes depress wage opportunities or the poor and may even dampen their wage rates. But, is there a case for a reversal? Would green shifts in mainstream agriculture benefit livelihoods of the poor? As much of the green shifts are labour intensive (increasing organic matter use, diversified crop systems, livestock integration, biomass enhancement, system of rice intensification) wage opportunities may go up. Ecological restoration in general enhances the natural resources availability in the that benefit the poor. Restoration of predators of harmful insects at a larger level following non-use of chemical pesticides by all farmers decreases pest incidence in general. Common infrastructure/ services reduce transaction costs for the poor; in some cases, it opens up the market for products where the poor have a relative advantage in production.

We use the above three 'Arenas' as a framework to explore 'greening' options in NRLM.

1.4 Present Position

NRLM recognises that 'multiple-livelihoods' is a key strategy for survival of the poor. Stabilising, enhancing and diversifying the existing multiple-livelihoods base of poor households is a key strategy in NRLM.

The MKSP inherits this strategy but with an almost, near exclusive focus on agriculture. Much of the MSKP strategy was derived from the Community Managed Sustainable Agriculture (CMSA) programme in Andhra Pradesh, among others.

The key areas of focus in MKSP and their implicit implications for 'greening' are:

- Focus on locally-adopted resource conserving and knowledge-centric, farmer-led and environment-friendly technologies.
- Community mobilisation and institution building
- Enhancing skill-base of women in agriculture
- Participatory planning approach as against earlier 'packaged scheme-based' approaches.

The focus in production systems is on restoration of soil productivity, enhancing biomass, usage of non-chemical methods of pest and disease control, biomass generation and multiple-cropping systems. *The focus is solely on lands and agriculture practiced within the operational land holdings of the poor*.

MKSP or NRLM do not explicitly mention livestock, fish or other production systems; cattle rearing for milk production however, is acknowledged at several places.

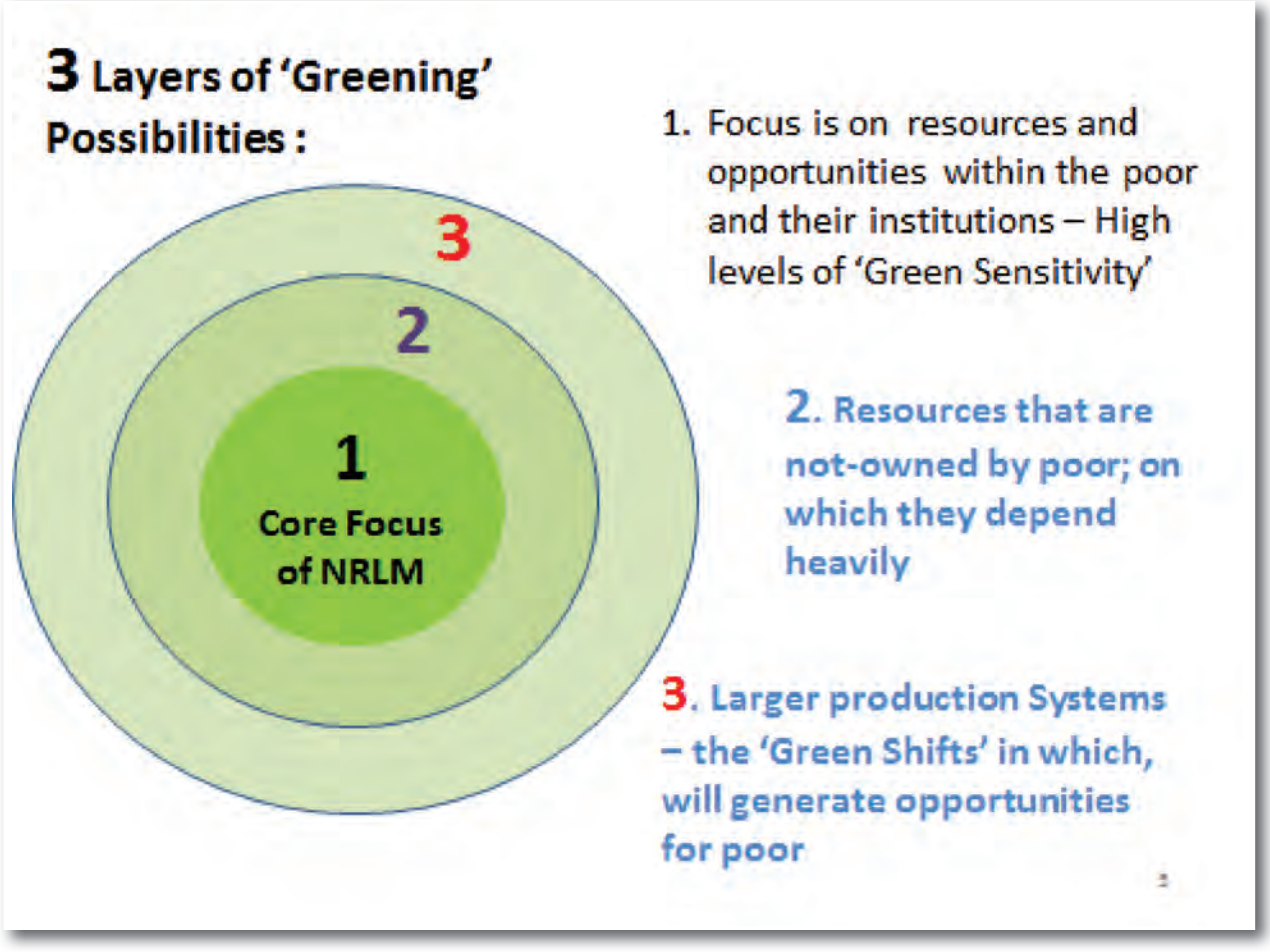


Figure 1: Framework for Exploring Greening Options

2. PROPOSALS FOR GREENING

Based on the review of various experiences on the subject across country, the proposals for greening NRLM are explored as discussed in the framework mentioned in section 1.3 above.

2.1 Greening ARENA 1: Greening Opportunities within the Operational Holdings of the Poor

NRLM and MSKP have a robust framework consisting of almost all aspects of on-farm sustainable agriculture (crop cultivation) practices (see MKSP guidelines). But it assumes that the adoption of these practices by farmers are a matter of building knowledge and skill in addition to some infrastructure

development. The (one time) investment structure under NRLM and MKSP reflect this assumption. Some of the ***green outcomes*** are:

1. Shift away from using chemical inputs in agriculture reduces external costs of cultivation and helps in restoration of natural processes such as replenishment of soil nutrients, higher moisture capture in soil, increase in beneficial insects etc.
2. Restoration of soil health (and multiple crop-systems) essentially builds up soil organic carbon and helps in carbon sequestration. Perhaps, MKSP is the only programme that invests substantially in soil organic inputs outside commercial organic agriculture programmes.
3. Intensive knowledge inputs to farmers in closely observing and strengthening natural cycles and farm-level ecologies builds a 'green perspective' to farming on a large scale; perhaps, this could be the single most important outcome in the efforts of MKSP.

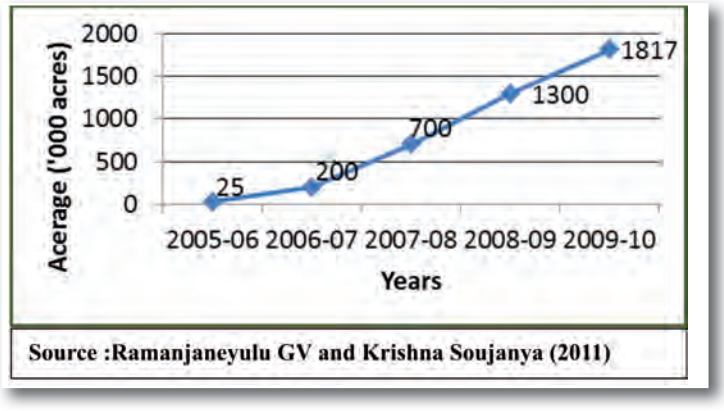
Community managed Sustainable Agriculture

"The CMSA approach replaces the use of chemical pesticides with a combination of physical and biological measures - including eco-friendly biopesticides - and complements it by adopting biological and agronomic soil fertility improvement measures leading to reduced use of chemical fertilizers. This has significantly reduced the cost of cultivation, the need for large amounts of credit, and indebtedness that results. These transformational changes have been achieved without significantly reducing productivity and yields for the participating farmers. Initial results from CMSA in Andhra Pradesh show a significant net increase in farmers' incomes in addition to significant health and ecological benefits".

Vijay Kumar et.al., 2009

(This document provides a detailed account of CMSA processes)

The ecological contributions of an intensive campaign for promoting sustainable agriculture such as CMSA in Andhra Pradesh are well known. The major greening benefits of programmes such as CMSA are:



- Arresting of land degradation
- Carbon sequestration in soils due to addition of biomass and enhancement of life in the soils
- Restoration ecological regenerative processes resulting in
  - Less usage of chemical inputs (and their attendant ecological benefits)
  - Reduction in non-renewable energy consumption.
  - Higher groundwater recharge

In addition to the environmental outcomes, a transition to sustainable agriculture can have multiple spin-off economic benefits for the poor as has been illustrated by the experience of Ramachandrapuram village in Khammam district (see Box).

A major implication of the CMSA experience for NRLM is the demonstration of ***scalability potential*** of knowledge and management-oriented sustainable agriculture approaches on the platforms of organised communities through a system of community-level resource persons.

Sustainable Agriculture Transitions can Spin Multifarious Impacts

Ramachandrapuram: Land taken out from mortgage.

JulurpaduMandal, Khammam District

Ramachandrapuram, a small tribal village in Julurpadu Mandal of Khammam district, AP, was under severe distress in 2004 when the CMSA began. A quiet village with about 75 farm families cultivating about 400 acres of land had all the cultivated land mortgaged to money lenders. After the CMSA began in the village, farmers repaid the loans and got back their lands *(as profits increased due to a substantial reduction in costs of pest management)*. Today, the entire village could have their land back.

Scheduled Tribe Farmers, Land Mortgage Status and Adoption of NPM

Year	Land Mortgaged Prior to 2004*		Land Recovered from Mortgage after 2004		Land Leased in for Cultivation	
	No. of Farmers	Area in Acres	No. of Farmers	Area in Acres	No. of Farmers	Area in Acres
2004	68	147.5	--	--	--	--
2005	35	85.5	33	62	--	--
2006	--	--	35	85.5	--	--
2007	--	--	--	--	9	15

**Mortgaged to Money lenders and/or Input dealers*

Source: Ramanjaneyulu GV and Krishna Soujanya, 2011

The Bihar Rural Livelihoods Programme also has demonstrated similar capacities in pro-poor institutions to scale-up system of rice intensification to a large scale and in achieving yield levels of 3 to 4 times the average state yield of about 2.3 tons/ ha. (BRLP, 2011).

As NRLM has been built on similar institutional building blocks as SHGs, the mission can potentially take up large-scale programmes on a slew of greening initiatives that complement the livelihoods of the poor. NRLM is uniquely placed in this context, having a strategic advantage over any other related line departments or their programmes, to make an impact.

Further Greening Opportunities under Greening Arena 1

MKSP, the flagship programme of NRLM is scaling up programmes similar to CMSA across the country. However, there are several areas that are yet to become part of the core of CMSA but can potentially impact on livelihoods and environment positively. Issues of livestock for e.g., are important both for livelihoods and ecosystems. This section highlights some of these potential areas, but, are confined to greening arena - 1 i.e. resources owned/ operated by the poor.

a. ***Focus on draft-power:*** Lack of access to animal-draft power is an important strategic dimension considering its prevalence in most of the NRLM blocks. Animal draft power have a strategic advantage over the mechanised ones in backward NRLM blocks owing to undulating topography and nature of soils. A systematic understanding of the niche and role of animal draft power and its full of bullock-based draft power. Strengthening animal draft-power also directly contributes to promotion of livelihoods and will provide public goods in reducing per ha consumption of fossil fuels spent on draft power. Each bullock pair contributes about 0.5 to 0.78 kW energy. With the scale of NRLM the potential greening impact is substantial. Also, this is an important area of action, which is not the mandate of any other government department. MKSP/NRLM need to build a specific understanding and intervention focus on this subject.

b. *Diverse Seed Systems in the Hands of community:*

Many of the NRLM Blocks are predominantly rainfed with diverse land types. Crop diversification is a traditional adaption mechanism in the farming systems i.e., suitability to different land types with varying soil and moisture conditions and to reduce risk of rainfall distributional failures. Maintaining diverse seed sources (of varieties and crops) and access to such seed are important support systems for diversified agriculture. Also, it appears that several of the NRLM districts are biodiversity hotspots.

NRLM may have positive or negative impact on such agri-biodiversity. A conscious recognition of such diversity and strategic initiatives to promote agri-diversity integrated into its own sustainable agriculture programmes is required. It needs to be built into the strategic framework of NRLM. There are several examples across the country[3], though not well documented on seed banks that serve both the purposes of making seed available to the community and, also, in situ conservation of local seed material. There is an added advantage in NRLM taking up this agenda considering the institutional base it is promoting in the remote parts of the country where agri-input market penetration is also relatively low. Traditional rice varieties (with varied colours) and millets in particular offer substantial potential as niche areas of intervention for promotion of value-added products that also helps in the conservation of biological diversity.

Experience of Leased Plough Bullocks under AP DAI

The intervention involves capital subsidy (revolving fund based) given to the village organisation to purchase pairs of bullocks at the rate of one pair for 30 acres. The organisation then auctions them for operation on an annual basis on the condition that the land of the poor not having bullocks be given first priority. This has evolved as a separate enterprise for the bullock operators each earning about INR 20,000 per annum on various agriculture operations. The animals are insured and the bullock operator gets into a fodder-supply arrangement in lieu of the tillage. Meanwhile, the organisation gets the returns in the form of annual lease amount for animal replacement in about five to six years. This initiative has shown a BC ratio of about 1:5. *(World Bank, 2011, http://www.wassan.org/apdai/apdai_11.htm and Draft 2 Report on APDAI, WASSAN).*

c. ***Perspective on Water:*** NRLM remains silent on the issue of access to water though it is central; it is central to security of farm production and related livelihoods. Experiences galore on the subject; PRADAN's popular 5 percent model of farm ponds in the Eastern region, experiences of Pani panchayat in Maharashtra, and Pani Chetna Manch's experiences in Palamau district of Jharkhand, DHAN Foundation's experiences on tank irrigation systems in Tamil Nadu and AP, are some of the examples on managing surface irrigation/water sources for the security of crops against seasonal rainfall failures and for small irrigation. This is a core issue in securing agriculture-based livelihoods of the poor. In the tribal and backward areas where entire villages become the constituency for NRLM, comprehensive investments water harvesting for supplementary or protective irrigation must be taken up through convergence. Water harvesting is already part of MGNREGS', watershed development and other programmes. CRIDA has generated an extensive knowledge base on the subject of farm ponds. For a compilation of many such experiences across the country refer to Rao K.V. et. al., (ed), 2009. The impacts are more quickly visible in humid and sub-humid areas of central India.[4]

[3]Experiences with Sahaja Samrudda in Karnataka, CIKS in TN (http://www.ciks.org/seedbanks.htm), Deccan Development Society,Timbaktu Collective and WASSAN in AP, Navadhanya for example, have shown the possibilities of diversification when diverse seed material is available locally with in the community. An array of experiences is available in the form of "seed banks" all across the country but these are not systematically documented or published. For a synoptic overview of seed banks see Lewis and Mulvany P.M., 1997

[4]See also Kakade B.K., (undated) for a detailed technical account of networked farm ponds tried out in Karnataka, case study on livelihoods impact of farm ponds in Adilabad (http://www.icar.org.in/node/585). DHAN foundations' extensive work on tank irrigation systems (http://www.dhan.org/reports.php). GAA, 2005 provides a compilation of some best practices in water management. Manuals on INRM and the 5 percent model are available with PRADAN, Delhi.

A major issue to be confronted here is the low marginal holdings of the poor to spare land for farm ponds; administrative innovations are needed to address this issue. ***Water harvesting from the livelihoods perspective (as against generic groundwater recharge) needs to be the focal area for NRLM. Protective irrigation (see box).***

The Government of AP has taken up a large-scale programme on digging of borewells in the lands assigned to the poor. Of late, it is introducing a system of collectivising groundwater access and its use to protect rainfed crops under the Indira Jala Prabha programme[5], similar pilot programme was also taken up by the Department of Agriculture, AP, in the drought-prone Anantapur district.

Box : Protective Irrigation:

Rainfall distribution failures induce high levels of vulnerability in agriculture-dependent livelihoods. These will be further accentuated by climate change. Frequent crop failures are common even in the rainfed humid and sub-humid regions with high rainfall. Such failures preempt the possibility of any surplus generation and induce indebtedness.

Protective irrigation is to secure crops from such rainfall distribution failures. It involves provisioning of, at the most, three irrigations during the crop period in kharif season for the rainfed crops. Also, such supportive irrigation during critical periods of crop growth is proven to enhance yields by 30 percent. A variety of sources such as farm ponds, check dams, tanks, diversion weirs, lift-irrigation systems etc., can be tapped for this purpose. Access to groundwater for such purposes gives a good measure of security. Extending protective irrigation on an extensive basis covering most of the rainfed lands of poor will have major impact on stabilising their livelihoods. Access to water is also crucial for livelihood diversification.

Several examples of 'protective irrigation' are emerging. For instance, a National Agriculture initiative, pooled the borewells of the schedule tribe farmers along with the new borewells accessed through a government programme into a common grid of pipelines to provide protective irrigation to a patch of about 45 acres of rainfed land, even to those farmers without borewells (see CRIDA (2009), similar experience is detailed in Anwar S.K. (2005). A large-scale initiative in Anantapur has been analysed from a groundwater perspective by Ratna Reddy (2012). The experiences show substantial increase in productivity and non-borewell owners getting access to protective irrigation and in preventing crop failures.

The Working Group on NRM and rainfed farming in its report for the XII Five-Year Plan highlighted the need to make 'protection of rainfed crops' the core tenet of water policy in rainfed areas. Such strategic orientation to protect large-scale rainfed farms from the vagaries of rainfall distribution brings in enormous stability to the livelihoods and farming of the poor.

More importantly, availability of water on the farm (even in limited measures) opens up large-scale possibilities of in-situ or on-farm composting, biomass for soil, introduction of trees into farming systems and intensification of land use. The 'public good - green outcomes' of such a shift to '*protective irrigation for rainfed crops*' would be commendable in addition to being a singular differentiator in making an impact on livelihoods. Such a strategy needless to say, needs to be founded on collective management of groundwater.[6] (also see Planning Commission, 2012).

[5]See Circular No 45 /2834-RIDF-XVII-IJP-2012, dated: 08 -07-2012 of the Commissioner, Rural Development, Govt of AP.

[6]Experiences on collectivisation of groundwater are now emerging. The NAIP programme anchored by CRIDA, APDAI programme anchored by WASSAN and SERP, programmes of CWS in Anantapur, FAO - supported APFAMGS programmes, Pani Panchayat experience in Maharashtra etc., have generated substantial case study to evolve a strategy.

d. Livestock Initiatives

A perspective on livestock owned by the poor is still largely missing. Going by the generic practices in the sector, they are mostly around distribution of cattle for milk production or goat or sheep or poultry as 'asset distribution' through an array of loan instruments. Most often the newly inducted animals are of external breeds with 'high productivity' and poor levels of local adaption.

Livestock mortality is high, particularly in kids, lambs and chicks. Common grazing lands are also being increasingly degraded. Distribution of livestock irrespective of backup services and quality of grazing lands results in high mortality and increasing debt burden for the poor. External breeds with their heavy demand for inputs worsens the situation. Programmes that ignore these realities often exacerbate the problem.

Crop diversification and access to water is crucial for supporting the livestock economy of the poor. Increasing tendency towards mono-cropping will have a detrimental impact on the livelihoods as much as on the environment. Strengthening livestock-crop integration must be actively built into sustainable agriculture strategies.

The livelihoods of nomadic, semi-nomadic and stationary pastoral systems are complex and are yet to find a place in the overall programme design. These need specific attention.

While point (a) above offers scope for improvising on the existing strategic framework of NRLM/ MKSP, the points (b) to (e) need to be brought into the NRLM framework within greening Arena-1 as discussed; they substantially impact the livelihoods of the poor while also generating larger green outcomes.

Programme Strategies: Greening Arena 1:

While the programme on sustainable agriculture seems to be developed in some detail (reflected in the guidelines of MKSP), there are still some serious issues of concern that need to be considered.

a. The Question of Continued Adoption:

The foremost is the ***question of continued adoption*** of these practices in the farm after the project is complete, especially in instances such as:

i. Increasing labour costs-alternative options for wage employment, particularly impinging on the management time of the farmer that is crucial in this approach.

ii. Lack of support from the mainstream systems (including infrastructure development, markets, extension and technology development).

While NRLM is being implemented at a fast momentum on sustainable agriculture, the support systems required for such agriculture to take root fall outside the mandate of NRLM and the Rural Development Department. Promotion of sustainable agriculture under NRLM is confronted with the absence of any incentives on manure or organic matter, near absence of support for NPM in the mainstream, poor development of markets on NPM inputs, aggressive campaign on chemical inputs etc. Agriculture across the world is being sustain with state support in different forms; not to recognise such a need may result in long-term failures.

This also brings in the question of forms of support while promoting sustainable agriculture. Is extension or knowledge-support through community workers and credit availability through SHGs sufficient for these practices to take roots beyond the project period?

NRLM need to take a long-term view of sustainable agriculture so that the practices take root than focus only on immediate project success.

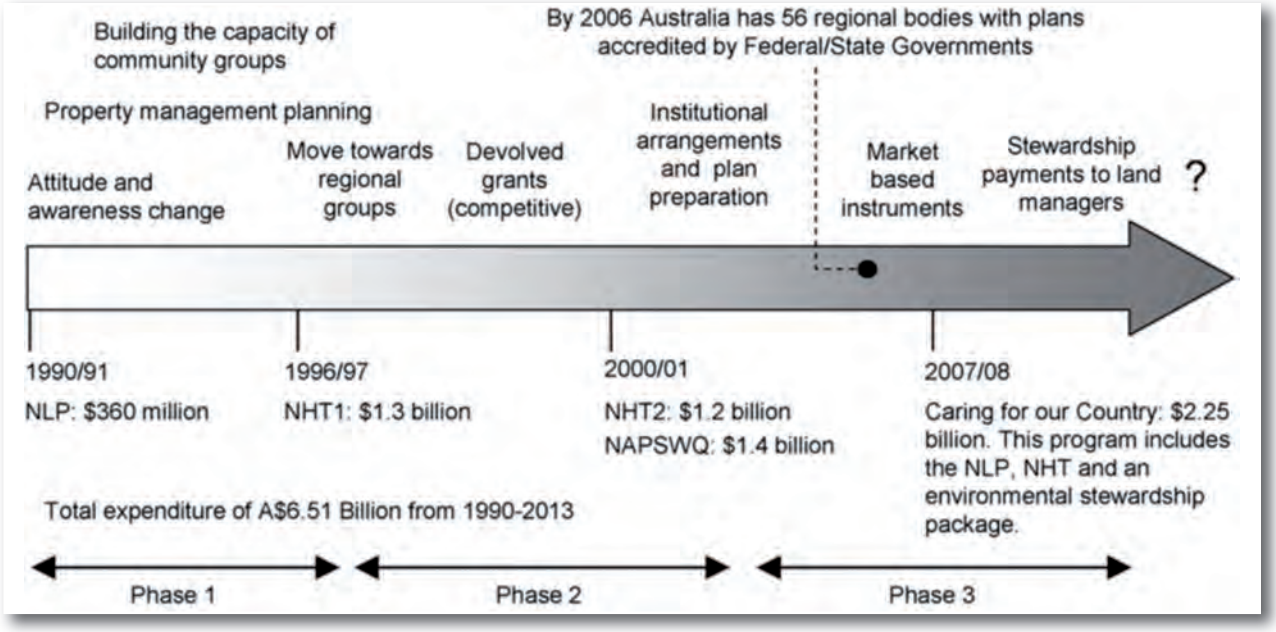


Figure 2: The evolving focus of Australian natural resource management programmes.

Source: Hajkowicz, 2008

The experiences of natural resources management programmes and their transition towards more direct payments towards environment stewardship in its "Caring for the Country" programmes (Hajkowicz, 2008) offer some ground for further exploration. As illustrated in the figure above, with the realisation that 'building awareness and capacity of the community group' alone the Australian government moved towards evolving regional institutional arrangements and competitive project-based grants devolved to the regional institutions for NRM programmes. Inadequacy of such measures and the not-so successful market-based instruments, are now leading to programmes like 'Caring for the Country' designed around "***stewardship payments***". The issue that the government is now confronting is continued adoption of sustainable land care practices by farmers. Systems for linking expenditure to outcomes and adopting standardised metrics for valuing outcomes are suggested to be major areas of focus.

System of rice intensification and CMSA also suffer the same inadequacies. Discontinuation of these practices by farmers who practiced them for some time in spite of their proven benefits is a serious issue. Green outcomes of such practices are substantive, for e.g., 30 percent saving in irrigation water in SRI. Some of the foundational practices, such as manuring, may not be economically viable for some farmers with growing labour costs (or opportunity cost of family labour). The situation is much depressed with the stagnation in agriculture prices and net incomes. Strategic innovations are needed to deal with these issues.

An Indian equivalent of 'stewardship payments' could be-provision of defined days of labour under MGNREGS for viability-gap-funding of specific sustainable agriculture practices that have large environmental and social/economic benefits but are not practiced in general for reasons of economic viability. This however, needs to be experimented on a pilot basis and further explored.

b. Expanding the Scope of MKSP

Recognising the role of protective irrigation, livestock and fisheries as integral to the livelihoods of poor and evolving an appropriate intervention frame is necessary. Such integration necessitates changes in the MKSP programme strategies in the following aspects:

- Look beyond an expanding knowledge base and credit to include sourcing hard investments in land development and water for access protective irrigation, building positive incentives for crop-diversification, setting up livestock primary health care services etc. Convergence with MGNREGS and IWMP etc., and agriculture department programmes assumes importance.

- Work out appropriate institutional models to deal with communities more dependent on livestock and fisheries. Evolving institutions of the primary stakeholders (rather than a mix of them across different livelihood portfolios) and working with them directly may give better results.

There are good experiences available across India within the SHG movement on these aspects.

Green Indicators and measurement of green outcomes: One of the indicators monitoring MKSP is improvement of soil health; but these are quite inadequate. It is important to develop appropriate (feasible at a large scale) scales to measure green outcomes of sustainable agriculture practices and quantify of their aggregate benefits.

Defining the set(s) of sustainable agriculture practices and monitoring their continued practice needs to be built into the system. As the green outcomes of such practices can be easily assessed (as a one time exercise) the annual flow of green outcomes can be estimated. Such an estimate can be a source for attracting some kind of "stewardship payments" from NMSA; at least for supporting MKSP and other such programmes.

2.2 Greening Arena 2: Resources that are not owned by poor but on which their dependence is high

While the focus of NRLM investments are presumably on individual households, the social capital base established as a part of the programme is meant to enhance the poor's collective capacity to access resources. The focus of the collectives is on credit linkages, member services, knowledge sharing, apart from a general sense of empowerment and providing a conduit for the investments under NRLM. Theoretically, the SHGs and their collectives are free to take up any initiatives.

In practice however, the overall direction is set by the nature of investments made available to the groups, their guidelines and the facilitators' bias. Generic access to credit and specific programmes taken up by the local NRLM units drive the programme; these being decentralised allows substantial leeway in terms of evolving locally relevant initiatives. But, the existing framework of NRLM/ MKSP makes it less likely that interventions beyond the farms of individual households will be taken up. It is also because, such steps are more complex and dealing with mainstream challenges is outside the realm of the institutions.

The question is whether Greening Arena 2 is relevant for NRLM to make substantive sense for both generating livelihoods and achieving greening outcomes? This section makes a case for this with the help of some examples.

Case 1: Livestock, Poor and Natural Resources

Livelihood Dimensions: Having marginal land holdings, it is commonly acknowledged that most of the poor depend highly on the commons for their own household needs, inputs to the farm and more specifically for grazing. FES (2011) revisited the issue brought out by works of N.S. Jodha who studied 3000 households across 100 villages over 22 districts spread in eight agro-ecological zones.

Table 1: Annual fodder requirements met from commons for different livestock across landholding groups (percentage of total fodder requirements)

Land category	Bullocks		Indigenous cattle		Crossbred cattle		Buffalo		Small ruminants		Camels	
	1	2	1	2	1	2	1	2	1	2	1	2
Landless	0.31	34.67	0.74	52.66	0.1	32.54	2.36	66.22	3.45	63.67	0.05	90.33
Marginalfarmers	1	39.82	0.92	45.42	0.15	23.70	0.58	26.81	3.24	53.73	0.01	50.00
Smallfarmers	1.04	40.42	1.03	49.57	0.13	31.41	0.74	35.25	6.04	58.56	0.01	26.00
Others	1.43	33.54	1.85	47.94	0.28	34.35	1.02	35.76	5.55	63.85	0.15	47.84

1: Mean holding per household
2: percentage annual fodder requirement met from commons
Source: FES, 2011

If crop-residue from private fallows are also added, it is easy to discern the substantive dependence of livestock economy of the poor on the commons; the Table above shows that this is true of cross-bred cattle and across all farm-size holdings.

Interventions in intensification of feed and fodder in the commons and private fallows, are key to strengthening livestock economy of the poor (both landed and landless). Similar points can also be made on the following:

1. Small ruminants and backyard poultry constitute a major part of the asset structure of the poor; more than the products derived from them, increase in the animal stock itself is valued and is a source of primary capital accumulation.
2. Backyard poultry offer annual incomes in the order of about INR 2000 to 3000 per household in addition to household nutrition[7]. Small ruminants bring in liquidity to farming and create avenues for capital accumulation.
3. Bullocks are critical to small-holder farming – as small holders are lowest in priority for mechanised service providers. In several of the areas of NRLM (central Indian tribal areas for example) – the topography and economy is such that mechanisation may not be an distant option.
4. The scope for stall-fed dairy is limited in the contexts of the poor without access to irrigated lands and in several of the interior districts with poor connectivity.
5. Access to preventive health care is also limited, resulting in high levels of mortality, particularly in goat kids, sheep lambs, piglets and poultry resulting in tremendous wastage of fodder resources.

The small ruminants, bullocks, backyard poultry, pigs etc., are generally at the periphery of livestock interventions usually dominated by dairy. The standard livestock initiatives within development programmes focus on:

a) Loans to purchase livestock with or without subsidy (accounts for 60 to 70 percent of the loans taken through SHGs or from revolving funds).

b) Loans for purchase of bullocks are in general not encouraged with informal 'ban' prevalent within the banking system and in development programmes.

c) Breed-related interventions focusing on i) introduction of external breeds of dairy animals (Murrah, Jersey or HF) ii) artificial insemination; both aimed at making the animals 'more productive'.

d) Marketing interventions around milk.

e) Sporadic health or livestock vaccination camps.

f) Livestock insurance managed by communities has been successfully used in the case of large ruminants (by SERP in Andhra Pradesh) – on the platform of the federations of SHGs.

Table 2: Status of inducted Murrah buffaloes under *Pashukranthi Pathakam* in Medak district, AP

	Number	**Percentage**
Retained	42	26
Died	3	1
Disposed off	119	73
Total purchased	164	100
Calf mortality		
Total calves born	164	
Calf survived till weaning	101	57
Pre-weaning Calf mortality	71	43

Source: Bhagya et al., 2011

[7]These figures are from an unpublished case study on back-yard Poultry anchored by WASSAN for the Rainfed Livestock Network in six states.

The dominant perception behind these interventions is that the poor do not have livestock, rather quality livestock, and therefore, the development interventions need to focus on 'distribution of livestock and 'upgradation of their breeds. Did this method work for livelihoods?

The Table above from a study of 164 Murrah buffalos[8] shows the devastating effects of such induction of external breeds in rainfed contexts. Several such experiences are also reported in Vidarbha and other regions. Many a times, these interventions end-up increasing the debt burden of the families as they fail to make suitable arrangements for their upkeep.

What then should be the strategic framework of intervention in the livestock sector in NRLM; as livestock is going to be one of the major areas for livelihood enhancement?

Greening Dimensions:

Grazing-based livestock systems are the main stay of the poor in asset building. They also ensure nutrient flow within the landscape and helps in biomass regeneration. Stocking densities of small ruminants, goats in particular, and their role in biomass degradation however, is much debated.

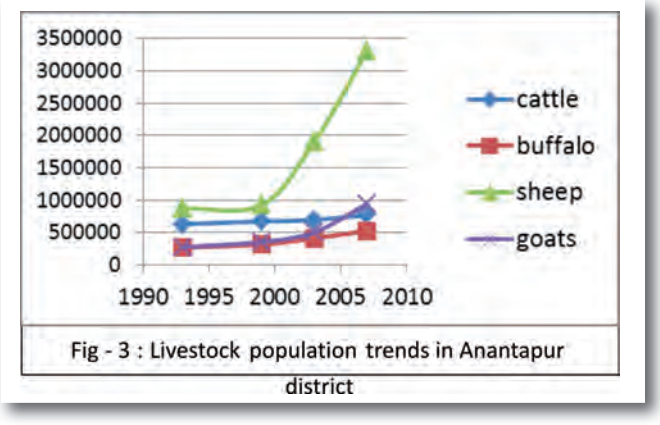


Fig - 3 : Livestock population trends in Anantapur district

The dominant coping strategy of the poor in marginal environments, when subjected to repeated crop failures, is to enhance small ruminants such as livelihood buffers as in the case of Anantapur district in AP (see Fig. 3).

Promising and growing meat markets help poor in their pursuit of asset building. Owing to high fecundity, the multiplication rates will be faster and there is little need for increasing livestock population through induction of new animals.

The spurt in small ruminant economy, provides a great opportunity for the landless and marginal farmers to convert their crop residues from private lands (not owned by them) into income. Unrestricted growth in their population, on the other hand, may accentuate degradation. Any movement towards stall-fed animals will keep the trade outside the bounds of the poor as it requires dedicated land and water and becomes capital/resource intensive.

Regenerating tree based fodder for small ruminants and regeneration of grazing lands in general creates stakes for the rearers in ecological restoration processes. Foundation for Ecological Security in various states (Rajasthan, Odisha, AP, and Karnataka), Seva Mandir's experience in Rajasthan, Ananta Paryavarana Parirakshana Samithi's efforts in regenerating about 70,000 acres of common lands in Anantapur bears testimony to these complementarities. The work of ANTHRA in AP on sheep, Sahjeevan in the case of bunny buffaloes in the Kutch grass lands, Lok Pashu Palan Samithi in Rajasthan with camels, WASSAN's work with varied livestock, among others, provide sufficient ground for synthesising programme strategies in line with the aforementioned reorientation.[9]

Such a shift from 'livestock distribution' to 'establishing support systems' on a community institutional base can be a win-win situation allowing the poor to benefit from the buoyant meat markets while at the same time, addressing the issue of protection and regeneration of the common lands and biomass intensification. ***Livestock rearers can have stakes in healthy and green landscapes.***

NRLM is uniquely positioned for this purpose because of its institutional base at the community level that allows for meaningful negotiations and norm creation. Such a strategic shift within NRLM however, is a major challenge given its current orientation.

[8] This is a programme of Govt of AP as a part of the Prime Minister's relief package for farmers' distress in rainfed areas.

The issue of animal draft-power on the other hand needs subsidised capital infusion in making such services accessible to the poor on a rental basis through animal draft power entrepreneurs. The capital costs of bullocks is, however, absorbed by the programme while the entrepreneurs from amongst the poor takes up such enterprise. Such investments can plug the draft-power deficits within a village. One can estimate the potential green outcomes of such a strategy where fossil fuels are replaced by renewable sources on a large scale. NRLM needs to source such bulk investments from mainstream agriculture programmes such as mechanisation schemes.

Box : *On the other hand, a concerted effort at regenerating grazing resources and biomass by introducing suitable institutional measures of social protection, technological measures, and provision of drinking water with some provision for wage labour to cushion the costs helps in increasing the body weight of the animals on an average resulting into large-scale production enhancement and incomes. With accessible preventive and curative health care services, the mortality rates can be further reduced. Investments on community-based extension and on institution development can help poorer farmers to concentrate more on animal productivity (for e.g. rearing of goat kids/ lambs upto 20 kg body weight instead of selling them after weaning at 10-12 kg body weight) resulting in growth together with the available grazing and other forage resources. Institution development will also enhance demand for livestock services provided by the government.*

In this strategy, livestock asset creation is left to the individuals (as credit is also available through SHGs and bank linkages), while the programme invests on setting up the support systems for healthy livestock production.

Case 2: Fisheries in Rainfed Water Bodies

Fisheries in rained-water bodies (outside marine, river/stream tanks with assured water supply) is another classic case where interventions outside the resources owned by the poor households can bring in substantial livelihood gains to the poor while achieving green outcomes.

Technology Options for Enhancing Fish Production under Different Water Resources in Rainfed Areas

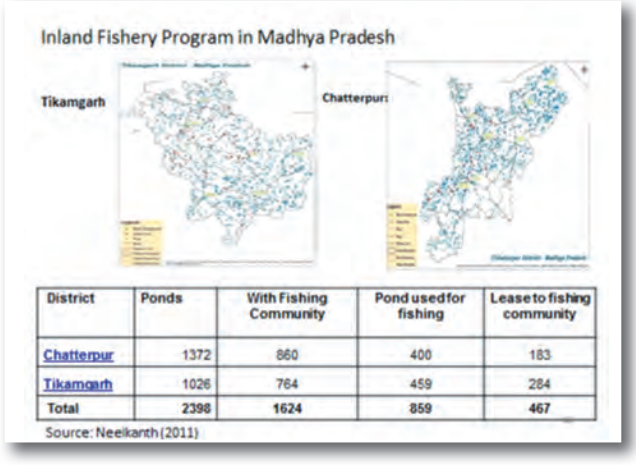
Resources	Resource Developments	Technology options	Aquaculture potential
Seasonal water bodies	Facilitation of the maximum storage of water	Seed production Culture of minor carps Early stocking	1.5-2.5 tons/ha
Perennial water bodies	Weed clearance, water exchange, bund development	Hatchery development Carp culture Mixed farming	2.5-3.5 tons/ha
Water harvesting structure	Ensuring minimum water level for 6 months	Culture of carps or small cat fish like magur, murrels	1-1.5 tons/ha
Community pond	Development of institutions for community management	Carp culture	2-3 tons/ha
Farm pond	Deepening of pond, water storage	Seed production Freshwater prawn Composite culture	1.5-2 tons/ha
Paddy fields	Field modification	Paddy-cum-fish culture Integrated farming	1-2 tons/ha
Small irrigation tanks	Maintenance of minimum water level	Culture based fisheries	0.5-1 ton/ha

Source: *Working Group on NRM and Rainfed Farming Planning Commision, 2012.*

[9]Depinder Kapur (2010) provides an overview of the dependence of livestock on commons. South Asia Pro Poor Livestock Program of FAO and NDDB has several case studies on the subject. Documentation on Good Practices on Livestock and Commons are available at :http://sapplpp.org/goodpractices/CPR-Livestock/, For details of the methodology of natural regeneration followed by APPS see : http://appsatp.org/natural_regen.htm.

There are several instances across India where such interventions have been made. The common pre-intervention situation across these casses was: a lack of clear rights for the communities, nexus between contractors and local leaders, absence of any management, near absence of any technical improvements resulting into bottom-line productivity. The experiences of Vikalp in Tikamgarh and Chatterpur districts of MP, Sahabhagi Vikas Abhiyan and Western Orissa Rural Livelihoods Programme in Odisha, GNNS and WASSAN in AP, and experiences of several others provide substantial basis for evolving a strategic framework.

Strategic initiatives of Vikalp in Chatterpur district in organising fisherfolk cooperatives benefitted 12,000 households securing their rights over 151 ponds. A three-pronged approach by Vikalp a) to secure rights for fishers over ponds b) organising women and fishers, strengthening fish production, introduction of fish-nurseries and establishing market linkages and c) articulating a larger "fish for fishers" policy initiative to streamline lease procedures and rights of fishers, has contributed substantially to the growth in incomes of the members. A larger community-level organisation, Achhrumata Machhuwara Sangathan spearheaded the campaign on leasing rights to ponds.[10]



District	Ponds	With Fishing Community	Pond used for fishing	Lease to fishing community
Chatterpur	1372	860	400	183
Tikamgarh	1026	764	459	284
Total	2398	1624	859	467

Source: Neelkanth (2011)

The Government of Odisha has reserved fish production in local water bodies to the women SHGs. Western Orissa Rural Livelihoods Programme has integrated fisheries development in its watershed development programmes. A series of Better Practice Guidelines were also drafted by WORLP[11]. Breaking the contractor-local leaders nexus in fisheries cooperatives and introduction of staggered harvesting for local vending by women are prominent in outcomes WASSAN's case which has now been scaled-up to cover 300 tanks in four districts in through collaboration with MGNREGS, Fisheries Department, SERP and NFDB.

In all the cases, the programme interventions were around organising the primary stakeholders, breaking the contractor-local leader nexus and securing fishing rights in the water bodies, technical interventions, sourcing quality seed and promoting local business around these actions in addition to improving institutional and technical capacities of the fisherfolk. Policy intervention has been predominantly in terms of securing fishing rights over water bodies. With the present levels of low productivity, there is immense potential for fisheries in this niche sector in most of the NRLM blocks.

Such initiatives that promote organised production help in conservation of water bodies and in preventing encroachment. Fish production in these water bodies mostly uses natural feed and fertility in the water bodies, thus, reducing the ecological foot-print of fish production. Moreover, there is substantial unsatiated local demand that can be potentially realised as income.

How to create mechanisms to deal with contending issues such as breaking the contractor-local leader nexus and securing rights over water bodies would be a strategic issue that needs special mechanisms within the NRLM programme design. Can such issues be dealt with within a formal SHG and their federation structures? Does it need specialised strategies of *sanghatan* i.e. organising those with primary stakes to secure their rights? Can such issues be dealt with through policy reforms? Does is need strategic partnerships? These are the programmatic design issues for NRLM.

[10]For a detailed account of this case study see Feroz and Neelkanth Mishra (2011). Also, see http://www.wassan.org/apdai/APDAI_publications/Process_Manulals/reviving_community_managed_tank_based_fisheries.pdf for initiatives by WASSAN in AP and Tripathi and Haylor (2005). Aquaculture Development Report, Volume 1. Western Orissa Rural Livelihoods Project, Government of Orissa.

[11]See www.worlp.com. Various publications and training materials are available with the Orissa Watershed Development Mission, Bhubaneshwar.

Case 3: Groundwater and its Management for Protection of Rainfed Crops

The NRLM's administrative Blocks, barring those in three states, are mostly rainfed. Vulnerability of rainfed crops to rainfall distributional failures is the bane of rainfed agriculture. Soil organic matter addition, inter and mixed crops and bio-pest control measures strategised in MKSP are risk mitigating for pest/disease risks and provide some resilience to short dry spells. However, failures due to mid and long dry spells are unavoidable; productivity losses due to rainfall disturbances are quite common, often making rainfed farming unviable. Climate change further accentuates the problem.

Securing rainfed crops is the key to brining stability to the livelihoods of the poor who dependent on rainfed farming. Stability in rainfed farming is fundamental for a poor family to move up on the livelihoods ladder. The need for a momentum towards a 'protective irrigation' paradigm was detailed earlier essentially around securing water for protecting rainfed crops of the poor.

This section delves into the major issue of ***security of investments made on groundwater access***.

Several government programmes such as Indira Jala Prabha in AP, Million Wells programmes in other states provide access to groundwater irrigation to the poor through subsidised loans. Returns on these investments and the life cycle of these groundwater systems are sensitive to the stage of groundwater exploitation. Fast decreasing groundwater tables (within a span of few years) makes the entire investment dysfunctional.

Many migrant labourers invest their hard earned surplus into sinking new borewells often borrowing the deficit money at high rates of interest. Groundwater access is the most coveted investment of the poor next to purchase of land. Investment in digging of borewells is quite often a gamble. Either public or private, groundwater investments are sensitive to the extent and rates of extraction of groundwater from the common pool resources.

Without bringing in some order, at least at a local scale, interventions related to groundwater become high-risk investments. Such strategic efforts at bringing groundwater into a management system limiting its extraction to the extent of renewability must become an integral part of groundwater development support for the poor.

Instances of social regulation of groundwater are emerging. APFAMGS' programme in AP has developed several tools of participatory monitoring of groundwater[12]. The Centre for World Solidarity along with its partners in Anantapur district has developed processes for social regulation of groundwater extraction and sharing (Anwar S.K., 2005). WASSAN's experience mentioned earlier on 'collectivisation of borewells' for protective irrigation with specific rights for non-borewell owners is gaining ground with the Rural Development and Agriculture Departments scaling-up the concept in their own programmes. A comparative analysis of these three cases was also attempted (Ratna Reddy, 2012).

These instances demonstrate that appropriate community-level regulations in access, extraction and sharing of groundwater (or even surface water) is essential and it is in the domain of a common pool resource; therefore, the programme needs to negotiate with those above the poverty line to secure water rights and also, ensure regulatory mechanisms to limit extraction.

Planned protective irrigation targeting the rainfed lands of the poor, and if required, incentivising the non-poor to be part of such collectives to share water can substantially and quickly alleviate poverty. NRLM must take special steps for this purpose.

These initiatives will also generate substantial green outcomes. Water allocation for initial survival of trees, for composting and for diversification would bring in biomass. More importantly, security of investments helps farmers focus on their land.

Above all, these efforts lead to sustainable and equitable water management leading to better adaptation to climate variability and climate change.[13] Security of crops, and investments and secured biomass availability for diversification of livelihoods contribute to poverty alleviation.

The cases of livestock, fisheries and irrigation are taken more as an illustration of the kinds of greening options in Arena 2. Regeneration of forests and forest lands, access to forest produce etc., similarly will have substantial impacts on hydrological cycles, livestock production and agriculture productivity in the forest fringe villages. Nature of the issues and problems to be confronted, however, remains the same.

Programme Strategies in Greening Arena 2:

Planned interventions on natural resources not owned by the poor contribute much more to poverty reduction. These initiatives, core of the ecological problems of the country, offer much larger greening outcomes. Common features of such actions within the Greening Arena 2 are as follows:

- The actions deal with common pool natural resources (grazing lands, ground/ surface water resources, fisheries in common pool water bodies) unless the 'common dilemma' is specified.
- Issue of rights over these resources are rather 'messy'
- Securing rights over these resources for the poor involves negotiation with non-poor
- Investments cannot exclusively benefit the poor

These features impose considerable complexities in operation and need intense facilitation. In spite of such complications, they need to be at the core of NRLM for two reasons:

a) These resources can substantially reduce poverty

b) The institutional strength of NRLM at the community level and as a convergent programme makes it uniquely positioned to deal with these issues.

2.3 Greening ARENA 3: Effecting 'Green Shifts' in Mainstream Production Systems

The poor are heavily dependent on the labour opportunities available within mainstream agriculture. They benefit from labour-absorptive and labor-productivity enhancing shifts in the mainstream. Rampant and large-scale mechanisation across the country fuelled by low labour productivity and scarcity, is fast eroding wage labour opportunities. These shifts essentially substitute human labour and organic inputs with mechanisation and chemicals that work against the environment.

Are there synergies between positive green shifts in the larger economy and poverty reduction? Can these shifts substantially benefit the poor?

Case 1: Millets and the Poor

With the large-scale spread of rice and wheat fuelled by public distribution system (PDS), millet has substantially reduced in area and in the consumption basket. Loosing their place in the food grains market have resulted in multiple issues in rainfed areas. Millets are grown in several inter-cropping systems and on marginal lands. Nutritional issues at the household level, escalating cost of food grains for household consumption and in maintaining the PDS at national level, tendencies of mono-cropping, etc., are some of the issues that have arisen.

Introducing millet into the PDS has been a long-standing demand of several organisations, more prominently led by the Deccan Development Society and Millets Network of India (www.milletindia.org). Shifts in consumer demand towards millets, their inclusion in the PDS along with concerted public action on establishing appropriate processing facilities, support for floor prices backed by procurement etc., will have substantial impact on regeneration of area under millet cultivation. Apart from restoring

[12]http://www.fao.org/nr/water/apfarms/index.htm

[13]Groundwater-sharing agreements among farmers owning and not-owning borewells, equal claim on kharif protective irrigation resulting in equitable distribution of groundwater, ban on new borewells in a given area and moisture enhancing and water harvesting measures to improve resource sustainability, and protective irrigation to secure crops against drought spells and provide adaptation to climate variability and climate change. These initiatives address the core of groundwater issues i.e. regulation and bringing groundwater into a management system.

millet into the diet of the poor, these efforts will significantly fuel millet demand restoring it in the crop systems in rainfed areas, thus, having an overarching impact on the poor. The rainfed regions have a strategic advantage in millets production. Interestingly the National Convention on Millets organised by the Millets Network of India has among their charter of demands the issue of paying farmers bonuses for nutritional services, climate change services (carbon sequestration) and for water conservation, the coveted green outcomes. (DDS, 2012).

Should not NRLM have a specific set of steps to strengthen such initiatives in the mainstream that largely benefit the poor? Finding niche markets for 'cage-free eggs' and meat in the free-ranging systems, developing premier markets for indigenous varieties of rice, millet, *Kadaknath* chicken, *desi* cow milk, promoting NPM and organic product markets with participatory guarantee systems (PGS) etc., are all initiatives in the same domain of Greening Arena 3. These initiatives will have the following specific livelihood advantages for the poor:

1. Green shifts in the non-poor's production systems opens up input markets, particularly for locally-made (labour absorptive) bio-control formulations where poor have a relative advantage in production.
2. They open up skilled labor markets for the poor; system of rice intensification is one such example.
3. Technological diffusion will be easier and transaction costs lower. Large-scale adoption of green practices will have a multiplier effect on ecosystem restoration; easy protection of plantations from grazing, availability of inputs on a regular basis, technological development, etc., are some examples.
4. Larger product markets open up where production systems of the poor have comparative advantages; millet and minor pulses are couple of examples.

Identifying and prioritising specific action areas and evolving appropriate partnerships and making strategic investments may be planned.

VII. Recommendations for Greening NRLM: Agriculture-based Livelihoods

Based on a synthesis of the greening opportunities discussed above, specific operational strategies to integrate action in the NRLM programme design are discussed here. Given the mammoth task of building pro-poor institutions, it is perhaps a difficult proposition for NRLM to internalize the three greening arenas in its strategic framework universally. However, if such strategies are not internalised the full potential of NRLM's social capital to positively impact poverty will be lost.

It might be a wise proposition to generate these experiences within NRLM in parallel. **Separate streams of action as sub-projects** can be initiated in line with MKSP as a sub-project within NRLM. Two streams of parallel action at scale may be initiated across the country. These measures can be initiated in places where institutions are relatively mature and where quality field-level facilitation is already in place. These sub-projects can be treated as innovative components of NRLM with additional facilitation support. Clear linkages with other mainstream programmes like MGNREGS, IWMP and RKVY must be established for leveraging resources and institutions. The objective of these initial pilot initiatives is to establish standard operational protocols for scaling up within NRLM in due course. Two streams of projects are suggested below in addition to MKSP, which is already operational. The following section outlines these strategic interventions:

1. Stream 1: Expanded MKSP – Options under Greening Arena 1

This first stream will build on MKSP expanding its scope to include the gaps identified in Greening Arena 1. It is important that the question of continued adoption/adaptation of various sustainable agriculture practices by farmers in a given area is thoroughly analysed and issues identified. These set of projects shall work within the existing institutional frame of MKSP (SHGs and their federations) and by bringing in additional focus on:

a. Continued adoption of sustainable agriculture practices
b. Establishing community-managed seed systems for diversification
c. Addressing issues of animal draft-power
d. Integrating clear steps on water for protective irrigation
e. Integrating initiatives on livestock systems (including backyard poultry) into crop systems (shifting from livestock distribution establishing support systems)

NRLM needs to evolve a strategic framework to include both as it has done for sustainable crop cultivation; the same needs to be built into its guidelines. The process steps can be synthesised form the existing experiences available for piloting and standardising.

Expanding the scope of MKSP on the above lines entails incorporating the following aspects in the programme structure:

1. Several of the initiatives are investment intensive. The convergence platforms with mainstream programmes like MGNREGS, IWMP need to be strenthened. Appropriate systems need to be evolved in dealing with such grant-based programmes within the facilitation structure of SHGs that are oriented towards decentralised loan-based operations.
2. It is also recommended that the project mode of functioning with investments in terms of loans, capital subsidy, institution and facilitation investments should also consider outcome-based incentives for continued adoption of sustainable agriculture practices. If possible, negotiation with the National Mission on Sustainable Agriculture in term of payments against measured green outcomes for continued adoption or environmental stewardship payments could be initiated. Such mode of functioning brings in a measure of accountability, seriousness in outcomes and continuity in the use of sustainable agriculture practices.
3. A prerequisite for instituting such measures is putting in a system of measuring green outcomes - green metric. It is expensive and difficult to measure the green outcomes (soil quality as mentioned in MKSP guidelines). Calibration of green outcomes to adoption of certain practices and measuring the practices may be more practical proposition.
4. Another challenge of expanding of the scope of MKSP is the need for multi-disciplinary expertise at the grassroots level. Generating initial success in several places and developing a pool of community-level resource persons and facilitators through structure; investments have brone rich dividends in the past.
5. An institutional problem that surfaces is the diversity in the livelihood profiles of the SHGs and their federations. Expanded MKSP scope requires more intensive work and specific measures along the production systems that may require specific institutions of primary stakeholders. The concept of common interest groups have been tried in several places but the demand might be for a more formal organisations like producer companies. The evolution of such institutions on the platforms of SHG federations need to be strategised and thoroughly experimented.

2. Stream 2: NRLM – An Innovation Stream or Challenge Programme in Sustainable Agriculture (Greening Arena 2)

This stream of pilot projects is much more challenging. Structurally, they need to be operated at an aggregated level of a block/*Mandal*/clusters of gram panchayats. In addition to intensive efforts in line with MKSP, the natural resource base into which the production systems of the poor are embedded in must be systematically analysed. Initiating measures to secure required rights (not only usufruct but also management and development rights) over resources, bringing institutional systems around resource management and adequately investing in these resources to improve productivity, realising better incomes from the enhanced production must be integral in the programme. Establishing support systems such as primary health care for livestock are also crucial.

These initiatives will produce bigger greening outcomes simultaneously at a landscape level. Perhaps, the realisation of livelihood benefits will be much stronger as these interventions get access to key resources, i.e. commons, forests, water, livestock, to the poor.

This stream of innovative pilot projects operate at a higher scale and focus on the security of rainfed crops by providing protective irrigation, integrated livestock initiatives in a reformed framework, accessing fisheries rights for the poor in local water bodies and bringing in technological innovations. Evolving appropriate institutional systems is foundational. The key points of departure for these pilot initiatives from the existing framework of NRLM/MKSP are as follows:

1. Initiatives are planned at a higher (landscape) level and the starting point is an intensive participatory exploration of opportunities for the poor to intensify their livelihoods base (rather than household-level plans). Such opportunities are explored in the natural resources base at a higher level particularly with respect to intensification of grazing and forage resources, accessing surface and groundwater, accessing water bodies, etc.
2. Evolving negotiated agreements with non-poor, if required, and evolving institutional systems of resource management, use and governance.
3. Integrating investments from various sources (including agriculture, fisheries, irrigation etc.) with NRLM. Investments from NRLM, however, need to be strictly tied to the benefits accruing to the poor.
4. If need be, specialised primary stakeholder groups and their federations can be established and nurtured for specific interventions. Convergence with gram panchayats is a necessity, particularly in the sphere of resource governance.
5. A block/Mandal-level programme is a better unit of integration of programmes, mapping of opportunities and institutional development (rather than a district or village level).
6. Specific engagement with mainstream government departments and other institutions might be a prerequisite; modalities of such convergence with rural development programmes must be established at a higher level.

At the pilot stage, more facilitation would be required until standard operating procedures evolve.

An initial pilot of this nature can be implemented in phased manner – initially, one in each state and then expanding to one in each district after the first year. The programme can then be universalised, as it takes root, at the conceptual, administrative and community levels. It is important that the centre initiates such a programme with the NRLM identifying capable partners and developing appropriate partnership agreements. As it involves intensive learning, a 'learning cell' may be centrally established for synthesising experiences and evolving necessary protocols.

NRLM can make substantial contribution to greening outcomes with its scale, coverage and institutional base. No other programme, expecting Watershed Development, has such potential on Greening India. This could be a unique contribution of NRLM, if articulated well.

This stream of programmes may be opened within NRLM as competitive grants for qualified NGOs, consortium of NGO-research organisations or networks specialising in this agenda.

VIII. Proposals for Greening NRLM: Non-farm and Artisanal Livelihoods

1. Assessing the potential

Various tools and methodologies exits to assess greening. They offer both a means to identify and quantify any existing potential of policies and investment programmes in providing new green employment. The selection of tools is largely dependent on the questions to be answered. In addition, the selection is also dependent on other factors such as the skill base and capacity of the sub-sector and most importantly, the social and institutional domain.

In the non-farm sector, greening potential can be considered as products resulting from the application of environmental science to address and mitigate the negative impact of growth and development. These may include, among others, products designed to improve:

1. Air quality
2. Biodiversity
3. Negative impact of climate change
4. Negative impact from the use of fossil fuels
5. Non-environmentally friendly buildings
6. Disposal of hazardous materials
7. Land-use practices
8. Management of natural resources
9. Recycling and recovery of resources; such as soil, sediment and earth quality
10. Solid waste management; Water quality management

1.1 Non-Farm Sectors and its Scope:

Major sectors and sub-sectors that are operating in India [both manufacturing and service sectors] are:

Table 1: Livelihood Sectors and Sub-sectors Established in Rural Areas

Sl. No	Sector	Subsector
ARTISNAL		
1	Textiles	Handlooms, Garments, Power looms, Embroidery, Lace work, Zari, Batik, Kalamkari, Jute & cloth products, Banjara cloth works, Painting Sarees, Blanket making
2	Handicrafts	Wood, Metal, Artworks, Clay Products, Leather, Flower Vase making, Hats Making
3	Jewellery	Metal, Stone, Gems, Pearls, Imitation jewellery
4	Leather	Bags, Purse, Belts, Footwear, Cobbler
5	Toys	Soft, Wood, Leather, Clay, Plaster of paris
6	Food Products	Pickles (veg & non-veg), Bakery products, Milk products, Chips, Puffed rice, Street food vendors
Off-Farm & Non-Farm		
1	Agro or Horticulture-based	Dal, Sugarcane, Paddy, Chilli powder, Garlic paste, Haldi powder, Mango jelly, *Chikki* making, Cashew and salt making
2	Fisheries	Aquarium, Fish seedling, Dry fish, Boat repair
3	Forest Based	Leaf plates, Tamarind, Herbal products, Fruits, Bamboo products, Cane, Broom

4	Electrical & Electronics	Decorative bulbs, Sound system, Satellite dish services, TV, VCD and other Electrical equipment repair
5	Chemicals and Minerals	Soaps, Surfs, Detergents, Incense sticks, Candles, Fireworks, Phenyl & acid making, Vibhuti vundales, *Cumcum* and bindi making;
6	Others	Paper plates, Tent house, Orchestra, Mat weaving

Specifically in the context of NRLM, efforts of the Government of India to build on local institutions (social capital) has been significant. This has also facilitated, to an extent, the availability of credit for productive purpose to spark entrepreneurship in the community. The efforts, thus far, have led to demand for business development services, for manufacturing and services sectors.The existing enterprises need support to improve their performance while there is huge demand for new business opportunities. The above two segments offer growth potential for individuals and collectives.

Hence, the greening agenda has to be considered in light of the platform and client base, such as the one available under NRLM.

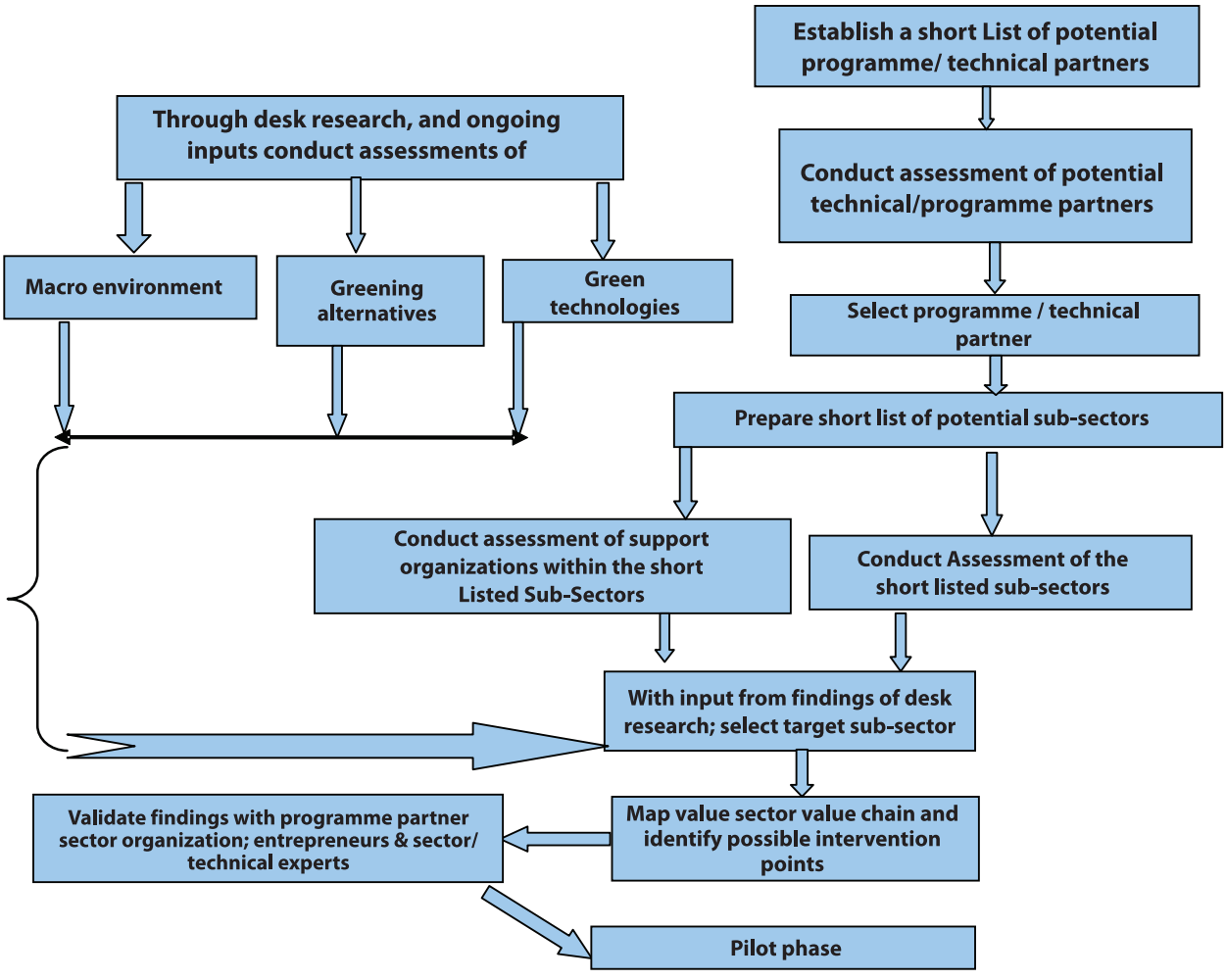
Assessment and Value-Chain Perspective:

It is imperative to identify the value-chain perspective to draw out the nodes/potential of greening. The basic function of a value-chain analysis is to clearly identify the inter-related links in the chain and to identify opportunities to "add value" at each link in the chain. In the case of greening, the value-chain analysis can be used to identify where value can be added through the application of green technologies and processes. Value in this sense, can be seen as cost savings accruing from reduction in waste, water and/or energy consumption. "Value" comes from increased productivity from units using the correct technology and/or tools, better processes and receiving fair results from increased sales due to marketing of the product as "Green" or environmentally compliant.

Figure 3
Business Ladder:
Kinds and Levels of Off-farm & Non-Farm Sector Enterprises vis-à-vis Entrepreneurs

Growth Micro-Entrepreneur **Growth** • Multiple businesses, one of which is usually agriculture based • Diversification into non-agricultural activities • Expanded business, requiring good knowledge of products and markets • Able to get and service loan from rented or own premises • Needs more formal credit	• Qualifies for loan from one of the larger financial institutions such as Commercial Bank, National Bank or other commercial banks • Financed from savings, retained earnings, and enterprises • Have mixed low and medium skills with the owner working together with some unpaid family members • Assets of current and moderate value, more mixed fixed assets with access to services • Stable ventures with potential for diversification and specialisation growth • Majority are second-generation enterprises such as trading in specialised off-farm based products, petty shops & manufacturing such as fabrication etc.
Stable Micro-Entrepreneur **Stability** • Manages own business or with help of family • Employs one or two at upper end of this category • Fixed place for artisan-trade type of business • Develops a fixed workspace though some are still mobile trading • Absence of operating licence from local authority • Self-raised capital investment in business • Expanding businesses requiring experience and skills • Capital required for expansion	• Difficulty getting loans from bank • Women increasingly able to access group loans • Financed by savings, retained earnings and enterprise itself with some low-value fixed assets and limited access to services; owners tending to work independently unless they want to grow when they seek financial assistance • Basic business training and credit management necessary • Available assistance focusing on training currently provided by NRLM.
Subsistence Micro-Entrepreneur **Viability** • Self-employed, independent income generation, temporary market stalls with short-term goals and not interested in expansion • Sales at roadside, within the community and at nearest markets • Personal savings (mostly men) or borrowing through groups or from family (mostly women) used to start up business	• Inexperienced in business management • Rely on family labour where necessary • Usually seasonal activities on a small scale • Assistance combines training with some credit,
	Survival Activities: Pre- Entrepreneur

Figure: 4
Assessment Process



2. Good Practices:

There are encouraging signs and results from many initiatives around the world. A number of these come from developing countries, including emerging economies. They illustrate a positive benefit stream from specific green investments and policies. If scaled up and integrated into a comprehensive strategy, they could offer an alternative development pathway, one that is pro-growth, pro-jobs and pro-poor.

Few of these examples, a limited selection from a growing range of experiences in different sectors, are summarized below, highlighting their economic, social and environmental benefits. While some represent established broad-based policies and investment programmes, others are pilot projects or local ventures. In this sense the examples underlines that a green strategy is not limited to national or other government policy levels but can take root wherever there is the leadership and vision to make this transformation.

2.1. Renewable Energy in China

Passed in 2005, China's Renewable Energy Law serves as the principal framework for development of the sector. The law offers a variety of financial incentives, such as a national fund to foster renewable energy development, discounted lending and tax preferences for renewable energy projects, and a requirement that power grid operators purchase resources from registered renewable energy producers. The combination of investments and policy incentives has encouraged major advances in the development of both wind and solar power.

Wind Power

The additional generating capacity from wind power has exhibited an annual growth rate of more than 100 per cent from 2005 to 2009. With new installations of 13.8 GW becoming operational in 2009, China led the world in added capacity, and is second in terms of installed capacity, after the US. To reflect the increasing ambition in the industry, the government has indicated its intention to increase its previous target of 30 GW of installed capacity by 2020 to 100 GW. To directly encourage local wind turbine manufacturing, China has implemented policies to encourage joint ventures and technology transfers in large wind turbine technology and mandated the use of locally-made wind turbines. The Ministry of Science and Technology has subsidised wind energy R&D expenditures at varied levels over time, beginning most notably in 1996 with the establishment of a renewable energy fund. Domestic wind turbine makers, such as Sinovel Wind, Goldwind Science and Technology, and Dongfang Electric, have contributed an increasing share of total new installations. Together they accounted for at least half of the market dominated by foreign firms until 2008. China's National Development and Reform Commission issued the Interim Management Measures for Renewable Power Tariff and Cost Allocation in 2006, and the Interim Measures on Renewable Power Surcharge Collection and Allocation in 2007. Together with the Renewable Energy Law, the regulations aim to encourage a reduction in the price of wind power by stipulating that a competitive pricing bidding model be used for the majority of wind power development in China.

Solar Power

Being the largest Solar PV manufacturer in the world, China produced 45 per cent of global solar PV in 2009. The domestic solar market has started developing more recently, with about 160 MW solar PV installed and connected to the grid in 2009. But with more than 12GW of large projects in the pipeline, it could rapidly become a major market in Asia and the world. For solar PV, the government has also indicated that the target for installed capacity in 2020 could be increased from 1.8 GW to 20 GW. China is now the world's largest market for solar hot water, with nearly two-thirds of global capacity. More than 10 per cent of Chinese households rely on the sun to heat their water with more than 160 million square metres as total collector area. The rapid development of the Solar Water Heater (SWH) sector is due to its basic profitability for both business, manufacturing the units, and households that install them. There are also considerable health and sanitation benefits afforded by the improved availability of hot water, made more feasible and economic with solar water heater systems. Within the context of the Eleventh Five-Year Plan for New and Renewable Energy, an Implementation Plan on Promoting Solar Thermal Utilization in China was adopted in 2007. Under this national policy, the installation of SWH systems is given priority for major hot water consumers, such as hospitals, schools, restaurants and swimming pools.

Job creation

The energy sector as a whole generates output worth US$17 billion and employed an estimated 1.5 million at the end of 2009, of which 600,000 were in the solar thermal industry, 266,000 in biomass generation, and 55,000 in solar photo-voltaic and 22,200 in wind power. In 2009 alone, an estimated 300,000 jobs were created. China's experience provides an example of policy led growth in renewable energy that has created jobs, income and revenue streams for nascent low carbon industries.

2.2. Feed-in Tariff in Kenya

A Feed-in Tariff (FIT) is a policy instrument that makes it mandatory for energy companies or "utilities" responsible for operating the national grid to purchase electricity from renewable energy sources at a pre-determined price that is sufficiently attractive to stimulate new investment in the renewable sector. This, in turn, ensures that those who produce electricity from identified renewable energy sources such as solar, wind and other renewable sources have a guaranteed market and an attractive return on investment for the electricity they produce. Aspects of FIT include access to the grid, long-term power purchase agreements and a set price per kilowatt hour (kWh).

FIT's objectives are to:

a) facilitate resource mobilisation by providing investment security and market stability for investors in renewable energy sources (RES) electricity generation

b) reduce transaction and administrative costs by eliminating the conventional bidding processes

c) encourage private investors to operate the power plant prudently and efficiently so as to maximise returns.

By making a long-term commitment to the development of renewable sources of energy and stipulating a long-term power purchase agreement of minimum of 20 years, the Kenyan Government has taken a critically important step in the development of the country's significant potential for renewable energy generation, while pursuing equally important economic, environmental and social policy objectives. In January 2010, Kenya revised the FIT policy, which resulted in the addition of three renewable energy sources: geothermal, biogas, and solar energy resource generated electricity. In addition, the revised policy extended the period of the power purchase agreements from 15 to 20 years and increased the fixed tariffs per kilowatt-hour for pre-existing wind, biomass and small-hydro power under FIT.

Expected Benefits:

a) Environmental integrity including the reduction of greenhouse gas emissions

b) Enhancing energy supply security, reducing the country's dependence on imported fuels; and coping with the global scarcity of fossil fuels and its attendant price volatility

c) Enhancing economic competitiveness and job creation.

Initially covering wind, biomass and small hydro, the policy is planned to include geothermal sources of energy. It is expected that the FIT policy in Kenya could stimulate about 1300 MW of electricity generation capacity. If the projected generation capacity is realised, this could contribute significantly to ensuring security of electricity supply in the country by increasing the reserve margin. Furthermore, since the resources used consist of relatively low cost local fuels, it is likely to reduce costs for the consumer. Benefits targeted are a triple-win of additional renewable-based generation capacity to the country; enhancing employment and poverty alleviation in the rural areas; and increasing income opportunities for business development. As Kenya's greatest renewable energy potential is in rural areas, the effects of the FIT policy are expected to trickle down and stimulate rural employment. This can happen through the construction of power plants, but also in the context of agro-industries, in particular sugarcane, which is predominant in the country. It is estimated that the sugar factories have directly and indirectly contributed to job creation by supporting about 200,000 small-scale farmers within the sugar belt in western Kenya, and that between five and six million people either directly or indirectly benefit from the sugar factories.

Observed Impacts :

Since the announcement of the FIT policy, some sugar companies have planned to upgrade their biomass-based co-generation potential in order to benefit from FIT. While full effects have not been realised yet, Kenya provides an example of how a forward-looking energy policy could contribute to matrix diversification, improved benefit streams to small rural producers, and enhanced local development.

2.3 Solar Energy in Tunisia

Between 2005 and 2008, clean energy plans have already allowed the Tunisian government to save $1.1 billion in energy bills, relative to initial investments of $200 million in clean energy infrastructure. Primary energy consumption from renewable, together with savings from energy efficiency, are expected to reach 20 percent of total energy consumption in 2011. In December 2009, the government presented the first national Solar Energy Plan and other complementary plans with the objective of increasing the share of renewable energy sources from just under 1 per cent to 4.3 percent in 2014. The plan includes the use of solar photovoltaic systems, solar water heating systems and solar concentrated power units

for electricity generation. Total financial resources to implement the plan have been estimated at $2.5 billion, including $175 million from the National Fund, $530 million from the public sector, $1,660 million from private sector funds, and $24 million from international cooperation, all to be spent by 2016 on 40 renewable energy projects. Approximately 40 percent of the resources are devoted to the development of energy export infrastructure. The energy savings expected to result from the Solar Energy Plan could reach 22 percent for 2016, with a reduction of 1.3 million tonnes per year of CO

Solar water heating systems – the PROSOL programme

The Tunisian Solar Programme (PROSOL) – a joint initiative of the Tunisian National Agency for Energy Conservation (ANME), the state utility Société Tunisienne de l'Electricité et de Gaz (STEG), the United Nations Environment Programme and the Italian Ministry for Environment, Land and Sea – provides an example of solar thermal market development. Financial and fiscal support combines a capital grant qualifying for VAT exemption, customs duty reduction and a bank loan with a reduced interest rate. Repayment of the loan is organised through the regular utility bill of STEG, with local banks receiving support that allows them to finance SWH projects with reduced interest rates. This arrangement has generated direct financial benefits for the end-users, when comparing the size of the monthly instalments for a SWH system to the earlier electricity bills. A complementary interest rate subsidy was available during the first 2 years (2005-2006) of the programme, reducing the interest rate of the loan to 0 per cent to the final end user. This support was discontinued from 2007 and annual interest rates for loan repayment have been 6.5 percent since.The government provides a subsidy of 20 per cent of the system cost or $75 per square meter, while customers are expected to finance a minimum of 10 per cent of the purchase and installation costs. Over 50,000 Tunisian families now get their hot water from the sun based on loans amounting to more than $5 million in 2005 and $7.8 million in 2006 – a substantial leverage to PROSOL's initial cost of $2.5 million. With installed surface of the programme reaching 400 000 m2 , the government has now set a more ambitious target of 750,000 m^2 for the period 2010-2014, a level comparable to much larger countries such as Spain or Italy. As of 2008, PROSOL helped avoid 214,000 tonnes ofcumulative CO emissions. Jobs have been created as 42 technology suppliers were officially registered and at least 1000 companies installed the systems. In conclusion, the experience in Tunisia demonstrates the potential returns on investing in renewable energy, creating new jobs, and reducing dependency on fuel imports.

2.4. BAGH Block Printing

Block printing is an ancient art that has been practiced in India for thousands of years. The earliest documented evidence of this craft are from the times of Alexander the Great in 327 B.C., when he mentions 'beautiful printed cottons' in India. In fact, historical data suggests that even as far back as the days of the Indus valley civilization, block printing was in evidence in India.

Archaeological evidence from Mohenjo-Daro establishes that the complex technology of mordant dyeing had been known in the subcontinent from at least the second millennium B.C. The use of printing blocks in India may go as far back as 3000 B.C., and some historians are of the view that India may have been the original home of textile printing.

Bagh: A Geographical Introduction

Bagh is a village in Dhar district of Madhya Pradesh. It is around 150 km from Indore, the commercial capital of the state. Bagh gets its name from the ancient Bagheshwari Devi temple situated there, and is famous both for the ancient Bagh Caves, which are said to be more than half a million years old, as well as for Bagh printing. It is hilly terrain with thick forest cover and a considerable tribal population, mostly Bhils and Bhillalas. Other communities residing here are Other Backward Castes [OBCs] like Kurmis and Sirvi, and some Muslims, who are traditionally weavers.

Bagh Printing

Bagh printing in its current form started in 1962 when a group of Muslim Khatri weavers migrated from nearby Manavar to Bagh. They were originally from Sindh [now in Pakistan], and had since migrated to Marwad in Rajasthan and then to Manavar. They brought the block printing technique with them, which is now the unique Bagh-printing style.

Regions of Bagh Printing in India

Bagh printing is done exclusively in Bagh village in Dhar. However, other areas in India famous for block printing are: Rajasthan: Jaipur, Sanganer, Bagroo, Apli and Barmer; Gujarat: Mandvi, Dhamardhka, Mundra, Anjar, Jamnagar, Surendranagar, Jaitpur, Ahmedabad, Baroda and Deesa; Andhra Pradesh: Mausilipatnam; Tamil Nadu: Tanjore; Delhi; and Uttar Pradesh

Producer Communities

Bagh printing is controlled by the five to six Muslim Khatri families of Bagh who also own the manufacturing units. The artisans working in these units belong to various communities: Rajput, Bhil, Bhillala and Teli. The Khatri families of the area have trained these artisans. Some Scheduled Castes and OBCs are also working in these factories. Thus, there is no suggestion of any linkage between the trade and the caste of workers, except that the unit owners are from the Muslim Khatri community.

Process:

Making Wooden Blocks

This process invloves the following steps:

- *Preparing designs:* The master weaver prepares designs on graph paper. This is normally a geometrical pattern or a natural design with flowers or leaves.
- *Selecting the wood for blocks:* Teakwood pieces without defects like warping, knots or irregular granules are selected for the preparation of wooden blocks.
- *Preparing the block:* The teak blocks are smoothened using carpenters' tools. Following this, a white primer is put on the surface to make it smooth and clear. Then the craftsman draws the design on it from the graph paper.
- *Engraving designs on the blocks:* The craftsman engraves the delicate designs on the block using sharp carpentry tools. After checking the design by taking a print on paper, he finetunes the block as required.
- *Preserving the blocks:* Once prepared, these blocks are immersed in oil for a few days to provide greater stability and to protect them against warping and insect attacks. This stage is important as during printing these blocks are constantly in touch with water-based dyes and are thus vulnerable to warping.

Dyeing

Red: For making red dye, a solution of alum and the powder of tamarind seed is boiled and left to cool in a plastic vessel. This solution is then filtered through a fine cloth. For a deep color dye less viscous solution is used and for fine printing, a thick solution is used. Black: Black dye is prepared by mixing alum and iron ore. Violet: for this indigo is used; yellow: For this turmeric and harada are used.

After this comes, dyeing. In order to provide the Bagh print cloth their characteristic contrast and finishing, the cloth passes through a process of dyeing once again. For this *alizarin* and *dhavadi* flowers are boiled together in big copper containers concealed in a cement structure under which a fire using wood, leaves, etc. is made. The printed cloth is put in these vessels and is left to boil for five to six hours. The red printed portion, which has alum, takes its color by reacting with alizarin. At the same time, the dhavadi flower works like bleach on the unprinted portions, which have been dyed with harada to make it white after boiling.

What makes them Special?

The fabric used originally was cotton; though now tussar, crepe and silk are being used with excellent results. Every process used is manual and though the techniques and designs are age-old they have a contemporary appeal. What makes them especially appealing is that these dyes are superior to chemical dyes in every respect. They leave no harmful effects, they are bio degradable and eco-friendly. They also improve with each wash in shine and colour. An entire array of products ranging from bed-spreads, sarees, dress material, dupatta, pillow covers and cushion covers are available. Lastly, they come with assured quality cloth, fast colours, and guaranteed authenticity.

Limitations of Natural Dyes

Tedious extraction of colouring components from raw material, low colour value and long dyeing time pushes the cost of dyeing with natural dyes considerably higher than with synthetic dyes.

V. Sustainable Technology and Design in Auroville

Sustainable Technology

Technology plays an important role in the pursuit of sustainable living. Within Auroville, several research institutes are continuously working on innovative processes to reduce energy and water use by modifying and integrating new and existing technologies.

Solar Technology

Solar technology is widely used within the various communities and is the largest renewable source of energy in Auroville. The most common application of solar technology is for water pumping, water heating, street lighting and, in some cases, electricity generation.

Solar Electricity

Some communities and buildings run completely on electricity produced by photovoltaic (PV) panels. The PV systems used within Auroville are custom-designed by Aurovillian groups, and integrate inverter and battery storage systems for cloudy and rainy days. Currently, there are 400 houses running solely on solar electricity within Auroville.

Solar Water Pumping and Heaters

Over 80 percent of the solar technology in Auroville is used for water pumping and heating. Many of the operations for the waste water systems, and well/boreholes rely on this form of energy to move water. Aurovillian solar service and solution experts have formulated simple and low-maintenance pumping and heating systems.

Solar Technology in Practice: Auroville Solar Kitchen

The largest and most striking use of solar technology in Auroville is the Solar Kitchen. The concept of the Solar kitchen came out of the desire for a practical and sustainable communal space within Auroville. Currently, the kitchen serves approximately 1000 lunches a day. The kitchen's power system is designed as a hybrid system (solar and diesel run) with diesel stepping in when solar energy generation is too low to support the kitchen's operations. The solar system component is a solar bowl design, which uses hundreds of mirrors to focus sunlight onto the heat receiver. The coils around the heat receiver are filled with water and when the water turns to steam, it is pumped below into a boiler room, and used for cooking. The solar bowl is currently the largest in the world. The diesel system component was installed to replace an inefficient, high maintenance and dangerous solar storage system which was initially installed. Many of the cooking utensils have been customised to suit the needs and system of the solar kitchen.

Waste Water Technology

The Center for Scientific Research (CSR) has applied innovative methods to customise the available waste water technologies to fit the various Auroville community needs. The CSR waste water systems designs are based around tenets of simplicity, affordability, and need for minimal energy input. To avoid the inefficiency and high cost of municipal waste water management, CSR has adopted various techniques of Integrated Decentralized Waste Water Systems. The systems consist of underground containment and pre-filtration tanks, and overhead oxygenating and polishing ponds. For commercial and urban spaces that have little space for ponds, the institute has designed a cylindrical vortex system which takes advantage of centrifugal and centripetal forces to filter and oxygenate the water. The resulting 'gray' water from the system may then be reinserted into the water table, or used for local irrigation purposes. Another technology used for waste water treatment is Effective Micro-organisms (EM). EM is an organic liquid composed of microbes, which quicken the decomposition of waste and compose. When effectively added to waste water, it reduces the amount of sludge in black and grey water.

Electric Vehicle (EV) Technology:

A large portion of the energy consumption in Auroville is spent on transporting people and goods. To reduce their carbon footprint, and create a healthier natural environment, Auroville is looking to expand the use of electric vehicles (small electric cars, electric bicycles and electric motorcycles). There are various working components to successfully integrating electric vehicles into the community.

1. Central to the success of EV is the installment of charging points at convenient locations throughout the community. Currently, plans are underway to install charging points between the city area and green belt areas. The major obstacle facing designers is finding cheap but green options for operating the charging points (preferably having the points detached from the central grid).
2. Awareness campaigns around the advantages of EV over petrol motorcycles and mopeds are also important for the successful implementation of EVs. However, one major challenge to full EV adoption is the number of EVs that would be required to replace existing vehicles. To address this issue, designers within Auroville are researching methods to:
    a. Effectively convert current vehicles into EVs.
    b. Create an integrated transportation scheme that will optimise shared rides, bicycle loans, and public transportation.

Wind Technology

Few projects and communities within Auroville take advantage of wind technology for energy production. The few projects that do take advantage of this renewable technology use the power generated solely for their water systems. Although wind energy is not a viable resource for constant energy supply within Auroville, exploration and integration of this energy source in the energy mix has the potential to further reduce reliance on non-renewable energy inputs.

Sustainable Design

Looking at design from a sustainable angle involves incorporating and utilising the natural environment into planning and design. Architects, planners and product designers within Auroville have centralised the core of their innovations around sustainable design.

Product Design

Products designed on any scale require careful consideration to effectively optimise its usefulness, and reduce its environmental cost. A lot of thought and creativity is put into the design process in Auroville, which is integral to the creation processes:

1. Understanding the exact need for the product- Thoroughly understanding the consumers' needs will substantially increase the utility gained and the lifespan of the product. The product of sustainable design should integrate practicality, and usability into its design.

2. Using local and high quality input- The aim of any sustainable design is to reduce the embodied energy of a product. The most effective approach to reducing energy consumed is the use of local input. Designers, sometimes, face the dilemma of prioritising the use of local input or high quality input, and an effective designer's job is to creatively find a balance between the two.
3. Effective logistics- The production stage does not mark the end for a sustainable product design. It is important for the product designer to incorporate supply logistics into the design and production process. The location of production and supply chain are one of the many logistical concerns that must be considered by the designer.

Architectural Design

Architecture and design within Auroville is highly experimental around natural architecture. Natural architecture takes advantage of locally available building materials, as well as the layout and contours of the project site. By effectively planning the building design, the architect can take advantage of natural lighting and wind direction to reduce the need for artificial lighting and cooling systems. There are two main inputs that are being experimented with in Auroville – ferro-cement, and earth blocks.

Building Materials: Ferro-cement and Earth Blocks

Ferro-Cement

Ferro-cement is made using chicken mesh plastered in mortar (cement, sand and water). Since ferro-cement requires less material than reinforced cement, it is largely preferred over conventional cement for construction. Apart from the economic advantage, ferro-cement is also very flexible and is the appropriate material for 'niche applications'. Ferro-cement is the ideal construction material for infrastructure that is periodically/seldom used, and requires minimal design intricacies (such as school buildings, religious buildings, etc). Currently, the cement industry contributes about five percent of global CO_2 levels. A wider-scale adoption of ferro- cement in construction can therefore lead to significant reduction in CO_2 emissions.

Earth Blocks

Earth Blocks (or e-blocks) are building blocks made of soil, sand, and five percent of cement mixture. The eco-friendly blocks are produced by first mixing the components with water, manually compressing them with customised presses, and cured for approximately 28 days to reach a 'dry compressive strength of 7.5 MPa',. Aside from the eco-friendly input used in the production process, the use of localised inputs (soil from the surrounding site) immensely reduces the embodied energy since there is less need for transportation, mechanised block production, and firing processes amongst others. According to the Earth Institute, embodied energy for a finished wall (in MJ/m3) made of eblocks is 19 percent less than concrete solid blocks, and over 70 percent less than fired brick. Other benefits of e-blocks include the aesthetic earthen look it naturally possesses, humidity regulation (with proper planning and design), and the low maintenance it requires in the long run (versus cement plastered walls, which require periodic re-plastering and painting). [For more information on e-blocks visit: www.eblockindia.com.

The Earth Institute has increased the durability and functionality of these two buildings materials. Architectural design is also centered around maximising the utility of spaces by integrating functionalities into common spaces. By efficiently designing the building/infrastructure, it is possible to decrease the required building area (and effectively the cost and embodied energy of the project). Sustainable architectural design must incorporate the following aspects:

1. Understand the basic requirements of the users. The process of 'understanding' involves questioning the 'whats', and 'whys' of the users' requirements. By thoroughly understanding the users' requirements, the architect can effectively reduce the building area by designing multi-functional and multi-purpose spaces.
2. Include user/client(s) in the design process. Active participation by the user/client is integral for incorporation of sustainable designs within the building.

Solid-Waste Management

Waste generates economic, social, and health related costs and liabilities around the world. Solid waste services consume up to two percent of GDP in developing countries and up to 50 percent of cities' administrative budgets. By turning waste into a resource and encouraging the reduction, reuse and recycling of waste, significant gains can be achieved in decoupling waste production from economic growth.

IX. Recommendations for Greening NRLM: Non-farm and Artisanal Livelihoods

While current innovations in manufacturing tend to focus primarily on technological advances, organisational or institutional changes have often driven development and complemented the necessary technological changes. The need now is to identify and adopt new business models or alternative modes of provision. Improved benchmarking and better indicators would help deepen understanding of greening. There are no existing methodologies to the overall trends and characteristics of greening. Further progress in benchmarking and signifying indicators might include the development of a "greening scoreboard" that combines different statistics or the design of a new dedicated survey. This could help improve the understanding of the nature, drivers/barriers and impact of greening and raise awareness among policy makers and the community at large. Creating a successful greening policy requires deep understanding of the interaction of supply and demand.

It is imperative to:

- **Identify Sub-sector:** identification of green nodes.
- **Develop a Business Model for Green Business Advisors:** institutional innovation [institutional and human resource development].
- **Draft a Greening Manual:** across the sectors and sub-sectors.
- **Draft Green Clusters and Aggregation potential:** strengthening enterprise-university linkage.
- **Identify Green Substitution Potential for Existing Enterprises:** technology, product or process based.
- **Provide Guidance on Indicators for Sustainable Livelihood and Enterprise Development:** There is need to bring clarity and consistency by developing common terminology and understanding of the indicators and their use.
- **Identify Promising Policies for Greening:** Careful evaluation of the implementation of various policy measures for greening would be helpful for identifying "promising greening policies". Since the non-farm sector has its interface with several departments and ministries.
- **Build a Common Vision for Greening:** An understanding of greening by conducting in-depth case studies that could form the basis for developing a common future vision for environmentally-friendly social systems and roadmaps.
- **Develop a Scoreboard:** With the substantial insights obtained, it would be mandatory to consider the development "greening scoreboard" for benchmarking green activities and public policies by combining different statistics and data.

Sustainability Indicators

Sustainability indicators are essential for quantitatively assessing the greening potential of technology, community and institutions.

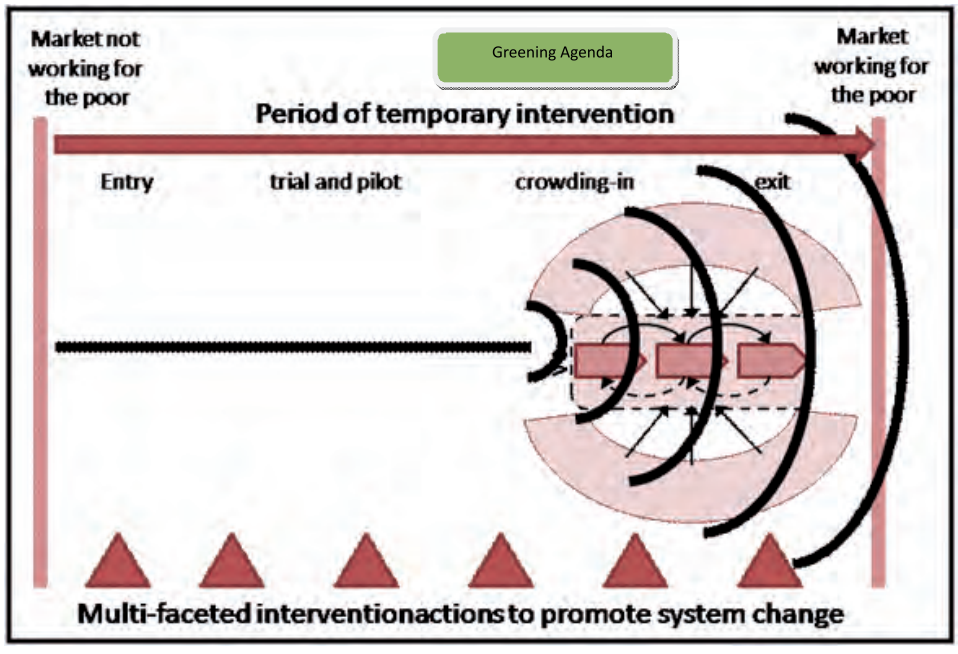
A Categorised List of Sustainability Indicators

Category	Description	Similar Indicators or Examples
Individual Indicators for off- farm and non-farm enterprises	Measure single aspects individually	- Core set of indicators - Minimum set of indicators
Key Performance Indicators – KPI	A limited number of indicators for measuring key aspects that are defined according to goals	
Composite Indices	Synthesis of groups of individual indicators that is expressed by only a few indices	
Material Flow Analysis	A quantitative measure of the flows of materials and energy through a production process [Process-related greening potential]	- Material balance - Input-output analysis - Material flow accounting
Environmental Accounting	Calculate environment-related costs and benefits similar to a financial accounting system	- Environmental management accounting - Total cost assessment - Cost-benefit analysis
Eco-efficiency Indicators	Ratio of environmental impacts to economic value created	- Factor
Life-cycle Assessment Indicators	Measure environmental impacts from all stages of production and consumption of a product or service;	- Ecological footprint - Carbon footprint
Sustainable Reporting Indicators	A range of indicators for non-financial performance to stakeholders	- Guidelines
Socially Responsible Investment Indices	Indices used for sustainability performance	- Sustainability index

Creating Regional Clusters for Greening:

"Competitive clusters" have been established in various regions to conduct innovative projects in partnership between businesses, research institutes and training organisations with a focus on one or more identified markets. Several of these clusters are currently implementing high-growth potential in a specific sector. Examples include handlooms, handicrafts and various other artisanal clusters in the country. Such initiatives are expected to bring growth and employment opportunities in the regions and increase the attractiveness of the market through enhanced visibility in terms of its green agenda.

CLUSTER-BASED STRATEGIC INTERVENTION



The Green Business Adviser (GBA) Concept:

The GBA concept is that of a broker of small enterprise-related services. Enterprising poor people look for external competencies to facilitate their access to various business support services that might help them launch and stabilise their businesses, including market-access services. In this respect, the role of GBA should be that of listening to the problems of small rural entrepreneurs and helping them find solutions, infuse suitable green technology and offer solutions for process or product. GBAs may also assist small rural entrepreneurs to anticipate problems linked to their activity, especially with regard to financial management and/or technology failure. An important function of the GBAs is to interface between rural financial institutions and small-scale rural entrepreneurs, especially by screening investment proposals. Finally, GBAs can link micro and small entrepreneurs with markets, either directly or through specialise, market-related services.

Green Services:

Complementary to green technologies, green services include:

a. Research and development leading to the creation of green technologies: manual on greening potential in various sub-sectors

b. Education/training services linked to the development of para-workers/ technicians involved with the installation, use and/or repair of green technologies

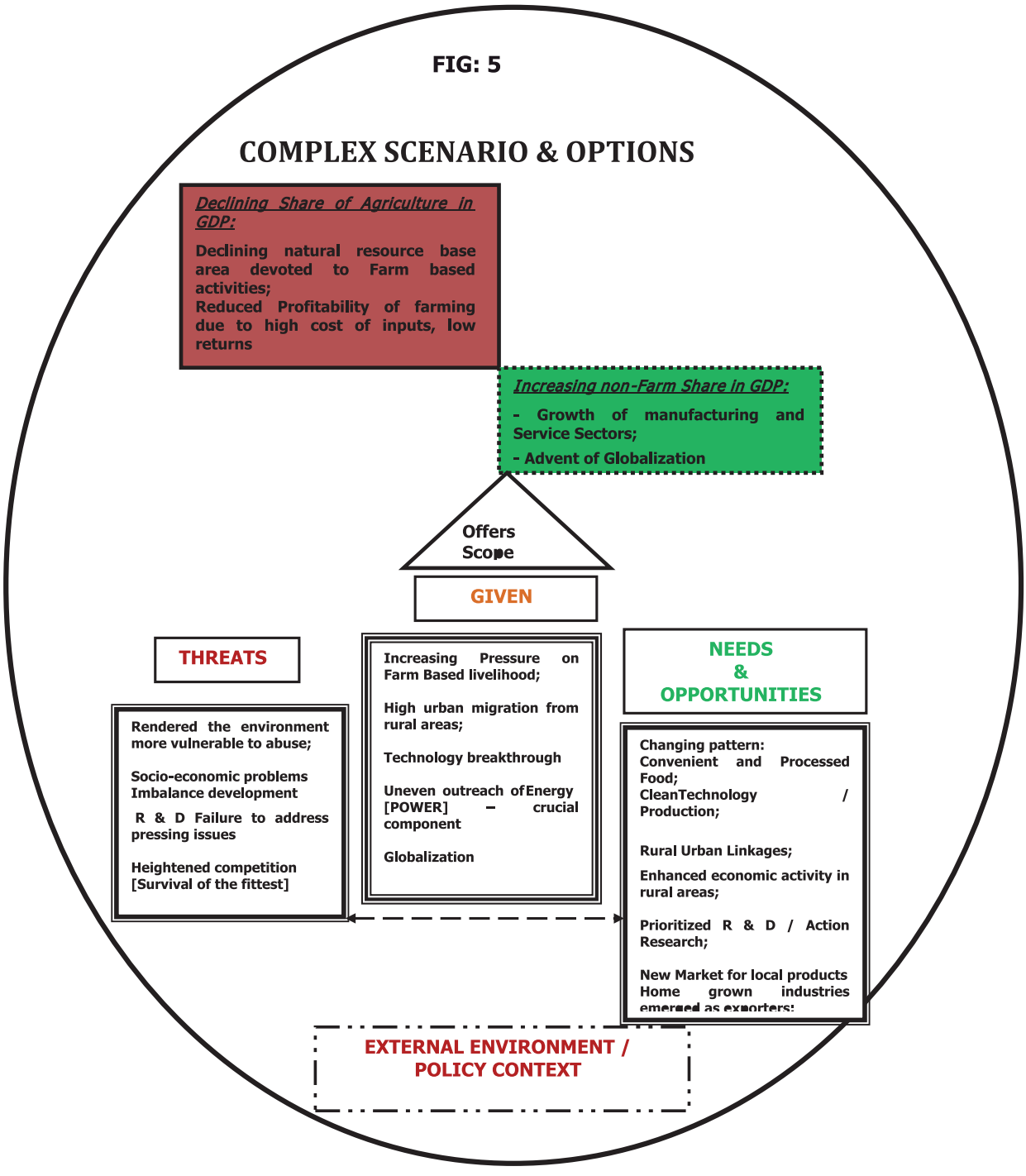
c. Business consulting/advising services linked to the adoption and/or use of green technologies

d. Information/knowledge dissemination promoting the use of green technologies

e. Facilitating funding (loans/grants) for the purchase and/or operation of green technologies

The above agenda needs suitable infusion in light of the figure: 5 below:

FIG: 5



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Greening the National Rural Drinking Water Programme

Depinder S Kapur
India WASH Forum
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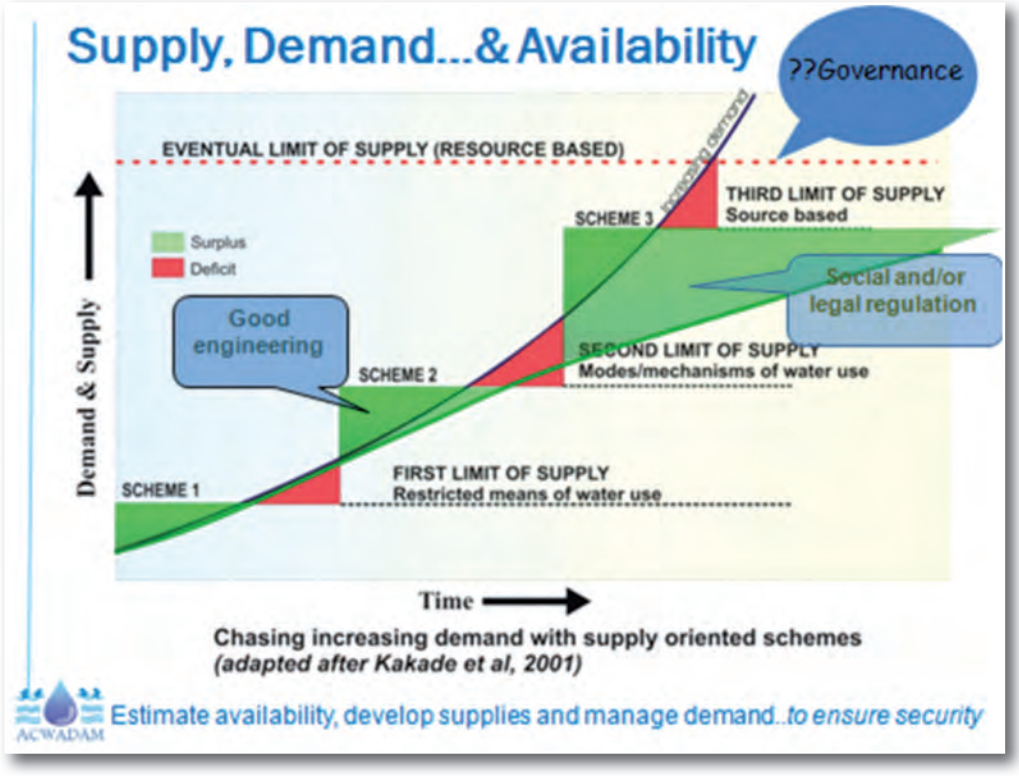
FINAL REPORT

Depinder Kapur is the National Coordinator of the India WASH Forum and an independent consultant and researcher, editor of the bi-monthly WASH Policy e-Newsletter. He has been the WSSCC National Coordinator in India since 2007, Country Head of WaterAid India and worked with Oxfam, CARE India, SPWD and AKRSPI. He was a member of the Planning Commission's Working Group on Rural Water and Sanitation for the XII Five-Year Plan and has contributed to national and South Asia level WASH sectors.

Recommendations

UNDP sponsored a study to look at all the programmes under the Ministry of Rural Development and the Ministry of Drinking Water and Sanitation to identify gaps and remedial measures towards greening of these programmes. The report is based on a desk review of the national rural drinking water programme guideline and lessons drawn from a few innovative programmes in India that have addressed environmental issues in addressing water supply service delivery in rural areas. The draft recommendations of the study were presented to the respective Ministers and a gathering of experts and practitioners organised by UNDP on 15th May 2012 in Delhi.

There is increasing pressure and demand for water. New technology has extended our ability to extract more water. In some villages, we find that more than one drinking water scheme is taken up or more than one water source is created – yet there is shortage of water. **See figure below** (Courtesy Mr. Himanshu Thakkar, ACWADAM).



Good engineering can augment water supply but good governance is needed to ensure demand management and sustainable water security. Social and/or legal regulation will be required to manage and control water demand. This will ensure that the water can be shared over a longer period of time or with increasing population.

Key Recommendations of the Study are:

1. **Meeting rising expectations of drinking water supply with assessments of environmental impacts of increasing supply:** People's expectations for piped water supply as tap water inside their homes in place of public handpumps, is evident everywhere. Rural folk witness large water supply schemes for urban areas drawing water from distant rivers and lakes, often bypassing several villages on their way. In meeting the piped water supply expectations in rural areas, environmental considerations need to be assessed.

1.1 **Where will the additional water for enhanced rural water supply come from?** There cannot be permanent water security without managing demand for water and focusing solely on augmenting supply. This needs to be prominently addressed in any Policy and Guidelines statement of rural water supply

1.2 **Fragile ecosystems** of deserts and areas with impermeable soil types have a risk of rising ground water tables threatening human settlements and agriculture. This was witnessed recently in Jodhpur - district in Rajasthan - where water resources created to meet drining water demand led to rising ground water table and salinity.

1.3 **Dependence on long-distance piped water supply networks** requires complex multi-village water supply networks and management systems. Operation of these schemes is complex. If not operated with resource conservation and resource efficiency, these can inflate demand, lead to wastage of water and emergence of secondary problems, such as water logging, and increased disease burden, among others.

2. **Making the NRDWP(2010) guidelines greener:** The national flagship rural water supply programme guidelines have many positive elements. The recent experience of the 2012 Draft National Water Policy has lessons for the NRDWP as well.

2.1 **Defining non negotiability in the NRDWP and prioritising ecological and environmental considerations** will help. This could include for example

2.1.1 Comprehensive community-based, and not simply a technical, water resource planning taking into consideration all uses of water and not just drinking water

2.1.2 Prioritising local sources over external sources of drinking water supply

2.1.3 Demarcation and protection of drinking water sources in a village

2.2 The Draft National Water Policy 2012 has many positive elements but the priority that was needed in the preamble/core of the Water Policy is missing. There needs to be **an explicit policy statement in the NRDWP guidelines on managing the increasing demand for domestic water and for securing water as a common pool resource** – before looking at solutions for augmenting supply.

2.3 Where additional water is required for expanding the piped water supply, sustainability of the additional water source needs to be established. As a guidance, the **NRDWP should prioritise dependence on local water sources and invest in improving them**.

2.4 **Priorities of local communities/panchayats - in situating the water source, in deciding on the technology and type of water supply – should be accepted by the Rural Water Supply engineers**.Often expensive engineering solutions are imposed from outside; these have a high running costs and O & M implications and are not sustainable. It is also true that in some instances the panchayat may decide on expensive unsustainable piped water supply systems. However, as a principal of democratic governance and as per the NRDWP guidelines of panchayats taking over water supply, there is no short cut. Transparent "water security planning" is required. Any village water supply planning should not remain an engineering exercise in closed files.

2.4.1 Village water supply system with its capital cost, running and O&M implications- should be prominently displayed in the village for all.

2.4.2 Repeated failures to develop sustainable water sources from government funding should be discouraged. This should be done as part of the IEC component.

3. **Third party environmental audits of drinking water schemes and programmes are** needed: Currently state-level technical agencies are themselves evaluating the impacts of their technical interventions ranging from fracturing, blasting and fissuring, underground dams, etc. These are being done as means to increase permeability of ground water and recharge aquifers.

4. **Drinking water quality assurance:** Water quality is emerging as a major concern across rural India. Water pollution ranges from e coli - induced bacteriological contamination to flouride and arsenic emerging in ground water after intensive exploitation of groundwater, to industrial and agriculture-based ground water contamination. NRDWP guidelines provide for an upgraded Water Quality Surveillance programme with district-level laboratories for monitoring water quality. The following measures will help in ensuring better results:

   4.1 **Some emergency interim measures to monitor water quality** on a sample basis is needed, till the time that the protocol of 100 percent water source monitoring for water quality is put in place. If this is not done, there is a risk to the health of a large section of the poorest populations that are affected by water quality problems.

   4.2 **IEC programmes should focus on water quality issues:** Specially in arsenic, flouride, uranium and related contamination that is not visible or whose impacts are slow and fatal in the long term. Lack of awareness of contamination of ground water is a major factor that needs to be addressed urgently.

5. **Source sustainability:** Source sustainability is prioritised in the NRDWP guidelines. Village and district-level water security plans are expected to deliver sustainability of water sources for assured and enhanced water supply. Preparation of these plans is supported by programme allocations. This is a welcome step. In order to ensure that water security planning is effective and not just another technical paper produced by the District Water and Sanitation Missions, community engagement in the planning process is required.

   5.1 **Water security planning keeping the priorities right**: Keeping ecological considerations at the base of all water planning, prioritising social mobilisation for community control, applying water science for identifying the best engineering solution – this is the process that needs to be followed under NRDWP for water security plans currently being prepared.

   5.2 **Comprehensive water-use planning**: The experience of Hivre Bazar in Maharashtra has shown that comprehensive water use planning is required taking into consideration all types of water uses and controlling demand for different uses of water in times of drought. In most parts of India, water security plans will need to factor in all demands on water and ensure that sources of drinking water do not dry up. Capacity of panchayats and support of technical agencies, NGOs and experts will go a long way in making comprehensive water-use planning an ongoing concurrent exercise that facilitates choices, and not a one-off activity for producing a report.

   5.3 **Drinking water security mapping with community involvement**: Experience of Sahjeevan Trust in Gujarat has shown that in the extreme arid environment of Kutch district, it is possible to achieve drinking water security by developing local water sources and from rain-water harvesting. By involving the community in identifying the water sources, it is possible to do ground truthing-based water resource planning at scale. Sahjeevan achieved this for 50 percent of the blocks of Kutch district. Village maps were prepared outlining priority drinking water sources. The plans were followed up by community measures to protect, develop and recharge local water sources for village-level drinking water security.

   5.4 **Well-based drinking water supply**: Dug wells are being developed as an environmentally green option for sustainable water supply. The introduction of hand pumps and borewells led to abandoning of dug wells that were traditional sources of safe drinking water. Emergence of water quality issues of flouride and arsenic and falling ground water levels and borewells, have revived interest in dug wells. MGNREGS provisions for reviving dug wells and addressing the situating of dug wells along river beds and water aquifers, with active engagement of the community and their knowledge in situating the well and in managing the source, has given a boost to dug wells.

5.5 **Stream flows for water and sanitation security in Eastern and Western Ghats**: There is potential to develop stream-based drinking water and sanitation infrastructure in the Eastern and Western Ghats. Ensuring stream flows is key to sustainability of this measure. Water from the streams can be tapped in storage tanks/pumps along the stream bed in the valleys, for supply to habitations for their sanitation and drinking water needs and transported upstream using pump-sets including solar pumps as demonstrated by the Sahjeevan Trust. Water purification and treatment measures also need to be installed.

6. **Resource-use Efficiency : greener technology for rural water supply**

6.1 **Gravity flow systems of rural water supply in hilly terrain and in remote tribal areas** are an environmentally-sustainable means of water security. Many NGOs in Eastern and Western Ghats have been developing potential sources of gravity-low systems of water supply for both irrigation and drinking water.

6.2 **Gravity flow-based water systems can be augmented with stream-based water conservation, treatment and pumping systems.** Recent experience shows that where stream flows exist, there is a higher potential of water use. There is a need to look beyond gravity flow-based water supply systems to higher investment in stream-based water supply systems. Investment will be needed to first ensure stream flows by taking physical and social measures to augment stream flows and prevent water pollution. Secondly, investment will be needed in creating water storage infrastructure of water tanks, purification and pumping to habitations upstream (overhead water tanks) for household-level supply of water to meet all household water needs and, if possible, for livestock.

6.3 **Solar pumps for drinking water supply**. Conventional energy of diesel and electrical pump-sets is a major operating input cost for piped water schemes in rural and urban areas. Failure to pay for repairs and maintenance of pumping systems and electricity bills often results in discontinuation of electricity and pumping of water. Recent experience of small photo-voltaic cell-based pump-sets of 0.75HP in providing a ground lift of more than 30mts, low operating and maintenance costs, has given a boost to solar pumps as energy sources. The ministries of water and sanitationa nd non-conventional energy can forge an alliance to develop practical options for more solar pump-set installations in rural water supply. A mix of institutional and household water supply systems using solar pumps should be tried and monitored in all states and lessons drawn for wider analysis and modification of schemes in a conference-research mode.

7. **Conclusion: Incremental Steps to Green Rural Water Supply**

7.1 Guidelines must commit explicitly to specific green results

7.2 Proposals from GP level upward must contain green impact assessment of resource development and use. Sanctioning authority must provide for green activities (such as water source recharge) within each approved project;

7.3 Steps should be taken to ensure water source sustainability before construction of drinking water supply system

7.4 Monitoring of water quality at GP level must be done twice a year for groundwater, and daily for piped water

7.5 Additional funds should be made available for gravity flow systems, use of solar/wind or energy-efficient pumps, rainwater harvesting for recharge and roof-rain water harvesting, recycling or treatment of waste water

7.6 Village Water and Sanitation Committee must mobilise villagers for community-based water security planning and water quality monitoring

1. Introduction

Greening the National Rural Drinking Water Supply Programme is an important initiative addresses ecological and environmental issues in addition to the growth, equity and sustainability programme guidelines that also provide a policy direction.

This study is a desk review of programmes and guidelines of Rural Drinking Water Supply, as part of a larger initiative by the UNDP India programme to support a greening review of all programmes of the MoRD and MoWS at the request of the Minister incharge of both Ministries. The key findings of the research were presented at an international workshop held in Delhi on 15 May 2012. This report has been prepared based on a wide range of consultations. The list of people consulted is in Annex 1.

The report contains a case study-based practical analysis of the contemporary problems and opportunities in the rural water supply sector and the guidelines of the flagship national rural drinking water supply programme. The report is not an exhaustive document detailing each needs or a detailed analysis of each problem and its solution. The report is aimed at providing a good grasp of the key aspects of the national programme guidelines, an analysis of the aims and means outlined in the document and of lessons learnt from some projects that have tried to address critical issues. Given that the rural drinking water supply programme has, till date, primarily focussed on augmenting rural water supply, there are very few instances of green initiatives. The recommendations of this study address the following environmental/ greening aspects:

- Source sustainability in
  - qualitative aspects (chemical and bacteriological contamination) and
  - quantitative (flow) where measures are taken to protect and enhance source sustainability
- Resource-use efficiency issues in pumping water for rural drinking supply.

The recommendations will hopefully contribute to identifying greener options for the INR 10,500 crore per year programme outlay.

Review of the National Rural Drinking Water Programme(NRDWP) Guidelines

1. **Implementation challenges for the NRDWP**
2. **Best practices in "greening" the programme**
3. **Practical examples greening of rural water supply**

2. Greening Rural Development: Rural Water Supply

Rural water supply programmes have increased the reach of safe drinking water supply. From village to habitation-level coverage, rural water supply has expanded significantly. Eradication of guinea worm and setting of minimum norms of 40lpcd of water per capita, have long guided the rural water supply schemes that have moved from hand pumps to piped water supply.

The NRDWP 2010 guidelines are ambitious in their aim to move beyond the quantitative minimum water supply standards (from minimum litres per capita per day supply to non-quantified water security). However this is happening at a time when there is massive slippage reported in rural water supply, with more and more partially-covered villages emerging and coverage of rural water supply slipping from 96 to 69 percent in 2010.

The National Flagship Rural Drinking Water programme has passed through many phases of reform. The 2010 NRDWP guidelines mentions that the programme is in the fourth phase of implementation. Starting with the Accelerated Rural Water Supply Programme (ARWSP) of 1972-86, the launching of the Technology Mission in 1986-87 renamed as Rajiv Gandhi National Drinking Water Mission (1991-92), and the Sector Reforms of Swajaldhara (2002). The NRDWP (2010) represents the fourth phase, with sustainability (quality and quantity of water) as its core focus.

Principles : Greening of Rural Water Supply

Rural drinking water supply has so far been seen as a basic needs programme with the aim of delivering a minimum level of potable drinking water to all. Till the mid 1970s, having at least one functional open dug well, was considered a measure of water security at the village level. With the advent of modern technology, hand pumps and pipelines were considered to provide safe potable water as compared to an open dug well. Bore-wells and reliance on ground water-based irrigation also assumed significance from the early 1980s. Greening of rural water supply assumes significance from here. The three year drought of 1985-87 was a major disaster in terms of crop productivity and massive deaths of livestock from fodder shortage, but drinking water was not such a problem for livestock and humans. However with the pumping of groundwater in the 1990s, there is drinking water shortages every year and tanker-based drinking water supply is now made for villages in North and South India almost every summer on a large scale.

Greening of rural water supply includes two critical components;

- **Conservation and regeneration of resource base** (ground water)
- **Reduction of water wastage and energy conservation**

Since water encompasses a large domain of ministerial oversight for the Government of India and goven the limited mandate of this paper, the actions suggested in this greening framework are specific to the Ministry of Water Supply and Sanitation only.

Conservation and Regeneration of Resource

India has a wide variation in rainfall patterns and water use. Conservation of ground water assumes importance given that nearly two-thirds of India is arid or semi-arid. However there are areas of rising ground water and water logging where this does not apply.

Conservation and regeneration refers to both qualitative and quantitative aspects of rural water supply. Emergence of flouride is partly because of excessive extraction of ground water.

In the arid and semi-arid areas of India, rural drinking water supply schemes must focus on conservation of ground water use. It has been reported that in some areas of central India deep aquifers are accessed by piped water supply schemes to supply water to villages under Swajaldhara like schemes. These are expensive piped water supply schemes that mine ground water and the source dries up in a few years. Then, some other source is identified to access drinking water. Reliance on ground water should be on unconfined aquifers to the extent possible, and not on confined aquifers.

In areas with higher rainfall and spring water, ground water may not be exploited. In this context, resource base consists of the hills and forests. Spring sources need to be conserved not only by afforestation and watershed management interventions, but also by relying on stream flows in the downstream valleys and using them to augment water needs of habitations. This will lead to effective water conservation and usage.

Identifying good sources of ground water in or near a village and earmarking it for drinking water for a habitation/village and undertaking measures to augment its water recharge – is another aspect of water conservation and use.

Rainwater harvesting for household drinking water as well as community infiltration tanks, has been an old and tested means of water security. Investments made at the household level for water conservation are essential to reducing reliance on ground water.

Reduction of Water Wastage and Energy Conservation

Broken pipelines and taps not fitted with closure knobs are responsible for wastage of precious rural water in semi-arid and arid areas. There are remnants of dilapidated large pipeline-based water supply systems

in Kutch and Rajasthan in the last few decades, bearing testimony to not only wasted investments but also precious water loss.

Reliance on external water supply also implies investment and energy consumed in pipelines and transmission of water by applying pressure. This is evident in urban water supply in cities like Bengaluru that pump water from the Cauveri from a lower elevation to the city, more than a 100 kms away. In rural water supply, specially in multi-village initiative, this is evident in the large pipeline schemes.

Any consideration for increasing water supply from pressure-based piped water supply should factor in the losses possible due to poor management of the system at the district/block/village/habitation level.

Even where piped water supply is provided only for a limited and fixed time during a day, water losses can occur when taps are broken or by overflow of storage tanks.

Positive Features of NRDWP:

- **Decentralisation:** Primacy of the role of PRIs and the intention of transferring management and fiscal responsibilities to them.
- **Resource management:** incentivise district and village water security planning. Strengthen capacity of the district planning board/zilla parishad and of gram panchayats for preparing holistic plans.
- **Addressing exclusion:** reaching SCs, STs and women
- **Coordination:** between different departments and agencies

The positive green feature of NRDWP is the emphasis on sustainability, allocation of 20 percent funds for promoting traditional water conservation and rain-water harvesting.

However certain activities of hydro-fracturing clubbed under sustainability interventions need to be carefully applied as the outcome may be detrimental to ideal source sustainability.

Need for managing water demand

The NRDWP guidelines admit growing water insecurity and the need for addressing this:

- Admitting that water availability crisis will deepen, yet move away from a minimum lpcd norms to 24x7 water supply for all
- Enhancing water security at source level, and aiming at grid-based district/sub-district piped water supply

The NRDWP guidelines are ambitious when they make a call for "permanent water security". Yet the guidelines admit that augmenting rural drinking water supply in the face of water stress and climate change, is a major challenge.

The focus on more piped water schemes and moving away from 40 litres per capita per day (lpcd) limit to an open-ended service provisioning, comes at a time when rural drinking water coverage levels in India have shown reversal manifest in slippages of rural habitations moving from fully-covered to partially-covered villages. *The major environmental concern stemming from the guidelines therefore is: where the additional water for piped water schemes will come from and how will source sustainability be assured along with increasing the supply of water.*

Typology of rural drinking water supply in India consists of:

- Traditional water harvesting sources/systems
- Roof-rain water harvesting (for remote habitations)
- Shallow (dug) wells. Sanitary wells as described in the PRADAN case study
- Hand pumps (ensure groundwater recharge and planning based on actual measurement of resource capacity)

- Borewells/tube wells (with solar pumps or more efficient pumps) based single-and multiple-village water schemes
- River-based water supply networks (Narmada Canal-based rural water supply in Gujarat, Indira Gandhi Canal Project in Rajasthan)
- Water supplied in tanker trucks in some rural areas in the summer months

Environmentally speaking, traditional water harvesting systems, roof rain water harvesting, hand pumps and safe and protected shallow wells tend to prioritise local and sustainable use of water - these provide the most green option for rural drinking water supply, as against deep borewell and river-based rural water supply schemes.

While evaluating the environmental impact of river based drinking water supply systems, the energy consumed in building canals and pipelines based water supply from river based systems is not taken into account.

However the focus of the NRDWP guidelines is more on larger grid-based piped water supply networks, and not on prioritising local water source-based drinking water supply.

3. Environmental Analysis of Rural Water Supply Programme

The evolution of the national rural drinking water supply programme and its environmental analysis can be done for the four distinct phases:

- Emphasis on increasing coverage with deep drilled hand pumps under ARWSP (1972-86)
- Mission-mode approach followed under the RGNDWM (1986) with stress on water quality, and appropriate technology
- Demand-based rural water supply: sector reforms and Swajaldhara in 1999
- Sustainability and quality emphasis of NRDWP 2010

The first phase of increasing coverage was undertaken when bore-well-based pumping technology was introduced in India along with the green revolution. While safe drinking water eradicated guinea worm and reduced diarrheal morbidity significantly, it came at an environmental cost of depleting ground water levels and emergence of salinity, fluoride and arsenic contamination of drinking water. National norms of rural water supply were adopted and these included a commitment to ensuring 40 lpcd, one hand pump serving 250 people and a maximum distance of 1.5 kms or 100 vertical metres of distance from the hand pump.

The mission mode in 1986 galvanised the achievement of safe drinking water as a national goal. The nodal department at the centre was charged with the mandate of guiding states and devising programme schemes to support appropriate technology, systems and trained manpower to achieve the goal of drinking water for all. More financial resources were allocated for rural water supply. The expected environmental impact of this phase was anticipated in terms of better monitoring to ensure source sustainability, check worsening ground water quality and capacity development of government staff to address environmental issues including water security. Unfortunately the anticipated environmental outcomes did not materialise. Ground water depletion crisis worsened.

In order to push for higher service standards of piped water supply, an innovative demand-lead sector reform programme Swajaldhara (pilot project of World Bank called Swajal), was launched by Government of India in 1999. Community ownership and maintenance, 24/7 rural water supply in single and multi-village piped water supply-based schemes with 90 precent central subsidy was undertaken. The anticipated positive environmental impact of this programme was expected to result in reduction of wastage and enhanced appreciation of water conservation and use. Only a limited success was achieved. Instances of ambitious and expensive piped water supply schemes designed that could not be paid for in terms of operation and maintenance, were reported in several places. Adequate community organisation and engagement was missing to ensure demand-lead sustainable projects.

Electricity bills and maintenance of motors and pipes emerged as a major issue and negated the investments made in many expensive schemes and projects in Karnataka[1] and several other states in India. Except for Maharashtra, no other state reported a majority of their Swajaldhara schemes breaking even and operating for more than five years.

The National Rural Drinking Water Programme 2010 guidelines are progressive in their commitment to addressing issues of access, equity, quality, source and systems sustainability. The challenge is implementation of these guidelines on the ground for green outcomes.

Budget Allocation of NRDWP and its Green Import

The NRDWP guidelines provide for the following programme fund allocation at the state level:

- 45 percent funding for increasing coverage
- 20 percent for water quality
- 20 percent for sustainability
- 10 percent for operation and maintenance
- 5 percent for support activities

The high allocation for increasing coverage, explains the increasing environmental stress on rural water supply. The budget support for sustainability, is one specific greening commitment of NRDWP. This has been explained in detail later in this section.

The budget for water quality, represents a recognition of this growing problem, often induced as a result of reckless mining of water. Mitigating water quality stress can often lead to more piped water supply engineering solutions and less reliance on environmentally-safe means of alternative drinking water security. More and more money can be spent on expensive treatment and piped-based water supply projects, as has been witnessed in the expensive piped water schemes proposed in arsenic-affected Balllia district of UP.

3.1. Water Quality

Water quality remains a major challenge in the drinking water programme. The NRDWP guidelines mention the need for adopting the 2004 National Rural Drinking Water Monitoring and Surveillance Programme approach. The NRDWP guidelines stipulate the need for "all drinking water sources to be tested twice a year for chemical contamination". This is a lofty ideal, however given the poor progress of the 2004 water quality surveillance where the water testing kits and training did not resulted in regular monitoring of water, it will require major effort if all water sources (not just the government hand pumps) are to be tested twice a year. Water quality challenges are:

- Bacteriological water contamination
- Contamination from flouride and arsenic
- Industrial waste and agriculture-based ground water contamination

A UNICEF study of water quality in select states of India in 2008 found high microbiological and chemical contamination of ground water coli contamination. Bihar at 84 percent, Jharkhand and Orissa at 69 percent each and even Tamil Nadu with a relatively more developed rural water supply had 70 percent e coli contamination of its drinking water sources. Flouride contamination was as high as 81percent in Tamil Nadu, 93 percent in Bihar, 64 percent in Rajasthan and 61percent in Jharkhand.

Water testing laboratories at the sub-division level are also mentioned in the NRDWP guidelines. Again the experience so far, specially in areas with arsenic and fluoride contamination, has been of lack of water testing by the existing laboratories.

Until new laboratories are in place, some emergency interim arrangement and water testing protocol is needed in the NRDWP guidelines given that water is so fundamental to life.

In the place of profit-making private agencies, NGOs and charities, with experience of working on rural

drinking water supply, can be shortlisted through competitive bidding to operate good quality drinking water testing laboratories at the block or district level, to undertake random sampling of rural drinking water sources. Their work can be monitored by government-run colleges/universities supported by the Ministry (MOWS).

3.2. Source Sustainability

Slippage of fully-covered villages (with drinking water access) has been a major problem in India. Rural drinking water coverage fell from 96 percent in 2009 to 69 percent in 2010. Hence the NRDWP guidelines prioritise protection of water sources - springs and wells.

The guidelines provide 20 percent of the funds for source sustainability. As per the NRDWP guidelines "20 percent allocation for sustainability-swajaldhara is on a 100% central share basis to be used exclusively to achieve drinking water security by providing specific sustainability components for source and systems with major emphasis on tribal areas, water quality affected areas, dark and grey areas as specified by CGWB...". This is a welcome shift from the erstwhile Swajaldhara scheme, with 20 percent of rural water supply budget allocation going towards for promoting demand-based rural water supply schemes with 90 percent central government subsidy.

However in order to protect and sustain the source of drinking water, a larger unit area of water catchment and command may need to be addressed, not just the immediate catchment of one or more drinking water sources in a village/habitation. Funding for this will not be enough from the MoWS, 20 percent budget allocation.

Drinking water security, therefore, needs to be part of the overall water security (covering all water uses). The NRDWP is supporting the preparation of village and district water security plans, with this aim in mind. Two years since the release of the NRDWP guidelines, not many comprehensive water security mapping exercises have been undertaken. MoWS is working with World Bank's Water and Sanitation Program (WSP) to develop pilot mapping projects in different typologies/parts of the country.

So far there has been a limited success in generating village and district water security plans through community led mapping of groundwater aquifers and surface flows to identify a menu of priority water sources and options for different uses of water for all purposes in a village. Aggregation at block and district levels of demand and supply that is not just an aggregation of village level water sources planning, still needs to be done.

The initiative by Sehjeevan Trust in Kutch, Gujarat, demonstrated that with people's involvement and knowledge, it is easy to identify and map good ground water sources. Managing and mapping demand and use of scarce water is also possible if there is sufficient community involvement and the rural water supply scheme is not supply driven.

Merely relying on technical mapping of ground water potential and planning for augmenting water supply will not help.

4. Best Practices in Greening Rural Water Supply Programme

Rural drinking water supply programme has to date primarily focussed on augmenting rural water supply. People also demand instant solutions to water shortages. Droughts and excessive ground water withdrawal has resulted in increasing pressure on limited water resources and technical solutions. Tanker and trains now provide rural water supply in many parts of the country. A lack of enabling an policy environment has contributed to the erosion of community control over water resources and their management. There are very few instances of green initiatives in rural drinking water.

The recommendations of this study address the following environmental/greening aspects:

- Source sustainability in

[2]NRDWP guidelines released on 23 August 2010

- qualitative aspects (chemical and bacteriological contamination)
- quantitative (flow) - measures taken to protect and enhance source sustainability

- Resource-use efficiency issues in pumping water for rural drinking supply

4.1 Water Source Sustainability Interventions

Drinking water source sustainability is a part of larger water use and sustainable livelihoods. Comprehensive water management planning at the level of a village or a watershed, is key to drinking water source security. This means looking at all water sources – surface and sub-surface water.

The best case study of comprehensive water management planning is the Hirve Bazar in Maharashtra, see reference below.[3]

This equity outcome of watershed development is not atypical. In most water projects where similar water allocation practices are followed, those with more land are the greatest beneficiaries, although some benefits accrue to those with less land too, via the route of increased agricultural work and consequent higher demand for labour. What is less common is the attempt to try and ensure greater equity via the use of watershed-plus measures.

In Hivre Bazar, watershed-plus measures were actively targeted towards those households who either did not directly benefit from watershed development or lost from it in some manner (e.g. giving up land). Four watershed-plus measures were particularly important – developmental schemes, savings groups, improved availability of water for drinking and household use, and improved health and education facilities.

Drinking and household water: Though drinking water is usually mentioned in the list of objectives of watershed development (e.g. in government guidelines such as Government of India, 2003), it is the technical works involved in watershed development that are given importance in the actual working of projects. The distribution of the increased water post-watershed development (including its distribution across various uses such as irrigation versus water for drinking and household needs) is not something that is explicitly considered. The usual outcome is that people with pre-existing sources of water or the means to construct new sources have access to increased water, while others continue to struggle, even for drinking water. It is only in a few cases (such as Hivre Bazar) that communal sources have been built for drinking water.

In Hivre Bazar, schemes for handpumps were among the many developmental projects undertaken in the aftermath of watershed development. Twelve hand pumps were installed various points in the village to provide water for household needs and for drinking. This has ensured that the benefit of improved drinking and household water has not been restricted only to those with private sources of water, but has been more widely dispersed to reach the poor and landless households. Further, improved water availability has also meant that there is no dependence on state government tankers in the summer months and the distance that one has to walk for water has considerably reduced. Since it is mainly women and female children who fetch water, they are the main beneficiaries.

Other examples include:

- Sehjeevan-WASMO water science-based rural drinking water systems,
- Maharashtra's Groundwater Survey and Development Agency (GSDA) work on traditional and modern recharge of aquifers

What is important to note here is the mapping of all types of water requirement in a village, planning the use of this water and limiting the extraction of water through crop planning. Hence, this is different from the narrow focus on source sustainability as advocated in the NRDWP guidelines. The Pani panchayat work of Salunkhe in Maharashtra had, in the 1980s, demonstrated the mutually-shared benefits of controlled ground water extraction resulting in sustainable water yields including drinking water, for everyone all year round.

[3]http://www.cised.org/wp-content/uploads/equity-in-watershed-development-case-study-hivre-bazar.pdf

Technological solutions to ground water recharge including blasting and fissuring, underground dams to check base flows are engineering options that can disrupt natural flows and destroy what limited potential of water harvesting may exist. They may also succeed in augmenting ground water but its implications need to be assessed carefully.

4.2 Community-based natural resource management augmenting drinking water supply

Watershed development contributes to augmentation of aquifers, however this depends on various factors. Soil permeability varies a great deal, recharge may happen elsewhere from where conservation is taking place. However, along with watershed management, controlling water demand is also required. Some successful watershed development projects in India suffer from drinking water shortages on account of intensive extraction of conserved water for livelihoods and livestock.

Traditional rain water harvesting structures of Rajasthan have already received wide attention thanks to the work of Mr. Anupam Mishra. Unfortunately few traditional water harvesting structures are being revived. More and more common pool resources and water bodies are being encroached. *Tankas*, the smaller household rain water conservation storage, are being used as piped water storage tanks in some places.

There are a few examples of rural water supply projects in tribal areas on forest lands where community involvement in protection of forest resources, development of gravity-based piped water supply systems and controlling water use are the basis of water management.

- Foundation for Ecological Security (FES) and Gram Vikas, both in Orissa – have demonstrated effective community-based sustainable rural water supply systems.
- Gram Vikas has an integral sanitation component along with piped water supply from dug wells on forest lands, as part of household piped water supply systems.
- FES sources water from the aluminium-rich Koraput Hills for and irrigation. The Sikkim government under its spring regeneration has demonstrated the effectiveness of spring-based drinking water security. [4]
- Himmotthan Society in Uttrakhand has gravity flow-based water supply in more than a 100 villages.

Conservation of water on the hills through water recharge measures, protection of green by social control over cutting of forest, keeping the water catchment area clean from human and animal intervention - is integral to the gravity flow-based water supply systems that have been successfully providing drinking water in many tribal areas of India.

In the Eastern and Western Ghats where the mountain elevations are not extreme, a longer term sanitation and drinking water security may require shifting focus from spring-based gravity flow systems to stream-based water treatment and pumping systems.The first step for this will be to conserve and promote perennial stream flows in the hilly regions. Piped sanitation and water connections from gravity flow systems may not be sufficient to meet household requirements. Gram Vikas model is based on pumping of ground water from forest catchment wells. Building big water sumps to store water high up on the hills is not practical and will disturb the eco-system. As the need for water for downstream villages increases, there will be a need for sanitation-related water requirements as well. In some areas with enough spring water flows, Diversion Based Irrigation (DBI) systems can be extended for providing drinking water as well. However it may be better to start planning for sump-based harvesting of the stream water flows in the valleys, for meeting future drinking water and sanitation needs of communities. Water quality will then become a major challenge given surface water flows and contamination from the surface flows. This can be addressed by micro-water treatment.

[4] http://www.sikkimsprings.org/

4.3 Decentralised systems sustainability that impact on efficiency and conservation of water

Efficient rural water supply systems that are under prudent community management, can contribute to water conservation. Single village-based rural water supply schemes in place of multi-village schemes, tend to be more successful in ensuring both source sustainability and meeting the needs of the community. Well maintained hand pumps also ensure that more and more hand pumps are not needed and contamination of ground water does not take place from poorly maintained pumps.

- Well-based drinking water supply in villages of Jharkhand and West Bengal (PRADAN) and Gujarat (Utthan) are good examples of community-managed sustainable drinking water supply scheme.
- Community-based hand pump maintenance in UP (UNICEF) highlights the benefits of both resource conservation and water quality.

5. Case Studies: Examples of Greening Interventions in Rural Water Supply

5.1 Solar pump energised drinking water supply: Sahjeevan Trust, Kutch

High energy costs of pumping water are often the root cause of unsustainable piped water supply systems in most parts of the country. In a recent study of Karnataka rural drinking water (ASHWAS study by Arghyam, Bengaluru), it was found that in all villages, the piped water supply schemes have huge unpaid electricity bills. In many other parts of the country, it is also found that electricity supply remains erratic and connections to rural habitations get disconnected when farmers do not pay bills for their irrigation pump sets.

Photo-voltaic cells-based solar pumps have been successfully promoted by Sahjeevan Trust as cost effective and locally-managed technology for not only water pumps but also for lighting and a host of local livelihood applications, in the difficult terrain of Kutch.

The technology of solar pumps is linked to the concept of every village becoming self-reliant in meeting its drinking water needs and operating and managing all drinking water technologies and distribution. Ground water recharge became a key component of the initiative. Each village identified the best drinking water source that could yield them assured water throughout the year and took steps to protect it and use it for meeting their drinking water needs.

Using the subsidy offered for procuring PV solar panels and through a partnership with Auroville Renewable Energy, Sahjeevan Trust was able to initiate work in 2001 in a few villages in Kutch district of Gujarat.

In this process the village water security plans of the NRDWP Guidelines 2010 were met and also translated into action in delivering drinking water security.

Solar pumps replaced the costly diesel pumps thus taking care of electricity supply failures in rural areas as well.

A small 0.75HP solar pump set can replace 10HP diesel pump sets to provide enough energy to lift water from a bore wells. The pilot project of Sahjeevan Trust demonstrated a solar powered submersible 0.75HP pump lifting water from a 30 metres suction head, transported over a distance of 1.8 km PVC pipeline to the village over a gradient of 14 metres from the well to the water tank in the village.

The solar technology pump has the following components:

- Solar module panels of 1800Wp
- 0.75HP pump
- Inverter

The economic viability of the solar pump is based on the low operating cost with no fuel as compared to a diesel pump set. Estimate of financial viability of the first soalr pump set set up by Sahjeevan Trust

shows a monthly life cycle cost at INR 26 as compared to INR 58 for the diesel pump set. This translates into a low INR 3/month per household towards O&M of solar pumpsets. Even this money goes to cover the part-time wages of a person employed from the village to operate the solar pump. The technology does depend heavily on subsidy from the government to provide PV-cell panels to operate the pump.

5.2 Diversion-based Irrigation/Drinking Water Supply: FES, Odisha

In the hilly slopes of the Eastern Ghats of Odisha, spring water flows for irrigation and drinking water requirements of the tribal habitation is being utilised as a green solution to sustainable drinking water security. Foundation for Ecological Security(FES) has demonstrated a scaled-up programme of diversion-based irrigation and drinking water supply in Koraput district of Odisha.

Diversion based gravity channels for spring waters

Diversion channel-based irrigation is a traditional system of diverting run off water and delayed flows from the main flow line to cultivable lands through an arrangement of channels on contours. This system is more popular in tribal areas where the topography is highly undulating and difficult to lift water to the higher elevation lands- a temporary barrier made out of stones and mud against small or medium streams. Water is diverted from the main flow to their lands through channels excavated on contour.

The project has implemented five schemes covering a total command area of 56.55 ha benefitting 209 households. Irrigation channels 5 km long were created costing approx. INR 20 lakhs. It should be noted that these schemes provide virtually free drinking water supply to all the villages. Enabling provisions for the success of Diversion Based Irrigation-Drinking water supply schemes are;

- Protected spring catchment areas
- Year-round spring flows
- Community-managed and maintained diversions channels
- Community water stand-posts

Hilly terrain of western and eastern ghats provide an ideal location for this technology. While spring water are naturally filtered safe drinking water sources from nature, their water yields may not be enough to sustain a higher level of water use for sanitation. Building bigger tanks high up on the hill slopes, to store water for sanitation and water requirements may not be possible and the construction may risk the spring water yields.

Hence there is a need to develop stream based drinking water and sanitation infrastructure in the eastern and western Ghats. Ensuring stream flows is a key to sustainability of this. Water from the streams can be tapped in storage tanks/sumps along the stream bed in the valleys, for supply to the habitations for their sanitation and drinking water needs and transported upstream using pumpsets including solar pumps as demonstrated by Sahjeevan Trust. Water purification and treatment measures will need to be installed.

5.3 Dug Well-based Water Supply: PRADAN, Jharkhand

Dug wells have been the traditional source of rural drinking water. Each village had at least one or more dug wells and these were maintained by the village community. However with the onset of hand pumps, the use and maintenance of open dug wells, have been neglected. Many wells were closed or became waste dumps.

With borewell-based piped water supply proving unreliable and expensive supply in many parts of the country, and with growing fluoride and arsenic contemination in ground water – interest in reclaiming dugwells and making them clean and secure for drinking water, is gaining ground.

Dug wells are an environmentally-green option for extracting drinking water. Many NGOs find dug wells a reliable local water source instead of expensive borewell or multi-village piped water supply schemes. The bore wells operate as a community water source and are fitted with storage tanks and pipes for transporting water to an overhead tank in the village for gravity flow to households. PRADAN has promoted well-based drinking water supply in Jharkhand and West Bengal.

PRADAN has successfully demonstrated 20 well-based drinking water supply schemes in Jharkhand, using the funds available from the rural water supply programme and peoples own contributions. All the schemes are managed by the community, including recovery of O&M expenditure. The Village Water and Sanitation Committees (VWSC) have been activated, Standard Operation Procedures developed position for a well alongside a stream selected, laying of pipeline and location of overhead tank and distribution pipe network carried out by the VWSC. A cash contribution of INR1000 per family is secured upfront(in 3 installments) from all households in the village. Each household contributes INR 80 per month for the assured piped drinking water supply in their homes. Some other positive features of this initiative include: at least 50 percent members of the VWSC are women, fortnightly cleaning of the water storage tank and focus on sanitation and promotion of behaviour change for toilet usage.

The highlight of this initiative is that it is a single village piped water supply solution and ensures- from installation to operation and maintenance – the entire work is carried out by the VWSC working under the panchayat unlike multi-village piped water supply schemes where the installation and management of the water supply remains in the hands of the PHED or rural development departments.

5.4 Mitigating Arsenic in Drinking Water: Innervoice Foundation, Balia, UP

Arsenic in ground water has emerged as a major problem all along the Indo Ganjetic plains. It affects some of the poorest populations of India, whose resistance to arsenic poisoning is low. The problem is compounded by the decades of assurance that ground water from deeper aquifers drawn from hand pumps and borewells is safe drinking water. The Government of India has recently approved the setting up of an Arsenic Centre in West Bengal to address the problem.

In a research paper on arsenic in ground water in West Bengal, Dr. Dipankar Chakravorty found, "Till to-date, we have analyzed by FI-HG-AAS 1,10,000 hand tube well water samples from 9 arsenic affected districts. Out of them, 51percent are unsafe to drink according to the WHO recommended value of arsenic in drinking water (10 mg/L). In our preliminary study, 95000 people were clinically examined from arsenic affected districts of West Bengal and 10100 people (9.4 percent including 2 percent children) were registered with arsenical skin lesions. At least 100 cancer and few hundreds suspected Bowens disease were detected. Approximately 90 percent of the children below 11 years, living in arsenic affected villages show elevated level of arsenic in hair and nails. Infants and children might be at greater risk from arsenic toxicity due to more water consumption on body weight basis. Villagers are using arsenic contaminated water not only for drinking and cooking but also in agricultural field. Our study during last two years reveals the presence of elevated level of inorganic arsenic in food chain and in those consumer products where groundwater is used in affected villages. To combat this deadly arsenic menace we need to increase awareness and educate our villagers about the problem and instead of reckless use of groundwater we should preferably utilize our vast available surface water, rain water with people's participation". [5]

The first intervention in addressing the problem of arsenic therefore is raising awareness about the problem in the affected areas as well as strengthening the diagnostic capacity of public and private health systems. People still do not know that the painful ulcers and bone deformities and cancer, are a result of the water that they are drinking.

In the district of Balia in UP bordering UP and Bihar on the river Ganga, a small initiative is trying to address the problem of arsenic in ground water, using community awareness and mobilisation as a key approach. The small people's initiative has the following lessons:

- *Awareness is the key to addressing arsenic in drinking water*. There is large-scale lack of awareness and apathy among both the affected populations as well as private and public health systems and doctors on the presence and risk of life threatening cancer from consuming arsenic-affected water.
  - IEC component of the rural drinking water supply programmes has not addressed this critical issue and this must be done on priority.
  - Engagement of schools and universities in awareness raising on arsenic in ground water is needed
  - Formal education component in school curricula and training of school teachers, Anganwadi workers and ASHA workers, panchayat functionaries on the nature of arsenic contamination and its testing will help a great deal.
- *District-level water quality testing laboratories are currently dysfunctional and need to be activated for arsenic testing.*
  - Field kits distributed under the 2004 Water Quality Surveillance programme cannot test for arsenic. There is a need to popularise water quality testing.
  - Making the laboratories user-friendly. District laboratories should be encouraged to test any sample given to them by anyone from the community. A very nominal fee, if any, could be charged.

[5]Paper presented at the Fifth International Conference on Arsenic and its Health Effects: http://phys4.harvard.edu/~wilson/arsenic/countries/SDAbstractsSPEAKERS.pdf.

  - Schedule of testing, dissemination of results and awareness-raising should all be combined in the water testing intervention.
  - Monitoring of results should be done at the district level in all reviews by the Collector.
- *Dug wells are one alternative to arsenic-affected ground water* that is drawn from deeper aquifers by hand pumps and bore wells. Instead of large and expensive multi-village water treatment-based piped water supply schemes, there is need for sustainable village-level drinking water supply options.
- *Recharge of ground water leads to a significant reduction in arsenic*. In Balia, water samples with 1000 ppm of arsenic was converted into drinkable water with simple recharge measures for ground water.
- *Creation of new community dug wells for drinking water and for revival and recharge of old functional wells; their regular cleaning* can be done from MGNREGS works.
  - Ground water recharge will reduce arsenic in ground water and make water from wells safe for drinking. Roof rainwater and surface water can be used to recharge the ground water and wells.
  - Collective action at panchayat level is needed.
  - Involvement of schools and universities in IEC and water testing needed
  - Awareness of arsenic can be raised through school education.
- *Experience of many types of arsenic filter treatment plants has not been encouraging.* The filters do not completely elemenate arsenic, these are often eternally procured, costly and difficult to clean and replace. Safe disposal of arsenic sludge/filters is a major concern. Often the filters breeds complacency and people keep using the water after the life of the filter or when the filter stops working. The experience of Inner-voice Foundation with cheap charcoal-sand based matka filters is positive since these are small filters using locally available materials. They are cheap and easy to maintain. However Inner-voice Foundation also believes that these filters have a risk of poor maintenance and therefore a longer term solution for arsenic-free water at source is the solution. Inner voice Foundation is promoting dug wells with regular monitoring as the viable option in Balia.

Annex 1

Terms of Reference of the Study

The main objective of the paper is to examine the potential of the National Rural Drinking Water Programme and to recommend changes in the guidelines and implementation framework of these programmes to achieve "green" outcomes as co-benefits in addition to their core objectives.

The aim will be to examine the National Rural Drinking Water Programme in order to understand their implications for the environment – both positive and negative, as well as the potential to bring about environmental benefits that may be in the form of sustainable use and conservation of natural resources, reduction of pollutants and greenhouse gases, safe disposal of contaminants and building the resilience of communities and service (drinking water) provision to climate change and natural resource degradation. In specific, there will be opportunities related to the selection of source, technology and design of the supply system, operations and maintenance, etc. The study will highlight lessons from relevant government programmes as well as initiatives undertaken by civil society organizations as illustration of the possible greening potential. These examples need to be analyzed to the extent that they have been or are scalable and offer lessons for the public funded progamme under review.

The key tasks while undertaking the study will include:

A. Review the National Rural Drinking Water Programme from an environmental perspective in order to:
   - Assess the direct or indirect environment implications, both positive and negative, of the programme
   - Examine the potential of the programme for addressing environmental issues leading to positive environmental benefits, reducing the ecological footprint and building resilience of communities and services
   - Identify and document case studies or models within India wherein similar initiatives and programmes have led to significant environmental benefits, including through (but not limited to) review of responses to query on 'greening rural development programmes' posed by UNDP on UN Solution Exchange and the global UNDP networks.

B. Contribute to the execution of the Workshop on "Towards Greening Rural Development Programmes in India: Lessons from International & National Experience" scheduled for May 14-15, 2012, through:
   - Identification of key resource persons (experts on rural housing for the poor) who can select 3-4 best practices and present these at the workshop session
   - Coordination of the session on National Rural Drinking Water Programme at the workshop, including contacting speakers, confirming participation, reviewing speaker presentations
   - Presentation of implications for the National Rural Drinking Water Programme i.e. Revision of Guidelines, Capacity Development etc at the end of relevant workshop session,
   - Finalisation of workshop report on the relevant session

C. Provide practical and actionable recommendations for revision of the guidelines and operational frameworks for greening National Rural Drinking Water Programme.

Annex 2

List of Experts Consulted

	Expert	Organisation
1.	Dr. Mihir Jena	FES, Koraput, Orissa
2.	Ms. KrupaDholakia	Sahjeevan, Kutch, Gujarat
3.	Mr. Sourabh Singh	Activist, Balia, UP
4.	Mr. Himanshu Kulkarni	ACWADAM, Pune
5.	Mr. SujoyMazumdar	MoWS, Delhi
6.	Mr. Aidan Cronin	UNICEF, Delhi
7.	Mr. Yusuf Kabir	UNICEF, Mumbai
8.	Mr. Amit Mehrotra	UNICEF, Lucknow
9.	Mr. Kurian Baby	IRC, Netherlands
10.	Mr. S Samuel	WSP, Delhi
11.	Mr. Joe Madiath	Gram Vikas & India WASH Forum
12.	Ms. Nafisa Barot	Utthan, Gujarat & India WASH Forum
13.	Mr. KJ Joy	SOPPECOM, Pune
14.	Ms. Seema Kulkarni	SOPPECOM, Pune
15.	Mr. Rajesh Ramakrishnan	NRMC, Delhi
16.	Mr. Anand Sekhar	NRMC, Delhi
17.	Mr. Amit Nair	Consultant, Delhi
18.	Ms. Padmaja Nair	Consultant, Lucknow
19.	Mr. Shashank Deshpande	GSDA, Pune
20.	Mr. Vinod Kothari	SRTT, Dehradoon
21.	Mr. Arun Pandhi	SRTT, Mumbai
22.	Mr. Ravi Chopra	Peoples Science Inst, Dehradoon
23.	PRADAN	PRADAN, Jharkhand
24.	Members and Trustees	India WASH Forum

Greening the Total Sanitation Programme

Centre for Science and Environment
New-Delhi

Greening the Total Sanitation Programme

1. Background and Context for the Study

Most of the rural population of India depends on natural resources for their subsistence and livelihoods. At the national as well as global levels, there is increasing focus on environmental issues and sustainable development across various economic and social sectors. Major emphases of greening of development programmes has been on (a) restoring and conserving natural resources and ecosystems (b) developing clean technological solutions and infrastructure and (c) innovations for reducing carbon emissions and environmental pollution. This can stimulate rural economies, create jobs and help maintain critical ecosystem services that are vital to the economy and human health and wellbeing and, also strengthen resilience to climate-induced change particularly of the rural poor who are amongst the most vulnerable to the impacts of climate change and natural resources degradation.

The Ministry of Rural Development (MoRD) is the nodal ministry for effecting change in rural areas through several programmes aimed at poverty alleviation, employment generation, infrastructure development and social security. Its main objective through these programmes is to alleviate rural poverty and ensure improved quality of life for the rural population. The topic of this paper is the Total Sanitation Campaign (TSC), the flagship rural sanitation programme of the Ministry of Drinking Water and Sanitation[1] (MDWS). While originally envisaged as a means to achieve universal sanitation coverage, it has significant potential for improving the natural resource base and rural environments beyond the narrow perceived mandate of toilet construction.

2. Defining 'Greening Rural Development'

The concept of greening rural development implies the kind of development that improves the rural environment in terms of natural resource quality and quantity and thereby the sustainability of livelihoods and incomes, mitigation of scarcity and reduction of the burden on women. 'Greening rural development' intends to strengthen the livelihoods based on environmentally sustainable use of their local environment and natural resources. It aims to improve the quality and carrying capacity of eco-systems, strengthen their resilience and reduce the ecological footprints of development interventions.

3. Aims and Objectives

The overall aim of this paper is to examine how the Total Sanitation Campaign can be re-oriented to become more environment-friendly and to recommend changes in the guidelines and implementation framework to achieve 'green outcomes'.

To achieve its aim, this paper examines TSC to understand its implications for the environment – both positive and negative. It elaborates on the methods to bring about environmental benefits that may be in the form of conservation and augmentation of natural resources, reduction of pollution and building the resilience of communities to climate change. The study highlights lessons from relevant government programmes as well as related initiatives undertaken by civil society organisations as illustrations of possible greening potential. These examples are analysed to the extent that they have been or are scalable and offer lessons for TSC.

[1]Ministry of Drinking Water and Sanitation was previously known as 'Department of Drinking Water Supply (DDWS)' which was formed under the ministry of rural development in 1999. In 2010, DDWS was renamed Ministry of Drinking Water and Sanitations and conferred the status of 'ministry' in 2011. The Ministry of Drinking Water and Sanitation is responsible for overall policy, planning, funding and coordination of drinking water and sanitation, and headed by the Minister of Rural Development.

To achieve its overall aim, paper follows the structure below:

1) Review of 'sanitation programme' from an environmental perspective in order to:
   - Assess direct or indirect environmental implications, both positive and negative.
   - Examine the potential of greening sanitation programmes for addressing environmental issues leading to environmental benefits, reducing the ecological footprint and building the resilience of communities
   - Identify and document case studies or models within India wherein similar initiatives and programmes have led to significant environmental benefits, including thorough (but not limited to) review of responses to query on 'greening rural development programmes' posed by UNDP on UN Solution Exchange and the global UNDP networks.
2) Provide practical and actionable recommendations for revision of the guidelines and operational frameworks of the sanitation programmes.

4. Objectives and Environmental Implications of Total Sanitation Campaign

A number of programmes, initiated by the Ministry of Rural Development, are already linked to green outcomes or have implications for environmental protection, conservation, and maintenance of natural resources. This paper looks at TSC.

Providing basic sanitation facilities is among the most critical development challenges for developing countries, and greening sanitation is an essential component for achieving sustainable development. The greening sanitation programme contributes towards, both, the environmental conditions as well as socio-economic conditions of communities. Basic sanitation still remains India's foremost challenge with 200 million people still lacking a toilet and defecating in the open; lakhs of villages do not have adequate solid and liquid waste management.

The Campaign was launched by the Department of Drinking Water and Sanitation, Ministry of Rural Development, with a vision of creating an environment that is clean, healthy and contributes to the economic and social well being of all rural citizens.

TSC has demonstrated significant potential for improving a component of the rural environment. For example, Community-Led Total Sanitation (CLTS) in which people conduct their own appraisal and analysis of open defecation and take their own action to become open defecation free (ODF). Most importantly, CLTS focuses on behaviour change, essential for achieving and maintaining ODF, rather than building infrastructure. The Government of India buttressed TSC with an award scheme Nirmal Gram Puruskar (NGP) in which ODF panchayats are given a cash award. As a result of this campaign, there has been an exponential increase in access to sanitation facilities. There has been almost 4.5 per cent increase each year in sanitation coverage compared to 1 per cent coverage each year before the launch of this programme.

Total Sanitation Campaign aims to:

1. Bring about an improvement in the general quality of life in rural areas.
2. Accelerate sanitation coverage in rural areas to access to toilets to all by 2017.
3. Motivate communities and Panchayati Raj Institutions (PRIs) promoting sustainable sanitation facilities through awareness creation and health education
4. Cover schools and *anganwadis,* by March 2013, with sanitation facilities and promote hygiene education and sanitary habits among students.
5. Encourage cost-effective and appropriate technologies for ecologically safe and sustainable sanitation
6. Develop community-managed environmental sanitation systems focusing on solid and liquid waste management

TSC has focused on aims 1 and 2 since its inception in 1999 at the expense of the other objectives. Information, education and communication (IEC) is the key to motivating communities and PRIs to adopt sustainable sanitation by creating a demand but it has never been executed seriously. In fact, IEC has always been an excuse to spend the allocation without devising any strategy. The result is an incomplete and ineffective IEC plan for any sanitation campaign, and little or no demand for sanitation from user communities. The performance of schools and *anganwadis* has also been patchy because of a programme overlap with Sarva Shiksha Abhiyan (SSA) and the Integrated Child Development Scheme (ICDS). Even though 96 percent schools reportedly have toilets, just 39 percent have separate toilets for girls and boys; 76 percent *anganwadis* have toilets. Eco-san has been incorporated into the TSC guidelines for 2011, but little has been done to operationalise it and popularise this method of separating solid and liquid excreta. Very little, if anything, has been done to promote solid and liquid waste management (SLWM).

The results have been far below expectations. Surveys have shown that the core activity of promoting the use of toilets has been poor, even in villages that have been awarded NGP, only 81 percent households have access to toilets, and only 63 percent use toilets. That means about 450 million people defecate in the open. The reasons are mainly to do with the quality of construction.

The situation of SLWM is extremely alarming. As many as 41 per cent people throw garbage on the streets, while the rest either throw it in a compost bin (34 per cent), or have household collection or throw it in a waste bin. Even the latter options are not satisfactory since panchayats or municipalities (in peri-urban areas) collect and throw garbage from households and bins in the nearest depression. Therefore, just a third of the solid waste in rural areas reportedly makes it way to a composting unit.[2]

Furthermore, waste water finds its way to the nearest water body. A whopping 54 percent report their waste water flows into a pond, well or other depression. Another 20 percent say it flows into a community drain, from whence it again flows into a water body. Just 26 per cent use the water for kitchen, gardening or direct it to soak pits. Due to the lack of better infrastructure and management, this leads to losses in biodiversity and eco-system resilience. At a global level, the situation is dire. One estimate is that in developing countries, 90 percent of waste water is directly let into rivers, lakes or oceans, leading to a proliferation of dead zones.[3]

The poor condition of SLWM coupled with low use of toilets has the makings of a human health disaster and could have major impacts on the quality of natural resources. The health benefits of sanitation become apparent only with 100 per cent toilet usage and proper SLWM. Poor solid waste disposal pollutes the soil with plastic and other materials; leachates from so-called garbage dumps pollute shallow aquifers that provide drinking water for local people through hand pumps and dug wells. Similarly, surface water bodies polluted by waste water also contaminate shallow aquifers. Improper placement of toilets, such as upstream of a sub-surface underground stream, can pollute water sources.

Thus, human excreta, both liquid and solid, pollute water and eutrophies surface water bodies. Waste water degrades both surface and groundwater quality. Solid waste degrades other natural resources such as forests and grasslands. All these types of waste generate greenhouse gases (GHGs).

4.1 Negative Environmental Implications of TSC

Although TSC has a number of environmental benefits, if implemented without an effective environmental assessment and in segments without a comprehensive, integrated approach, it can have several negative impacts.

Since it was in the 1980s, the sanitation programme has gone through several redesigns. The most significant was changing it from a supply-led toilet construction programme to a demand-led sanitation

[2]Nirmal Gram Puruskar Awarded Panchayats: A Status Study, TARU, UNICEF and WSP, November 2008

[3]Corcoran, E., C. Nellemann, E. Baker, R. Bos, D. Osborn and H. Savelli (eds). (2010). Sick Water? The Central Role of Wastewater Management in Sustainable Development. A Rapid Response Assessment. United Nations Environment Programme, UN-HABITAT, GRID-Arendal. www.grida.no

programme in the late 1990s. However, even in this avatar, the sanitation campaign has not bitten deep enough. Its main objective has remained the construction of toilets, like its predecessors, with little attention being paid to behaviour change or the aspects of SLWM. Simultaneously, there has been a thrust towards providing piped water in villages. This will, or in some cases, has compounded the quantum of waste water generated by villages. Many villages and peri-urban areas already face severe problems in disposing solid waste; piles of rotting garbage at the entrance to villages are testimony to this. Together, they pose one of the biggest challenges to making the sanitation campaign more environment-friendly.

The lack of drainage in villages has meant that waste water streams down roads, forming puddles and eventually collecting in the nearest low-lying area. This is water from kitchens, bathrooms and occasionally collects human excreta from open defecation. This breeds mosquitoes and flies, increasing morbidity. The water percolates into the soil and pollutes the shallow aquifer that people depend on to draw water from wells or hand-pumps. This compounds the burden of disease.

Solid waste disposal is another blind spot. There is little or no provision for collecting and disposing any solid waste. Solid waste in rural areas is high on organic content, and has little inorganic matter. It is also full of plastic as no village has banned the bag; therefore garbage dumps are full of plastic bags. The most convenient low-lying area becomes the garbage dump that, in the rains, fills with water. This contaminated water again pollutes the shallow aquifers that people depend on for drinking and other domestic needs. Therefore, the lack of proper handling of solid waste adds to local morbidity rates.

The combined effects of pollution from waste water and solids are devastating. They pollute groundwater that is the lifeline of local people through hand-pumps and wells. Poorly constructed solid waste landfills generate GHGs. They increase morbidity and mortality, degrade natural resources, increase the burden of collecting firewood and water on women and adversely effect the local environment. Plastics and inorganic material persist in the environment and contaminate the water and soil in addition to blocking water-ways. Open defecation pollutes surface water bodies such as village ponds, and eventually ends up polluting groundwater with nitrates and bacteria. This is because people defecate on the bunds of ponds, instead of at a distance from them, and the social norms or behaviour that proscribed this have been forgotten or are violated.

It has been seen that the target-driven rush to construct toilets has adversely impacted water quality in many parts of India. In the densely populated villages of West Bengal, where practically every house has a pond, toilets are constructed in close proximity to the pond. This is leading to severe water quality problems and has negated any health benefits that may accrue from the construction and use of toilets; people use pond water for everything except drinking, including washing utensils. Similarly, in Kerala, the high density of pit latrines and poorly made and maintained septic tanks has rendered the shallow aquifer water unfit for drinking because of nitrate and bacterial contamination. Across Jharkhand, toilets constructed under the campaign and its earlier attempts next to village ponds are an indication of the lack of planning for both toilets and their location. None of them are being used; if they were in use, they would have contaminated the ponds.

The overall planning for sanitation that includes construction of toilets and solid and liquid waste management is done in isolation of other considerations such as watershed characteristics, location of other natural resources such as forests and grasslands and soil traits. This means that toilets are often located close to water sources and ponds. They are also located upstream of the village and their leachate pollutes groundwater flow, ending up contaminating drinking water sources such as dug wells and hand pumps. Additionally, poorly constructed latrines pollute ground water instead of safely containing excreta. If they are located in an inundation-prone area, the stored fæces pose a major pollution and health hazard during the monsoons.

The immediate impact of a poor environment is felt through the water cycle. Ground water polluted by excreta or solid waste is used for domestic purposes with little treatment, the control of the microbial and chemical quality of drinking water requires integrated management plans, which provide the basis for system protection and process control to ensure the numbers of pathogens and concentrations of chemicals present a negligible risk to public health. "Water safety plans" begin with system assessment and

design, operational monitoring and management plans, including documentation and communication. The elements of such plans build on the multiple-barrier principle, the principle of hazard analysis and critical control points (HACCP) and other systematic management approaches.[4]

4.3 Positive Environmental Implications of TSC

There have been several positive impacts of TSC as well, especially where toilet construction has been executed well with an effective environmental assessment and in coordination to the other objectives of TSC. If solid and liquid excreta are collected and treated as a resource, they can be a good input for agriculture if separated, processed and applied; the crucial aspect is hygienic collection and separation of excreta. A large percentage of solid waste from rural households is organic and can be composted; here again the crucial factor is segregation and subsequent processing and use. Grey water, most of the waste water in rural areas, can be used for kitchen gardens or in agriculture. Villages generate large quantities of organic waste and grey water. The Ministry of Drinking Water and Sanitation estimates their quantity to be 0.3 – 0.4 million tonnes, and 15,000 – 18,000 million litres each day. This is a significant resource and if harnessed properly, can mitigate the current demand for chemical fertilisers and water for agriculture considerably. While TSC emphasizes reuse and not disposal, the funds allocated for village level plans are a pitiful 10 per cent.

Some of these positive environmental benefits include:

1) **Controlling water pollution.** The full use of toilet ensures that one major sources of pollution is removed. Often due to the lack of adequate sanitation facilities, the local water bodies become the receptacles of sewage. Proper disposal of human excreta reduces the flow of pollutants into local water bodies and thus reduces the pressure on fresh water bodies. Thus, waste discharge is controlled at source and not allowed to flow into drains to local water bodies. Ensuring full toilet use also prevents people from defecating around ponds, that are another direct source of water pollution. Decomposed fæces from pit toilets can be extracted and used as manure once the toilet pit is filled. Toilets improve the health and safety of women, and school attendance.

2) **Waste water recycling and reuse.** Waste water is not allowed to flow on streets or drains but used for kitchen gardening or diverted to suitably constructed soak pits. This reduces the dependence on fresh water sources i.e., ground water and surface water for the horticulture. Waste water has some nutrients that are useful for plants.

3) **Solid waste composting for manure.** Most solid waste produced in rural India is wet kitchen waste, suitable for composting. Composting can be done at the household or community level. The waste is segregated into bio-degradable and non-bio-degradable at source, and the former is composted. The latter is either recycled or sent to a suitably prepared landfill. This not only provides manure to local farming but also reduces need for landfills, protecting other natural resources such as forests or grasslands that often become receptacles for garbage. Furthermore, the organic material helps develop the humus content of soil, which enhances the water retention quality of soil.

4) **Provides eco-friendly fuel/energy.** Human excreta and cow-dung can be mixed and used as feed for bio-gas plants. There are mental blocks to using this gas for cooking, but a community plant can provide gas for lighting. In several cases though people cook with this fuel. This further reduces the burden on women for fetching firewood, help saving the natural fossil resources and reduces air pollution. The by product of this process can be further used as manure.

5) **Helps in saving limited resources.** Urine contains 90 per cent of the nitrogen phosphorus and potassium (NPK) in human excreta. If disposed in water, it can lead to eutrophication. However, these substances are extremely valuable for agriculture. Eco-sanitation, as proposed under the TSC guidelines, offers a convenient way to separate solid and liquid excreta and use them for agriculture. This is important since it has been estimated that the reserve amount of phosphorous that can be

[4]Guidelines for Drinking-water Quality, Third Edition Incorporating the First and Second Addenda, World Health Organization, 2008

extracted economically will last only for another 100 years[5]. Similarly the reserves of sulphur and oil which are used to produce nitrogen will last for another 30-40 years[6]. Therefore, these toilets can preserve our mineral resources.

6) **Saves water-** Eco-sanitation also saves water since the toilets do not need any water to flush unlike pour-flush toilets that need 2-4 liters after each use.

Along with the above discussed environmental benefits, greening sanitation programmes can also be very beneficial towards the community's socio-economic development, as these initiatives promote better hygiene and health conditions, better social cohesion and, most importantly, contribute towards empowering women. Hence, in an ideal scenario, a green TSC can help improve a village's environment.

4.4 Greening Sanitation through Effective Solid Waste Management

This sections deals with non-excreta solid waste. The TSC guidelines state "Panchayati Raj Institutions (PRIs) are required to put in place mechanisms for garbage collection and for preventing water logging. Up to 10 per cent of the project cost can be utilized for meeting capital costs incurred under this component. The fund sharing pattern between the Centre, State and Panchayat /Community would be in the ratio of 60:20:20. Under this component activities like common compost pits, low cost drainage, soakage channels/ pits, reuse of waste water, system for collection, segregation and disposal of household garbage etc may be taken up."

Looking at this proviso, it appears that the focus is on minimising garbage to prevent water-logging, and the options provided are a means to that end. This needs to change. The objective must become a cleaner rural environment and protection of natural resources through better solid waste management. The guidelines need to be more elaborate and detailed, and allocation has to be raised substantially from 10 percent to 25 percent. It must be made a mandatory part of a district sanitation plan, without which the plan should not be passed.

The objective of solid waste management must be specified as closing the waste cycle and treating organic waste at the local level.

To achieve this, all households should be required to segregate waste into bio-degradable and non-bio-degradable and hand these over to a panchayat collection agency against a certain fee. Panchayats must be mandated to collect, treat and dispose segregated waste in a sustainable manner. Suitable IEC material have to be developed to inform people of the advantages of garbage segregation and treatment, what constitutes bio-degradable and non-bio-degradable waste, putting each in separate containers and how they have to be handled. Each panchayat or ward (in the case of large panchayats) needs to have a place for sorting domestic waste and the organic or bio-degradable waste will be composted using any feasible technology. The location will be fixed by the panchayat. Compost from the processing units will be used by the panchayats as manure for agriculture; the panchayat can set a price for this manure for sale to farmers. This can be a source of income to cover O&M costs.

There are a number of environmental, health and economic benefits from effective solid waste management. These are as follows:

- Environmental benefits - By closing the waste cycle, proper solid waste disposal prevents a major portion of waste from going to landfills. This prevents water and land contamination through leachates. Recycling and reuse reduces the need for virgin material. Proper solid waste disposal also reduces the impact on other natural resources such as forests and grasslands that either turn into dumps or are affected by solid waste
- Health benefits - Managing waste systematically reduces the number of disease vectors, and consequently, morbidity and mortality

[5]Steen I (1998), Phosphorus availability in the 21st century management of a non-renewable resource, Phosphorus Potassium, www.nhm.ac.uk/mineralogy/phos/p&k217/steen.htm

[6]EcoSan Res. (2003), closing the loop on phosphorus, www.ecosanres.org

- Climate variability - A small amount of waste to be disposed in landfills reduces GHG emissions
- Income - Manure from composting is a steady income source for the composting agency, whether individual or panchayat

Solid Waste Management Techniques

There are a number of techniques that can be applied for solid waste management at smaller levels. These include:

1. Organic solutions - Effective micro-organisms include specially cultured bacteria to decompose organic material. Some types are OS1 and Biosanitizer.
2. Composting - This is the least complicated and risky option. It converts solid waste to a form close to humus. It can be achieved under natural or accelerated conditions in a composting plant. There are four broad techniques
    2.1. Windrow composting is where a mixture of raw material is kept in long narrow piles called windrows, and are turned on a regular basis. This is an aerobic process.
    2.2. Passive aerated windrows, that eliminate the need to turn by supplying air through perforated pipes.
    2.3. Aerated static pile takes piped aeration a step further. Air is forced through perforated pipes by a blower and the pile does not need to be agitated to be turned.
    2.4. In-vessel composting, where composting material is placed in a container and a variety of aeration/turning methods are used to speed up the process.
3. Vermi-composting – here, composting is accelerated by the addition of earthworms, either the deep burrowing or surface type. Vermi-compost from deep burrowing earthworms retains food nutrients as micro-organisms break down food encouraged with aeration from the burrows of the earthworms. These earthworms eat soil, grind minerals into soil in their digestive systems and create new soil. On the other hand, surface earthworms eat the waste and compose the excreta, but this is not as useful for plant growth because of its higher fungal and actinomycete count. Therefore, the nutrients in vermi-compost from deep burrowing earthworms are of higher value as they have a higher number of micro-organisms, nitrifying bacteria and phosphate stabilisers. Vermi-composting is the second best option in terms of simplicity, after regular composting, for converting bio-degradable garbage to manure.
4. Composting with bioculture - Bioculum is a mixture of microorganisms developed for accelerated aerobic composting of organic waste. It has cultures of bacteria, fungi and actinomycetes. The bioculum is sprayed onto the garbage heap, staked in windrows. They have to be turned weekly for proper aeration, the temperature has to be kept at 65-70°C and humidity at 40 percent. Composting is completed in 4-6 weeks. The limitations are that skilled handlers are needed and the system cannot be used in households because of the large size of the compost heaps. It is more useful at garbage collection sites. The non-bio-degradable waste has to be further segregated and sent either for recycling or disposal in a suitable landfill. Suitable landfills can identified at the district level to bring this into the district sanitation plan and non-bio-degradable non-recyclable waste from the villages in the district can be disposed there. The landfill has to be scientifically sited and created to avoid inundation and groundwater contamination. It must not disturb any existing natural resource including forests, grasslands, wetlands or water bodies. Rag pickers can be employed at panchayats to remove all recyclable waste before non-bio-degradable waste is taken to a landfill. This will greatly reduce the amount of garbage entering the landfill, with attendant benefits of lower transport costs and GHG emissions. The recycling will also reduce demand for virgin material.
5. Ecological sanitation - This mimics nature's way of separating solid and liquid fæces. Excreta is collected in one container and urine in another. The excreta mixed with ash turns to manure that is rich in organic matter and has about 10 percent of the NPK present in human excreta, while urine has

the other 90 percent. The urine can be applied to plants with suitable dilution to provide adequate nutrients, while manure increases the organic content of soil. The wash water also mixes with urine. This is the best way to separate, naturally process and use human excreta in agriculture, while replacing chemical fertilisers.

Greening Sanitation through Effective Liquid Waste Management

Typically, waste water from domestic sources comprises grey and black water. The former comes from bathrooms and kitchens, while the latter is from toilets. Grey water is water generated by household processes such as washing dishes, laundry and bathing. It is not contaminated with wastewater from toilets (black water) and therefore contains very little pathogens. One exception is grey water generated by washing diapers. Since grey water is a reflection of household activities, its characteristics strongly depend on factors such as cultural habits, living standard, household demography, type of household chemicals used, etc. Nonetheless, specific grey water sources have specific characteristics:

- Kitchen grey water contains food residues, high amounts of oil and fat and some detergents. In may occasionally contain drain cleaners and bleach, which are very aggressive chemicals. Kitchen grey water is high in nutrients and suspended solids.
- Bathroom grey water is regarded as the least contaminated grey water source within a household. It contains soaps, shampoos, toothpaste, and other body care products. Bathroom grey water also contains shaving waste, skin, hair, body-fats, lint, and traces of urine and faeces. Grey water originating from shower and bath may thus be contaminated with pathogenic micro-organisms in small concentrations.
- Laundry grey water contains chemicals from soap powders (such as sodium, phosphorous, surfactants, and nitrogen) and may have bleaches, suspended solids, possibly oils, paints, solvents, and non-biodegradable fibres from clothing. Laundry grey water can contain high amounts of pathogens when nappies are washed.

Treatment of Waste Water

The choice of a grey water or total domestic waste water management strategy depends on the end use of the effluent. To improve the environment, grey water should be used to reduce dependence on ground water and surface water sources. Untreated grey water should not be allowed to mix with any other water – surface or ground. Therefore, the planning of such management systems should be done with the reuse in mind and should be adapted to a specified purpose, such as agricultural reuse, ground water recharge or discharge into inland or coastal waters. There are two main ways to handle grey water:

Direct utilisation of grey water (e.g. grey water gardens, grey water towers, etc.): Using grey water directly in gardens are the simplest and most cost-effective means of using grey water. The planted bed breaks down organic compounds and recovery of nutrients. Grey water is channeled into mulch-filled trenches to planted beds. The mulch holds back solids and diminishes evaporation. Grey water can be discharged either below of above the mulch, the latter being easier to do. Decomposing mulch has to be replaced with fresh material such as wood chips, back or rice husk. Plants take up the water and nutrients, and any runoff can be caught in a tank.

However there is limitation on the scale of usage. This cannot be used in high-density areas that generate large quantities of grey water. Therefore, it is ideal for rural households that have homesteads and space for kitchen gardens.

Application of small-scale constructed wetlands for the treatment of grey water and total domestic wastewater treatment:

Constructed wetland systems are simple, locally-manageable and cost-effective biological waste water treatment systems that utilise wetland plants, soils, and their associated micro-organisms to mimic natural wetland eco-system processes for the treatment of waste water. As the waste water flows through the

wetland, it gets treated through natural processes; pollutants in the wastewater are mechanically filtered, chemically transformed, and biologically consumed. With respect to the direction of waste water flow (i.e., horizontal or vertical), constructed wetlands are divided into reed beds, also known as horizontal flow constructed wetlands (HFCW), and vertical flow planted gravel filters (VFPGF), also referred to as vertical flow constructed wetlands (VFCW). In both cases, waste water needs pre-treatment to remove oil, fat, lint, large solids and food residues. This can be done through a series of settling tanks. The quality of water from these wetlands is good enough to discharge into surface water bodies and irrigation. The advantages of using small-scale constructed wetlands for the treatment of grey water are:

1. No power requirements
2. Natural processes are used to clean water, therefore no chemicals are needed and there are minimal recurring costs
3. Aesthetic and improves local biodiversity
4. In rural areas where land is readily available, set up costs are minimal. These can be higher in urban areas or where land is scarce
5. The water processed by the wetland can be used for farming or discharged into surface water bodies since it will be free of organic matters and chemicals

Ecological Sanitation

In today's societies the flow of plant nutrients is linear: nutrients are taken up from the soil by the crop, transported to the market, eaten, excreted and discharged. In a sustainable society, the production of food must be based on returning the plant nutrients to the soil. Ecological sanitation tried to achieve this in a safe and hygienic manner. It closes the nutrient loop.

The use of excreta on arable lands minimises the environmental impacts of farming caused by fertilizer run off. It also reduces water pollution, and degradation of natural resources, caused by open defecation. Another advantage of human-derived compost is that it is rich in phosphorous; in chemical fertilizers, about 25 percent of the phosphorous that is mined ends up in water bodies, causing eutrophication.

Ecological sanitation aims to promote the development, implementation and dissemination of socially- and culturally-acceptable, sustainable, hygienically-safe and ecologically-sound sanitation approaches. Several eco-san projects are being executed in different parts of India to:

(i) Introduce the ecological sanitation concept and to identify appropriate waste water handling approaches that satisfy technology, cost and institutional framework and enable maximising the utilisation of existing pipes and treatment facilities

(ii) Recover the nutrients from urine and fæces for agricultural purposes

(iii) Contribute to the reduction of waste water discharged to sewers through recycling of grey water. The alternative paradigm of ecological sanitation offers the potential of sustainable sanitation for developing countries.

Ecological sanitation is based on three fundamental principles: preventing pollution rather than attempting to control it after we pollute; sanitising urine and fæces; and using safe products for agricultural purposes. This approach can be characterized as 'sanitise-and-recycle'.

This approach is a cycle – a sustainable, closed-loop system. It treats human excreta as a resource. Urine and fæces are stored and processed on site and then, if necessary, further processed off site until they are free of disease organisms. The nutrients contained in the excreta are then recycled by using them in agriculture. An essential part of eco-san is to contain and sanitise human excreta before they are recovered and reused. Human fæces, rather than urine, are responsible for most diseases spread by human excreta. Thus, a method is needed to sanitise fæces.

There are two main methods: dehydration and decomposition. Dehydration, or drying, of fæces is easier if they are not first mixed with urine and water. When fæces decompose, the pathogens in them die and

are broken down. Thus, with either method, viruses, bacteria and worm eggs are destroyed. It is only then that fæces can be recycled. Urine is usually safe enough to be used in agriculture without further treatment, either directly or after a short period of storage. One purpose of an eco-san system is to form a set of barriers between fæces and flies, fields and fluids. This is done by containment of the fæces in a processing chamber or shallow pit where pathogens are reduced to an acceptable level before re-use. Then the contents may be removed for further secondary treatment to make them even safer. Urine In homesteads can be used directly. In large-scale systems urine should be stored for about 1 month before use. Don't apply urine less than a month before harvest on vegetables, fruits (except fruit trees) and root crops that are to be consumed raw. [7]

Urine is rich in nitrogen, while fæces contain organic matter, phosphorous and potassium. It can be estimated that urine contains 3-7 g N per litre. A rule of thumb is to apply the urine produced by one person during one day (24 hours) to one square metre of land per growing season. If all urine is collected, it will suffice to fertilize 300- 400 sq m of crop per person per year with N at a reasonable rate. For most crops, the maximum application rate, before risking toxic effects, is at least four times this dosage. Urine also contains lots of phosphorus, and it will suffice to fertilize up to 600 sq m of crop per person and growing season, if the application rate is chosen to replace the phosphorus removed. Urine can be applied neat or diluted. However, its application rate should always be based on the desired nutrient application rate and any potential need for supplementary water should be met with plain water, not diluted urine.

To avoid smell, loss of ammonia and foliar burns, urine should be applied close to the soil and incorporated as soon as possible. Urine is a quick-acting fertilizer whose nutrients are best utilised if the urine is applied from prior to sowing up until two-thirds of the period between sowing and the harvest. The best fertilizing effect is achieved if urine and fæces are used in combination with each other, but not necessarily in the same year on the same area. The amount of urine to be spread can be applied in one large dose or in several smaller doses, and under most circumstances the total yield is the same for the same total application rate.

For fæces, the application rate can be based on the local recommendation for the use of phosphorous-based fertilizers. This gives a low application rate, and the improvement due to the added organic matter is hard to distinguish. However, fæces are often applied at much higher rates, at which the structure and water-holding capacity of the soil are also visibly improved as an effect of its increased organic matter. Both organic matter and ash are often added to the fæces and they improve the buffering capacity and the pH of the soil, which is especially important on soils with low pH. Thus, depending on the application strategy, the faeces from one person will suffice to fertilize 1.5-300 m2, depending on whether they are applied according to heir content of organic matter or phosphorus. Fæces should be applied and mixed into the soil before cultivation starts. Local application, in holes or furrows close to the planned plants, is one way of economising on this valuable asset.[8]

Fæces contain most of the pathogens in human excreta and are the main source for transmission of enteric-infectious diseases and parasites. Therefore we should treat fæces based on the principles as below:

- Keep the volume of dangerous material small by diverting the urine and not adding water to the fæces.
- Prevent the dispersal of material containing pathogens by storing it in some kind of secure device (processing chamber, tank)

Ecological sanitation has several advantages over conventional sanitation. Some of these are:

- Recovery of nutrients and applying them safely in agriculture (marketing potential of urine and composted fæces)

[7]Paul Calvert, Peter Morgan, Arno Rosemarin, Ron Sawyer and Jun Xiao, Ecological Sanitation, Stockholm Environment Institute, 2004

[8]Håkan Jönsson, Anna Richert Stintzing, Björn Vinnerås, and Eva Salomon, Guidelines on the Use of Urine and Faeces in Crop Production, Stockholm Environment Institute, 2004

- Establishing a public-private partnership for operating the ecological sanitation facilities
- Promoting urban farming including rooftop farming
- Ensuring food security by providing quality manure/fertilizer
- Providing better health care
- Reducing consumption of commercial fertilizer thus saving energy and thereof reducing carbon emission
- Collecting urine on mass scale converted to dry crystalline fertilizer
- Making available of liquid urine fertilizer for city green areas
- Extracting phosphorous from urine
- Urine is an excellent fertilizer
- Separation keeps the volume of potentially dangerous material (fæces) minimal
- Simplifying pathogen destruction in fæces
- Reducing odor

5. Potential of TSC for Addressing Environmental Issues

Acknowledging the benefits (discussed above) of greening sanitation programmes, it is clear that these programmes have the potential to address a number of environmental issues without compromising socio-economic development, such as:

- It can strengthen livelihoods without risking environmental sustainability. If applied properly, greening sanitation programmes have a huge potential to strengthen livelihoods while enhancing environmental sustainability. It is possible to eliminate waste water and solid generation by converting all types of waste into usable material which not only help livelihoods financial but also improves the quality of environment. For example, excreta is converted to manure and can applied in the fields. Similarly urine is collected, diluted and applied in the fields for the phosphorus and nitrogen needs of crops. Organic solid waste, which is the bulk of rural garbage, is collected, composted (or vermin-composted) and used as manure. Furthermore, such an environmentally sustainable development initiative would not only encourage ecological practices that enable meeting the needs of future generations, but also promote change in production and consumption patterns in an equitable manner whereby resources that are currently being wasted are saved and channeled towards meeting the needs of everyone today as well as the needs of future.
- TSC can be extremely useful in reducing the ecological footprints of development initiatives. Greening sanitation programmes have the potential to enhance the efficient use of natural resources and increase the use of renewable and locally available material to reduce the generation of environmentally hazardous substances. Human excreta and cow-dung can be combined and used in biogas plants to replace biomass. This can be an excellent way to safely dispose human excreta, providing one or more houses with some cooking gas. The discharge from the biogas plants can be an input for composting and thereafter, use as fertilizer. Waste water is used directly in kitchen gardens or collected through drains, treated at a centralized location and discharged into a river/pond. The waste cycle, therefore, generates fertilizer and energy that can be used locally to replace chemical fertilizers and biomass.
- A green TSC has the potential to enhance the ecosystem's resilience. Human well-being and development both depend on the ecosystem's resilience. Greening sanitation programmes can be extremely useful in enhancing the capacity of ecosystems to cope with disturbances result from climate change, pollution and other human activities. Converting waste into useful resources not only protects nature and its valuable resources from exploitation but also helps maintain its health and resilience.

- Greening TSC can help protect and even augment local water resources such as lakes and ponds in villages. Each village has at least one of these structures, and more have been made under other government programmes such as the Mahatma Gandhi National Rural Employment Guarantee Scheme. These are crucial to local water security and helping communities mitigate the effects of climate variability. By ensuring proper SLWM, TSC can preserve the quality and quantity of water in these water structures.

6. Case Studies from India: Good Practices of Green TSC

Aasgaon (Maharashtra) – Case study of SLWM

The village Aasgaon is situated in the Satara district of the state of Maharashtra in India. The total area of the village is 22.5 hectares. It is a small settlement of 217 households. The total population of the village is 1,032 (according to the 2001 Census), of which 478 inhabitants are male and 554 are female, 143 people of this settlement village belong to Scheduled Caste, 21 people belong to Scheduled Tribes, 36 people belong to Other Backward Castes. The rest of the village belongs to the general category. Approximately 71 percent population of this village is literate. The primary occupation for most people of this village is farming followed by working in nearby towns.

The area of this resettlement was basically a waste land. At the time of resettlement, this area was a barren land without any source of water; a socially deprived village. The village had only one primary school and had no provision for secondary school education. However, the most critical challenge for Aasgaon was lack of safe and adequate drinking water and sanitation facilities. For 17 years, the village was completely dependant on water supply by tankers for their everyday water needs.

In the early 2000s, the village undertook a major initiative to improve sanitation under TSC. The State Government of Maharashtra launched a campaign known as the *'Sant Gadge Maharaj campaign'* to improve the condition of villages in terms of education, health and environment. The village panchayat mobilised the village community and the people, tired of 17 years of neglect, responded to the campaign. The most significant part of this campaign was the participation of women and their willingness for an active involvement in the campaign. As a result of such an active participation of the people, the village won the *Sant Gadage Baba Swachata Abhiyan* five times for achievements in different fields and was among the first to be awarded NGP. In 2000-01, Aasgaon won a third prize at the block level. Keeping up their active participation and affords, in 2001-2002 they won third prize worth INR 2 lakh at the district level. In 2004-05, it won the second prize worth INR 3 lakh at the district level.

Under TSC, the village adopted wise water management, that involves rainwater and grey water segregation and management. It constructed storm water drains through which the rainwater is channeled to maximise recharge. No grey water reaches these drains since it is completely used for kitchen gardens or tree plantation. Contour bunds and gabions were also built for watershed treatment and to maximise water recharge.

They have also tackled solid waste wisely. As a result of this and other programmes, each house has a biogas plant fed by human fæces and cowdung. Almost each house has a vermi-compost pit. The inorganic and non-compostable solid waste is recycled. There is a 100 percent toilet coverage and use. Community toilets have been constructed for those without individual toilets and visitors, which have extended sanitation coverage to the floating rural population. Villagers have planted over 10,000 trees and tended them through irrigation with grey water.

Therefore, TSC has catalyzed social transformation of the village and made it green. The people of Aasgaon suffered for 17 years with epidemic diseases, educational and economic losses. The most affected were the women. Not just their educational and economic development but also their dignity and self-respect were challenged. However, as result of people's participation and dedication Aasgaon has been socially and environmentally transformed.

This is an example where people have used all aspects of TSC along with state and national government programmes to improve the condition of their village. They have followed the norms for managing solid and liquid waste, have ensured their water security in this semi-arid area through rainwater harvesting, greened their village using grey water, produced substantial quantities of vermi-compost and manure from biogas plants, and ensured total sanitation.

Kaliyapalayam (Tamil Naidu) – Case Study of Ecological Sanitation

The Kaliyapalayam is a village located on the River Cauvery, in the Tirupur district in Tamil Nadu. It is approximately 374 km from Chennai.

The ecological sanitation initiative in Kaliyapalayam was launched in 2002 to reduce water use in sanitation, prevent water pollution due to open defecation (as the water table is high), by the Society for Community Organization and Peoples Education (SCOPE).

Initially, the gram sabha passed a resolution to construct eco-san toilets in 18 households. The whole concept was based on the demand-driven approach. From the selection of the model to the construction, all the stakeholders were consulted at each stage of the project. The concept was welcomed and quickly accepted by the residents. Initially, a 2-in-1 model was adopted where wash water and urine were mixed and collected in one chamber and, fæces were collected in the other chamber.

After one year, a study was conducted on the views/opinions of residents regarding the functioning of the toilets. It was found that the users were generally satisfied with the system. Based on their feedback of the residents, 2-in-1 model was replaced with 3-in-1 model in which urine, fæces and wash water are collected separately. Urine is collected in a mud pot with holes buried in the ground and the wash water is collected in a filter bed. The human fæces and the urine are used as fertilizer and the wash water is used for the kitchen garden and plants. The high initial cost of eco-san toilet is offset by long-term socio-economic and health benefits. Wash water applied to banana trees next to toilets assures irrigation at no cost, while the sale of manure and urine for agriculture contributed towards overall income for the village. These benefits provide 200 per cent return on the investment over the lifespan of a toilet.

Hence the programme not only contributes towards environmental sustainability but also proved to be extremely beneficial in social and economic terms. This proves the value of eco-san as a means to close the nutrient loop in solid and liquid waste in a safe and hygienic manner, while augmenting income both directly (sale of manure and urine) and indirectly through increased farm output.

Gram Vikas (Odisha) – A Case Study of Natural Resources Management

Gram Vikas is a rural development organization founded in 1971, working with poor and marginalised communities especially in Dalit and Adivasi communities of Odisha. The mission of Gram Vikas is to promote programmes which are sustainable, socially inclusive and gender equitable in order to enable the poor and marginalised rural populations or communities to achieve a dignified quality of life. The initiatives of Gram Vikas are aimed to energise an entire village/habitation, and are driven by the involvement of the entire community in planning, implementation and monitoring. It takes an integrated approach towards rural development that includes: natural resource management and watershed management, involving conservation and development of land, water and forest resources so as to mitigate the effects of droughts.

One of the major areas of Gram Vikas' activities is natural resource management. Under this programme, it has launched the rural health and environment programme (RHEP) in 1992. One of the main aims of this initiative was to provide uninterrupted water supply and dignified sanitation facilities.

To achieve an uninterrupted water supply, RHEP links the people with government rural water programme called '*Swajaldhara*'. Under this initiative, the financial cost of the programme, which includes the cost of tank and the pipe network, is provided by the government. The families/households pay a part of the capital cost in the form of material and labour. The users/residents pay a monthly maintenance charge to cover the operational and maintenance cost of the provision. This arrangement not only makes

the programme financial feasible but also proved to be extremely useful in enhancing the sense of responsibility and ownership among the community and ensures that the provision will sustain. Along with the monthly operational and maintenance cost, each household contribute INR1000 towards a common fund which is invested in a bank deposit. This fund is invested further to extend service to new households and to ensure 100 percent water supply coverage in the future. To ensure equitable access to this facility of clean water as the current social structure in many villages does not enable all community members to access clean water, Gram Vikas transforms this established social order by making it mandatory that all households are included in the programme and that the female heads of households must be involved in the decision-making process.

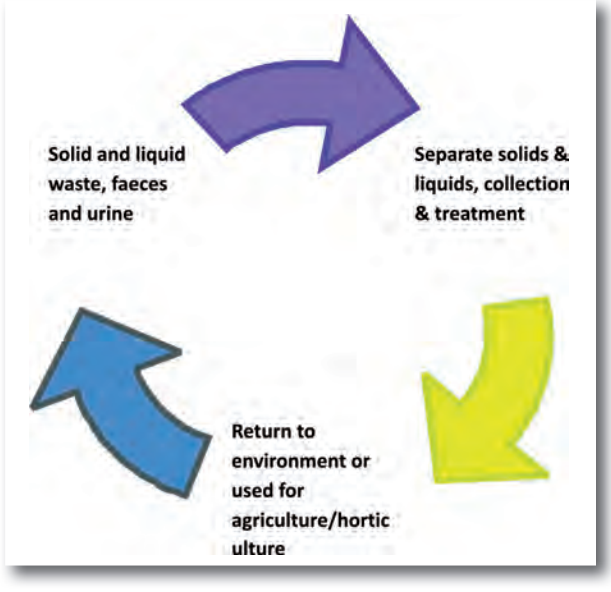
The practice of 100 percent inclusion keeps villages clean and eliminates sources of water contamination as each and every member of the village is involved in establishing, maintaining and benefiting from the sanitation system. This is also a way to break down caste and gender barriers and allow the marginalised to regard themselves as equals within the community. This development process is based on *MANTRA* governance programme's values of inclusion, sustainability, cost-sharing and social and gender equity.

For the sanitation initiative, the capital cost of a toilet and a bathing room (together ₹ 8,600) is jointly financed by Gram Vikas and the community. Gram Vikas contributes towards the material required for construction and the community contributes in terms of local resources and labour.

Clean drinking water and access to sanitation has resulted in over 80 per cent reduction in incidences of water borne diseases. A healthy community and habitat acts as a catalyst for sustainable development. This shows how effective IEC can mould even fissiparous rural societies into a more cohesive unit, working towards a common good. Using water and sanitation as an entry point, the NGO worked towards overall improvements in the rural environment and the natural resource base. This benefits women especially, and the whole community in general.

7. Conclusions and Recommendations

The central principal in greening TSC is to close the nutrient and water loops so they do not overlap. This is done by segregating, treating and reusing/ recycling solid waste (excreta, cow-dung, organic and inorganic garbage) and liquid waste (urine, grey and black water) so that little or nothing is wasted, pollutes water and other natural resources or ends up in a garbage dump.



To achieve this, priorities need to be rearranged to green TSC. The foremost is according much greater weightage to behaviour change, followed by solid and liquid waste management. Incentives, currently distorting the scheme, need to be restructured as do the awards linked to sanitation. The main aim has to become a green and healthy village, rather than trying to merely change defecation behaviour. Thus, TSC needs to move away from constructing toilets and hope people will use them to the wider aspects of watershed and natural resources protection and management, both of which are intrinsically linked to any water or sanitation programme.

The idea is to leverage TSC's momentum for safe handling of human excreta to improve watershed management. By bringing the siting of toilets into a watershed planning framework, it will dramatically improve the quality of groundwater as well as provide a ready source of manure to improve biodiversity. This has implications for improving forests and grasslands, both critical to better environmental management at the local level. It also have implications for eliminating sources of water pollution caused

by poorly located and built toilets, either because they leach faecal matter into groundwater or people do not use them, preferring open defecation. It also extends to eliminating the entry of both solid and liquid waste into the environment in raw form, and converting them to manure or other beneficial states before being returned to the environment.

Advocacy, Awareness and Behaviour Change

A basic input of TSC, IEC, has failed to produce significant behaviour change. This is largely because of a narrow focus and emphasis on intangible benefits of using toilets that most IEC campaigns dwell on. These intangibles are higher social status and dignity of women. IEC has largely ignored health and livelihood issues, even though there are studies to prove improved sanitation and hygiene drastically reduce the number of disability-linked life years (DALYs); these are more tangible messages rooted in the everyday experiences of the target audiences.

It is therefore suggested to move away from intangibles and focus on tangibles in IEC. The link between health and livelihoods is something every person is familiar with, and provides a sound basis for future IEC related to sanitation. It also allows for widening the scope of IEC to include solid and liquid waste management by linking it to improvements in local natural resources and water quality; in turn these allow people more time for either productive work or leisure. The impact on women is particularly pronounced since they are the primary water providers and firewood gatherers. An IEC campaign has to quantify these at the individual level for people to relate to SLWM and sanitation.

Sanitation - Planning and Construction

Sanitation must be placed within the larger watershed context so that it's environmental and health aspects are understood and appreciated. Sanitation planners have to consider surface and ground water flows, soil conditions, geology and climate while planning the sanitation campaign. The conventional single or twin-pit toilets are unsuitable for use in many parts of India where the soil is rocky, has a high porosity, in hilly terrain or in flood-prone areas. Therefore, alternatives are needed and they need to serve the purpose of safely containing and decomposing excreta without coming into contact with groundwater or human beings. Variants of dry composting toilets are probably best for India given the mostly hot, dry climate as they will ensure the fastest decomposition of faeces into manure. These also need to provide easy access to the manure since culturally, Indians will never 'stoop' to emptying out a pit full of excreta even if it has decomposed to manure as pit toilets are supposed to do. Containerisation is one solution, and can be easily manufactured to a variety of sizes for these types of toilets.

They must also close the nutrient loop by demystifying the value of fæces and urine as replacements for chemical fertilisers, in part or whole. There is literature available that provides equivalents; these must be linked to the cost of fertilisers so the economic benefits become visible rather than leaving it open to interpretation. There are scientific evaluations of the nutrient value of urine and fæces produced by different food combinations, and an 'Indian' diet can be taken as the basis of this argument. This argument can be buttressed by the health argument of using toilets, that also make it easy to collect, process and use fæces and urine. In fact, toilets can be projected as mechanism to harvest nutrients from human excreta and urine with a definite payback period. There are more details in the eco-san section.

Solid and Liquid Waste Management

Effective SLWM will involve source segregation, treatment and reuse or recycling. Villages generate mostly wet, organic solid waste (not excreta) that is suitable for composting or vermi-culture. The end product is manure, a replacement for chemical fertilizers and a natural soil enhancer. Composting technologies are many and varied, and only those that suit local agro-eco-climatic conditions should be suggested.

Therefore, it will be necessary to develop a matrix of these technologies that includes their details, costs, time periods for converting waste to manure, nutrient values and suitability for use in different agro-eco-climatic zones.

The tougher one is to institutionalise solid waste segregation and collection. The starting point is to include this in the district water and sanitation plan so panchayats have to also include it in their respective sanitation plans. The second is to provide a realistic budget that reflects costs of creating and running a garbage collection network, composting, packaging and distribution of manure. While it is hoped sales of manure will partly offset these costs, it cannot be assumed that the system will work on a full cost-recovery basis. Therefore, capital costs have to be covered along with a component of recurring costs. Institutional changes are needed at the panchayat level so that SLWM becomes part of the work of the village water and sanitation committees.

The same goes for liquid waste management. The ideal solution is use at the household level, but if a household has not use for waste water, it must be channeled through properly constructed, lined drains to a central point for treatment. Here again, it is necessary to allot funds for capital works, including a village survey, construction of lined primary, secondary and tertiary drains, and a simple treatment system based on local agro-eco-climatic conditions. All grey water must be segregated from storm water and used in agriculture/horticulture, to reduce the pressure on fresh water sources and pollution of surface or ground water. Storm water drains must convey rainwater to recharge points and should be part of the village water management plan. Institutionally and procedurally therefore, the district water and sanitation plan has to include a distinct water management plan with separate grey and storm water components. As with solid waste, the financial allotment should cover both capital costs and O&M since the scope for revenue recovery here is extremely limited. Panchayats should be supported to provide effective water management in villages. In the water management plans, care has to be taken to completely separate grey or black water from storm water since the latter will be used without further treatment for augmenting local water resources through surface storage structures or ground water recharge.

Eco-san

TSC guidelines mention eco-san as one of the options for improving sanitation and hygienically separating fæces from urine. These need to be elaborated and backed by suitable financial allotments. Much more work is needed to make eco-san acceptable by people given the different nature of eco-san toilets. An approach is to provide suitable loans for eco-san toilets, repayable through the savings on fertilisers. A typical eco-san toilet pays for itself over its lifecycle of 7-10 years through savings on chemical fertilizers. This point must be emphasized in promoting eco-san as an alternative to toilets.

Additionally, studies have shown reusing the excreta of one person as fertilizer can save a farmer around ₹ 3500 per year. For a family of five, the savings can be as high as ₹ 17,500 a year, in addition to the benefits of improved soil quality. This is another point that can promote eco-san toilets as well as improved hygiene.

The counter-argument to eco-san is open defecation, as that also returns the same nutrients to the soil in a more direct manner. However, eco-san adds the hygiene layer to nutrient recycling that open defecation lacks and decomposes faeces safely. It also separates urine and makes that available as a potent fertilizer.

Eco-san can be a potential source of income for the landless poor, if promoted as a source of organic manure and a replacement for chemical fertilizers. Most of these people work on farms, or as share-croppers and will therefore find the proposition of replacing expenditure on chemical fertilizers with eco-san manure attractive. Again, this has to find place in IEC campaigns and a suitable financial mechanism has to be worked out under TSC that covers this section of rural India.

Rewards and Incentives

These have worked well in the past, both at the central and state level, to promote sanitation. However, they need to be staggered and disbursed in installments rather than at one go, in tandem with progressive improvements in sanitation. Therefore, a village that has won the NGP should be given the first installment as recognition of its status, but the subsequent releases should be incumbent on

achieving other milestones such as SLWM and promotion of eco-san. This will work towards ensuring sanitation goes beyond construction and (partial) use of toilets, into a more holistic improvement of the rural environment and natural resources.

Therefore, TSC has to be reoriented towards better solid and liquid waste management, promotion of ecological sanitation, and staggered rewards or incentives to become environment-friendly.

Greening the Integrated Watershed Management Programme[1]

MV Rama Chandrudu, WASSAN 1 Oct 2012.

Greening the Integrated Watershed Management Programme

1. Introduction:

Starting from river valley development projects (during early 1960's) and employment assurance programmes, the watershed management projects in India have travelled a long way. Dr. C. Hanumantha Rao Committee proposed to bring drought proofing related (such as Drought Prone Areas Projects) and employment assurance related projects (such as food for the work, etc) under a single framework. These recommendations gave a new direction and meaning to the policy and practice of watershed management in India, in the form of guidelines in 1994. Over a period of time, these guidelines are revised several times to incorporate emerging experiences on the ground. The latest version of guidelines – Common Guidelines for Watershed Management Projects (2008) (Integrated Watershed Management Projects - IWMP) is also being revised to provide more flexibility and improve delivery systems.

Current generation watershed management projects have to find themselves in the midst of changing global equations; changing technology; climate change issues; deteriorating soil fertility; diminishing forest covers; depleting ground water; increasing urbanisation; decreasing productivity of several crops (irrigated/ rainfed crops); newer aspirations of younger generations in rural areas; increasing disparity between rich and poor; conflicting agriculture and land-use policies (corporatisation of agriculture; special economic zones; increasing mono-cropping; others); breaking institutional arrangements for rural/agriculture finances; increasing landlessness and further fragmentation of land; low level of political support for agriculture/rainfed crops – the list seems endless. Some of these issues are not new, while other issues are increasingly becoming important and more visible more recently.

Though the watershed management projects are inherently ecologically friendly, the above issues pose an important challenge to environmental sustainability of watershed projects and could threaten their core purpose, if necessary shifts are not made now. Given this background, this document makes specific recommendations for making watershed management projects greener. It also argues that the greening IWMP has to be sensitive to the above issues, which have a major influence on the governance and management of natural resources in rural areas.

1.1. Brief Profile of IWMP in India : Purpose and End Results:

Though the Common Guidelines for Watershed Development Projects in India (2008) does not mention the objectives/purpose of watershed management projects explicitly, the expected end-results/ outcomes are clearly defined.

1.2. End Results:

- All the works/activities that are planned for the treatment and development of drainage lines, arable and non-arable lands in the watershed area are completed with active participation and contribution of the user-groups and community at large.
- The user-groups/panchayats have willingly taken over the operation and maintenance of the assets created and made suitable administrative and financial arrangements for their maintenance and further development.
- All the members of the Watershed Committee and staff, such as Watershed Secretary and volunteers, have been given orientation and training to improve their knowledge and upgrade technical/ management and community organisational skills to a level that is appropriate for the successful discharge of their responsibilities on withdrawal of the watershed development team from the project.

- Village community would have been organised into several, homogeneous self-help groups for savings and other income generating activities, which would have achieved sufficient commitment from their members and built up financial resources to be self sustaining.
- Increase in cropping intensity and agricultural productivity reflecting an overall increase in agriculture production.
- Increase income of farmers/landless labourers in the project area.
- Increase in ground water table due to enhanced recharge by watershed interventions.

1.3. Dedicated Institutional Arrangements:

Common Guidelines for Watershed Development Projects in India (2008) have clearly defined the policy framework of watershed management projects in the country. Under this policy framework, the Department of Land Resources (DoLR), under the Ministry of Rural Development (MoRD) is sphere-heading IWMP. All states have established a state level nodal agency (SLNA). These SLNA function as a dedicated project management unit for IWMP in each state. At the district level, District Watershed Development Units (DWDU)/ Watershed Cell-cum-Data Centres (WCDC) are being established to manage the projects at district level. Project Implementing Agencies (from line departments/Non-governmental Organisations) are being appointed for facilitating implementation of watershed projects. These agencies would have a team of experts – watershed development team. It is expected that the above institutional arrangement functions in a dedicated manner enabling IWMP from the national to project/village level.

1.5. Project Features and Components:

A cluster of micro-watershed projects are selected for development and management. The total areas of this cluster of projects would be 5000 ha (approx). The unit cost of project is INR 12000 per ha. The project period is seven years. Funds are divided into three main components: a) Watershed works – mainly conservation of natural resources b) Livelihoods activities for those without asset c) Production system and micro-enterprises. Budget is also allocated for other costs such as preparation of detailed project report; monitoring and evaluation; institutional development and capacity building; PIA overheads, etc.

2. Greening IWMP

For making IWMP greener, it is important to understand the gaps in current policy and practice and develop a greater level of clarity on conceptual issues related to greening IWMP. It is also important to explain what should be the focus of IWMP in improving greener elements of rural areas. In this section of the report, these two points are covered.

2.1. Current Limitations of IWMP: From a Green Lens

One could argue that the policy and practice of watershed management projects are inherently supportive of environmental and ecological concerns. There is an implicit focus on regeneration of the natural resource base. However, there are few gaps, when looked through a green lens. In this section, these limitations are briefly explored.

2.1.1. Absence of Objective Statements and Explicit Green Concerns:

It is rather strange that the Common Guidelines for Watershed Development Projects in India (2008) does not explicitly state the objectives of the project. So it is difficult to assess the emphasis made on ecological balance and greening elements. Though end-results make considerable emphasis on community-centric approaches in project management; asset creation and maintenance, one could also argue that these end-results are not necessarily green or promote ecological balance. The experience

so far indicates that individual-centric resource-use pattern is promoted in most watershed villages unintentionally. Community-centric management systems are not really promoted intentionally, leading to major environmental catastrophes in many watershed villages. This gap between policy implicitly addresses green concerns) and practice a blatant violation of community-centric management of natural resources) is a major limitation of current generation of watershed projects.

2.1.2. Absence of Support Systems for Building Capacities and Limited Space for NGOs:

While there is an elaborate arrangement for project management, there is a clear gap in support systems particularly for capacity building. Similarly, projects under NGOs are also restricted up to 25 percent. Operationally, several states are not able to or not willing to employ NGOs as project implementing agencies. Given the need for participatory approaches and facilitation at village level for promoting green watersheds, this current gap in institutional arrangements is a major challenge in IWMP. It is highly desirable that committed and capable NGOs are given more formal space in the institutional arrangements of IWMP, which directly and indirectly helps to improve the green edge of the IWMP.

2.1.3. Absence of explicit statements of intension on ecological concerns:

Though there is an undercurrent of ecological security in the project components, past experience indicates that environmentally unsustainable agricultural/ production systems were being promoted under the above components in earlier watershed development projects. It is likely that these practices are continued even in IWMP leading to several challenges from "environmental sustainability" point of view.

2.2. Concept of Green IWMP and Green Foci of IWMP:

There are several popular concepts which shape the current practices under watershed projects. Together, these concepts and practices are producing results on the ground. It is increasingly becoming clear that these results are not always positive and sustainable (even if they are positive). The ecological concerns are not always driving these concepts, practices and results. Greening IWMP basically means making shifts in the current ways/means of thinking, understanding and acting on watershed management issues. The potential of IWMP in producing such green results would be realised only when the IWMP is able to focus on the following approaches for each component of IWMP.

2.2.1. Focus on Health of Soils:

It is important to realise that physical conservation measures are only the first step to retain soils and the organic matter within the fields, rather than the end objective. It is important that watershed plans and capacity building strategies/inputs should include a comprehensive approach for improving soil fertility and soil health. Role of relevant agronomical practices including farming systems approaches (such as diversified cropping systems; fodder; food; fuel; fruit crops on the same plot); external application of organic inputs (including composts; tank silt application; farm yard manures; others) need to be part of interventions in watershed management projects, along with soil conservation works (engineering works).

2.2.2. Focus on Protective Irrigation and Water Governance:

It is important to realise that augmentation of water resources is a necessary condition for water management, but not sufficient. Water resource governance and management has to be institutionalised at watershed level which includes – understanding water resource behaviour through participatory hydrological monitoring systems; sharing of water through community-based systems for ensuring protective irrigation to maximum number of rainfed farmers and appropriate decisions on cropping patterns including regulating areas under water intense crops. The watershed projects should be able

to provide incentives to promote community-based water systems, rather than individual-based water supply so that the water resources are equitably distributed and sustainably used.

Similarly, watershed action plans should contain special provisions for water supply systems for regeneration of biomass, for preparation of composts that improve soil conditions of rainfed lands; and other public needs (eg: drinking water for human beings and livestock).

2.2.3. Biomass – Focus on Nurturing Trees & Usufruct Rights:

Production of biomass is considered to be the most efficient way of harvesting solar energy. Biomass production on private lands (horticulture) is more successful as there is a package of investments at the farmer level. For plantations on common lands, it is important to move away from the planting-trees approach to growing-and-nurturing-trees approach. There is a need to develop a comprehensive framework for this purpose, which includes a package of investments linked to outcomes/survival rates; technical choices of species of trees/fodder varieties that are linked to livelihoods; allocation of usufruct rights and institutional arrangements for sharing benefits and protection of lands. The project management teams should be able to define the environmental/ ecological outcomes of plantation works, establish monitoring systems for measuring outcomes (environmental services) for biomass projects and evolve payment systems partly or wholly tied to outcomes and enhance the role of gram panchayat in this agenda. There should be incentives for gram panchayat/Forest Protection Committees for overseeing user-groups and others, who are engaged in planting/nurturing/protecting tree plantations/fodder plots on common lands/forest lands.

2.2.4. Livestock – Focus on Creating Robust Support Systems:

For effective and optimum flock size of livestock in a given watershed area, productive and regenerated common lands and support systems (e.g. health care, insurance, drinking water and fodder availability) are absolute requirements. So it is important that proper institutional arrangements and systems are developed as part of IWMP for ecological regeneration of commons (revenue/forest/fallow lands) for promoting livestock and also for nutrient recycling processes. Promoting diversified cropping systems also help in nurturing livestock and vice versa. Through revolving fund/convergence of schemes, livestock assets could be procured by individual members.

2.2.5. Production Systems – Focus on Low Energy Local Inputs in Agriculture:

IWMP has to make a decisive shift towards low external inputs based agriculture, which is a ecologically and environmentally sensitive approach. Low external input based sustainable agriculture or low-carbon farming has adequately proved that productivity of crops/lands is not compromised, while ecological/ environmental aspects are positively impacted. The profits at farm level also proved to be considerably high, as the cost of inputs is fairly low. IWMP should provide necessary incentives for promoting diversified cropping systems and also for rain fed crops. Considerable facilitation and investments are required for promoting local support systems such as seed banks; composting; pest management with local material/ practices; low energy systems. Capacity-building inputs under IWMP should focus on facilitation supports and local knowledge systems for promoting diversified cropping systems (crops; trees and livestock) and agronomy practices including pest management without harmful chemical pesticides.

2.2.6. Institutions and Governance – Essential Elements for Sustaining Green Results:

User-groups, Self-help groups and watershed committees are the most common building blocks of the watershed management projects. At present, most of these institutions are functional during the project execution period. They tend to collapse after the expenditure of project funds is completed. There are limited efforts to build these institutions in majority of the watershed projects. The focus of these institutions is largely on the execution of works, rather than management of natural resources; assets

created and growth of the members; regulated use of resources, etc. This is one of the primary reasons for unsustainable impacts of watershed management projects in the country.

Strong local institutions of communities are imperative for enforcing management and governance norms for regulated use of natural resources and equitable distribution of benefits from watershed management projects. These institutions could also regulate the land under agriculture (mainly what type of crops should be grown in how many acres of land), water resource use; type of agriculture (use of local inputs, instead of chemical and external inputs) and who should get benefits over water bodies/ common lands, etc. These mechanisms are essential for sustaining the positive benefits and ensure that the ecological concerns are realised/internalised in the growth processes of the village. Several such institutions also engaged themselves in collective marketing; supply inputs for production systems; thrift and credit, etc. So it is an important consideration that strong and well-capacitated local institutions are essential part of the greening process. Without this element, it is almost impossible to attain green results from IWMP. IWMP has to make clear and dedicated interventions on institution building processes such as organization of communities; building their vision and skills; evolving institutional processes such as planning and execution of plans; governance arrangements, etc. Serious efforts on this issue would produce desired institutions which ensure that results (outcome/ impacts) of IWMP remain green forever.

3. Environmental Analysis:

Watershed management projects are inherently supportive of environmental considerations. The impacts of IWMP on ecology and environment are largely positive. Some of the results of watershed management projects could not "mature" to produce high level of achievements, as there are not supplementing investments/actions. However, some of these positive results tend to be short lived due to externalities and/or internal limitations of the project design. Some of the externalities could convert the positive results/impacts of watershed management projects into negative impacts over a period of time, as there are no regulatory arrangements. In this section, these results of watershed management projects and the process in which they got transformed over a period of time (from positive to negative) are briefly explained.

3.1. Soils – Stopping after the first step:

Soils are important life supporting systems. Due to variety of reasons, soils are eroded, degraded and devoid of fertility. The current status of soils is deplorable in several rainfed areas. Through watershed projects, serious attempts were made to address the issue of soil degradation. Several types of mechanical or physical works were taken up for conservation of soil (bunding, trenching, gully control and water harvesting and such other physical earth works), which resulted in arresting the soil erosion and also improving the moisture regime in the soils to a great extent. This was considered to be the first step in improving the soil condition and very supportive to rainfed agriculture.

Though degradation and nutrient loss is arrested by these efforts, hardened soils without much organic matter do not help in better harvesting of rainfall in its profile. Very limited efforts are made to improve soil fertility; soil organic content, humus and bacterial life in soils. As a result, the ability of soils to resist drought/ dry spells and improve productivity is lost.

3.2. Water – More on Augmentation and Less on Management:

Water is life and water conservation activities take a lion's share of watershed budgets. Rainfall is the main source of moisture in watershed areas. Water management means making sure that humus/ moisture is available at the root zone of crops during dry spells. Currently, the main focus of many watershed management projects is to conserve rain water for recharging ground water. There is an excessive focus on supply side of water management. Similarly, water-use efficiency is limited to promotion of drip/

sprinkler systems. Many assets were created as part of watershed management projects which harvested run-off and conserved rainwater. This also helped in augmenting ground water resources. This is the most common and striking result of many watershed management projects in the country. The surface water bodies (tanks/farm ponds/check dams) also helped in providing irrigation through channel/ lift irrigation arrangements. Agriculture got substantial support and positive impact due to this activity in watershed management projects.

It is observed that farmers make investments on private borewells to use augmented ground water resources, leading to intense irrigation in pockets of farms/fields. This arrangement is generally unregulated and water resources are over-exploited by few individuals, while large chunks of rainfed lands starve for protective irrigation. Ironically, the area under intensive irrigation is considered as an indicator of success. This is common in many watershed villages where aquifers are dried up resulting into substantial loss of private investments in borewells. This problem cannot be solved by more recharge as the quantum of extraction is quite high. Deeper boreholes also increase the energy intensity of ground water extraction.

3.3. Biomass – Activity completed, but no results:

This is one of the areas of major failures in watershed development programs across the country. Plantation is taken up in project mode and funded as a project activity without any consideration for survival or outcomes. Strong stakeholder involvement is also missing. Investments on common lands/ forest lands are not tied up with usufruct rights. The survival rate of the plantations on common lands is very low. Another major limitation is also the missing link between biomass production (mainly fodder) and livelihoods promotions (such as livestock), during the planning processes.

3.4. Livestock – Sporadic and *Ad Hoc* Interventions:

Distribution of livestock is one of the most common activities under watershed management projects. This component is taken up under both works and livelihoods component. There are also attempts to organise health camps, vaccination services, etc. in a limited number of watershed projects. There is a high risk of mortality, in the absence of health care and insurance. There is also high emphasis on dairy in many watershed projects. Other forms of livestock are generally give low priority. The project activities/efforts are also sporadic and *ad hoc*. There are no institutional arrangements that take care of livestock needs in a comprehensive manner. Most of the livestock-related interventions produced positive impacts. But these results/ impacts are ephemeral, as there are risks of mortality; there are gaps in capital (to buy animals in the second round, in case of poultry/goatary); shortage of feed/fodder, etc.

Many of the results/impacts related to livestock were visible (over a period of time) only when individual families made substantial additional investment from their own sources. Wherever families mobilised additional funds for buying more assets; providing health care, fodder, etc, the income levels substantially increased.

3.5. Production Systems – Agriculture – Limited Experience:

Improving agricultural productivity is one of the important purposes of the watershed management projects. This focus on productivity is recently included in watershed management projects. Untill now, it was expected that a strong natural resource base (conservation and augmentation of natural resources) is adequate for improving productivity of crops. It was also expected that agriculture and other departments would make efforts to provide necessary inputs into the watershed villages. However, both farmers and departments tend to promote high external input-based agriculture, which is creating considerable pollution and causing soil/water degradation. Mono-cropping, hybrid/high yielding/BT seeds; chemical fertilizers and pesticides; intense irrigation and mechanisation are most common interventions related to

improving agricultural productivity. It is obvious that these do not support environmental regeneration and ecological balance. It is also established that these high external inputs-based agriculture is leading to fatigue and yields are not improving. Soil conservation and water for irrigation (as a result of water conservation) have significant positive impact on agriculture in the watershed context. There are limited efforts/examples that demonstrate low external inputs based agriculture, in watershed villages. The efforts related to agriculture productivity are largely related to demonstration of newer agriculture practices; provision of improved seeds; new equipment for harvesting/weeding, etc. These experiments/ demonstrations could produce positive results, but remain in isolation.

4. Proposals for Greening IWMP:

In this section, few schemes are proposed which are essential for making IWMP greener. It may be noted that these proposals/measures are not part of the current menu of interventions in watershed management projects in the country. There is a need for special efforts to integrate these initiatives/ proposals in the on-going IWMP projects in order to make them greener.

4.1. Improving Soil Health:

It is argued that soil conservation is only the first step in regenerating soils. Improving soil fertility requires considerable effort, which are currently missing in the watershed management practices. There are several technical options for improving soil fertility, humus and biological (life/bacteria) characteristics of soils. Application of manures, tank silt, promotion of multiple/ diversified crops in the same plot – are some of the most common practices. Good practices in promoting soil fertility would try to convert an agronomical practice into a product that could be easily adapted by a large number of farmers. Similarly, an incentive system would be created for producing these products and also for using these products. Support systems such as capacity building inputs, marketing linkages, storage facilities, convergence with other projects could also be integrated into these efforts.

Box : Good Practices – Improving Soil Fertility

- CROPS (Warangal District, Andhra Pradesh) promoted a combination of interventions such as tank silt application, farm yard manuring; diversified farming systems that could improve soil fertility. The villages where these activities are promoted completely stopped application of chemical fertilizers, over a period of time.
- COFA (Maharashtra and Orissa) and WASSAN (Andhra Pradesh) have been promoting diversity in crops and on-the-farm compost preparation. The bunds of compost pits are used to grow a variety of quick growing trees, which could also be easily converted into manure.
- BAIF (Karnataka) promoted intense biomass plantations as part of tree-based farming systems. The agriculture plots would have variety of trees/fodder/other plants that would produce considerable biomass (apart from fruits, etc). These trees and plantations were protected and nurtured by farmers. The availability of abundant biomass on the plots motivated the farmers to convert the tree litter into useful manures for the fields. This approach proved to have several benefits – improved soil fertility, continuous income for farmers from tree products, support for livestock, reduced wind speed as these trees function as wind breakers.
- AKRSPI (Gujarat); AKRUTI (Kadapa, AP) : KVK (Nalgonda, AP) promoted women self-help groups and entrepreneurs who started producing vermi-compost on a commercial scale. Farmers purchased the vermi-compost bags and found that it is the best alternative to chemical fertilizers. This model demonstrated that every farmer does not have to produce compost and a local producer group could provide a bag of good quality manure at an affordable rate. This model has far reaching positive impacts on soil conditions.

For improving soil fertility (going beyond soil conservation), the following efforts should be made part of IWMP:

- Make considerable investments in educating farmers and changing their mind-sets towards green approaches for improving soil fertility.
- Interventions such as agro-forestry and plantations on common lands and forest lands and diversified farming systems and the livestock sector should be linked to manure production systems.

Additional investments have to be provided to manufacture composts/manures/decoctions/others products from locally available biomass/animal waste. PIAs of IWMP should identify local groups/ entrepreneurs who could take up these activities as an enterprise and provide financial incentives as part of productivity enhancement component of the project, to these groups. Similarly, efforts need to be made to converge with relevant schemes of other department (e.g. vermi-compost plants from the agriculture department).

- Encourage farmers to buy these products and-use them regularly, as these products are available regularly at cheaper rates and good quality.
- Watershed committee has to ensure that land use pattern in the villages gives due priority for generating biomass from common lands/ private lands/ forest lands. The committee also has to ensure proper pricing for these products.

4.2. Water Security through Management and Governance:

Augmenting water resources is only a necessary condition, but not sufficient for ensuring water security. As mentioned earlier, augmentation of ground water resources is only leading to more scarcity. Unregulated use of ground and surface water is leading to greater chaos and unsustainable water resources.

It is proposed that water resource planning at the community level has to be conducted to ensure water security for all. The water security plans should be based on scientific inputs and community-level interactions. Planning process should include assessment of groundwater potential; mapping of aquifers; mapping of drainage lines and surface water bodies; assessment of current water resource use. The focus should be on conservation, utilisation and management of water resources. This is a major shift from the current action planning processes, which concentrate on just conservation. Water security plans should also ensure that all types of uses (drinking water; domestic water; water for (critical) irrigation; water for fisheries; water for livestock; water for livelihoods; water for ecological purposes; water for rural industries and other purposes) are integrated in IWMP.

The action plans should aim at providing critical irrigation to kharif/ rabi crops to the maximum number of farmers, rather than providing intense irrigation to small pockets of lands. This requires considerable investments on necessary infrastructure for sharing water and transporting water within the watershed areas. Similarly, investments are also required for providing infrastructure that enhances the water use efficiency (drip and sprinkler systems). Incentives are essential for promoting community based sharing systems. This is a shift from individual-centric to group-based systems. These incentives could be in the form of capital expenditure for infrastructure; legal sanctions for setting and practicing norms.

Investments for improving humus/bacteriological life in the soils are also an important consideration for water management, which is already discussed in previous sections.

Community-based governance systems (planning for conserving and using water resources; contribution from farmers; monitoring of water resources; norms for equitable distribution of water resources) are critical for water resource planning. IWMP has to make provisions for facilitating community-based institutional arrangements and capacity building inputs, apart from providing necessary infrastructure for conserving and sharing water in equitable manner.

4.3. Livestock and Biomass – Central to Livelihoods:

Livestock is one of the surest ways of promoting natural resource base linked livelihoods. Livestock has a critical function in ecological revival, apart from improving the economic status of rural communities. In promoting livestock-related interventions, IWMP has to make the several shifts.

It is proposed that IWMP establishes strong support systems for the promotion of livestock such as health care system; insurance system and fodder/feed production by regenerating common/forest/private

lands. Water security plans in IWMP would ensure that drinking water is available along the grazing routes. Specific efforts/investments would be made to improve local breed of livestock. Funds available under IWMP would be used to channel credit support to individual families to develop livestock assets at the family level. Efforts would be made to ensure proper marketing support is established for livestock-related products. Planning for livestock would ensure that flock size, local economy and ecology are balanced within the carrying capacity of local ecology.

IWMP consciously promotes diversity in livestock and agriculture. A healthy mix of different types of animals - dairy, small ruminants, fisheries, birds and other species- would be part of IWMP interventions.

Biomass production is an important part of green IWMP. Investments for biomass generation without community protection would be futile. IWMP has to evolve ecologically-sensitive and appropriate land-use pattern that ensures biomass production from agricultural lands/ common lands/forest lands for different purposes - soil fertility improvement, animal consumption (feed/fodder) and human needs. In dry and harsh ecological conditions, the investments have be comprehensive for ensuring survival of plantations/trees – which include watering for three to five years; protection; improvements in nutrient/fertility of soils; processing units at community level.

Institutions of communities (cooperatives/ producer companies) would be established to ensure that production chain of livestock-related occupations are sustained and effective. Effective linkages between livestock, agriculture and regeneration of common lands/forest lands would be established to ensure that animal wastes are converted into manures/nutrients for soils. Similarly, required fodder/feed produced from regenerated common lands for animals. These linkages could be in the form of eco-enterprises by local entrepreneurs. IWMP would make necessary investments to promote these initiatives in watershed villages.

Water Governance – Good Practices

- 5 percent Model by PRADAN, Jharkhand: This model demonstrated that rain water could be harvested/ stored on each plot by reserving a small share (5 percent) of total area. Series of such pits which harvest rainwater helped in improving the soil moisture regime and also providing critical irrigation during dry spells.
- Participatory Hydrological Monitoring (Andhra Pradesh Farmer Managed Groundwater Systems): User groups of bore wells are engaged in monitoring groundwater; rainfall; surface waters and decide about cropping patters for the rabi seasons. Based on the information/ analysis of water resource, the bore well user groups took decisions related to area under different types of crops (irrigated/ irrigated dry and rain-fed), to ensure water availability for all crops.
- Groundwater Pooling and Sharing for Critical Irrigation during Kharif: WASSAN, Andhra Pradesh facilitated the collectivisation of groundwater. A grid/ network of pipelines is established to link bore wells of farmers who own bore wells and agree to share ground water with others, who do not have bore wells. This system helped to convert groundwater into a common pool of resource and evolve an institutional arrangement for sharing the same without over exploitation.
- Social Regulation of Groundwater (Centre for World Solidarity, AP): Bore well owners are motivated to share water with others who do not have bore wells. Incentives are provided for enabling sharing of water, such as sprinklers/ drip systems. New bore wells are restricted in the village and social norms are established for sharing and using groundwater.
- Farmer's Cooperatives for Water management (DSC, AKRSPI and NM Sadguru Foundation, Gujarat): Large number of farmer's cooperatives was established to run and manage irrigation systems (lift irrigation schemes; canal irrigation schemes; etc). Partnerships with government departments are formally established in the management of water resources. Irrigators Cooperatives took other responsibilities such as input supply, agriculture credit, etc.

4.4. Agriculture – Low Carbon Farming:

Current practices of agriculture are largely high external input-based agriculture. This not only harms the ecological security and environmental sustainability, but also reduces the profitability of agriculture. There is also deepening distress in agriculture due to the high risks involved, in the

Box : Good Practices – Agriculture

- Large number of women self-help groups in Andhra Pradesh stopped using chemical pesticides and started using local material/decoctions for pest control and management. This reduced pollution induced by chemical pesticides at farm level and also improved the ecological conditions. Natural predator system was revived.

light of climate change related implications. Given this background, IWMP consciously promotes low carbon farming which is low external inputs based agriculture. Farmers would be given adequate incentives for promoting use of local material for improving soil fertility and pest management. IWMP evolves appropriate incentives for promotion of green agronomical practices. As part of this, farm-practices that restore farm-ecologies (soil biology, predator complexes) would be encouraged. Capacity-building efforts would focus on promotion of pollution-free agricultural practices. IWMP provides financial support to evolve systems such as seed banks; processing units of traditional crops; marketing arrangements for traditional crops, which are also grown using low external inputs.

- Carbon Farming Coalitions (of NGOs) in different parts of country are promoting agriculture practices that require low external inputs. Sustainable agriculture practices are being integrated into local institutions of SHGs and farmers cooperatives.
- Dhan Foundation (Tamilnadu), Revitalization of Rainfed Agriculture Network and Deccan Development Society (Andhra Pradesh)
- Seed villages and seed banks help to promote diversity in agriculture and food security. Dependency on external markets are replaced by local institutional arrangements and also revives traditional farming practices that had low pollution levels (Green Foundation, Karnataka).

Box : Good Practices – Livestock and Biomass Production

- Watershed committees/apex bodies of women self-help groups took the responsibility of mobilising contributions from local communities and government schemes for providing vaccination services regularly. Local volunteers, government veterinary departments and local institutions shared responsibilities in institutionalizing the community-based vaccination services. This helped improve the health of livestock (NABARD funded watersheds projects and NAIP – CRIDA in Andhra Pradesh).
- Women self-help groups were established and members from the mature SHGs formed another institution for promoting poultry at a large-scale. The poultry from women SHGs developed a brand image and of space in local markets. (PRADAN, Jharkhand).
- Networks of Livestock rearers established and support systems developed for better livestock management (WASSAN and Inter Cooperation, Andhra Pradesh).
- Dairy production improved by establishing community-based artificial insemination systems (BAIF, Andhra Pradesh).
- Fisheries in rainfed tanks were promoted by local institutions of fisher cooperatives. Leadership of existing cooperatives was changed and cooperatives re-structured to ensure producer control over fisheries occupation. Necessary funds were provided from watershed development projects. (WASSAN and its partners found their in NABARD funded watershed projects).
- Foundation for Ecological Security (Gujarat/Rajasthan/AP); Ananta Paryavarana Parirakshna Samiti Network (AP): natural regeneration of common lands by local communities. Institutional arrangements were evolved for protecting and regulating the use of common lands. Norms were established for sharing products from common lands (grass, fruits, etc). Assured fodder availability from regenerated common lands triggered growth of livestock-based economy in rural areas.
- Horticulture was promoted with intense investments on farm lands of tribal farmers. (WADI Program of NABARD - BAIF and several other NGOs).
- Dry Land Horticulture is promoted by providing additional incentives for watering and protection till the trees survived. (Rural Development Trust/ Accion Freterna, Anantapur)
- Bagepalli CDM Reforestation Programme has finally been registered as an A/R CDM Project (ADATS, Karnataka).

5. Recommendations:

5.1. Two Streams of IWMP: Phase-Wise Approach and Gradual Shift towards Greening

The complete shift towards green watersheds would take considerable effort and changes in the ongoing processes and institutional arrangements. So it is proposed that the shift towards complete green watersheds takes place in a phased manner. Till then, it is proposed that the IWMP is organised into two streams.

- Stream 1 – General IWMP
- Stream 2 – Green IWMP

In stream 1, the changes would be incremental and project results would move towards more green/ ecologically sound status. The revised guidelines of IWMP would address some of the core concerns in the ongoing IWMP from ecological perspectives. Meanwhile, stream 2 would be initiated to demonstrate the proof of concept and feasibility of idea. The lessons from stream 2 would be transferred into stream 1 – within five years. After five years, both streams would be merged into a single stream – Green IWMP. During this five years period, necessary institutional arrangements, policy provisions and financial support systems would be established, based on the lessons from stream 2. It is expected that the five-year period would be necessary to transform the watershed projects into green watersheds in the country, without creating confusion and contradictions at the operational level. Annexure 1 gives details of these IWMP streams. The project design is articulated for greening IWMP in these two streams.

5.2. Improve Green Capacities

The shift from normal to green watersheds is primarily a shift in the understanding and action on watershed management projects. These shifts require to be facilitated through a systematic approach. This processes demands unlearning and re-learning of basics of watershed management projects. There is a need to re-interpret objectives; actions and end-results of watershed management projects. This entire process requires considerable efforts in reorienting project teams at all levels. The capacity building processes have to re-invent themselves in re-articulating the project designs; developing an understanding of projects (in its totality) and project management tools. Community-level institutions; community leaders; gram panchayat members; project facilitators (WDT/ PIA members; district and state level officers) need capacity building inputs on the revised designs and newer elements of the program. Capacity-building inputs have to support the process of envisioning green watershed approaches. The paradigm of agriculture, natural resource management practices and project management tools have to be re-stated. It is recommended that the Department of Land Resources makes significant investments in building "green capacities" of all project partners in a systematic manner. Resource support organisations have to play an important part of this process. As part of institutionalising capacity building service delivery (towards green watersheds), the Department of Land Resources should develop effective and functional partnerships with a large number of resource support organisations, which can develop resource materials, modules and resource persons who could develop green watersheds. These resource support organisations also play an important role in demonstrating the proof of concept by taking up pilots in different agro-ecological conditions in the country. The experiences/ lessons from these pilots (Stream 2 in Annexure 1) would be documented and would be formed as the basis for mainstreaming.

5.3. Monitoring Systems for Green IWMP: Quantifying Green Results:

Department of Land Resources develops an inventory of indicators that could quantify the changes and green impacts of watershed management projects in a systematic manner. Annexure 1 gives details of such end results which could establish the level of achievement of watershed management projects in terms of ecological/environmental parameters. However, there is a need for developing fool-proof

monitoring systems for quantifying these outcomes/impacts on ecology/environment exactly.The Department of Land Resources has to develop effective partnerships with research institutions that could develop protocols for keeping track of inputs/ processes and also estimating environmental services (in terms of positive impacts on environment). These protocols have to be rigorous and based on scientific principles.

Annexure No 1

Towards Green Watersheds

Re-designing of IWMP:

In this section, the new design of watershed management projects in India is proposed. This new design is presented in the form of "Guidelines for Green Watersheds in India". The guidelines are presented in the following framework.

Programme Design: Stream 1 – General IWMP

- Objectives, End-Results and Core Values
- Institutional Arrangements
- Programme Phases and Programme Components
- Additional Programme Components that produce green results
- Financial Provisions

Programme Design: Stream 2 – Green IWMP

- Objectives, End-Results and Core Values
- Institutional Arrangements
- Programme Phases and Programme Components
- Additional Programme Components that produce green results
- Financial Provisions

Programme Design: Stream 1 – General IWMP

1. Objectives

The main objectives of Stream 1 General IWMP are mentioned below.

1.1. Encouraging restoration of ecological balance in the village through:

- Sustained community action for the development of natural resources including operation and maintenance of assets created.
- Simple, easy and affordable technological solutions and institutional arrangements that make use of, and build upon, local/ indigenous technical knowledge and available materials.

1.2. Improving the economic and social condition of the resource-poor and the disadvantaged sections of the Watershed Community (which is directly or indirectly dependent on the watershed) through:

- Optimum utilisation of the watershed's natural resources (like land, water, livestock, vegetation, etc.) that will mitigate the adverse effects of drought and prevent further ecological degradation.
- Distribution of the benefits of land and water resources development and the consequent biomass production in an equitable and gender sensitive manner.
- Strengthening the relationship between communities and watershed resources and formalising their entitlements over common property resources.

2. End-Results

2.1. End Results related to Economic and Ecological Aspects:

- Cultivable fallow land is brought into agriculture.
- Waste lands are brought into productive use.
- Crop diversification takes place and crop intensity is increased.

- Production and productivity of crops, livestock, forests and other enterprises increased.
- Groundwater resources are recharged and maintained.
- Surface water resources are increased.
- Access to water (critical irrigation) increases for resource-poor families.

2.2. End-Results related to Institutions and their Capacities:

- Institutions of watershed communities are established. Members of these institutions would have necessary capacities and experience to promote culture of collective action (collective problem analysis, planning, implementation, monitoring, contribution, maintenance and management of assets, livelihoods and other basic services) and take the interventions forward and are engaged in growth processes, without compromising on ecological aspects of the natural resources.
- Several resource persons are available at community level/ block level for supporting the resource management processes. Alternative and new leadership emerges.

2.3. End-Results related to Planning and Implementation:

- Action plans that address concerns of community (natural resources, production systems, livelihoods, equity and gender) in general and vulnerable groups in specific are prepared and executed by respective institutions.

2.4. End-Results related to Convergence and Resources:

- Watershed based institutions will have necessary resources – finances (contribution, WDF, other funds); capacities (knowledge, skills); linkages to mobilise additional resources, services and projects.
- Watershed based institutions would develop linkages with line departments, banks and other resource organisations and start accessing their services/ support.
- Income generating opportunities created and incomes of the poor households enhanced.

3. Institutional Arrangements

3.1. National Level:

Department of Land Resources, of the Ministry of Rural Development, steers stream 1. The role of DoLR is largely to provide policy framework and evolve operational mechanisms for project management. DoLR supports state governments in implementation of the project. DoLR also ensures that proper support systems are established for building capacities; project management tasks (planning, reviewing, monitoring, etc). It constitutes a national level steering committee to oversee the project policy, progress and execution. With the support of National Rainfed Areas Authority and other resource organisations it addresses issues related to project management and policy formulation, from time to time.

3.2. State level:

State-level nodal agencies are already established in majority of states for managing IWMP. This SLNA is responsible for implementing and managing stream 1 in the respective states. The main functions of SLNA are to develop state level process guidelines; state perspective plans; operational strategies for capacity building and MEL systems; deploy teams at state and district levels; identify project implementing agencies; and ensure smooth fund flows. SLNA would organise project review meetings on a half yearly basis. It also facilitates convergence across all departments and ensures smooth them.

3.3. Support Voluntary Organisations:

DoLR and SLNAs identify reputed, capable and committed resource organisations from the NGO sector. These agencies would function as State-level Support Voluntary Organisations and Regional Support Voluntary Organisations. They offer a variety of capacity-building support services to IWMP from state to village levels.

3.4. District Watershed Development Unit/ Watershed Computer-cum-Data Centre:

This district level unit is established where watershed projects are being implemented. The main function of this unit is support SLNA in project management of IWMP. This unit supports the PIAs to develop detailed project reports and annual action plans; conducts monthly reviews and facilitates convergence at watershed level. Ensuring smooth fund flows is also one of the responsibilities of this unit.

3.5. Project Implementing Agency (PIA):

SLNA identifies three categories of Project Implementing Agencies. PIA is mainly responsible for facilitating watershed management projects in the selected villages.

3.5.1. Line Departments

It is found that line departments are busy with their own commitments and the hardly able to prioritise watershed projects. However, line departments could be still identified as PIA, if they agree to depute their staff as coordinator for IWMP on a full-time basis. The line department could constitute its own watershed development team, by hiring professionals on a contractual basis.

3.5.2. Watershed Implementation Wing of SLNA

SLNA could establish a dedicated department or mission with dedicated staff for IWMP. These members could be hired on a contractual basis as per the project needs. This implementation wing of SLNA functions as a PIA for select watershed projects.

3.5.3. Reputed NGOs

There are several reputed, capable and committed NGOs who have considerable expertise on watershed and related fields. SLNA has to identify these agencies and give them the responsibility of implementing the projects, as PIA.

3.5.4. Watershed Development Teams:

Each PIA would appoint a team of professionals and para-professionals, who whould work as the watershed development team (WDT). For a cluster of 10000 ha, a watershed development team consisting of six members would be constituted. They would include a coordinator, three experts on engineering, agriculture and institution development, an accountant and a data entry operator. This team would be supported by para-professionals who are from the local villages. These members would be trained by Support Voluntary Organisations. This team is to be appointed by all categories of PIAs.

3.6. Watershed Implementation Committee

Representatives from user-groups and SHGs would constitute a Watershed Implementation Committee. A bank account would be opened in the name of this committee to receive funds from SLNA and transfer the same to respective user-groups/SHGs as per the annual action plans. Village-level para-professional will help the committee maintain necessary records and books of accounts, etc. This committee would be registered as a society and will be dissolved after the works/ treatment works are completed.

3.7. User-Groups:

Members from the select watersheds, who are dependent on watershed resources and assets, are organised into user-groups. Representatives of these groups would be nominated into watershed implementation committee.

3.8. Self Help Groups:

Members who agree to form a group and save money voluntarily are called self-help group. These groups could be constituted by women, men and/or both. These members regularly save money and take loans from their savings. The watershed projects would provide grants/loans to these members so that the activities/enterprises are financially supported. These groups could take up a number of activities such as production, processing, marketing, enterprises etc.

3.9. Cooperatives and Producer Companies:

From the activities of watershed plans, different types of peoples' institutions are likely to emerge. These institutions could be cooperatives, producer companies etc. These institutions help its members to pursue economic growth-related activities, such as procurement of inputs; marketing of products; thrift and credit. There could be a number of such institutions in each watershed, depending on the nature of watershed plan, activities and opportunities in the villages. Watershed projects could provide capacity-building inputs, institutional support and financial/ technical support to these institutions.

3.10. Watershed Governance Committee – Sub-Committee of a gram panchayat:

The management of watershed's natural resources (governance; setting and following norms) is the responsibility of the Watershed Governance Committee, which would be a subcommittee of the gram panchayat. This subcommittee consists of members from self-help groups, user-groups, cooperatives, and other committees (with a specific focus on natural resources). This subcommittee functions under the supervision of gram panchayat. The main function of this committee is to ensure that the watershed resources are properly managed and exploitation is minimised.

4. Programme Phases and Programme Components

The project under stream 1 is divided into the following phases. Each phase has a specific objectives; activities and expected results.

Project Details	Main Activities	Expected End Results
Name of the Phase: Preparatory Phase Time 1 Year Objectives: Necessary arrangements for community based natural resource management systems are made and new culture of collective action is initiated	Developing perspective plan for five years and detailed annual action plan for the first year; preparation of base-line reports Formation of user-groups/SHGs for the first year/ watershed implementation committee Fund transfers and capacity development inputs Execution of production systems plans for the entire village Execution of first year annual plan for selected user groups including entry point activities	Perspective plans and detailed annual action plan Base line report and execution systems are in place Watershed Implementation Committee is formed Entry Point Activities are completed
Name of the Phase: Resource Development and Management Phase Time Period: 4 Years Objectives: Institutional arrangements for resource management/governance started functioning and rural economic growth is propelled without undermining ecological balance of natural resources	Establishing Watershed Governance Committee (as a subcommittee of gram panchayat) and building the capacities of this committee. Developing annual action plans for each year for three components – natural resources development; production systems; livelihoods Formation of cooperatives and producer companies for facilitating growth Formation of user-groups/SHGs as per annual action plans Execution of annual plans for conservation of natural resources; production systems and enterprise development	Institutional base is created for regulated use of natural resources and governance of the same (subcommittee) Cooperatives/producer companies of local communities are formed End-results as per the project guidelines are achieved

5. Additional Programme Components that Produce Green Results:

The following are the additional components that are included in Stream 1 to ensure green results. These components are included based on the lessons learned from good practices in the country.

5.1. Green Capacities:

The shift from normal to green watersheds is primarily a shift in the understanding and action on watershed management projects. These shifts require to be facilitated through a systematic approach. This processes demands unlearning and re-learning the basics of watershed management projects.

There is a need to re-interpret objectives; actions and end results of watershed management projects. This entire process requires considerable efforts in re-orient the project teams at all level. The capacity building processes have to re-invent themselves in re-articulating the project designs; developing an understanding of projects (in its totality) and project management tools. Community-level institutions; community leaders; gram panchayat members; project facilitators (WDT/ PIA members; district and state-level officers) need capacity building inputs on the revised designs and newer elements of the program. The capacity building inputs have to support the process of envisioning green watershed approaches. The paradigm of agriculture, natural resource management practices and project management tools have to be re-stated.

6. Financial Provisions (in percentage)

S No	Item	Current	Proposed Revision
1	Administration	10	15
2	Monitoring	1	0.5
3	Evaluation	1	0.5
4	Entry Point Activities	4	0
5	Institution Building	0	4
6	Capacity Development	5	4
7	Detailed Project Report (DPR)	1	1
8	Watershed Development Works	56	65
9	Livelihoods Activities for the asset less persons	9	0
10	Production systems	10	10
11	Consolidation Phase	3	0
12	Total	100	100

- It is proposed to increase the budget for administration from 10 to 15 percent. This is meant for meeting the costs of PIA (salaries of WDT including data entry operator; accountant; rent; travel, communication and consumables). SLNA/ DWDU should not retain any part of this amount. This budget will completely go to PIA only.
- The budget for monitoring is reduced to 0.5 percent. Out of this budget, 0.25 percent will be retained at PIA level; 0.125 percent will be retained at district level and 0.125 percented at SLNA level.
- The budget for evaluation is reduced to 0.5 percent. This is completely retained at SLNA level.
- Activities related to production systems would be organised as part of entry-point activities. So the budget for EPA is eliminated. It is proposed that support systems for improving rainfed agriculture be initiated during the very beginning of the project. These activities should benefit the entire village/ watershed area and create necessary rapport between villagers and PIA.
- 4 percent of total budget is allocated for capacity development purpose. Out this, 2.8 percent is retained at PIA level. 0.8 percent at SLNA level and 0.4 percent at DWDU/WCDC level. This budget is to be used for providing a variety of capacity building services such as training, exposure visits, developing IEC material/modules, providing hand holding support to PIA/WMTs, establishing secretariat of Consortium of Resource Organisations, etc.
- Four percent of total budget is used for institution building. This budget is retained at watershed governance committee level. The expenditure would be made as per the recommendations of watershed implementation committee and PIA. This budget is to be used for paying service charges of para workers, organise meetings, providing hand-holding support to community-based organizations (user-groups/self-help groups/cooperatives/watershed implementation committees/ para workers/gram panchayat), registration charges, communication campaigns, etc.
- One percent of the budget is allocated for preparing the detailed project report. This is not changed. This is converted into an annual budget, from an one-time grant. This budget is retained at the PIA

level. This budget is used for meeting costs of preparing base line reports, annual action plans, service charges of watershed planners, travel, software/purchase of data-bases, etc.

- Budget for watershed works is increased from 56 to 65 percent. This budget is retained with the watershed implementation committee. It is used for conserving and developing natural resources and providing infrastructure for promoting community-based sharing of natural resources and improving efficient use of natural resources, etc.
- Budget for livelihoods activities for the asset-less persons is expected to be mobilised from the National Rural Livelihoods Mission. This is not allocated from IWMP. The budget that would be mobilised through convergence with NRLM is meant for creating livelihoods support systems for poor families and creating necessary infrastructure, capital, and facilitation supports. This budget will be retained with the watershed committee.
- Budget for production system and micro-enterprises is retained at 10 percent. This budget is meant for promoting productivity of crops, lands, water, forests, livestock. Necessary support systems (infrastructure, facilities such as seed banks/ custom hire centres of equipment; demonstration of new technologies; scaling-up of newer technologies etc.) would be supported from this budget. This fund would be used as a revolving fund for user-group/SHG/other institutions. This budget would be retained with the watershed implementation committee. This committee is responsible for releasing this grant to respective groups and recovering the same. During the project period, this fund would be transferred to mature cooperatives/self-help groups so that these groups would use this as running capital for a variety of economic enterprises.

7. Additional Funds:

It is proposed that additional funds be made available for strengthening the following components. These funds should not be included in the above project components.

- Staff at SLNA and DWDU/WCDC.
- Strengthening capacity building support systems
  - Support Voluntary Organisations at state and regional level
  - Establishing Secretariats for Consortium of Resource Organisations
- Independent research, monitoring and project management support systems

Programme Design: Stream 2 – Green IWMP

1. Objectives

The main objectives of Green Watershed Management Projects:

1.1. Encouraging restoration of ecological balance in the village through:

- Sustained community action for the development of natural resources including operation and maintenance of assets created.
- Simple, easy and affordable technological solutions and institutional arrangements that make use of, and build upon, local/ indigenous technical knowledge and available materials.

1.2. Improving the economic and social condition of the resource-poor and the disadvantaged sections of the watershed community (which is directly or indirectly dependent on the watershed) through:

- Optimum utilisation of the watershed's natural resources (like land, water, livestock, vegetation, etc.) that will mitigate the adverse effects of drought and prevent further ecological degradation.
- Distribution of the benefits of land and water resources development and the consequent biomass production in an equitable and gender-sensitive manner.
- Strengthening the relationship between communities and watershed resources and formalising their entitlements over common property resources.

1.3. Enhancing and diversifying livelihood options for poor through:

- Establishing their institutions for development and sustainable management of watershed.
- Developing necessary capacities (knowledge, skills and attitudes) and financial capital for poor members of different watershed based institutions.
- Facilitating employment opportunities and convergence of several programmes at watershed level.

1.4. Improve the potential of rainfed areas by:

- Enhancement of agricultural productivity and production systems or rainfed agriculture in a sustainable manner.
- Enhancement of food security and incomes from sustainable farming practices and use of natural resources.
- Greater access to income-generating opportunities and focus on their human resources development.

2. Expected End-Results:

Integration of ecological, livelihoods, equity, gender and empowerment concerns in the watershed development projects could produce a set of end-results that are additional to the results from conventional watershed projects. On the completion of IWMP, the following end-results are expected:

2.1. Economic and Ecological Results:

- Cultivable fallow land is brought into agriculture
- Waste lands are brought into productive use
- Crop diversification takes place and crop intensity is increased
- Production and productivity of crops, livestock, forests and other enterprises increased
- Groundwater resources are recharged and maintained
- Surface water resources are increased
- Access to water (critical irrigation) increases for resource-poor families
- Green jobs are created and employment opportunities increased
- Use of external inputs in agriculture minimised
- Farm ecology improves and predator complexities revived

2.2. Quality of life:

- Improved food and nutritional security for resource-poor families
- Reduction of distressed migration
- Drudgery of women reduced
- Women's role in decision-making processes significantly improves

2.3. Institutions and their Capacities:

- Institutions for watershed communities are established. Members of these institutions would have necessary capacities and experience to promote a culture of collective action (collective problem analysis, planning, implementation, monitoring, contribution, maintenance and management of assets, livelihoods and other basic services) and take the interventions forward and are engaged in growth processes, without compromising on ecological aspects of natural resources.
- Several resource persons are available at community and block levels to support the resource management processes. Alternative and new leadership emerges.
- Necessary institutional arrangements are established at national, state, district, project, gram panchayat levels for transforming watersheds into green watersheds.

2.4. Planning and Implementation:

- Action plans that address concerns of community (natural resources, production systems, livelihoods, equity and gender) in general and vulnerable groups in particular are prepared and executed by respective institutions.

2.5. Convergence and Resources:

- Watershed-based institutions will have necessary resources – finances (contribution, WDF, other funds); capacities (knowledge, skills); linkages to mobilise additional resources, services and projects.
- Watershed-based institutions would develop linkages with line departments, banks and other resource organisations and start accessing their services and support.
- Income generating opportunities created and incomes of the poor households enhanced.

2.6. Influence of Projects:

- Experiences of these projects are able to influence stream 1 and other projects and ensure that ecological and economic concerns are integrated into project designs.
- Effective project management and facilitation systems are established.
- Necessary policy and statutory arrangements are established for empowering local institutions to ensure ecological balance with economic growth.

3. Core Values:

- Growth without compromising ecological balance
- Centrality of community-based institutions and governance arrangements
- Belief in partnerships and recognition of the need for facilitation support
- Decentralisation and organisational reforms
- Appropriate technology

4. Institutional Arrangements:

The institutional arrangements would be the same as in stream 1. In addition to these, the following category of institutions would be main actors in stream 2.

4.1. National Resource Organisations:

- National Resource Organisations from the voluntary sector and ICAR streams would be identified in different parts of the country. Consortia of these resource organisations would be established in each state to take up the following project tasks.
- Implementation of green watershed management projects
- Monitoring and quantification of environmental services and benefits on ecology
- Establishing protocols for planning, execution and monitoring of green watershed management projects
- Designing of relevant policies, legal provisions and sanctions, funding protocols, sensitisation of policy makers and project managers, etc.

It is expected that the above Consortia of Resource Organisations would pool in a variety of expertise to improve the green dimensions of the watershed management projects. Each consortium would have an implementing agency, an academic and research institution, a technical/support voluntary organisation. These three agencies will provide necessary inputs at the village level towards achieving green results.

5. Programme Components and Phases

The programme components under green watershed management projects would be driven by local conditions. It is difficult to define a set of programme components for this stream. However, broad processes, phases and protocols are defined, which are applicable to all regions of the country.

- Awakening ecological conscious and developing commitment:
- Defining green goals, plans and green results
- Execution of action plans
- Monitoring of environmental benefits and ecological services

A brief description of the above phases/ processes is presented here.

5.1. Awakening Ecological Conscious and Developing Commitment: A Self Selecting Process of Villages:

Community-centric approaches and commitments are fundamental to promoting green watersheds. The local communities have to make several shifts from current practices (of production systems) to green practices (as indicated in the earlier sections). They have to agree to improving the current systems of management of natural resources and switch to low external input-based agriculture/ production systems including shifting to more environmentally-friendly cropping patterns. This agreement and commitment have to be explicitly stated by local communities. This would be possible only after providing considerable capacity-building inputs, dialogues and exposure to good practices. The process of dialoguing, motivational inputs and analysis of local situation have to be very different in this stream of watershed management projects. The entire green project would move forward only on the strong commitment and awakened conscious of rural communities towards green watersheds. Project implementing agency would facilitate dialogue, the participatory analysis of current situation and organise exposure visit to good practice villages. Baseline surveys of the watershed area would be conducted to assess the current carbon print of the villages. Research institutions/support voluntary organisation play a critical role in this process. During this phase, expected non-negotiable results (from watershed management projects) would be defined jointly by local villagers and facilitating teams. Based on this, villagers have to express their commitment towards achieving these results. The green watershed projects would be implemented only in those villages, where local villagers express their commitment and willingness to achieve green results.

The Project Implementing Agency; Support Voluntary Organisation and Academic/Research Institution would mount a large campaign to raise awareness on the greening processes; Non-Negotiables (in terms of conservation and governance of natural resources; production systems); expected end results; role to be performed by local institutions/individuals. Whichever villages comes forward to follow these non-negotiable processes and establishes its credentials would be further supported to take up the project.

Through this process of awareness, capacity building (exposure to good practices; participatory situation analysis/ reflection) and explicit demonstration of commitments towards green results, villages under green watershed stream would be selected. In this process, villages select themselves by demonstrating their willingness and commitment.

5.2. Defining Green Goals, Plans and Green Results

After the self-selecting process is completed, the villagers collectively define green goals, plans and green results with the support of the PIA, support voluntary rganisation and research institution. Based on the local conditions and potentials, the village-level institutions define the green goals and develop action plans accordingly. In this phase, they also articulate possible green results at the end of the project interventions. Though the green goals and results are location/village specific, an indicative list of green goals and results are briefly listed here.

5.2.1. Natural Resource Management Related

- Water is available for all purposes (drinking, agriculture, fisheries and ecological needs) and all users (human, livestock, fisheries)
- Water (ground water, surface water, soil moisture and rainwater) use is regulated by local communities without compromising on the current levels of income
- Drinking water sources are augmented and sustained. These sources are protected from exploitation and contamination. Drinking water is available for all seasons of the year to all families in the village.

- Natural streams/springs in watershed areas are regenerated and became perennial
- Soil erosion is controlled in all plots of land.
- Soil fertility is improved in X percent rainfed land
- Each household/ family has a minimum five trees at home
- Each agriculture plot has at least 50 trees on bunds/plots
- Common property land resources are developed and fenced (social and physical). Productivity and diversity of biomass/wildlife fied
- Usufruct rights are conformed to identified user-groups. Income to gram panchayat from CPR lands is increased.
- Forest lands are regenerated and forest-dependent communities get entitlements over forest products.

5.2.2. Production systems

- Food and nutrition security achieved for all
- About X percent farmers adopt and practice diversified farming systems, multiple crops, livestock and tree-based farming, low-carbon farming
- Master farmers are available to support knowledge-based agriculture in each village
- Cost of cultivating crops is reduced from X percent (in 2011) to (X-Y) percent in 2012 for XYZ percent of farmers in A, B, C crops
- X percent of farmers move towards pesticide-free agriculture. There is a movement towards pesticide-free villages
- Community-level systems are established for sharing ground water and surface water for kharif, rabi and summer crops
- Water and fodder security for livestock achieved
- Fish cultivation is in the hands of fishermen in all villages
- Community-based vaccination services are provided in time for all types of livestock in the village

5.2.3. Institutions

- Producer co-operatives established for agriculture and other commodities at the village/cluster level
- User-groups (men and women) functional
- Maintenance of assets ensured
- Regulated and equitable use of natural resources (land, water, biomass) ensured
- Engage in production systems as a collective
- Institutions for regulated use and equitable distribution of water (surface water and drinking water) established in each village. Women play an important role in management of drinking water systems in the village
- Producers co operatives, commodity groups-joint liability groups established at village/ cluster level
- Convergence and partnerships between farmers' organisations and marketing agencies, banks, research institutions and other financial institutions established

5.2.4. Quality of life

- People in the watershed have access to sanitation, cleanliness and protected safe drinking water
- All get nutritious food and have good health

- Every family member have knowledge about watershed
- Poor and poorest of the poor families get sustainable income
- Every family benefits from group and collective action.
- Men and women get equal rights and opportunities.
- Collective action addresses and solves the problems of villages
- All are in a position to utilise the technology and knowledge
- All primary needs of family are available in a village.

5.2.5. Support systems

- Each village would have established a Climate Information Center that provides the following information and support services:
  - Climate and weather; water resource-related information for crop planning; livestock; seed; agriculture implements; information related to diversified-farming systems; pest management practices; linkages with markets; financial institutions; research institutions; etc.
- Each village would have local experts (para workers; volunteers; book keepers; resource persons; consultants) on different themes
- Entrepreneurs on production systems are operating in each village (livestock, nursery, agriculture extension workers and non-farm activities)
- Regular documentation of experiences/good practices undertaken and these documents are available for local as well as global communities
- Regular and systematic support for action research and monitoring systems (community based; GIS and IT enabled) established and these systems support the learning processes of communities and project managers/policy makers

5.3. Developing Action Plans for Green Watersheds:

The PIA would support local institutions to develop a perspective/strategic plan for five years. Annual action plans would also be developed broadly within the framework of the perspective plan. Capacity-building inputs and the planning process would be guided by lessons from good practices and required shifts mentioned in the earlier sections of the report. The following framework would be followed for developing annual action plans and perspective plans, for various components.

Type of Resource and Use	Conservation/ Development and Production Systems related activities and plans	Production Systems and Utilisation related activities and plans	Governance and Management related activities and plans
Key Questions to be answered as part of this action planning →	What activities are taken up to conserve/develop this resource? What arrangement/ activity is proposed for improving the status of this resource?	What facilities/ infrastructure/ mechanisms/activities are to be taken up for improving the utilisation pattern; utility; productivity of this resource?	What institutional arrangements, norms/ practices are necessary to promote sustainable use and equitable benefit flows?
Key Questions that need to be answered for greening of watershed management projects →	What kind of activity/ strategy would reduce dependency on external agency and external input, in the above process?		
Water for Drinking and Domestic Uses			
Water for irrigation			

Water for Livestock			
Water for Fisheries			
Water for Ecological Purposes			
Water for Cultural Purposes			
Agricultural Lands			
Fallow Lands			
Forest Lands			
Common Lands			
Livestock			
Biomass			
Watershed-based Institutions			
Watershed Functionaries			

Based on the inputs from support voluntary organization, technical and academic institutions and PIA, watershed communities would develop a clear plan-of action, in the above framework. For each component, relevant technical and perspective building-related inputs would be provided to all concerned agencies. The green goals and end-results would guide the process of decision making and choices at the local level. These discussions would be converted into annual action plans giving details such as – objectives, expected end-results, activities, operational strategies, budgets, timelines, location and concerned community members and support systems. Emphasis on governance/regulatory arrangements would be part of these action plans. The action plans also would mention indicators that assess the effectiveness of these initiatives.

5.4. Execution of Action Plans

These action plans would be formally presented by concerned user-groups/self-help groups/ cooperatives/producer groups in a *Grams Sabha*. *Grama Sabha* would formally approve these action plans and also sanction the norms/institutional arrangements (particularly in case of usufruct rights, cropping pattern systems, water-use regulatory arrangements, etc.). Based on these approvals, state-level nodal agency would release the fund to the watershed/village-level institutions. These funds would be released as per the approved annual action plans.

5.5. Monitoring and Evaluation Leading to Environmental Services:

The projects under this stream are expected to achieve results that are pro-environment and ecologically sensitive. The following indicators are used for measuring the effectiveness of these initiatives.

- Number and percentage of families who do not have drinking water scarcity throughout the year
- Number of streams that are re-generated in the village
- Number of months per year for which the local streams are flowing
- Number of months per year for which there is no fodder scarcity
- Number and percentage of farmers who have access to support irrigation
- Carbon foot-print of the village (amount of energy used in agriculture)
- percentage of farmers who stop using chemical pesticides
- percentage of farmers who stop using chemical fertilizers
- percentage of farmers who are self-sufficient in fertilizer inputs (using local inputs)
- percentage of farmers who switch to multiple crops (from mono-cropping) and diversified-cropping systems

It is expected that the execution of action plans would generate considerable environmental benefits and support the process of ecological restoration in rural areas, without compromising economic development. The base-line report would consist of irrefutable data of the above indicators before the project begins. By establishing scientific labs to measure the results on the above indicators, the evidence would be established. Those farmers who establish the credentials of their commitment towards green practices (natural resource management/production systems) would be rewarded. The carbon credits from environmentally-friendly watershed development projects would be aggregated and suitable mechanism would be established to get payments for environmental services. The Department of Land Resources would develop suitable protocol for facilitating the aggregation of carbon credits and marketing the same in the global and local markets.

6. Financial Provisions

The projects under this stream have open-ended funding support. This stream provides funds for facilitating community action towards green watersheds. The fund would also be released as per the action plans that are to be developed by the local communities. The community-level commitments towards sustainable flow environmental benefits and equitable distribution of the same would be assessed before releasing the subsequent instalments. Monitoring reports from labs would be used for this, in addition to the records that are to be maintained at the farmer and group level. DoLR would allocate about INR 500 crores for supporting this stream.

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GREENING THE NATIONAL RURAL HOUSING SCHEME:

INDIRA AWAAS YOJANA

OPPORTUNITIES AND IMPLICATIONS FOR 'GREENING'

UNDP, NEW DELHI

DR. P K DAS
1860, Brahmaputra Apartments,
Sector 29, NOIDA 201303
pkpeudas@gmail.com,
+91 9811241456
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Greening The National Rural Housing Scheme

1. Introduction

1.1 Shelter Situation

The objective of this report is to examine the existing Indira Awaas Yojana (IAY) guidelines to understand whether it is adequate to support MoRD's mission on greening rural development. In case there are gaps, this report will put forward action-oriented recommendations.

Shelter and habitat are the two important components of rural development. Shelter is a fundamental human right, which establishes social equity and human dignity. Globally, there is a strong correlation between economic development and housing quality. According to XII Five-Year Plan, the rural housing shortage for BPL[1] households is about 40 million for the period 2012-2017. This means that we have to supply 914 shelter units per hour over the coming five years. Majority of the EWS and LIG in India cannot afford decent housing due to the high cost of construction. This forces them to compromise with the quality of living standard.

1.2 Indira Awaas Yojana Guidelines[2]

To address this sector of housing, the Ministry of Rural Development has initiated the Indira Awaas Yojana (2012) scheme to provide shelter for the poor in rural areas. The objective is, primarily, to help in construction/upgradation of dwelling units of rural BPL households belonging to members of Scheduled Castes/Scheduled Tribes, freed/bonded labourers, minorities and other non-SCs/STs by providing them lump-sum financial assistance. The implementation process is as follows

- Programme implemented through the zilla parishads/ District Rural Development Agency (DRDA)
- Houses built by the beneficiaries themselves by making their own arrangements for procurement of construction material, engage skilled workmen and also contribute family labour. The beneficiaries have complete freedom regarding construction of the house.
- No contractor to be involved in the construction. However, suitable local non-governmental agencies with proven good track record, if available, may be engaged for assistance in construction of dwelling units. Zilla parishads/DRDAs can help the beneficiaries in acquiring raw material on control rates, if they so desire or request the zilla parishads/DRDAs in this regard.
- Efforts should be made to ensure that the house is disaster-resistant with permanent walls and roofing. It should have (i) adequate space for pursuing livelihood activities; (ii) a verandah; (iii) stair case to go to the top of the house; (iv) rain water harvesting system; v) and should be barrier free.
- In addition, local carpenters and masons should be trained for skill upgradation and use of low-cost technology and local material under the Swarnjayanti Gram Swarozgar Yojana (SGSY).
- IAY encourages the use of local materials and cost-effective disaster-resistant and environment-friendly technologies developed by various institutions. Help of building centres may also be taken to get information on cost-effective technologies/materials and conducting training for rural artisans.
- The state governments may publish a book containing various designs relevant in the area, along with the site plan, structural design foundation, etc. These books should be kept in the gram panchayats.

[1]Below Poverty Line

[2]IAY, updated 2012

- Plantation of trees in the entire habitation or around the individual house may be taken up simultaneously. Trees may be planted near the housing clusters so that, in due course, enough trees are available nearby, to enable the beneficiaries to source fuel/fodder/small timber.
- Latrine could be constructed separate from the IAY house on the beneficiary's site.
- Funds should be transferred only directly into the beneficiaries' accounts in a bank or post office.
- Construction of house → 45,000 in plain areas and 48,500 in hilly regions
- Upgrading unserviceable households→ 15,000 in both cases
- In addition to the assistance provided under the IAY, a beneficiary can avail a loan of upto INR 20,000 per housing unit under the differential rate of interest (DRI) scheme at an interest rate of 4 percent per annum
- Upto 20 percent of the total funds can be utilised for upgradation of existing kutcha houses and toward subsidy for construction of houses with credit from banks/financial institutions. Credit- cum-subsidy will be provided subject to the following conditions: i. rural households having an annual income of upto INR 32,000 only. ii. ceiling of subsidy under the scheme INR 12,500 per household. The upper limit of construction loan under this scheme is INR 50,000 only
- Financial assistance of INR 10,000 per beneficiary or actual, whichever is less, will be provided for purchase/acquisition of a homestead site of an area around 100-250 sq.m.

1.3 Analysis of IAY Guidelines

The IAY guidelines cover the important requirements of sustainable green housing for the BPL. However, the questions remains as to, whether the guidlines are being translated into actions at household level through adequate technical support and campaign. Is there a mechanism to make sure that the IAY shelters are getting access to the information on cost-effective environment-friendly technologies? Are there Rural Building Centres available to support the IAY beneficiaries? Are there adequately trained construction workers to construct disaster-resistant shelters for the IAY households? Most of them may not be able to create an enabling environment for greening IAY.

Shelter is a life-time investment for most Indians and hence, people will be highly cautious in making a decision on this matter. There is a great need for confidence building by creating an enabling environment where technical and managerial support for IAY shelters must come to the people. There is a need for a community mobiliser, making use of the MoRD's housing portal (under process) and most importantly a Building Resource Centre (BRC) than a Building Centre. The earlier HUDCO attempt of Lab to Land has not been particularly successful because, by and large, most of them turned out to be only a production centre and weak on training and consultancy. Most of the IAY guidelines could be implemented with the help of a Building Resource Centres. The recent ongoing in-depth study on building centre by HUDCO is already moving in this direction.

One important aspect, which is rather difficult to implement, is upgrading existing *kutcha* houses. Assuming that upgrading means converting the houses into pucca or at least semi-*pucca* structures, will need special attention. It will require a cadre of multi-skilled masons, carpenters and supervisors. It is possible to render this service by forming self-help groups and/or through the Building Resource Centres.

Another crucial issue in IAY is the cost of construction. The fund allocated under the programme per households is too meagre to provide a shelter suitable to the basic needs of a human being. If an IAY beneficiary constructs her/his shelter with INR 45,000-50,000, only 125 sq ft of covered area could be built, assuming INR 400 per sq ft. It should be noted that the minimum spatial requirement for a BPL family is at least 322 square feet. Therefore, with RCC and the brick-based system today, one can only build 125 sq ft, which is 39 percent of the desirable minimum for each household. Therefore, there is a strong need for exploring different avenues of cost saving for new construction that should be easy to maintain. Experience shows that the cost-effective construction systems are inherently environment-friendly. This point has to be clearly conveyed to the beneficiaries.

One way of dealing with the IAY shelter in the context of high cost of cement, steel and brick-based construction would be to go in for an incremental approach. One could start with a pucca toilet and kitchen and the rest of the shelter in intermediate technologies which could be bamboo, renewable timber, rammed earth, etc. Following This, the shelter could be transformed into a completely pucca building. Global experiences shows that small loans taken a number of times is a strong viable option for housing for the poor.

1.4 Summary

The above discussion indicates that IAY is a vastly complicated area with cost being the most pivotal element. Under such circumstances, pursuing greenness in isolation may appear to the IAY beneficiaries as a trivial issue. Field experience shows that there is a strong need for awareness and capacity building at every level starting from the *Zila Parishad* officials down to the beneficiaries. Apart from the concept of bringing shelter support at doorsteps through BRC, one needs to, a) orgnanise campaigns on the economic feasibility of green buildings, b) provide incentives for adopting green design and technologies, c) develop a simple tool to measure greenness which would be understood by the block level engineers and the beneficiaries, d) strong partnership between the *Zila Parishad* Building Resource Centre and IAY beneficiary, e) identify a committed community mobiliser.

The following section defines greenness in the context of IAY. It discusses ways to achieve greenness and balance socio-economic and environmental issues.

2. Greening Rural Housing

2.1 DEFINING GREENNESS: IAY CONTEXT

Building industry needs natural resources as raw materials, which are processed by using energy to make product such as brick, steel, cement, etc. In this process, it discharges solid and liquid wastes and emits harmful gases into the atmosphere. The production and the process of using the materials and building activities at site consume a significant amount of water. The main objective of greening rural housing is to reduce the consumption of natural resources, reduce using non-renewable energy, harvest and use renewable materials, recycle industrial (e.g., fly ash) and agriculture waste (e.g., rice husk) and emit minimum CO_2. All these are expected to result in disaster-safe shelters. Greenness of IAY could be examined under the following heads for the entire life cycle of a shelter.

a) The best way to conserve the eco-system would be by using inherently low energy and emission-intensive materials. The second best approach is reducing material consumption with the help of efficient technologies and design, e.g., rat-trap bond, compressed stabilised earth blocks, use less brick and cement than solid brick wall.

b) Using regenerated/renewable materials in construction. Harvest fast growing structural timber, bamboo, straw bales, etc. Adopt rainwater harvesting and solar and wind power systems in building design to indirectly increasing resources such as water, energy.

c) Recycle materials wherever possible.

d) Reduce CO_2 emission by using less emission-intensive materials and technologies as well as by adopting points a, b and c.

e) Increase ecosystem resilience (capacity for self renewal) by adopting points a, b, c and d above.

f) Increase community resilience to cope up with climate change by designing buildings to withstand the predicted increased frequency and magnitude of hazards in the coming decades.

2.1 The Scope of Green Development

Buildings are planned, designed and implemented and used for at least 50 years. During the use-period, building needs periodic maintenance to ensure safety and good physical conditions. When maintenance becomes economically not viable a building is replaced with a new one. This is the whole life cycle of a building. Greenness should be inbuilt in the entire process of a building's whole life. To enable this one needs a robust database of construction technologies, which does not exist at present. There are scattered data sources which need to be acquired, analysed and homogenised to create a common source. Planning for green development has to consider the following issues in the whole life cycle of a building.

2.1.1 How to Achieve Greenness in IAY

i) Conservation

Green buildings should use low energy and emission intensive materials such as rammed earth wall, CSEB masonry, etc. The basic ingredients of these are converted into building materials with the least amount of processing (energy/emission intensive) from their natural forms. There are other ways to reduce the consumption of the basic materials. For example, about 7ftX7ft 230mm solid brick wall consumes 480 bricks and about 66 kilograms of cement. If one uses rat-trap bond of the same wall thickness, one would consume 400 bricks and 36 kilograms of cement. Therefore, one can save a considerable amount of brick and cement and thus will reduce embodiment of non-renewable energy and emission of CO_2.

Brick production could be detrimental for the environment as well as economy. Owing to the increase in demand of brick as construction material, agricultural lands have been turned into agriculturally

unproductive lands in India. Quite often highly fertile soil is used for brick-making losing a huge opportunity cost of agriculture[3]. This problem is sometimes increased in places where farmers are constrained to sell soil for brick-making because their neighbours have sold soil which leaves a 4-6 feet deep gap in the surface levels between those who have sold soil and those who have not (Kathuria, 2007). This is causing a faster rate of fertile soil loss, which is not recoverable. Therefore, compliance with the rules is important to protect agricultural land. However, under IAY, one should use technologies that consume less brick to reduce the current rate of fertile soil depletion.

ii) Regeneration/Renewal

A building could be green if it uses replenish-able materials such as bamboo and fast-growing structural timber, straw bale, etc. These types of technologies have low embodied energy and emission. Unfortunately many people view them as temporary and maintenance intensive, which is far from truth. Most of the problems, through a traditional approach could be resolved by adequate designing and detailing. Success of bamboo-based technologies and fast-growing timber lies in joint detailing with appropriate material. There are many good examples in this regard, which could be adopted in IAY [4].

iii) Recycling/Reuse

Fly ash, a waste product of thermal power plant is a pollutant. It could be converted into blocks for building wall and roof. Fly ash-cement blocks are available in many places. Fly ash with lime and gypsum (FALG[5]) make good blocks for structural use in buildings. A good example of reusing agriculture waste is rice husk for brick making, which could be found in places, such as Andhra Pradesh.

iv) Maintenance

If one uses construction technologies based on locally available low energy materials and replenish-able and renewable energy-based materials and technologies, the repair and maintenance will also have less negative impact on the environment.

v) Replacement

For IAY at the household level, this may not be a critical issue. However, there is a need for macro-level study on various methods of safe disposal or recycling of salvaged materials. Theunynck (2007) shows that in African countries, 3 percent of school building stock need replacement annually. Applying the same figure on 40 million IAY shelters, the annual replacement would be 1.2 million units annually, which is a huge number and their environmental impact assessment would be worth investigating.

vi) Transportation

Transportation of raw materials to the production yard and carrying the finished products to the site and taking away the salvaged materials after the building's life is over also consume energy and emit gases into the atmosphere. The use of local materials will reduce negative environmental impact on this account.

Greenness of a building could be examined on the basis of the above six points over the whole life span of a building. If a construction has the least environmental impacts from the six points, it could be termed as green. This could be done by developing an objective method of evaluation with reference to buildings constructed with brick wall and RCC-slab roof.

[3]Environmental cost of using top-soil for brick making – A case study from India, www.webmeets.com/EAERE/2008/prog/getpdf.asp?pid. (accessed 11 June 2012)

[4]Kaley Vinoo and, Venu Bharati (2000), 'A Comprehensive Volume on Bamboo', Aproop Nirman: Nagpur; Jayanetti D L, Follet PR, B (1998), Bamboo in Construction: An Introduction, TRADA, INBAR, DFID: UK

[5]N. Kalidas and Bhanumati Das of The Institute for Solid Waste Research and Ecological Balance (INSWAREB, Visakhapatnam, had developed FaL-G (acronym for flyash, lime and gypsum) technology, as an eco-friendly building material. They have been making sustained efforts for promoting Fal-G cement and bricks in the last two decades.

2.1.2 How to achieve Greenness in IAY

Carrying Capacity: The current type and rate of human activities are accelerating the eco-system towards its carrying capacity. Bartlett (1998) refers to Giampietro et al. (1992) and explains that the term "carrying capacity" refers to the limit of the number of humans the earth's atmosphere can support in the long term without damage to the environment. From the building activity point of view, the speed of approach towards the earth's carrying capacity could be slowed down by adopting green technologies. This will also help the eco system for its self renewal. In a large-scale construction programme such as IAY, a significant amount of CO_2 emission could be cut down by using appropriate technologies. Experience shows that the quantum of CO_2 emission in a context could be reduced to a quarter of cement and steel intensive construction systems. Thus reduction, regeneration, recycling, etc., will help in prolonging the carrying capacity of the earth from a construction point of view and hence, will increase the eco system's resilience.

2.1.3 Community Climate Change Resilience)

Community Resilience: Community has a great role in reducing resource degradation. There are instances where un-prudential cutting of trees from the forests, lack of awareness on water conservation, use of fire wood for cooking, overuse of soil for brick making, etc. could be harmful. Sometimes poor people are constrained and thus cause resource degradation, which could be reduced by providing appropriate culturally suitable alternative materials through grass-root level BRCs. In addition, there is a need for awareness building and appropriate incentives (described later) in this respect.

Climate Change Resilience: Greenness includes disaster safety and climate change mitigation and adaptation. Disaster safety in new construction could be ensured by adopting appropriate materials, technologies and structural designs. However, a more difficult issue is retrofitting of existing buildings in disaster-prone areas. Community-level awareness and upgrading skills of construction workers is crucial in this respect. Community is the best resources to identify local-level hazards and coping measures.

Therefore, the environmental impact audit report comprising of Section 2.1.1 to 2.1.3 due to IAY should be submitted by the district to the central government so that India can report it to international communities and demand similar action in developed countries, the biggest polluters.

2.2 Scale of Greenness: Local and Global

Greening is both a global and local issue. There are International treaties/commitments/regulations, scientific regulations to cut down emissions and depletion of natural resources to protect the environment. However, its success will depend upon how the grass-root-level human activities respond to these. It is equally important for the international community to make recommendations based on ground realities. Achieving greenness is all about top-down and bottom-up partnership. After the Copenhagen Summit in 2009, India agreed to cut its CO_2 emission by 20-25 percent below the 2005 level by 2020. In 2005, India emitted 1.4111 billion tons of CO_2[6]. It means a reduction of 0.282 billion tons of CO_2 which is huge, though achievable if it is targeted in a phased manner with periodic monitoring and control in place.

2.3 The Balancing Act

This section has been focused on how to support this movement by making IAY and rural habitat green which will complement the overall objective of the MoRD. However, one has to tread carefully while greening rural development through IAY for the BPL families since it is already a vastly complicated area in rural development with funding and land constraints being the two most crucial challenges for both the government and individual households. To most people involved in IAY, this new approach may raise eyebrows with questions such as, "why complicate an already complicated matter"?

[6]cdiac.ornl.gov/ftp/trends/emissions/ind.dat

Considering INR 50,000 for each household, the 40 million shelters would cost INR 2 trillion. The allocation per household is too low to construct a shelter of an acceptable living standard. No wonder that the major focus of all concerned is on cost alone. Many consider the other aspects of IAY as a luxury. However, too much emphasis on cost tends to ignore environmental issues. It is important to note that the large number of buildings constructed under IAY could have significant negative impact if not based on suitable design and technology. Considering the employment situation in the rural areas, one has to view construction as an opportunity for income generation at local level. Therefore, sustainability of IAY could be achieved through a balancing act of cost effective, environment-friendly design and technology that maximise income generation opportunities through construction at the local level.

Hence, it is apparent that 40 million IAY shelter construction programme is an opportunity and threat as well. For example, housing production could be an opportunity for creating substantial local-level livelihood. On the other hand, materials and methods of housing construction, if not prudent, will deplete natural resources, many of which could be non-renewable. Procurement, manufacturing and transportation of raw and finished building materials, etc. emit varying degree of CO_2 and other GHGs into the atmosphere. The answer lies in a balancing act of the three major components of IAY housing.

Hence, viewing IAY only through the green lens will be difficult. By and large, most of the cost-effective systems are inherently environment friendly. Therefore, there is a strong need for conveying the message to IAY beneficiaries that there is no conflict between affordable housing and the green movement.

3. Environmental Analysis

Construction in any form has negative impact on the environment in terms of depleting natural materials, leaving harmful wastes and emission. Traditional style of living was in harmony with nature and had the least negative impact on environment. With the population explosion there is a large demand for housing. Economic inequality has resulted in a situation where rural population are forced to live in maintenance-intensive low-quality living environment. Therefore, they aspire to have permanent shelter that they see as synonymous with cement, steel and brick-based construction.

How did they get this view? In the rural areas the government buildings are made of brick wall and reinforced cement concrete roof. The rich peoples' houses are also built in the same manner. When rural people watch TV they find that the buildings in all cities and towns have the same technologies.

Any conscious architect should design a building keeping in mind that it should be the least harmful to the environment. They should also attempt to compensate for the negative environmental impact by appropriate landscaping, passive solar heating/cooling, and other architectural techniques. However, in reality, we seldom find any evidence to this effect. In the engineering and architecture educational institutes emphasis is on urban centric hi-tech systems, which are highly damaging to the environment. Moreover, the heavily westernised syllabi have made the education system focused on cement, steel, bricks, and glass-based technologies. There is hardly any room for traditional technologies. Research and development in traditional technologies is virtually non-existent. Therefore, engineering and architecture fraternities are pro industrially produced energy and emission-intensive technologies that is endangering our already over-stressed environment. It has serious implications for IAY.

IAY guidelines recommend *pucca* shelter for the beneficiaries. This is interpreted by the engineers and architects as something built in cement steel and bricks. All these are non-renewable energy and CO_2 emission intensive and thus non-green systems. Since these materials are produced in large industries, they have to be transported to different rural areas which not only increase cost, it also depletes a large amount of fossil fuel and emits significant amounts of CO_2.

On the other hand, IAY guidelines explicitly encourage the use of locally-available and environment-friendly materials, disaster-resistant technologies, etc. There are recommendations on the role of rural building centres and state governments in promoting cost-effective, disaster-safe and environment-friendly technologies. However, these are hardly visible at the grassroot level. Experience of APPEP, DPEP, and IAY programmes in many states reveal that the government engineering departments were reluctant to adopt anything beyond the industrially produced energy intensive materials. The reasons for this being: a) not there in codes; b) analysis of rates not available; c) needs higher level of supervision, d) non-availability of skilled construction workers.

Solutions to all the above issues are either already there or could be created with government's support. However, the major issue is that the engineers and architects need to be made aware of the fact that there is no choice other than cost-effective and green shelters because of massive material shortage and the detrimental impacts most of the popular materials have on the environment. The following is a discussion on the extent of damage major building materials have on the environment.

One major hurdle in construction industry is shortage of materials. For example, India is estimated to have more than 100,000 brick kilns, producing about 150-200 billion bricks annually[7], which is not adequate to meet demands. If all the IAY shelters are built with brick wall at the rate of 7,500 bricks per 20 sq m there will be a need for 297 billion bricks for 40 million shelters. Similar calculations show that there is shortage of cement and steel as well.

However, just increasing the capacity of production may lead to ecological problems. Brick firing is energy-intensive and in India, annually 24 million tonnes of coal is consumed by the brick industry, which is about 8 percent of its total coal consumption. In addition to coal, the Indian brick industry consumes a

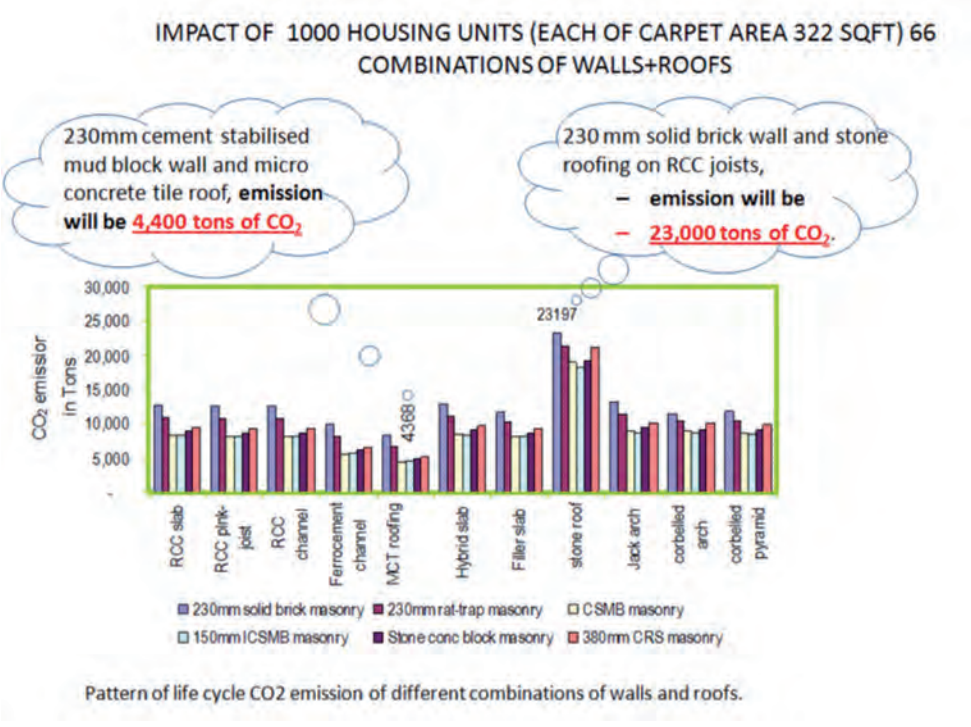
[7]Brick Kilns Performance Assessment & A Roadmap for Cleaner Brick Production in India January 2012 A report prepared by Greentech Knowledge Solutions, New Delhi In association with Enzen Global Solutions, Bangalore (India) University of Illinois, Illinois (USA) Clean Air Task Force, Boston (USA) Entec AG, Hanoi (Vietnam) A Shakti Sustainable Energy Foundation and Climate

large quantity of biomass fuels. The fuel cost of bricks is in the range of 35 to 50 percent of its production cost. Stack emissions are a major source of air pollution by the brick industry.

The brick industry uses fertile top soil from agricultural fields. The unplanned and unregulated use of such soil for brick-making is a major area of concern. Production of 140 billion bricks per year (year 2000-01 estimate) requires around 540 million tonnes of soil (depth of excavation 0.5–2 metres). Assuming an average depth of excavation of 0.75 m; around 500 sq. km of agriculture land is adversely affected by brick production every year[8].

Use of local materials along with prudential use of cement is perhaps a good alternative. A solid brick wall consumes 480 bricks, 65 kg cement. If one uses rat-trap bonded masonry one would need 400 bricks and 36 kg - a significant saving in cement and bricks. In terms of non-renewable energy, solid brick masonry embodies 486 mega joules (MJ) per cum against 388 MJ in rat trap wall. The CO_2 emission of solid brick wall is 327 kg/cum against 254 kg in rat trap. Every bag of cement is equivalent to 50 kg of CO_2 and every ton of steel is 3.56 times more CO_2-intensive than cement.

Figure 3.1



Pattern of life cycle CO2 emission of different combinations of walls and roofs.

There are many good examples of green approaches in construction. Figure 3.1 shows the pattern of CO_2 emission of different walling and roofing systems in Ranga Reddy district of Andhra Pradesh. This Figure shows that, one had the option of using cement stabilised mud block wall and micro-concrete tile roof leading to emission of 4,400 tons of CO_2 against the option which would have led to emission of 23,000 tons of CO_2. Thus it shows that even within energy-intensive materials one could achieve greenness by adopting appropriate technologies. It may be noted that apart from embodied energy and CO_2 emission, cement and brick-based systems also deplete natural resources such as lime stone and destroys fertile top soil. As a sharp contract, any bamboo-based construction will have the least amount of impacts on environment.

This environmental analysis of IAY shelter construction has examined the reasons for the engineers' and architects' lack of interest in green technologies. It also shows the extent of negative impacts caused by materials like brick, cement and steel. The question at this point is – "are there good examples which could be adopted in IAY to make it green? The following section shows that it does.

[8]TERI (2012), Energy Efficiency Improvements in the Indian Brick Industry, http://www.resourceefficientbricks.org/background.php (accessed on .....)

4. Proposal For Greening IAY

Globally, the construction industry is one of the most resource-intensive and environmentally damaging one in the world[9]. It accounts for 40 percent of the total flow of raw materials into the global economy every year. It consumes natural resources, many of which are produced or derived through processes which are detrimental to the environment. Therefore, the construction industry has to consider the following to minimise damage to ecology and support green development; a) conservation/regeneration and sustenance of natural resources and ecosystem; b) reduction of pollutants and GHG; c) resilience against climate change.

From IAY perspective, conservation of natural resources, in the broader sense, may be assumed to conserving the earth itself by protecting its capacity for self-renewal. Time scale of earth's self-renewal is important. For example, resources such as oil and coal and other minerals (iron, lime stone and aluminium, etc.) would need millions of years. These are termed as non-renewable.

Most plants grow in top soil. Soil comes from rocks and materials from dead plants and animals. It takes thousands of years for soil to form. Brick-making in many places use the top soil. On the other hand there are materials such as bamboo, which require much less time to regenerate. Bamboo is a very flexible building material and strong enough to make disaster-safe shelters.

Industrially produced construction materials emit harmful waste materials that pollute the soil, air and water. One of the most worrying issues is the emission of CO_2, leading to global warming.

One very important issue in green IAY is resilience against climate change. There is a growing international awareness on this issue. Resilience in the context of IAY refers to the ability of the supplied shelters to absorb increased hazards due to climate change. IAY shelters have to better withstand the effects of severe weather events predicted over the next decades. Internationally, governments are taking steps to try and make themselves resilient to the effects of climate change.

Annexure I provides a detailed analysis of 10 good examples where greenness has been achieved, though partially.

4.1. International and Indian Practices: Range Of Green Approaches

The national and international experiences reveal that there is no dearth of good examples of green shelters. However, most of such examples address the greenness issues partially. This report assumes that superimposition of such examples will cover the whole domain of green housing. Some of the good examples in other countries could be modified to suit the local conditions in India. This section cites good examples from which replicable elements in Indian conditions could be derived. The paradigm of green shelters could be categorised into three following groups.

- **RCC-based:** Predominant focus is on cement and steel-based systems

The agencies such as Central Building Research Institute (CBRI), Building Materials & Technology Promotion Council (BMTPC), Structural Engineering Research Centre (SERC), etc. are promoting these with support from research institutions. Under this approach greenness is achieved by rationalising structural members and basic building blocks. Many international examples fall in this category.

- **Hybrid:** Agencies such as Application of Science and Technology for Rural Areas (ASTRA), Centre of Science & Technologies for Rural Development (COSTFORD), Development Alternatives (DA) , Auroville Earth Institute, etc., follow a middle path between the vernacular and the cement and steel. CRATERRE, France, Kassel University, Germany, etc. follow this path.

[9]http://www.businessandbiodiversity.org/construction.html

While the first group of people primarily adopted cement and steel-based systems in construction shelters, people such as Laurie Baker, Hassan Fathy did not take that route by choice. The latter group adopted modern methods of analysis to exploit the potential of the traditional materials as much as possible.

- **Pro-Vernacular:** Many NGOs and individuals follow this path. This is a minimum intervention approach, where mud, thatch, straw, etc. are used following traditional techniques.

One of the major problems of most of the existing good examples is the general lack of scientifically acquired data on the construction technologies and designs. Many are enthusiastic about promoting their ideas. However, they put less emphasis on data. As a result, the data collected in these instances are partial at best. For example, most of the databases in the present context are focused on cost and labour intensity and less on embodied energy and emission. Lack of a common energy handbook is one of the main reasons for heterogeneity of data on embodiment of energy and emission.

This section will examine a few good examples (national and international), under the following heads

– Project Background
– Key elements of the approach to achieve green outcomes
– How the above was achieved? e.g.
  - How was greening achieved? Was there cost saving as well?
  - What and whose capacities were built and how
  - How were green outcomes defined and measured for monitoring (specific indicators)
  - How was innovation supported and sustained?
  - How can these lessons be up-scaled?

4.2 Case Studies

Case Study 1: South Africa-Venda Shelter (Pro Vernacular)

Project Background: This project was an architect-planner's own initiative towards creating modern vernacular in the rural context of Venda in Limpopo province of the Republic of South Africa. It is situated on the border with Zimbabwe. The project aimed to influence local people to enhance their own housing conditions to reduce periodic maintenance of their traditional shelters

Key elements: It was primarily a vernacular-based construction project. Hence, it had the inherent quality of greenness and environmental sustainability, which any vernacular system has. The buildings constructed are of least embodied energy and emission. One of the key features was recycling of shower water to flush the WCs and kitchen waste to nourish the small garden and green landscape around the buildings. The key elements of this project were use of locally available mud and thatch so that a climate suitable shelter could be constructed. The promotion of local skill was an important consideration in this project. One major and, perhaps, unique feature of this shelter was application of local art forms through shelter.

Lesson Learnt : Adopt recycling of wash water for WCs and utilisation of kitchen waste. Both needs appropriate technical solutions suitable for the rural areas. The Indian equivalent of integrating artwork with buildings is already there in terms of using Rangolis on walls and floors.

Table 4.1: Excerpts from Table I.1 of Annexure I: Summary of Venda House

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
South Africa: Venda Shelter	Use of local materials recycling of shower water and kitchen waste application of local art forms through shelter.	Locally available rammed earth and thatch roof. Local timber glue was used as lacquer, to insulate wall surface. Saving was about 40 percent with respect to RCC and brick-intensive systems	Traditional construction workers were trained to use modern construction tools and a local blind sculptor had been training local people in this trade.	There was no attempt to carry out such exercises. Balancing issues – socio-economic and environment.	It was an individual's effort and was not supported by any government or international donors.	People have closely watched out the performance of the building for a while and then started adopting some of the new techniques used in this project

Case Study 2: Bantwanana (Hybrid)

Project Background: The schools constructed under the Ministry of Education in the Eastern Cape Province of South Africa were based on brick, RCC and corrugated zinc sheet roofing, which were expensive and energy intensive. In the post apartheid period, when equity was the major focus, the government realised that there was a need for a large number of schools for the population who were neglected for centuries.

The Ministry of Education with support from DFID, initiated a search for cost-effective and environment-friendly design and technologies for constructing schools based on the local vernacular of the Xhosa communities. The idea was to set a trend of modern vernacular interpretation through school construction that will inspire people to adopt the same systems in their own shelters.

Key elements: The key elements of the programme were to achieve sustainable school and shelter for the poor based on cost-effective, labour-intensive and environment-friendly technologies. This was to address a large section of peoples' education and shelter for social equity and revitalise traditional Xhosa architecture and local skills. The site was in a high-wind zone and there were instances of roof being blown off buildings with rectangular plan-form. By adopting traditional round plan-form, the buildings were made strong to withstand high-speed winds.

Resource mapping (search for local materials, technologies and skills) revealed that sabunga (decomposed dolerite) available at the outskirts of the village could be used for block-making to act as a substitute for walling material, which was otherwise brought from Cape Town (900 kms from the village). Laboratory testing of cement stabilised (7 percent) block showed strength of 6 mega pascal (MPa), which was adequate for a two-storey building. Roof was constructed with thatch and blue-gum poles, which were local materials. Blue gum is a fast growing tree and hence, renewable.

A NGO by name Van De Lewis Foundation was in Eastern Cape promoting cement-stabilised mud block for wall. The NGO was contracted to provide the technical support for the production of stabilised blocks. Their technical people were trained in CRATERRE, France. A local institute, Eastern Cape Appropriate

Technology Unit (ECATU), was identified as the local nodal agency who was envisaged to be the champion on cost-effective, environment-friendly and livelihood-supporting technologies evolved through the progrmme. The School Management Committee was the client.

Lesson Learnt: The revised role of HUDCO rural building centres as Building Resource Centre will bring technical support on greenness to the doorsteps of IAY beneficiaries (ECATU example). The use of round plan-form made the buildings high-wind resistant. Thus, it is a good example for integrating disaster-resistant buildings for resilience to combat climate change. The indicators for measuring greenness are a sound basis which could be adopted into IAY.

Table 4.2: Excerpts from Table I.2, Annexure I: Summary of Bantwanana school, Eastern Cape

Examples	**Key element**	**How the above was achieved? e.g.**				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Eastern Cape	Sustainable school and shelter for the poor people; use of labour intensive & environment friendly technologies. School Community based construction	Reduced transport cost and energy and emission, Use of compressed stabilized earth block from Sabunga , Roof with locally available thatch and blue-gum poles,. Local people trained for block making	First of all, ECATU was trained by Van De Lewis. local school dropouts were identified by the SMC, trained by VAN De Lewis and ECATU jointly.	The indicators were a) unit cost of construction, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) emission of CO_2,	Government termed this as Bantwana model; With their own money, they have been replicating Bantwanana type buildings in Maluti and other areas of Eastern Cape	These systems been adopted by local people supported by local government & ECATU as a local level production cum resource centre.

Case Study 3: Mud Building in Bangladesh (Pro Venacular)

Background: Dipshikha, a NGO in Bangladesh, undertook a project on sustainable school building based on local vernacular. The main objective of the NGO was to help children in rural areas to learn to read and write. The NGO engaged two German architects to construct the mud and bamboo school, which is a good example of low energy and emission-intensive option. The architects designed this building with clues from the traditional knowledge amalgamated with the latest scientific knowledge. Though this is a school project, all its technical knowhow were derived out of traditional shelters and hence, the final product is equally applicable for rural housing.

Key elements: Under this project local traditional building materials have been combined with modern knowledge on construction technologies. The building consists of rammed straw-reinforced mud walls finished with mud tapped with timber batten to make surface tough. The roof is finished with sheets of corrugated galvanised iron. This approach to construction supports green movement because of its low energy consumption and low emission of CO_2. As it is based on local materials and skills, the buildings are affordable and enhance local-level income generation, thus helps in social equity.

Lesson Learnt: Bamboo beams can be used as structural members to span a large room. The artistic application of the use of bamboo is the other replicable aspect of this example.

Table 4.3: Excerpts from Table I.3, Annexure I: Summary of Mud school, Bangladesh

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Bangladesh	Traditional building materials combined with modern knowledge on construction technologies.	Locally available bamboo as structural members, rammed straw-reinforced mud walls-recyclable or renewable & locally available materials Data on cost not available	Local craftsmen were trained & involved in construction of the building so that they could assimilate the knowledge and carry forward to adopt the same systems in rural housing.	There was no such reporting on this issue.	Use of beams with a bunch of bamboo was the major innovation. It was a privately funded project. Did not gain popularity in govt. sectors	Political will, Harvesting bamboo, Local training institutes. Few buildings could be constructed in Dhaka

Case Study 4: Sri Lanka (Hybrid)

Project Background: During the civil war in Sri Lanka people from Mannar district in the Northern Province were forced to move to Putalum, 80 kms away. When the civil war was over, these people began to come back to their own place and started resettling from 2010. Room to Read (international NGO) in Sri Lanka was permitted to build 42 child-friendly schools which was supposed to encourage people to shift to Mannar with families. The government was convinced that, if local area specific technologies could be evolved through the school construction, it will help in creating enabling environment for the local people to have their own sustainable shelters. Two pilot projects were constructed in two villages of Silwathurai, Mannar, Sri Lanka.

Key elements: The project attempted to identify sustainable designs and construction technologies which are cost effective, easy to maintain, create employment at local level and with the least negative impact on the environment. Use of local materials was another object to create a local level construction material market and also to increase income multiplier effect. This being a high-wind zone, appropriate precaution was taken both in design and technology for safety as per the latest building codes of Sri Lanka. Thus climate change issues were also addressed. As mentioned before, the expected spin off was to create a local materials-based construction system so that shelter becomes affordable, establishing social equity.

The local materials were sand, stone and timber. Hence, concrete block masonry wall, stub footing (450mmX450mm random rubble posts 1800mm c/c), clay tiles roof on timber understructure were adopted.

Lesson Learnt: Locally available materials-based construction and choosing the right season for construction are significant to green approaches. The analysis of rates and greenness of different technologies could be adopted in IAY since there is great similarity in this regard between Indian and Sri Lanka.

Table 4.4: Excerpts from Table I.4, Annexure I: Summary of Mannar, Sri Lanka

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Mannar Sri Lanka	Identifying cost effective and environment friendly disaster safe design and construction technologies; creating local level employment. creating a local level construction material market	Resource mapping (search for local materials and skills) conducted in all the 42 project villages . Stub footing in stone and cement, locally produced concrete blocks Clay tiles on timber. Appropriate roofing system was evolved.	RTR engineers trained at Colombo, local communities were informed about innovations. on-site training was conducted where masons, carpenters from other project sites took part.	Parameters for evaluation of technologies; a) cost, b) labour intensity, c) embodied non renewable energy, d) use of renewable, e) reduced CO_2 emission.	The entire exercise was funded by RTR. The masons, carpenters and the trained engineers are using the innovations done in the pilot projects.	On exit of the pilot projects, The next step would be to establish a local level production cum resource centres to support individual HHs to build and maintain their own shelters.

Case Study 5: Post-NARGIS Shelter Programme, Myanmar (Pro Vernacular)

Project Background: Cyclone Nargis struck the coast of Myanmar on 2-3 May 2008 causing massive damage to lives, and livelihoods and properties which made a landfall in the Ayerrawady and Yangon divisions. An estimated 2.4 million people were also severely affected in thirty seven townships where a large number of rural population lives. In the post cyclone period a large number of INGOs and NGOs along with donor partners came forward to rebuild the perished/damaged shelters for the coastal areas, which is primarily the rural areas.

Key elements: One key area of the project was integrating Disaster Risk Reduction (DRR) with rural and urban planning and developmental works in shelter. A study was conducted to assess the shelters in the Delta (coastal) area of Myanmar and its resilience for future disasters and thus addressing the priority of actions III and IV of the Hyogo Framework of Actions (HFA[10]). The intervention in shelter reconstruction had the inbuilt features such as greening shelter, establishing social equity through cost effective disaster safe construction systems, environmental sustainability & climate related risks (addressed through HFA). This has relevance in the context of IAY. Based on region specific multihazard map, different design and technology options should be reviewed and suggested.

Lesson Learnt: Disaster-safety integrated in planning and design, engineers' acceptance of bamboo and timber based systems. Building Resource Centre (HUDCO) as technical support to the IAY beneficiaries is sustainable.

[10]III. Use knowledge, innovation and education to build a culture of safety and resilience at all levels, IV. Reduce the underlying risk factors

Table 4.5: Excerpts from Table I.4, Annexure I: Summary of NARGIS, Myanmar

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
NARGIS, Myanmar	Integrating disaster risk reduction (DRR) with rural and urban planning and developmental works in shelter. addressing the priority of actions HFA III, focus on "build back better".	Promoting owner driven shelter programme. ABC (anchor,bracing, coonections) was the essence of disaster safety; use of timber, bamboo, tiles with RCC stubs ; programme viewed as great opportunity for income generation & skill development.	Capacity building of communities, carpenters, masons and top level management- many were trained after NARGIS, Manuals prepared for disaster safe green; affordable housing, ICT materials were distributed widely in the coastal areas	Indicator type 1: Greenness, cost and livelihood; Indicator type 2: 12 parameters of comfort of shelters; Indicator type 3: seven indicators of disaster safety; This project had considered most of the aspects of rural housing	Funded by donors and supported by government. For design check a consortium was established. Small production units established by INGOs	Model for up scaling shelter movement is in place; Small decentralized production cum training centres key to the success; UN-HABITAT appointed Asian Institute of Technology to establish the above

ICT: information and communications technology

Case Study 6: Northern Karnataka Rural Housing (Hybrid)

Project Background: SDC[11] had initiated a programme on sustainable rural housing in India. Two of the pilot projects were in Bijapur and Bidar districts of Karnataka. The project had aimed at developing affordable, disaster safe and comfortable shelters expected to withstand the forces of natural for at least 50 years. Participatory design approach by involving the beneficiaries was adopted for sustainable designs. For those above poverty line (APL), the designs and technologies were prepared to build shelters incrementally over time.

Involvement of the community in the entire process of design and implementation not only made the designs acceptable to the people, it also reduced cost of construction. The local NGOs were considered to be the future champions of such movement since they worked in partnership with the communities.

Key elements: The following were the key elements of the programme

1. Evolving a participatory process of design to reflect living pattern on house design.
2. Improving the ventilation, sanitation (including waste water drainage and waste management) and water supply condition (including rainwater harvesting systems) for a healthy and harmonious environment.
3. Deriving cost effective and energy efficient construction technologies based on use of local building materials and skill; which may be called intermediate technology-random rubble stub footing, random rubble 380mm wall, stone roofing.
4. Community awareness on new technologies.
5. Capacity building of local masons.
6. Poverty reduction through livelihood generation.

Between 2006-2007, a total of 111 buildings were constructed by SABALA[12] in two Talukas (Bijapu and Basavan Bagwadi) under this programme. Cost of each shelter was INR 45,000 (INR 10,000 Rajiv Gandhi Rural Housing Corporation + INR 10,000 State Government subsidy + INR 25,000 bank loan + labour

[11]Swiss Agency for Development and Cooperation

contribution of beneficiaries). Following the success of this programme SABALA has established a women's bank named Chaitanya Mahila Co-operative Bank. Annually, about 150-200 women receive housing loan from the bank. The women benefitting from this are both from BPL and APL.

Lesson Learnt: Participatory design, local training-cum-building resource centre, involving the district and block-level engineers could be adopted in IAY.

Table 4.6: Excerpts from Table I.6, Annexure I: Summary of Northern Karnataka Housing

Examples	**key element**	**How the above was achieved? e.g.**				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Northern Karnataka	Understanding pattern of living gender sensitive shelter Evolve a participatory process of design,. technologies based on use of local building materials and skill; Poverty reduction through livelihood generation	*Footing and Walling:* Use of stub footing and cone foundations (for black cotton soil) ; use vertical reinforcements & band ; Stone wall 380mm thick Roof: a) Cudappa stone roofing on precast RC joists, b) Shallow vault in brick.	A small group of young architects from SABALA and about fifteen masons and carpenters were trained as master trainers.	parameters used; a) low unit cost, b)ease of maintenance, c) gender issues, d) low embodied non renewable materials, e) encourage renewable f) encourage using industrial/ agriculture waste, g) Low CO_2 emission	SDC had funded the project to develop a replicable model for rural housing in Karnataka. They supported all the innovations evolved through research and resource mapping	Interface with local Nirmithi Kendra for training and production, travelling mela on technology; Block and District level government engineers as partners, mobile unit for production, Nirmithi Kendra on wheel.

Case Study 7: COSTFORD (Hybrid)

Project Background: The Centre of Science and Technology for Rural Development (COSTFORD) was founded by Laurie Baker and others in 1984 as a non-profit voluntary organisation and started construction activities in 1986. It is a self-sustaining organisation supported by institutional clients. For private buildings they charge a fee for design and supervision which is the main source of their finance. COSTFORD views every project as an opportunity for research and development. However, the biggest contributor to its innovations could be attributed to Laurie Baker.

Key elements: COSTFORD consists of social workers, educators, architects, engineers, scientists, technologists and others. It promotes empowering and enabling the poor and weaker sections of society to improve their living conditions by application of appropriate and people-friendly technologies and adopting participatory, transparent, and gender-sensitive processes. Housing is the largest component of COSTFORD's 25 years of work in providing cost-effective, energy efficient, resource-sensitive architecture.

Construction technologies such as, rat-trap, jaali wall, filler slab, arches, frameless door and window, bamboo, mud construction, etc., are promoted by COSTFORD in pursuit of green housing. The main principle of COSTFORD is to eliminate, as far as possible, structural redundancy and costly finishes. In rat-trap about 25 percent bricks are saved compared to that of solid brick wall. This also reduces the consumption of cement. Additionally, the use of jaali walls acts as a good alternative to costly timber doors and windows. The frameless door and window simply eliminate the costly frames. Their present emphasis is on bamboo shelter.

[12]NGO working in Northern Karnataka, http://www.sabalaindia.com

The use of cost effective technologies saves cost which could be at least 15 percent of the brick, cement and steel intensive systems, although it varies from place to place depending upon local conditions.

COSTFORD, in the last 25 years, has been conducting capacity training programmes for both women and men. It has provided awareness building of over 25,000 people from all walks of life on ways to effect positive societal change. Participants include social workers, engineers, home-based women, architects, construction workers, technologists, state government officials, students, Panchayat Raj representatives, visitors from other states in India and abroad, etc. COSTFORD trains masons on-the-job and at present they have more than 1000 trained masons. It also trains engineers who join them as interns.

Lesson Learnt: Creating a cadre of grassroot level masons and engineers to bring the green technologies at the doorsteps of the beneficiaries. Use of rat trap and filler slab roof could be adopted with least training and supervision. Working in partnership with government departments is a lesson to be learnt.

Table 4.7: Excerpts from Table I.7, Annexure I: Summary of COSTFORD

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
COSTFORD	COSTFORD promotes empowering & enabling poor & weaker sections of society to improve their living conditions by application of appropriate and people-friendly technologies & adopting participatory, transparent & gender-sensitive processes	By using Rat Trap, Jaali wall, Filler slab, arches, frameless door & window, bamboo, mud construction, etc. It eliminates structural redundancy and costly finishes. Saves least 15 percent of the cost of brick, cement and steel intensive systems	It conducts capacity training for social workers, engineers, home-based women, architects, construction workers, etc. COSTFORD trains masons on job It also trains intern engineers	Greening is inbuilt in COSTFORD's entire process. However, it does not provide indicators & database on greenness of their technologies. COSTFORD is preparing Green Building Code.	COSTFORD is self sustaining & has institutional clients, financed by Local, State &/or Centre. Fund is also from consultancy of private buildings. Main inspiration and contributor for innovations is Laurie Baker	COSTFORD has already up-scaled their technologies at grass root level. This is one example in which the technical expertise reaches the doorsteps of HHs. Local government's support is its strength

Case Study 8: Development Alternatives (Hybrid)

Key elements: Development Alternatives (DA) was established in 1982. It is a research and action organisation, designing and delivering eco-solutions for the poor and the marginalised. It has both national and international experience in the field of addressing poverty challenges, cost-effective and environment-friendly construction technologies.

DA promotes a wide range of technologies for rural housing. Among some of their technologies are Compressed Stabilized Earth Block (CSEB), Micro Concrete Tiles (MCT), Ferrocement Channel (FC) roofing, etc. DA has a strong component of skill building in all the technologies they use in rural housing. It has local level centres (e.g., Jhansi) in rural areas. DA technologies are based on reduction of energy intensive cement, steel, bricks, etc. which also reduces emission of CO_2.

DA brought Vertical Shaft Brick Kiln (VSBK) Technology to Datia from China in 1996 and through intensive research, was adapted to Indian conditions. TARAgram Datia houses a centre for brick excellence, which provides technical support services to brick manufacturers. The success of this technology is boosted due to the availability of fly-ash waste and sponge-iron waste near the site.

DA has training institutes. Apart from that it carries out on-site hands-on training of construction workers. They have produced a large number of skilled workers in many states. DA has been successful in developing a structured modular training methodology with quality assurance and targeted delivery. The courses are practical and applicable, yet based on research on management and organisations.

Selection of DA technologies are based on parameters; a) unit cost, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) emission of CO_2.

Lesson Learnt: Creating a cadre of grassroot level masons and engineers to bring the green technologies at the doorsteps of the beneficiaries. HUDCO rural building centres may study DA's Datia, Jhansi, cases. to know what made them successful. Use of CSEB, MCT and FC in IAY would be appropriate in promoting greenness.

Table 4.8: Excerpts from Table I.8, Annexure I: Summary of DA

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
	Development Alternatives is a research and action organisation, designing and delivering eco-solutions for the poor and the marginalised.	Use of low energy intensive materials such as, CSEB, MCT, FC roofing, etc. DA brought Vertical Shaft Brick Kiln (VSBK) Technology from China & adapted to Indian conditions. In APPEP, average saving of DA buildings were about 12 percent - 18 percent.	DA carries out on-site hands-on training of construction workers. They have produced a large number of skilled workers in many states. DA has structured modular training	DA has an energy handbook, it needs updating. Selection of DA technologies are based on; a) unit cost, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) emission of CO_2.	DA is funded by various agencies, it has international collaboration . DA generates money from consultancy as well. Scientist in DA is devoted to research on various aspects of energy efficient technologies	While DA technology has been successfully been implemented in many housing projects, it is yet to gain a wider acceptance. DA technologies could be up-scaled if they are included in BIS codes

Case Study 9: Auroville Earth Institute (Hybrid)

Project Background: The Auroville Earth Institute (AEI), previously named the Auroville Building Centre/ Earth Unit, is in a mission to bring awareness about earth architecture and technologies, and it covers worldwide examples.

Key elements: AEI has been able to demonstrate the possibilities of the earth as a building material. It has government approval for the use of Compressed Stabilised Earth Block (CSEB) especially for disaster resistance. Auroville promotes CSEB with cement stabilisation as walling material. Their stabilised rammed earth wall is not only cost-effective (in some areas) and environment-friendly, it has immense aesthetic appeal. Among the roofing systems FC, different types of domes and vaults in stabilised compressed earth block are notable. AEI promotes greenness with the help of primarily earth based products. All the above materials have inherent quality of greenness in terms of consumption of energy and emission intensive materials such as cement and steel. While there is ample evidence that these technologies are cost effective, there was no data in this regard.

The various courses held in Auroville aim to introduce and promote the technology of stabilised earth to build with. The AURAM equipment for earth construction and the technologies taught have been

developed by the Auroville Earth Institute. AEI has trained over 6,700 people from 67 countries. It has also been given two international and 11 Indian awards for its excellence in building and architecture[13].

AEI uses greenness indicators such as, embodied energy and emission of GHG, etc. It emphasizes on the use of local materials that reduces transportation cost, energy and emission. However, AEI does not provide information on the way they measure greenness of CSEB, FC, etc.

Auroville has received support from a considerable number of governmental and non-governmental agencies, foundations, corporate donors and private well-wishers in India and abroad. AEI does research on earth-based materials and technologies which are cost and energy effective. These technologies are disseminated through training courses, seminars, publications and consultancy within and outside India.

Lesson Learnt: CSEB needs to be brought under BIS codes such as IS: 1905-1987 on masonry. FC roof could be adopted in rural housing. The HUDCO rural building centre should be inspired by the quality of training rendered by AEI and its high quality building products.

Table 4.9: Excerpts from Table I.9, Annexure I: Summary of Auroville Earth Institute

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
	Auroville Earth Institute (AEI), is in a mission to bring awareness about earth architecture and technologies, and it covers worldwide examples from past to present.	Following green technologies are promoted by AEI- Stabilized rammed earth foundations & walls with 5 percent cement, Stabilized rammed earth rammed manually, various vaults with CSEB, FC	Training courses held in AEI aim to introduce and promote the technology of stabilised earth. AEI courses consist of both theory and practical classes. To date, the Earth Institute has trained over 6,700 people from 67 countries	AEI uses greenness indicators such as, embodied energy and emission of GHG, etc. AEI does not provide information on the way they measure greenness of CSEB, MCT, FC, etc.	AEI's innovation runs with support from a considerable number of governmental and non-governmental agencies, foundations, etc. in India and abroad. AEI does research on earth-based technologies which are cost and energy effective	AEI attracts many engineers, architects and construction workers to their training programmes. It needs mechanism like HUDCO rural building centre for up scaling greenness

Case Study 10: APPEP (RCC-based to Hybrid)

Project Background: DFID and Government of Andhra Pradesh jointly initiated a project to search nationwide for cost-effective and environment-friendly construction technologies to construct more buildings within budget. Most of the sources of the research were the shelter sector. In the process, 11 different roofing systems, six types of walling systems and three types of foundations were identified. In Ranga Reddy District of Andhra Pradesh, 56 buildings were constructed by adopting all the identified technologies. The buildings were completed by the middle of 1996. Subsequently, an evaluation was conducted between 14 October and 23 November of 1998. A multi-disciplinary team consisting of national and international experts examined all the buildings.

Key elements: A nation-wide survey identified various options of technologies, which were short-listed on the basis of the following criteria:

- durability
- availability of materials and skill

[13]Transfer Of Earth-Based Technologies, The Earth Institute – Auroville, Tamil Nadu, Documentation Of Best Practice, March 2011, Researched and Documented By: OneWorld Foundation India

- energy consumption
- cost
- income generation
- acceptability
- maintenance requirements

The project had created a database to provide a menu of roofing, walling and foundation systems. Reliable information on the life cycle cost and environmental impacts was developed. This project provided a unique opportunity to observe the aging of a variety of materials and technologies in one consistent setting – being built in the same time, located in the same climatic zone, having same end usage and constructed under the same degree of supervision.

A year long rigorous research helped in identifying cost-effective and green technologies for various regions of India. Care was taken to make sure that the embodied non renewable energy of the adopted technologies and emission of CO_2 were low. The use of renewable energy was encouraged. In APPEP the cost savings ranged between 10 to 35 percent of the cement, steel and brick intensive construction. The Panchayati Raj Engineering Department engineers were trained for six weeks. During implementation the masons and the contractors were given hands-on training on the job.

A mathematical model was developed by considering the following indicators to do the balancing act of cost effectiveness and greenness of the technologies.

1) unit cost of construction - lower the better
2) income multiplier effect, higher the better
3) labour intensity- skilled, semi skilled and unskilled, higher the better
4) embodied non-renewable energy - lower the better
5) embodied renewable energy - lower the better
6) embodied waste energy - higher the better
7) CO_2 emission - lower the better

Based on the above assumptions, the model did the balancing act of finding out the most appropriate construction technology in a particular context. This model has been tested in Bangladesh, Myanmar, Iraq, South Africa and Sri Lanka. Therefore, the model is robust enough to be used in any context.

A book titled *Vidyalayam* was published by DFID, which had all the required data for assessing suitability of technologies in a particular context. There was a significant impact of this project in many parts of India. Right after the innovation in Ranga Reddy, the Secretary to the Ministry of Health and Family Welfare, Orissa requested DFID to pay for the consultant to construct three cost-effective and environment-friendly primary health care units funded by the state government. This was implemented within 18 months.

The biggest impact of APPEP was on District Primary Education Programme (DPEP). Under DPEP 69,000 education buildings and 53,000 additional classrooms were constructed. Most of them were based on cost-effective and environment-friendly technologies.

Lesson Learnt: The APPEP experience was completely based on housing technologies and thus appropriate for IAY. Using APPEP data on cost-effective and environment-friendly technologies, the *Zila Parishad* should try to influence the IAY beneficiaries. The HUDCO rural building centres, in its revamped form, should be in the driving seat in promoting greenness and by brining this to the doorsteps of the beneficiaries.

Table 4.10: Excerpt from Table I.10: Summary of Andhra Pradesh Primary Education Project

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved Was there cost saving?	What & whose capacities were built and how	Outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
	DFID & Government of Andhra Pradesh jointly initiated a project on search for cost effective & environment friendly technologies to build more schools within budget. 56 buildings were constructed by adopting the identified technologies. The project had created a database on cost effective & green technologies	Resource mapping conducted across the country to acquire knowledge on cost effective and environment friendly technologies. Embodied non renewable energy of the adopted technologies and emission of CO_2 were low. The use of renewable energy was encouraged.	Panchayati Raj Engineering Department engineers were trained. Right after the training, the government engineers started the cost effective and environment friendly school buildings. During implementation the masons and the contractors were given hands-on and on job training	Following indicators were considered to measure cost effectiveness & greenness of the technologies -unit cost -income multiplier effect -labour intensity - embodied non-renewable energy - -embodied renewable energy- CO_2 emission – This approach has been tested in several countries	DFID had funded only the innovation part of the project. The end products were published in a simple and graphical format for easy understanding of the technologies and assessing the socio-economic and environmental impacts.	A book Vidyalayam was published by DFID which had all the required data for assessing suitability of technologies. Inspired by APPEP, the Ministry of Health and Family Welfare, Orissa constructed three cost effective and environment friendly primary health care units. The biggest impact of APPEP was on District Primary Education Programme (DPEP).

4.3 Summary of Case Studies

All the summaries have been compared with each, a) Key elements, b) How greenness was achieved, c) Capacity building, d) Indicators of greenness, e) Innovation and f) Up scaling. The emerged pattern is shown in Table 4.11. This will form the basis of recommendations of this report.

To reiterate, the construction industry has to consider the following to minimise damage to ecology and support green development:

a) Conservation/regeneration and sustenance of natural resources and eco system.

b) Reduction of pollutants and GHG.

c) Resilience against climate change.

Therefore, in the context of IAY, the Table 4.11 has been recast in Table 4.12 by categorising the emerged patterns under the above three heads. Table 4.12 is the list of actions that will reinforce the existing IAY guidelines towards MoRD's mission on Greening Rural Development.

Table 4.11: Pattern Emerged From The Case Studies That Are Suitable for Greening IAY

Key element	**How the above was achieved? e.g.**				
	How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
- Recycling of shower water and kitchen waste - Encourage local art forms through shelter- rewards for good traditional art works - Use cost-effective & Environment friendly technologies. - Community based construction - Traditional building materials combined with modern knowledge. - disaster safe design and construction - Priority of actions HFA III & IV - Participatory process of design - Homogenize existing database on cost effective & green technologies	- Resource mapping (search for local materials and skills) , Use local materials- reduce transport cost, energy and emission - Use of beams with a bunch of bamboo for large span, VSBK - Foundation: Stub footing, Stone wall 380mm thick - Wall: Rat Trap, CSEB, Stabilized Rammed earth, cement, concrete blocks - Roof: MCT, FC, Stone roofing, Filler slab, masonry vault, etc. - arches, Jaali as window / frameless door and window Disaster safety- ABC, Use vertical reinforcements & horizontal bands in seismic areas	- Encourage traditional skills, upgrade them to modern code & safety standards - Community awareness on green technologies - Capacity building of carpenters, masons and top level management- - Train government engineers - Disseminate ICT materials DA has structured modular training - AEI courses consist of both theory and practical classes. .	- unit cost of construction - labor intensity, - income multiplier effect - embodied non renewable energy, - embodied renewable energy - emission of CO_2, - parameters of comfort of shelters; - indicators of disaster safety; - Update energy handbook	Individual's effort Government – education, healthcare, housing departments Donors INGOs NGOS generate fund from consultancy fees from private buildings. Many NGOs have in-house research wings .	- People need time to adopt green technologies- must be supported by local government's & local level production cum resource centre - Local training institutes to be established. - Government buildings to adopt greenness - Local Nirmiti Kendra for training and production; - Travelling mela on technology; - Block and District level engineers as partners - Mobile unit for production - Technical support at HH doorsteps. - Include innovative technologies in BIS codes - APPEP influenced government of Orissa & (DPEP).

Table 4.12: Actions-based on the Case Studies: Greening IAY

SL	A	B	C
	CONSERVATION/REGENERATION AND SUSTENANCE OF NATURAL RESOURCES AND ECO SYSTEM	**REDUCTION OF POLLUTANTS AND GHG**	**RESILIENCE AGAINST CLIMATE CHANGE**
1	Adopt recycling of wash water for WCs and utilisation of kitchen waste. Both needs appropriate technical solutions suitable for the rural areas.		Community-based construction
2	Encourage local art forms through shelter - rewards for good traditional art works - aesthetics is as important as greenness.		Disaster-safe design and construction
3	Research on traditional building materials in the light of modern knowledge. Emphasise research on Bamboo and encourage its use by appropriate incentives.	Same as A3	Priority of actions HFA III & IV
4	Use cost-effective and environment-friendly technologies: - Foundation: Stub footing, Stone wall 380mm thick. - Wall: Rat Trap, CSEB, Stabilized Rammed earth, cement, concrete blocks. - Roof: MCT, FC, Stone roofing, Filler slab, masonry vault, etc. arches, - Jaali as window frameless door and window- - Homogenize existing database on cost-effective and green technologies of MoRD's web portal.	Same as A4	Participatory process of design
5	Resource mapping (search for local materials and skills) , identify local materials - reduce transport cost, energy and emission	Same as A5	Disaster safety - ABC (anchor, bracing and connection), Use vertical reinforcements and horizontal bands in seismic areas
6	Encourage VSBK technology - primarily government's responsibility to support private entrepreneurship.	Same as A6	Community awareness on green technologies
7	- Block and District level engineers in driving seat of greenness - needs capacity building.	Same as A7	Same as A7
8	- Encourage traditional skills, upgrade them to modern code and safety standards. - Capacity building of carpenters, masons and top level management, train government engineers. - Disseminate ICT materials; DA has structured modular training.	Same as A8	Same as A8
9	- Update energy handbook.	Same as A9	Creating a cadre of grassroot - level masons and engineers to bring the green technologies at the doorsteps of the beneficiaries.

10	Following indicators shows the whole domain of balanced decision-making on sustainable IAY shelters. The underlined ones are exclusively for assessing greenness of various construction technologies - Unit cost of construction, - Ease of maintenance - Income multiplier effect, - Labour intensity - Low embodied non-renewable energy - Embodied renewable energy - Recycling: encourage using industrial/agriculture waste - Low CO_2 emission - Additional parameters - Parameters of comfort of the shelters - Indicators of disaster safety (seven points) - Indicators: timeliness, quantity and quality	Same as A10	Same as A10
11	The revised role of HUDCO rural building centres as Building Resource Centre will bring technical support on greenness to the doorsteps of IAY beneficiaries. It is a good example of integrating disaster resistant buildings for resilience to combat climate change.	Same as A11	Same as A11
12	Government buildings to adopt greenness	Same as A12	Same as A12
13	- Local Nirmiti Kendra for training and production. - Travelling mela on technology. - Mobile unit for production.		
14			- Include innovative technologies in BIS codes
15			- People need time to adopt green technologies- must be supported by local government's & local level production cum resource centre technical support at household doorsteps

4.4 Special Notes

The use of bamboo must be encouraged. However, social acceptance of this technology remains a problem. Bamboo beam used with a bunch of bamboos could be as strong as RCC beam in terms of self weight to design weight ratio. Similar technologies will be a good competitors of RCC, steel or precast technologies as demonstrated in the mud school of Bangladesh. However, mud has it's inherent and age old problem of erosion and dampness in high rainfall areas, which could be addressed by using cement or lime stabilization of 7 to 10 percent. In terms of strength, the minimum compressive strength of CSEB is around 4 to 6 MPa against generally available brick strength of 5-7.5 MPa.

In many rural areas of India water is a scarce commodity. Rainwater harvesting is another area which needs cost-effective solution. The North eastern part of India has many indigenous solutions in this regard. Toilets in rural India are difficult to maintain due to lack of adequate water. The Venda example of recycling wash water from bathing to flush toilets is a replicable solution. Suitable technologies could be developed to make it a general solution.

The HUDCO-promoted lab to land through building centre movement, which could be a possible solution. However, it need a major conceptual change from its original design. One of the major reasons for failure

of the building centre movement was that it was too heavy on production and could not compete with the local materials market in terms of cost, quality and transportation to the sites. If a building centre is not commercially viable, it will not survive only on grant and loan. There is a strong need for making building resource cum production centre that provides all kinds of rural shelter construction consultancy from loan to construction.

Some of the building resource cum production centre should have maintenance booth. This needs a training facility for multi-skilled human resource.

In summary, it may be said that a resource mapping exercise should be conducted in any project area to understand the appropriate designs and technologies suitable to its context. This will address all the possibilities and issues discussed above. Resource mapping will enable one to identify the locally available materials, which will help in identifying the most appropriate one from the MoRD's portal in each context.

Many of the recommendations that came out of the analysis of the ten case studies are already there in the IAY guidelines. However, the existing guidelines could be strengthened by incorporating the findings from the case studies, shown in the Table 4.12.

In some states there are some examples of use of cost-effective technologies in IAY shelter, which are NGO driven. However, green approach is yet to be seen on a wider scale. Field experience and interactions with the experts revealed that there is a necessity for a very simple green metric system for measuring greenness of different construction technologies. The outputs of the green metrics should be graphical so that the beneficiary could understand where her/his shelter is on a green scale. Therefore, henceforth, in the remaining sections of this report the focus will be only on Green Metrics.

5. Green Metrics

5.1 Introduction

The objective of this section is to develop a simple green metric system that could be used by the block officers/engineers to measure greenness of different options of technologies in a context. This will enable them to promote the concept of greenness and its related incentives to the IAY beneficiaries. Green metrics will also help them calculate both the quantum of environmental impacts and greenness indexes of all the IAY shelters built annually in a block. With this, the state can review the speed and direction of their green movement towards the set target.

5.1.1 Energy and Emission Handbook

The first and foremost step for developing green metrics would be to publish an Energy & Emission Handbook for architects, engineers, planners, contractors, etc. The Handbook will provide information on the method of calculations, assumptions such as the boundary conditions, etc. It will show, in simple tables, the embodied energies and emission of CO_2 of each building material owing to the use of different types of fuel such as coal/petrol, electricity, wood, non-wood, agriculture waste, etc. It should also provide data on depletion of soil, consumption of water and transportation of the finished materials from production units to the construction sites. The architects, engineers, etc. will first calculate the quantities of materials for a particular building based on the building design. Following that she/he will multiply each quantity of material by the unit embodied energy, CO_2 emission, etc and get the total quanta of impacts on environment owing to the construction of one unit of an IAY shelter.

Since, it will take time to appoint multidisciplinary experts to develop the Handbook, as an intermediate measure, data on embodied energy and emission of CO_2 could be adopted for calculating greenness of IAY buildings based on the Energy Directory of Building Materials (DA, 1995) and the data from the experience of APPEP. To kick-start the green drive one needs a very simple model for calculating environmental impacts that will suit the capacity of a block-level junior engineer. Therefore, only the embodied energies and emission of CO_2 of each construction material at production yard has been considered. This will enable the block level engineer to report the environmental impact of different technologies in IAY. The environmental impact due to the on-site process has been ignored right now since field experience revealed that only a very small quantity of energy and emission were involved in the on-site process.

5.1.2 Database

Robust database on RCC and brick-based systems are available with all the government engineering departments. The recent web portal of MoRD, which is under process, will provide a wide range of database on construction technologies for all types of rural housing. These databases are from different contexts and under different conditions. Hence, the web portal has to homogenise the data gradually by conducting and in-depth research.

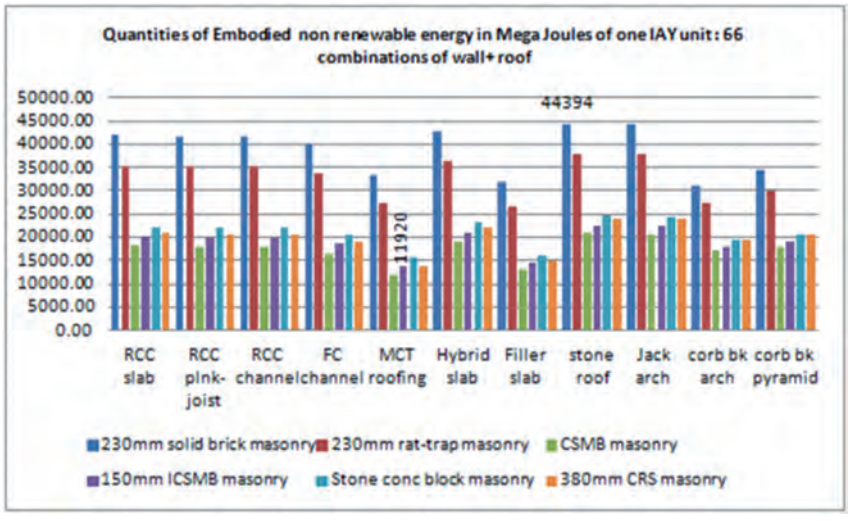
5.1.3 Measuring Environmental Impacts

As mentioned before, the government has targeted quanta of annual reduction in emission and embodied energy to achieve greenness in India. Therefore, it necessary to examine the extent to which IAY could help in reducing the energy and emission by adopting socio-culturally suitable materials and technologies in shelter construction. This could be done by analysing the embodied energy and emission by different technologies in a context by using data on construction systems and energy handbook. The following Figure 5.1 and Figure 5.2 show the different impacts one IAY unit can have owing to the use of different technologies.

Figure 5.1 shows that the maximum embodied non-renewable energy of one IAY unit is 44,394 MJ if one adopts stone-roofing and 230 mm solid brick wall. Stone has negligible embodied energy, however, the use of brick bat coba as roof water-proofing has made it energy intensive. The combination of micro-concrete tile roof with CSEB has the lowest embodied non renewable energy (11,920 MJ). Therefore, if micro-concrete tiles and CSEB are used in 10,000 IAY units, there will be a saving of 324 trillion joules of embodied energy equivalent to 90 Giga watts of electricity with respect to the option of solid brick wall and stone roof.

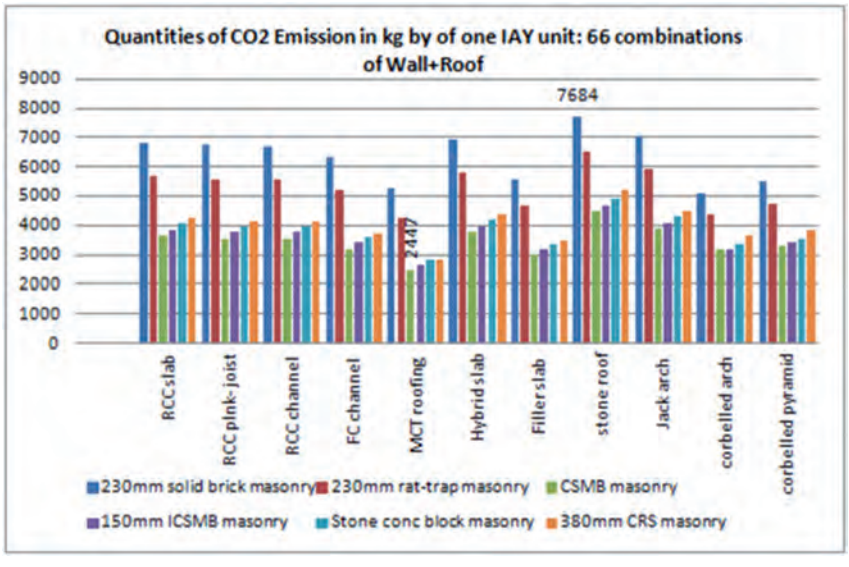
If one constructs 10,000 IAY units with micro-concrete tile roof with CSEB wall there will be a reduction in CO_2 emission by 52,000 tons compared to that of the emission by stone roofing and 230 mm solid brick wall.

Figure 5.1: Pattern of embodied non-renewable energy: Different walling and roofing technologies



Source: Based on APPEP database, 2001

Figure 5.2: Pattern of CO_2 emission: Different walling and roofing technologies



Source: Based on APPEP database, 2001

The quantitative aspect of different construction technologies shown in the figures above is useful for measuring IAY's speed of approaching greenness. However, one would need a process of calculating the greenness index of each IAY shelter based on which appropriate incentives could be given to the deserving households. The following section presents a simple process that measures how green an IAY shelter could be.

5.1.4 Proposed Green Index Calculator

The greenness of an IAY unit can be calculated with reference to a building constructed with RCC roof and 230 mm solid brick wall (20 sq m covered area). This combination of wall and roof is highly energy and emission intensive and will be assumed to be of zero green. The other extreme point of the scale is 100 percent green technology indicating that it has no embodied energy neither leads to any CO_2 emission. It is clearly a hypothetical case though bamboo-based building would be close to 100 percent green. Therefore, the greenness will be zero for RCC roof and brick wall tapering to zero as shown in the following Figure 5.3 ("B"). If one adopts different construction technology in a shelter, its negative impact on the environment will be calculated and placed in the diagram (shown in dotted line X-X).

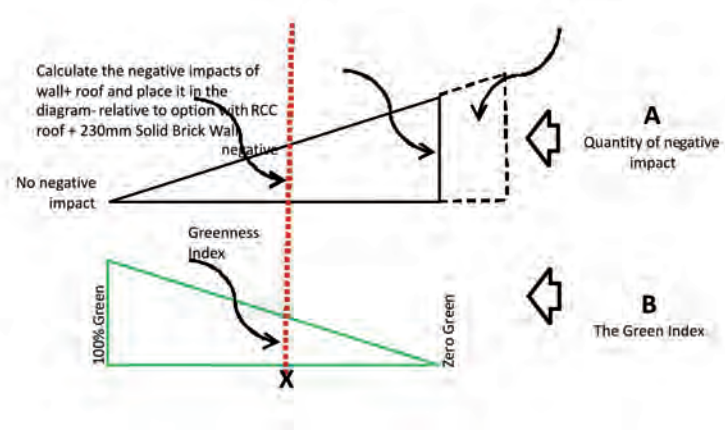


Figure 5.3: A simple model of calculating greenness of an IAY unit

In order to make the calculator simple, only the wall and roof have been considered since these two components of a building account for 60 to 70 percent of the total cost of a building and also have a major impact on environment. Tables 5.1 and 5.2 show robust data based on the energy emission by Development Alternatives and BMTPC (1993), TEDDY (1993)[14] and updated by Das (2005). This database provides a simple table showing the embodied energy and emission of a few roofing and walling technologies. The values in the following tables exclude the energy and emission due to transportation.

Table 5.1: Environmental impact data of roofing systems: Basic structure + roof water proofing/insulation + ceiling finishing and painting (wherever applicable)

	Roofs	**Embodied Non-renewable Energy**	**Embodied Renewable Energy**	**CO_2**
		MJ/ sq.m.	MJ/ sq.m.	Kg./sq.m.
RF01	RCC slab	511.82	137.26	85.14
RF02	RCC plank- joist	498.04	37.04	79.99
RF03	RCC channel	498.41	37.04	79.38
RF04	FC channel	430.30	17.62	60.96
RF05	MCT roofing	235.46	10.39	33.35
RF06	Filler slab	328.95	284.67	73.16
RF07	stone roof	640.82	214.41	127.61
RF08	Jack arch	633.74	102.97	96.89
RF09	corbelled brick arch	615.09	149.91	99.65
RF10	corbelled brick pyramid	620.56	144.50	97.14

[14]Energy Directory of Building Materials. (1995). Development Alternatives, Sponsored by Building Materials and Technology Promotion Council, New Delhi, India. TEDDY (Tata Energy Data Directory Yearbook). (1993). Tata Energy Research Institute, New Delhi, India

Table 5.2: Environmental impact data of walling systems: Basic structure, external plastering, pointing, internal plastering, internal and external paining (wherever applicable)

	Walls	Embodied Non-renewable energy	Embodied Renewable energy	CO_2
		MJ/ sq.m.	MJ/ sq.m.	Kg./sq.m.
W1	230-thk solid brickwork	529.57	209.65	86.11
W2	230 thk rat-trap	421.46	172.04	66.86
W3	230-thk CSMB masonry	134.54	64.06	33.15
W4	150-thk ICSMB masonry	181.77	26.47	38.97
W5	200-thk scb masonry	206.16	61.30	40.76
W6	380-thk CRS masonry	153.00	74.50	37.70

First, calculate the wall perimeter of the IAY building plan of 20 sqm plinth area. For a simple square plan-form it will be 22.42 m. Assuming a wall height of 3m, the surface area of the wall will be 22.42X3 = 67.26 sq m. Assuming a 300mm projection beyond wall, the total roof area will be 25.73 sqm. Now use the database from tables 5.1 and 5.2 to calculate the environmental impacts of, say, micro-concrete tile roofing with 150mm thick ICSBM wall against brick wall with RCC roof. The following table shows the process of calculation

Table 5.3: Process of calculating greenness index

Option 1

	Roofs	Embodied Non-renewable Energy	Embodied Renewable Energy	CO_2
		MJ/ sq.m.	MJ/ sq.m.	Kg./sq.m.
RF01	RCC slab → value in Table 5.1 (RF01) multiplied by 25.73 sqm- the roof area	13169.13	3531.70	2190.65
W1	230-thk solid brickwork → value in Table 5.2 (W1) multiplied by 67.26 sqm- the wall area	35618.88	14101.10	5791.76
	TOTAL OF WALL+ROOF OPTION 1	48788.01	17632.76	7982.411

Option 2

	Walls	Embodied Non-renewable Energy	Embodied Renewable Energy	CO_2
		MJ/ sq.m.	MJ/ sq.m.	Kg./sq.m.
RF05	MCT roofing → value in Table 5.1 (RF05) multiplied by 25.73 sqm- the wall area	6058.3858	267.3347	858.0955
W4	150-thk ICSMB masonry → value in Table 5.2 (W4) multiplied by 67.26 sqm- the wall area	12225.85	1780.3722	2621.1222
	TOTAL OF WALL+ROOF OPTION 2	18284.24	2047.707	3479.218

Greenness Index

		Embodied Non-renewable Energy	Embodied Renewable Energy	CO_2
		MJ/ sq.m.	MJ/ sq.m.	Kg./sq.m.
	Index of MCT roof+ 150 ICSMB wall with respect to RCC roof+ 230 solid brick wall	=(18284.24/48788.01)* 100= 33 percent,	=(17632.76/2047.707)* 100= 12 percent,	=(7982.411/3479.218)* 100= 44 percent,
	Savings	100-33=67 percent	100-12=88 percent	100-44= 56 percent
	Greenness Index→ Average Savings	Savings in two types of embodied energy and CO_2 emission of option 2 with respect to option 1. Average saving = (67+88+56)/3 = 70.33 percent		

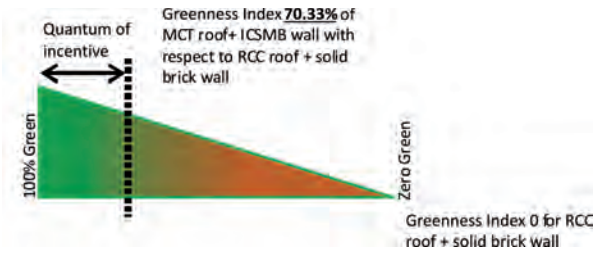


Figure 5.4: Greenness index of Option 2 with respect to Option 1

5.2 WEIGHT

One can assign weights to the parameters, i.e., embodied non renewable and renewable energies and emission of CO_2. If it is assumed that on a scale of 10, weights of non renewable, renewable energy and emission of CO_2 are 2, 9 and 5, respectively, the revised greenness index will be as follows;

Revised Greenness Index = (67X2 + 88X9 +56X5)/(2+9+5)= 75 percent

5.3 SPECIAL NOTES ON GREEN INDEX

The proposed model of greenness index calculation is very simple and could be introduced right away. However, in course of time, the model should be transformed to a sophisticated level to capture all the important aspects of greenness. For example, every 8 sq m of RCC slab requires 500 litres of water for mixing and curing. Such water should be equivalent of drinking water. Therefore, it is important to consider water intensity of different construction technologies while calculating greenness, especially in areas where it is scarce. If the act of curing is ignored due to lack of water, strength of cement concrete will get reduced significantly leading to high cost of future maintenance along with less life-span.

Greenness of a building could be controlled at planning, design, materials and technologies and construction management levels. For example, perimeter of an octagonal plan form is less than that of a square one for same internal area. Thus one can reduce material consumption in wall and foundation by adopting appropriate geometry. For areas with poor road condition, procurement of materials in good seasons will save on transportation energy and emission (management control). Table 5.4 shows the whole gamut of parameters for greenness calculation for IAY shelter.

Table 5.4: Showing control points, parameters, weights regulating greenness of IAY shelter

	TEN PARAMETERS OF GREENNESS										
Control Points	Non re-newable	Re-newable wood	Non wood, waste etc	Recycle Industrial waste	Water consum-ption	Liquid waste	Solid waste	Depletion of soil	CO_2 emission	Renewable materials-bamboo, etc	Control Point Weights
	KWH	KWH	KWH	TONS	LITRES	TONS	TONS	SQM	TONS	TONS	
Planning	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	WI (1)
Design	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	WI (2)
Materials & Technology	MT1	MT2	MT3	MT4	MT5	MT6	MT7	MT8	MT9	MT10	WI (3)
Management	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	WI (4)
	PW1	PW2	PW3	PW4	PW5	PW6	PW7	PW8	PW9	PW10	
	PARAMETER WEIGHT										

5.4 INCENTIVES

Depending upon the position of the greenness index in figure 5.4, suitable incentives should be given to households. The incentives should also be extended to the local building materials market if they sale green materials. Incentives could be as follows;

For IAY beneficiaries

- Preferential loan/grant
- Awarding households who have adopted greenness with
    - Subsidised green materials
    - Incentive for maintenance expenditure

Local Material market

- Preferential bank loan/grant
- Award for promoting greenness
- Rebate in electricity bill
- Rebate in octroi and other taxes

6. Recommendations

6.1 GREEN DESIGN:

Centuries of maintenance-intensive shelter and poor living conditions have forced people to look for affordable and maintainable building. However, acute financial crisis of IAY beneficiaries is a major constrain to this dream. As a result, greening will appear to them a trivial issue. This problem cannot be resolved by viewing greening IAY as a mere technical problem, neither as a management or policy matter. It is very important to make IAY beneficiaries informed clients by explaining the green benefits, e.g., a) green buildings are affordable and durable; b) there are incentives for adopting them. Since the IAY households choose technology to adopt for their shelter construction, such support should be available at doorsteps of the beneficiaries through, perhaps, community mobilisers. Apart from these, specific preparedness should be there at state and national level to create enabling environment for greening IAY.

While IAY guidelines cover most of the issues of green development, it needs to add some clarifications to ensure that the policies and strategies are translated into actions at grass-root level. There could be an appendix to the guidelines detailing how and what to do it at grass-root level. Strengthening *Zila Parishad* by capacity building and training its engineers on how to use the Green Index Calculator will be the first step. Re-activating the HUDCO BRCs to act as a doorstep support to the beneficiaries through its community mobilizers will be crucial. However, a strong partnership between *Zila Parishad* and BRC would be the key to success in green development. The following elements may be reflected in the IAY guidelines or its appendix.

6.1.1 Setting the Target:

Setting a goal is the first step towards green development. Set the target level of emission and embodied energy that has to be achieved in the next five years. For example, it could be based on GOI's committed reduction of CO_2 (baseline 2005) emission by 2020[15]. By using Green Index Calculator (GIC) one can estimate how much of CO_2 emission could be saved through IAY by adopting appropriate technologies. Similar goal-setting could be done for other components of greenness shown in Table 5.4. The GIC shown in the last section could be used to measure greenness as well as quantum of environmental impacts of different technological options in a context. This will enable to assess speed and direction of IAY's contribution towards the target.

6.1.2 Measures at National Level

- MoRD's portal on region-specific technologies and database should be homogenised. At present they are from different sources, different climates and different degrees of supervision and quality control. There is also a need to conduct in depth analysis and uploading results on the portal
- Revamp HUDCO's Building Centre as Building Resource Centre (BRC) to act as village-level consultants and resource support to the IAY HHs. There is a strong need for making building resource cum production centre that provides all kinds of rural shelter construction consultancy from loan to construction. BRC should be based on the case studies (see section 4 and annexure I) who have been successfully supporting people at rural areas. Some of the building resource cum production centre should have maintenance booth. This needs training facility for multi-skilled human resource.
- Development of Energy and Emission Handbook
- To resolve the engineers' common question "is the green technology as per code", there is a need to include green technologies in the respective building codes. This issue has been raised over the last ten years or more though without any success. Safety and durability of some of the green technologies could be derived from the already existing building codes.

[15]Indian target to cut its CO_2 emission by 20-25% below the 2005 level by 2020. In 2005, India emitted 1.4111 billion tons of CO_2. Which means a reduction of 0.282 billion tons of CO_2 by 2020

6.1.3 Actions at State and District Levels

General Measures

- At district level, BRCs to conduct resource mapping to know about the local materials, materials transported from other blocks/districts/states/countries, road condition, availability of electricity, water, etc. These will help in choosing the feasible technologies from MoRD web portal
- The quantum of construction in rural sector should be estimated to calculate the extent of environmental impact caused by various options of technologies and designs
- While promoting greenness, inform beneficiaries that cost-effective systems are green as well
- BRCs to convert the resource mapping data and web portal information into manuals showing different design, technology options with BOQ showing how much will it cost and what incentives one will get if they adopt a green design, such as financial, subsidised materials. While some of the states have such design books, they need to provide BOQs of different technology options along with their greenness indexes helping people to understand the kind of incentives they can have if they adopt green design and technologies.
- Manuals to detail, the different stages of incremental transformation of a pucca home from the initial core to the whole shelter. Inform them on how this is possible with small loans taken a number of times.
- Bring greenness to the doorsteps through community mobilisers from BRC, the green campaigners. This is perhaps the most important component in greening IAY. The question is who this person could be? The mobiliser should preferably a higher secondary graduate woman who is specially trained to explain green issues to the households. Every BRC will have several such Green Campaigners and their remunerations would be economically viable since once a household agrees to adopt green system, the BRC will get business.
- Image building→ build district collector's office, canteen, etc. in green technologies. Some of the MoRD's offices in Delhi should also adopt the same principle of image building. Use and promotion of cost effective technologies in shelter construction has been in India since independence. However, rural Indians are yet to see government buildings built with cost effective systems. Though late, it is the high time when cost effective and green building should be built in each district administration campus which is visited by most of the rural population.

Capacity building of construction workers

- Establish an institutional system for training of construction workers by developing curricula, pedagogy, process of examination and certification. Green technologies will be in the centre of such training since they are, by and large, cost effective and income generating as well. Training without setting up an institutional system will be a futile attempt. Take lessons from DA, AEI, COSTFORD, etc.
- The cost of training and how to raise it are crucial. One should explore the possibility of getting sponsorship of training from the industries as bursaries. The National Skill Development Centre's current skill development programme could be used for this purpose.

Monitoring and evaluation (role of the *zila parishad/panchayat*)

- Data of each building will be analysed by the Greenness Index Calculator (see section 5) to calculate the embodied non-renewable energy, renewable energy; reuse/recycle materials, etc. Bi-annual report should be prepared by *Zila Parishad* to monitor the progress of greenness against district-wise target.
- Annual state-level review meeting of mobilisers to discuss the progress of greenness towards the target. If there is a gap, the reasons will be analysed and corrective measures undertaken. The whole exercise should be connected to the national database, which will help in policy decision and strategic measures to make sure that the progress is continuous.

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Annexure I:

Good Practices Where Green Outcomes Have Been Achieved

National and international experiences reveal that there is no dearth of good examples of green shelter. However, most of such examples address greenness partially. Therefore, superimposition of such examples will cover the complete domain of green shelter. Some works in the domain of green shelter is scholastic in nature though not necessarily socially acceptable. Some of the good examples in other countries could be modified to suit local conditions in India.

One of the major problems of most of the good examples is the general lack of scientifically acquired data on the construction technologies and designs. Many are enthusiastic about promoting their ideas but put less emphasis on data. Data collected in such instances are mostly partial. For example most of the databases in the present context are focused on cost and labour intensity and less on embodied energy and emission. Lack of a common energy handbook is one of the main reasons for heterogeneity of data on embodiment of energy and emission.

This section will examine a few good examples (national and international) under the following heads

- Background
- The key elements of the approach to achieve green outcomes, e.g., social equity, environmental sustainability and climate related risks
- How the above was achieved? e.g.
  - How was greening achieved? Was there cost saving as well?
  - What and whose capacities were built and how
  - How were green outcomes defined and measured for monitoring (e.g., specific indicators)
  - How was innovation supported and sustained?
  - How can these lessons be up-scaled?

CASE STUDY 1: SOUTH AFRICA: VENDA SHELTER (PRO VERNACULAR)

Project Background: The Vendas came from the Great Lakes of Central Africa. They live the way they had for hundreds of years in their lush, mountainous and remote region, which is why their culture, language, arts and crafts have survived so strongly. Today, many Venda people live in Thohoyandou in the Limpopo province of the Republic of South Africa. It is situated at the border of Zimbabwe.

This project was an architect-planner's own initiative towards creating modern vernacular in the rural context of Northern Province of South Africa. This was to influence the local people to enhance their own shelter conditions to reduce periodic maintenance of the traditional shelters. Aesthetics of the shelter was of prime importance.

Figure I.1: Venda Shelter (right) – the influences (left)

The key elements: It was primarily a vernacular based construction project. Hence, it had the inherent quality of greenness and environmental sustainability, which any vernacular system has. The buildings constructed are of least embodied energy and emission. One of the key features was recycling of shower

water to flush the WCs and kitchen waste to nourish the small garden and green landscape around the buildings. The key elements of this project were use of locally available mud and thatch so that a climate suitable shelter could be constructed. The promotion of local skill was an important consideration in this project. One major and perhaps unique feature of this shelter was application of local art forms through shelter.

Resource mapping (search for local materials, technologies and skills) revealed that sabunga (decomposed Dolerite) available at the outskirts of the village could be used for block making to act as a substitute for walling material, which was otherwise brought from Cape Town (900 kms from the village). Laboratory testing of cement stabilized (7%) block showed strength of 6 Mega Pascal (MPa), which was adequate for a two storey building. Roof was constructed with locally available thatch and blue-gum poles. Blue gum was fast growing tree and hence, renewable.

A NGO by name Van De Lewis Foundation was in Eastern Cape promoting cement stabilized compressed earth block for wall. The NGO was contracted to provide the technical support for the production of stabilized blocks. Their technical people were trained in CRATERRE, France in stabilized mud block production. A local institute by name Eastern Cape Appropriate Technology Unit (ECATU) was identified as the local nodal agency who was envisaged to be the champion on cost effective, environment friendly and livelihood supporting technologies evolved through the progrmme. The School Management Committee was the client.

How the above was achieved? e.g.

– *How was greening achieved? Was there cost saving as well?*

  The Venda houses in the Northern Province of South Africa are made of rammed earth and thatch roof. It is constructed artistically that the ambience suited the local Venda pattern of living and its culture. Mud and thatch being local materials made such houses the most affordable option. Since the local-level masons were traditionally trained in these technologies, maintenance was assured. Therefore, these buildings had low whole life-cycle cost. Thatch was grown everywhere in the Northern Province abundantly and earth was available as well. This made the buildings least embodied energy and CO_2 emission intensive.

  The project was situated in a high-wind zone. Round plan-form, used traditionally with roof angle more than 30 deg, is a time tested safe building against high wind. Vendas are comfortable with it and such shelter form and technology have not changed over centuries. However, when the system of construction was studied it was identified that the only short coming of the system was in the roof thatch. While high wind could never damage the buildings, sometimes extreme high wind blew off thatch around the lean-to of the roof, which the traditional builders repaired with least effort. The project has developed an alternative detail to overcome this problem. Apart from this, high wind also caused loss of walling material which was gradual to be noticeable in three to five years. Local timber glue, which had the same effect of lacquer, was used to insulate the wall surface reducing surface abrasion.

  The building was 40 percent cheaper than that of one built in reinforced cement, concrete roof and brick wall.

– *What and whose capacities were built and how*

  The construction workers were trained to use some of the modern construction tools and techniques for improved quality and durability of the traditional system. A blind local sculptor, did all the artistic work in the Venda house. She had been training the local people in this trade.

– *How were green outcomes defined and measured for monitoring (e.g., specific indicators)*

  There was no attempt to define or measure greenness objectively. It was done intuitively. However, in retrospect, one can gather data and analyse it to create credible database to address the three balancing issues – social, economic and environmental.

– *How was innovation supported and sustained?*

As mentioned above, high-wind takes away some amount of materials from the wall surface. The local soil was analysed to understand grain size distribution as well other chemical and physical properties. This helped the designers create mixed design to enhance density of the local soil with modified ratio and a small portion of fine sand. This, significantly, increased the density and surface toughness of the mud walls. This project was an individual's effort and was not supported by any government or international donors.

– *How can these lessons be up-scaled?*

It has been reported that the shelters constructed under this project has significant influence in the neighbouring villages. People have closely watched the performance of the building for a while and then started adopting some of the new techniques used in this project.

Table I.1: Summary of Venda Shelter

Examples	**Key element**	**How the above was achieved? e.g.**				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
South Africa: Venda Shelter	Vernacular based construction project. use of local materials recycling of shower water and kitchen waste application of local art forms through shelter.	Rammed earth and thatch roof. Mud and thatch local materials Thatch is grown everywhere and earth is available as well. Local timber glue was used as lacquer, to insulated to wall surface. It had saved about 40% with respect to RCC and brick intensive systems	The traditional construction workers were trained to use some of the modern construction tools and A local sculptor, who was blind, had been training the local people in this trade.	There was no attempt to carry out such exercises. balancing issues – socio-economic and environment.	This had been an individual's effort and was not supported by any government or international donors.	People had closely watched out the performance of the building for a while and then started adopting some of the new techniques used in this project

CASE STUDY 2: BANTWANANA (HYBRID)

Project Background: The schools constructed under the Ministry of education in the Eastern Cape Province of South Africa were based on brick, RCC and Metal roofing, which were expensive and energy intensive. This was the legacy of the pre-apartheid regime, where schools were meant for the ruling class (the minority) and thus money was not the issue for supply and maintenance of such buildings. Thus school for the majority, i.e., the local Xhosa's, was grossly neglected. In the post apartheid period, when equity was the major focus, the government realized that there was a need for a large number of schools for the population who were neglected for centuries.

Figure I.2: Classroom at Bantwanana

The Ministry of education realized that if they continue with the pre-apartheid designs and technologies and attempt to address the supply and maintenance of school buildings, it will not be sustainable in terms of cost. The South African ecological system being fragile, depletion of natural resources and emission of CO_2, due to school construction was a major concern. Therefore, the Ministry of education, Eastern Cape with support from DFID, initiated a search for cost effective and environment friendly design and technologies for school construction based on the local vernacular of the Xhosa communities. The idea was to set a trend of modern vernacular interpretation through school construction that will inspire people to adopt the same systems in their own shelters. This was owing to the fact that if one has to give access to all children (MDG) one must also ensure that the children live in healthy shelters since education is a complete package.

The key elements: The key elements of the programme were to achieve sustainable school and shelter of the poor people based on cost effective, labour intensive and environment friendly technologies. This was to address a large section of peoples' education and shelter for social equity and revitalize traditional Xhosa architecture and local skills. Fragile ecological system was a major concern.

- **How the above was achieved? e.g.**
- *How was greening achieved? Was there cost saving as well?*

  Brick, cement and steel are very expensive and energy and emission intensive in South Africa. Additionally, long-distance transportation of materials also increased cost as well as energy and emission intensities. Burnt clay brick was brought from Cape Town, about 900 kms from the village. Cement and steel were brought from Johannesburg. The other issue was that most of the investment on school and shelter construction went out of the villages because of major materials being from somewhere else. Therefore, the government schools were expensive, energy-emission intensive and low labour intensive and also created the least income multiplier effects. The attempt was to make all these favourable.

  The local villagers constructed their shelters with local soil called Sabunga (decomposed dolerite). The source of Sabunga was in the outskirts of the village. Roof was constructed with thatch and blue-gum poles, which were local materials. Blue gum was fast growing tree and hence, renewable. Interactions with the traditional construction related people a) Incibi (designers), b) Umakhis (builders) revealed how they did material selection, seasoning and other construction and design related issues. The walls were made of rammed earth, which eroded in high wind driven rainfall. Rectangular planforms always created whistling sound due to high wind and also high bending on wall surfaces. Round form was free from this problem.

  After carrying out resource mapping, it was decided to use sabunga as walling material. Laboratory testing of cement-stabilized (7 percent) block showed strength of 60 kg/sq cm, which was adequate for a two-storey building. The blocks had tough surface that could reduce the loss of surface materials due to high wind. The thatch near the eaves were tied in a special system to avoid loss of materials in high wind. Additionally, large windows were provided to enhance indoor illumination of the rooms, which was not the case with the traditional buildings in the fear of high wind.

  A NGO by name Van De Lewis Foundation was in Eastern Cape promoting cement stabilized mud block for wall. The NGO was contracted to provide the technical support for the production of stabilized blocks. Their technical people were trained in CRATERRE, France in stabilized mud block production. A local institute by name Eastern Cape Appropriate Technology Unit (ECATU) was identified as the local nodal agency who was envisaged to be the champion on cost effective, environment friendly and livelihood supporting technologies evolved through the progrmme. Under the leadership of the DFID consultant and with the help of Van De Lewis, the ECATU's capacity was built who could be the future nodal point for technology promotion. The School Management Committee was the client

The project had an overall cost saving of 30 percent compared to that of their regular buildings constructed under the Ministry of Education made of brunt bricks, timber under structure and zinc roof. Because of the use of local materials, about 65 percent of the total investment on the school had benefited the local villagers leading to higher income multiplier effect.

– *What and whose capacities were built and how*

ECATU was trained by VANDE. Local school dropouts were identified by the SMC, and trained by VAN De Lewis and ECATU jointly. On completion of training, the recruits produced all the blocks needed for the school.

– *How were green outcomes defined and measured for monitoring (e.g., specific indicators)*

The indicators were: a) unit cost of construction, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) embodied industrial/agriculture waste energy. f) emission of CO_2,

– *How was innovation supported and sustained?*

Seeing the success of the programme, the Government of Eastern Cape termed this as Bantwana model. With their own money, the Eastern Cape government conducted a resource mapping exercise at Maluti, the high mountain region, with the help of a local champion by the name EDC. Thus local-level small production-cum-resource centres and trained local school dropouts were the two changes the Ministry of Education brought in.

– *How can these lessons be up-scaled?*

After five years, local people at Bantwana have started adopting these systems in their own shelters. The force behind this was the local government's political will and ECATU acting as a local-level production-cum-resource centre.

Table I.2: Summary of Bantwanana School

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Eastern Cape	Sustainable school and shelter for the poor people; use of labour intensive & environment friendly technologies. School Community based construction	Reduced transport cost and energy and emission, Use of stabilized mud block out of local soil called Sabunga , Roof with locally available thatch and blue-gum poles, Blue gum, a fast growing tree and hence, renewable. Local people trained for block making	First of all, ECATU was trained by Van De Lewis. local school dropouts were identified by the SMC, trained by VAN De Lewis and ECATU jointly.	The indicators were a) unit cost of construction, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) emission of CO_2,	Government of EC termed this as Bantwana model With their own money, they have been replicating Bantwanana type buildings in Maluti and other areas of EC	In five years, local people have started adopting these systems in their own shelters. The force behind this was local government's support and ECATU as a local level production cum resource centre.

CASE STUDY 3: MUD BUILDING BANGLADESH (PRO VERNACULAR)

Project Background: Traditionally rural shelters in Bangladesh were of mud wall and straw roof. These were maintenance intensive. Every year, one has to spend some amount of money on repair after every rainy season. These shelters did not perform well against flood, which was partially addressed by using high plinth on high land for building construction.

Over a period of time burnt clay brick replaced mud, though it is expensive. Roof was replaced by RCC for the economically well off people. For the poor people, corrugated galvanized iron sheets as roof is the most trusted one though climatically it is very unsuitable both for summer and winter with virtually no insulating capacity. Some people for economic reason use CGI sheets both for wall and roof which is rather a torture chamber- too hot or too cold in most part of the year. Bamboo mat is another walling material which is widely used in Bangladesh.

At present there is a contrast between the government engineering departments and the NGOs such as Grameen Bank, BRAC, etc. The former considers RCC and burnt bricks to be the only option, whereas, the NGOs are using pro-vernacular systems which are affordable, though needs periodic maintenance.

With this as a background, Dipshikha , a NGO in Bangladesh undertook an project on sustainable school building based on local vernacular. The main objective of the NGO was to help children in rural areas learn to read and write. The NGO engaged two German architects to construct the mud and bamboo based school, which is a very good example of low energy and emission intensive option. The architects designed this building with clues from the traditional knowledge amalgamated with the latest scientific knowledge. Though this is a school project, all its technical knowhow were derived out of traditional shelters and hence, the final product is equally applicable for rural housing.

The key elements: Under this project local traditional building materials have been combined with modern knowledge on construction technologies. The building consists of rammed straw-reinforced mud walls finished with mud tapped with timber batten to make surface tough. The roof is finished with sheets of corrugated galvanized iron. This approach to construction supports green movement because of its low energy consumption and low emission of CO_2. Because it is based on local materials and skills, the buildings are affordable and enhance local level income generation, thus helps in social equity. Because of it's low negative impact on environment, it reduces climate related risks.

– **How the above was achieved?**

– *How was greening achieved? Was there cost saving as well?*

As mentioned above, this project was based on traditional construction systems such as mud walls and straw-thatched roofs. Bamboo was used as structural members (fastened with jute ropes/ string), or flattened for wall paneling, or simply woven together to act as screens. All these materials are recyclable or renewable and hence, have the least negative impact on environment. Building materials wereavailable within the villages. This had a income multiplier effect and less depletion of diesel/petrol and emission of CO_2. This is how greenness was achieved in this project.

Use of beams with a bunch of bamboo was the major innovation. This can compete with RCC beams. The advantage of using bamboo beams is that it is very light weight with high bending capacity. In comparison, a RCC beams' self weight is considerable compared to the super imposed load on it. Bamboo being renewable and fast growing material is excellent in every aspect of the balancing act. It is among the top few green systems.

While it is obvious that this building was cheaper than RCC and brick construction, no data was available in this regard.

– *What and whose capacities were built and how*

The labour force was local, while the architect and consultants came from Austria and Germany. The local craftsmen were trained by the German architects and their aides in innovative techniques of building construction. The same people were involved in construction of the building so that they could assimilate the knowledge and adopt the same systems in rural housing.

– *How were green outcomes defined and measured for monitoring (e.g., specific indicators)*

There was no such reporting on this issue. However, basic information on the type of construction suggests that the building is minimum energy and emission intensive. While the renewable bamboo and recyclable mud were energy-friendly, the use of CGI sheets are energy intensive, though consumption of materials is low and hence, not significantly damaging to the environment. However, this will not be suitable in hot regions.

– *How was innovation supported and sustained?*

It was a privately funded project. The project does not appear to have influenced the government to adopt these techniques of cost reduction. Usually, cost-effective systems are not visually appealing. The mud school in Bangladesh breaks this pattern by creating an aesthetically pleasing building that is more akin to the local built forms. In Bangladesh the government engineering departments, like any other neighbouring countries, consider RCC and brick-based construction as the only acceptable systems. Until and unless there is a strong political will, such technologies will never get off the ground. The same holds true for India, Nepal, Pakistan, Sri Lanka, etc.

– *How can these lessons be up-scaled?*

Without political will, such systems will be difficult to replicate on a wider scale. There should be an enabling environment for harvesting bamboo locally. Local training institutes needs to be established. The universities should be engaged in promoting these technologies and through a lab to land connection the knowledge could be disseminated at grassroot levels. If a few buildings could be constructed in Dhaka within the governmental sectors, people will gain confidence in these technologies.

Figure I.3: Mud school in Bangladesh

Table I.3: Summary of School at Bangladesh

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Bangladesh	Traditional building materials combined with modern knowledge on construction technologies.	Bamboo as structural members, rammed straw-reinforced mud walls these materials are recyclable or renewable & locally available Bamboo, fast growing renewable material is excellent in every aspect. It is among the top few green systems	The local craftsmen were trained. The same people were involved in construction of the building so that they could assimilate the knowledge and carry forward to adopt the same systems in rural housing.	There was no such reporting on this issue.	Use of beams with a bunch of bamboo was the major innovation. It was a privately funded project. Did not gain popularity in govt. sectors	With strong political will, harvesting bamboo, Local training institutes to be established. few buildings could be constructed in Dhaka in the government buildings

CASE STUDY 4: SRI LANKA (HYBRID)

Project Background: During the civil war in Sri Lanka, people from Mannar district in the Northern Province were constrained to move to Putalum (80 kms away). When the civil war was over, these people began to come back to their own place and started resettling from 2010. There were hardly any resources for them to live except basic needs such as food and drinking water. There was a big problem about their shelter since it did not have local market for construction materials. The locality had a very limited number of skilled people.

Initially people were not very sure whether they could resettle in Mannar with their families. So in the early 2010, some of the family members from HHs came to Mannar and children and women stayed back in Putalam. There was hardly any form of shelter excepting a few shacks and tents. The government of

Sri Lanka wanted to encourage people to resettle fast and in support of that, wanted to create primary healthcare and schools in Silwathurai of Mannar District.

Room to Read (RTR, international NGO) in Sri Lanka got the permission to build 42 child friendly schools which were supposed to encourage people to shift to Mannar with families. The government was convinced that if local area specific technologies could be evolved through the school construction, it will help in creating enabling environment for the local people to have their own sustainable shelters. Two pilot projects were constructed in two villages of Silwathurai. The projects started in August-September 2010. An in-depth research was conducted locally available materials and skills to evolve appropriate form, shape and technologies.

The key elements: The project attempted to identify sustainable designs and construction technologies which were cost effective, easy to maintain, create employment at local level and with the least negative impact on the environment. Use of local materials was another object to create a local level construction material market and also to increase income multiplier effect. This being a high wind zone, appropriate precautions was taken both in design and technology for safety as per the latest building codes of Sri Lanka. Thus climate change issues were also addressed. As mentioned before, the expected spin off was to create a local materials based construction system so that shelter becomes affordable establishing social equity.

– **How the above was achieved? e.g.**

– *How was greening achieved? Was there cost saving as well?*

A resource mapping exercise was conducted in all the 42 project villages in Mannar. There was no local material except sand, soil and quartzite stone. Clay tiles were available at a distance of 70 kms from the pilot sites. Local timber was in abundance though there was no organized system to procure and market them. Steel was imported from South Africa and timber from Malaysia. Cement was imported from Australia, China and India. Based on resource mapping, the possible technologies were evaluated by using an assessment tool to narrow down the domain of feasible technologies in Mannar. It was decided to use construction systems that would consume least amount of cement, steel and other imported materials.

The soil was good and hence, stub-footing in stone and cement was the most appropriate option that not only reduced cost of foundation, it also reduced the negative environmental impacts. As far as the waling system is concerned, stabilised soil blocks was the first choice. However, there were a few problems with that. This being a high-wind and rainfall zone, there was the problem of surface erosion of the walling materials.

Fifteen years ago a group of engineers from a village in Mannar were sent to Pondicherry to learn about compressed stabilised earth block. When they returned, they produced such blocks and built a few buildings in a NGO centre. Because of lack of quality control, the buildings had eroded badly in the last decade. Therefore, it was decided to postpone the use of this technology for the following years since the community was not convinced about the suitability of earth block technology.

A local villager had a concrete block-making machine which was lying idle. The consultant, with the help of RTR engineers designed concrete mix and tested the blocks. Based on the test results, a new mix design was proposed and negotiated with the villager who owned the block-making machine. He agreed with the most reasonable cost. Thus the walling system was 150mm wall in concrete block in cement sand.

As far as the roof was concerned, there were three options, a) RCC slab, b) Zinc sheet on steel/timber under structure, c) Clay tiles on timber. Clay tiles were chosen as RCC was expensive, zinc was very low on thermal insulation and South African steel had high cost, energy and emission intensity. With local timber and clay tiles, the most appropriate roofing system was designed.

The pilot projects were designed as cost-effective systems with the use of rationalised structure and appropriate materials that maximised local level employment and minimised the damage to the environment. The local materials were sand, stone and timber. Hence, concrete block masonry wall,

stub footing (450mmX450mm random rubble posts @ 1800mm c/c), clay tiles roof on timber under structure were adopted.

– *What and whose capacities were built and how?*

This project started with capacity and awareness building. In May 2010, RTR engineers were trained in Colombo in resource mapping and hands-on-learning of different construction technologies and designs. Together with the engineers, a few masons also took part in the training by demonstration the construction of arches, stubs etc. Prior to this, the RTR officials were also trained by their regional office.

Before implementation, the local community members were informed about the innovations. During implementation, on-site training was conducted where masons and carpenters from the other project sites participated. Masons and engineers from other RTR projects were also brought to the pilot sites to demonstrate how work was being executed. One of the most significant outcomes of the project was reduced wastage.

The pilot projects had significantly increased employment opportunity for the local people due to the use of labour-intensive systems as well as encouraging the use of locally-produced building materials. A special impact was the tremendous capacity building of the RTR engineers, local masons and carpenters.

– *How were green outcomes defined and measured for monitoring?*

A resource mapping exercise was conducted to identify a list of feasible technologies and designs. The parameters for evaluation were a) reduced cost and ease of maintenance with minimum cost, b) labour intensity, c) minimum embodied non-renewable energy, d) encouraging use of renewable energy, e) reduced CO_2 emission.

– *How was innovation supported and sustained?*

The entire exercise was funded by RTR. Innovative systems such as stub-footing, concrete blocks with appropriate load bearing wall and rationalised timber-supported tile roof, etc. were adopted in the buildings. Such techniques used local materials, consumed less cement, steel and reduced wastage. However, this was not easy to implement. The usual difficulty of using a system for the first time, district specific socio-cultural and economic adversity, lack of local material market, absence of skilled construction workers, etc. were the major constraints. Unusually adverse weather conditions was a major problem in the pilot project. However, the project, in retrospect, has clearly laid down all the details so that in future there will be significant cost saving in the new designs. The masons, carpenters and trained engineers are using the innovations developed in the pilot projects.

– *How can these lessons be up-scaled?*

The Ministry of Provincial Education at Trincomalee was highly supportive and encouraging. They accepted the proposals and approved the designs in less than a month, which is a milestone in developing countries. There is strong political will to promote this type of construction systems with greening as the focal point.

On exit of the pilot projects, the villages had five teams of skilled masons, carpenters and bar-benders. These people have already started working as small contractors. The next step would be to establish a local-level production-cum-resource centre to support individual households to build and maintain their own shelters.

Figure I.4: School building at Mannar, Sri Lanka

Table I.4: Summary of School at Silwathurai, Mannar

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Mannar Sri Lanka	Identifying cost effective and environment friendly disaster safe design and construction technologies; creating local level employment. creating a local level construction material market	Resource mapping (search for local materials and skills) conducted in all the 42 project villages Stub footing in stone and cement, locally produced concrete blocks Clay tiles on timber. Appropriate roofing system was evolved.	RTR engineers trained at Colombo, the local community members were informed about the innovations. on-site training was conducted where masons and carpenters from the other project sites took part.	Parameters for evaluation of technologies were a) cost & ease of maintenance, b) labour intensity, c) minimum embodied non renewable energy, d) use of renewable, e) reduced CO_2 emission.	The entire exercise was funded by RTR. The masons, carpenters and the trained engineers are using the innovations done in the pilot projects.	There is a strong political will On exit of the pilot projects, The next step would be to establish a local level production cum resource centres to support individual HHs to build and maintain their own shelters.

Case Study 5: Post-NARGIS Shelter Programme, Myanmar (Pro-Vernacular)

Project Background: Cyclone Nargis struck the coast of Myanmar on 2-3 May 2008 causing massive damage to the lives and livelihoods and properties which made a landfall in the Ayerrawady and Yangon Divisions. An estimated 2.4 million people were also severely affected in thirty seven townships where a large number of rural population lives. In the post cyclone period a large number of INGOs and NGOs along with donor partners came forward to rebuild the perished/damaged shelters for the coastal areas, which is primarily the rural areas.

The key elements: One key area of the project was to integrate disaster risk reduction (DRR) with rural and urban planning and developmental works in shelter. A study was conducted to assess the shelters in the Delta (coastal) area of Myanmar and its resilience for future disasters and thus addressing the priority of actions III and IV of the Hyogo Framework of Actions (HFA[1]). The intervention in shelter reconstruction had the inbuilt features such as greening shelter, establishing social equity through cost effective disaster safe construction systems, environmental sustainability & climate related risks (addressed through HFA). This has relevance in the context of IAY. Based on region specific multihazard map, different design and technology options should be reviewed and suggested.

- **How the above was achieved? e.g.**
- *How was greening achieved? Was there a cost saving as well?*

  Use of less cement and steel-intensive construction systems was easily acceptable to both the government and the people. This is not the case in India or other neighbouring countries because of the engineering fraternity's inclination towards RCC and brick systems. Highly qualified structural engineers in Yangon conducted out analysis and design of venracular shelter systems against high wind. They recommended seven check points to assess wind vulnerabiility of a shelter. To the community, ABC (anchor, bracing, connections) was the essence of disaster safety.

  As mentioned above, the use of timber, bamboo, tiles with RCC-stubs made the entire programme green. The post-NARGIS shelter reconstruction programme was viewed as a great opportunity for income generation as well as skill development. However, no agency had objectively measured greenness of the shelters constructed by them.

[1]III. Use knowledge, innovation and education to build a culture of safety and resilience at all levels, IV. Reduce the underlying risk factors

About USD 500 was allocated per household to build 25 sq m of covered area. Perhaps the cheapest possible shelter in the subcontinent. A semi-permanent shelter of good quality was around USD 1000 as against the prevailing cost of USD 2000 for similar shelters in RCC and brick.

– *What and whose capacities were built and how?*

Manuals were prepared for disaster-safe green and affordable housing for the communities, carpenters, masons and top-level management. These manuals were drawn on already existing good examples in other countries. High quality training of masons and carpenters on disaster-safe construction was implemented in the cyclone-affected townships. At the end of the programme, the rural coastal areas, which were badly affected by NARGIS, had many trained carpenters and masons. Thus a favourable environment had been created to conform with HFA.

Posters, manuals and other training materials were distributed widely in the coastal areas for disseminating the concept of "build back safer" meaning when a damaged or collapsed building is rebuilt; it had to be as per the safety norm of the Myanmar's building code.

– *How were green outcomes defined and measured for monitoring?*

Indicator type 1: Balancing act - Greenness, cost and livelihood

After reviewing the design, visiting site and examining the survey reports, the parameters for evaluation of the technologies were: a) reduced cost and ease of maintenance, b) increase labour intensity, c) minimum embodied non-renewable energy, d) encouraging use of renewable energy, e) reduced CO_2 emission.

Indicator type 2: Comfort of the shelters

Greening shelter should be combined with comfort and social acceptability of construction technologies and designs. A detailed survey was conducted to understand peoples' preference on different issues of the households. Myanmar Survey Research conducted the users' feedback from all the affected townships in Myanmar. The questionnaire was designed by an international consultant from UNHABITAT Myanmar. There were 12 criteria for assessing the comfort level. The following were the people's preferences on comfort of the new shelters.

Figure I.5 A: Priorities of importance assigned by the respondents against 12 criteria

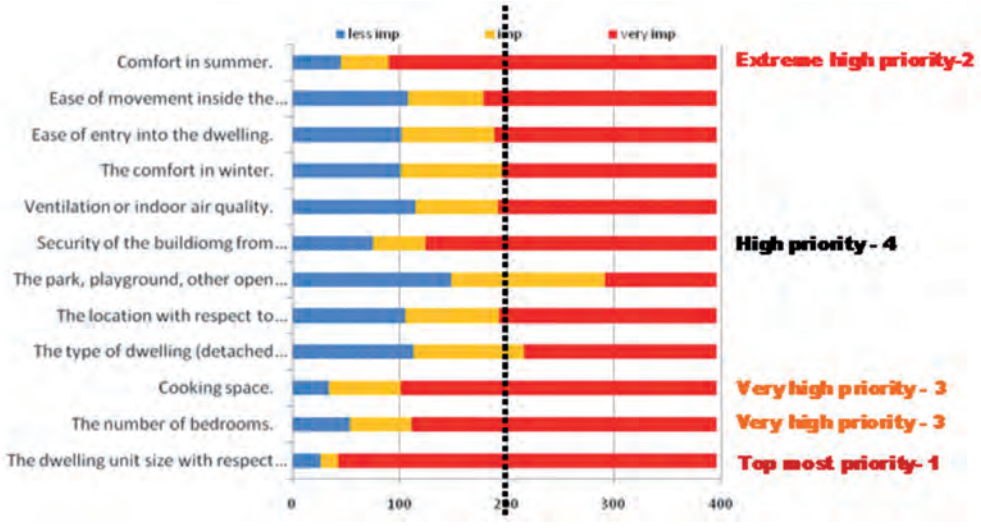
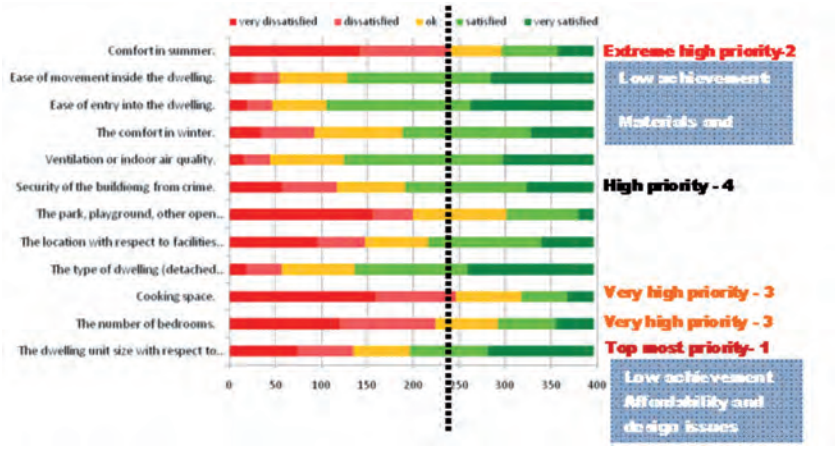


Figure I.5 B: Performance against 12 criteria



Summer comfort: The survey (November 2010) revealed that the respondents expressed, in general, dissatisfaction over their present houses compared to the ones they had prior to Nargis. Almost half of the respondents said that they lived in low quality houses when considering protection from the sun, per capita of space, adequacy of space between boys and girls, wind or harsh weather conditions. 42% HHs expressed satisfaction over rain protection, which is probably due the use of corrugated iron sheet roofing. However, the same roof caused discomfort in summer for the residents since corrugated iron roofing quickly traps in heat from the sun. Lack of ceilings in most cases is another cause for summer discomfort.

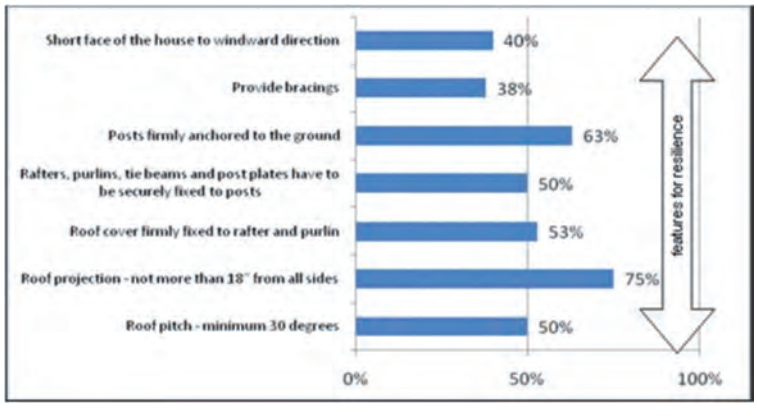
Expandability: The survey revealed that the households were happy with the provision for future expansion and transformation. Nearly two-thirds or 63 percent of the households gave positive comments on that aspect. However, it was important to know whether structural safety had been retained while expanding or modifying the given shelters. There was a strong need for clear guidelines in the manuals on the issue of expandability and transformation without jeopardising the original design of structurally safe shelter.

Disable-friendly: Twenty eight households of the survey area mentioned that they have members who had limited mobility. Only six said that their houses were designed for the convenience of their disabled household members. It was a very important component of shelter programme. The objective, in this regard, was to create barrier-free built environment with an emphasis on toilets and bathing facilities.

Indicator type 3: Disaster safety

Technology: Construction technology plays an important role in disaster safety of shelters. There are several prerequisites for such structural safety and in Myanmar the following seven were adopted for this purpose. The wind hazard safety of the shelters built in the post-NARGIS period was assessed under seven heads shown in the Figure below.

Figure I.6: The pattern of disaster-safety features of the HHs



The households surveyed had the above pattern of disaster-safety features in their shelters. The greatest achievement had been in restricting the roof projection within 450mm. Provision of bracing was the least. However, it must be noted that without all the above features, it is not disaster safe. By providing only partial features the building will not be safe from future cyclones. It was strongly recommended that there is a need for advocating through all the ICT materials on the need for all the features for disaster safety. *A true indicator of disaster resilience would be to capture data on how many shelters have all the seven[2] features. It will give a better picture of disaster-resilient shelter. This will also demonstrate on retrofitting requirements.*

Therefore, the indicators for measuring greenness, cost effectiveness, ease of maintenance, viewing construction as an opportunity for income generation, disaster safety and comfort levels are the most important features of the post-NARGIS reconstruction interventions. This project had considered most of the aspects of rural housing in Myanmar, which could be used elsewhere - perhaps one of the best examples where housing has been viewed as a complete package.

– *How was innovation supported and sustained?*

  All the innovations by the NGOs, INGOs, etc., were funded by donor partners and supported by the government. To assess the safety of the innovative systems, a consortium was established by involving all the stakeholders, both national and international. There was a large number of innovative walling and roofing systems suitable for high wind and cyclone.

  A few agencies had established production units to supply good construction materials to the communities. The need for local based production unit was highly necessary in the coastal belt of the country because of very poor physical access to the settlements. In most of the places, boat was the only transporter, which is dependent upon the high and low tide of the rivers. The decentralized small production units were established by INGOs with a view that in future people will run this on a co-operative basis. For sustainability, such centres must be market driven though initial support will be necessary for a while before they become self sustaining. UNHABITAT had appointed Asian Institute of Technology to establish a system of small decentralised production units in rural areas.

– *How can these lessons be up-scaled?*

  Myanmar has developed an institutional system for supporting the sustainable delivery of disaster-safe shelters for the poor people in the rural areas. The post-NARGIS reconstruction work in housing was reviewed in 2010 and it was proposed that Decentralised Small Building Resource Centres would be the key to sustain the innovations in shelter programme in Myanmar. Owner-driven shelter supply, repair and retrofitting appeared to be a sustainable way in Myanmar considering its socio-cultural heritage. The trained carpenters and the community members were to form a small production unit, which will have less overhead and complexity. They are easy to manage with limited managerial skills. Above all, these will create enhanced livelihood generating opportunity for the local people.

  There is already a work plan for establishing Habitec Building System (HBS) cottage industries in the peri-urban areas on a pilot basis. Habitec Centre of Asian Institute of Technology (AIT) has been involved in technology transfer of their HBS. UN HABITAT funded this programme in which each centre will be run by six people with one representative each from six villages. Six persons will run the Habitec centre, which will be a profit-making organisation, This could be the seed of a future Building Resource Centre.

[2]1) 1) anchor, 2) bracing, 3) fixing purlin/ rafter, 4) fixed roof cover, 5) roof projection, 6) roof pitch, 7) orientation

Table I.5: Summary of Shelter Post-NARGIS Programme

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
NARGIS, Myanmar	Integrating disaster risk reduction (DRR) with rural and urban planning and developmental works in shelter. addressing the priority of actions HFA III, focus on "build back better".	promoting owner driven shelter programme. ABC (anchor,bracing, coonections) was the essence of disaster safety; use of timber, bamboo, tiles with RCC stubs programme viewed as a great opportunity for income generation as well as skill development.	Capacity building of communities, carpenters, masons and top level management- many were trained after NARGIS Manuals prepared for disaster safe green; affordable housing ICS materials were distributed widely in the coastal areas	Indicator type 1: Greenness, cost and livelihood; Indicator type 2: 12 parameters of comfort of shelters; Indicator type 3: seven indicators of disaster safety; This project had considered most of the aspects of rural housing	Funded by donors and supported by government. For design check a consortium was established small production units established by INGOs	Model for up scaling shelter movement is in place; Small decentralized production cum training centres key to the success; UN-HABITAT appointed Asian Institute of Technology to establish the above

CASE STUDY 6: NORTHERN KARNATAKA RURAL HOUSING (HYBRID)

Background:

SDC had initiated a programme on sustainable rural housing in India. Two of the pilot projects were in Bijapur and Bidar districts of Karnataka. The project aimed at developing affordable, disaster safe and comfortable shelters expected to withstand the actions of natural forces for at least 50 years. Any technology that rendered a safe and comfortable living for 50 years was considered to be acceptable in the shelter programme. Participatory design approach by involving the beneficiaries was adopted for sustainable designs. For the Above Poverty Level people, the designs and technologies were prepared to build shelters incrementally over time.

Community had always been a great resource in shelter construction. Involvement of the community in the entire process of design and implementation not only made the designs acceptable to the people, it also reduced cost of construction. The local NGO were considered to be the future champion of such movement since they worked in partnership with the communities.

The key elements: The following were the key elements of the programme

1. Understanding the pattern of living so that a socially just, gender sensitive shelter can be designed.
2. Evolve a participatory process of design, which may lead to a reflection of livelihood patterns on house design.
3. Ensure the inclusion and acceptable location of toilet, bath and kitchen.
4. Improving the ventilation, sanitation (including waste water drainage and waste management) and water supply condition (including rain water harvesting systems) for a healthy and harmonious environment.
5. Deriving cost effective and energy efficient construction technologies based on use of local building materials and skill; which may be called intermediate technology
6. Community awareness on new technologies
7. Capacity building of the local masons
8. Poverty reduction through livelihood generation

Figure I.7: Participatory design exercise by involving the beneficiaries

– **How the above was achieved? e.g.**

– *How was greening achieved? Was there a cost saving as well?*

Resource mapping was conducted by involving NGO engineers and some of the young villagers. Feasible construction materials, technologies and skills at village level. Ten such villages were surveyed to create a robust menu of technologies and design in the project. Soil being scarce, materials compressed stabilised earth block technology was not recommended. Rat-trap bonded wall was a feasible solution considering the hot summer. However, the quality of brick being poor, plastering would have been needed making rat-trap a non-viable option. The most common materials in Bidar and Bijapur were random rubble stone, cuddappa stone and bamboo.

Expansive soil in Bijapur meant the need for light weight structure. It was observed that the local masons constructed very thick walls. They did not use bond stones which made the walls weak and hence there was a need for thicker construction. The community was used to this system for a long time and hence the thin wall, as an alternative, was not considered strong enough. The masons had to be trained since they were the resource persons in the villagers.

Footing and Walling: Use of stub footing and cone foundations was adopted. The use of mild reinforcements as vertical bands with horizontal reinforcements at DPC, lintel and roof had increased ductility in the structure and helped in reducing wall thickness to around 380mm. Use of bond stones was promoted.

Roof: The local NGO, SABALA, in collaboration with the local *Nirmithi Kendra*, produced precast RCC joists at site by involving the beneficiaries. Two types of roofs were introduced in the process of construction a) cudappa stone roofing on precast RC joists, b) shallow vault with brick.

RCC door and window frames were encouraged since they were available in the local Nirmithi Kendra. Red oxide flooring on 1:2:4 CC with 1:4 cement mortar leveling course and about 4mm thick 1:4 cement red oxide mix float on top with a total thickness of 40mm. All these technologies were chosen to make shelter affordable, labour intensive and least damaging to the environment. The community participated designs made the shelters acceptable to the people.

– *What and whose capacities were built and how?*

A small group of young architects and engineers were identified to support the NGO. They were involved in making the model shelters in the villages so that they could watch the whole process of construction. In each project village five masons were identified in Bidar and Bijapur. After the initial training, they were given hands-on training on stub footing and different types of roofing systems. In the process, the SABALA engineers and about 15 masons and carpenters were trained as master trainers.

– *How were green outcomes defined and measured for monitoring?*

  The parameters used were a) low unit cost, b)ease of maintenance, c) gender issues, d) low embodied non-renewable materials, e) encourage use of renewable materials f) encourage using industrial/ agriculture waste, g) low CO_2 emission

– *How was innovation supported and sustained?*

  SDC had funded the project to develop a replicable model for rural housing in Karnataka. They supported all the innovations evolved through research and resource mapping. However, the trained masons and engineers continued with similar construction techniques in other projects.

– *How can these lessons be up-scaled?*

  Interface with the local Nirmithi Kendra for training and production of appropriate construction techniques was established. A travelling technology mela was proposed to be designed with exhibition panels, scale models and hands-on training at each one of the project sites. The demonstration building was designed to be a place where information panels regarding house designs, combinations of technologies etc. should be displayed on a permanent basis. In addition, a manual was proposed (mainly through graphics) to aid local masons design and construct cost effective shelters. In places (Bidar) the NGOs promoted the recommended technologies for adopting them in the programmes like IAY etc. The block and district-level government engineers were made partners in this endeavour.

SABALA worked in partnership with the engineering college in Bijapur, which was developed as a resource centre. SABALA and SAMARASA were proposed to promote mobile unit for the production of precast-RCC joists, Micro-concrete tiles, cement/lime stabilised compressed earth blocks etc. It was a sort of *Nirmithi Kendra* on wheels. The machineries were to be under the control of the NGOs and were to be transported to the project sites as and when necessary. At least two trained master-masons were identified and a special training were imparted on production process, maintenance management, etc.

Between 2006-2007, a total of 111 buildings were constructed by Sabala[3] in two *talukas* (Bijapu and Basavan Bagwadi) under this programme. Cost of each shelter was INR 45,000 (INR 10,000 Rajiv Gandhi Rural Housing Corporation + INR 10,000 state government subsidy + INR 25,000 bank loan + labour contribution of beneficiaries). Following the success of this programme, SABALA established a women's bank named Chaitanya Mahila Co-operative Bank. Annually, about 150-200 women receive housing loan from the bank. The women benefitting from this are both from BPL and APL.

Table I.6: Summary of Northern Karnataka Shelter Programme

Examples	**Key element**	**How the above was achieved? e.g.**				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
Northern Karnataka	Understanding pattern of living gender sensitive shelter Evolve a participatory process of design,. technologies based on use of local building materials and skill; Poverty reduction through livelihood generation	A resource mapping exercise Footing and Walling: Use of stub footing and cone foundations (for black cotton soil) ; use vertical reinforcements & band ; Stone wall 380mm thick Roof: a) Cudappa stone roofing on precast RC joists, b) Shallow vault in brick.	A small group of young architects from SABALA and about fifteen masons and carpenters were trained as master trainers.	Parameters used a) low unit cost, b) maintenance, c) gender issues, d) low embodied non renewable materials, e) encourage renewable f) encourage using industrial/ agriculture waste, g) Low CO_2 emission	SDC had funded the project to develop a replicable model for rural housing in Karnataka. They supported all the innovations evolved through research and resource mapping	Interface with local Nirmithi Kendra for training and production travelling mela on technology; Block and District level government engineers as partners mobile unit for production - Nirmithi Kendra on wheel.

[3]NGO working in Northern Karnataka, Website: http://www.sabalaindia.com

CASE STUDY 7: COSTFORD (HYBRID)

Background: The Centre of Science and Technology for Rural Development (COSTFORD) was founded by Laurie Baker and others in 1984 as a non-profit voluntary organization and started its construction activities in 1986.

Figure I.8: Namboothiris' House, Kerala

The key elements: COSTFORD consists of social workers, educators, architects, engineers, scientists, technologists and others. It promotes empowering and enabling the poor and weaker sections of society to improve their living conditions by application of appropriate and people-friendly technologies and adopting participatory, transparent, and gender-sensitive processes. Housing is the largest component of COSTFORD's 25 years of work in providing cost-effective, energy efficient, resource-sensitive architecture.

– *How was greening achieved? Was there cost saving as well?*

  Construction technologies such as, Rat Trap, Jaali wall, Filler slab, arches, frameless door and window, bamboo, mud construction, etc. are promoted by COSTFORD in pursuit of green housing. The main principle of COSTFORD is to eliminate, as far as possible, structural redundancy and costly finishes. In Rat Trap about 25 percent bricks are saved compared to that of solid brick wall. This also reduces the consumption of cement. Apart from that the use of jaali walls acts as a good alternative to costly timber doors and windows. The frameless door and window simply eliminate the costly frames. Their present emphasis is on bamboo shelter.

  The use of cost effective technologies saves cost which could be at least 15 percent of the brick, cement and steel intensive systems, although it varies from place to place depending upon local conditions.

– *What and whose capacities were built and how?*

  COSTFORD in the last 25 years has been conducting capacity training programmes for both women and men. It has provided awareness building for over 25,000 people from all walks of life on ways to effect positive societal change. Participants include social workers, engineers, home-based women, architects, construction workers, technologists, state government officials, students, *Panchayat Raj* representatives, visitors from other states in India and abroad, etc. COSTFORD trains masons on job and at present they have more than 1000 trained masons. It also trains engineers who join them as interns.

– *How were green outcomes defined and measured for monitoring?*

  Greening as a philosophy is inbuilt in COSTFORD's entire process of selection of site, materials, and methods of construction. However, it does not provide detail information and database on the quantum of energy and emission saved by the technologies promoted by them. COSTFORD is in the process of developing a Green Building Code.

– *How was innovation supported and sustained?*

  COSTFORD is self sustaining. Its institutional clients are often educational facilities financed by local, state and/or central funding. Other public buildings include those commissioned by various combinations of centre, state, and local entities primarily for administrative facilities and educational institutions. For private buildings they charge a fee for design and supervision, which is the main source of their finance. COSTFORD views every project as an opportunity for research and development. However, the biggest contributor to its innovations could be attributed to Laurie Baker.

– *How can these lessons be up-scaled?*

COSTFORD is a large organization who has already up-scaled their technologies at grass root level. This is one example in which the technical expertise reaches the household doorsteps. Local government's support to COSTFORD is its strength.

Table I.7: Summary of COSTFORD

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
COSTFORD	COSTFORD promotes empowering &enabling poor & weaker sections of society to improve their living conditions by application of appropriate and people-friendly technologies & adopting participatory, transparent & gender-sensitive processes	By using Rat Trap, Jaali wall, Filler slab, arches, frameless door & window, bamboo, mud construction, etc. It eliminates structural redundancy and costly finishes. Saves least 15% of the brick, cement and steel intensive systems	It conducts capacity training for social workers, engineers, home-based women, architects, construction workers, etc. COSTFORD trains masons on job It also trains intern engineers	Greening is inbuilt in COSTFORD's entire process. However, it does not provide indicators & database on greenness of their technologies. COSTFORD is preparing Green Building Code.	COSTFORD is self sustaining. It has institutional clients financed by Local, State &/or Centre. It also generates fund from consultancy fees from private buildings. Main inspiration and contributor to innovations is Laurie Baker.	COSTFORD has already up-scaled their technologies at grass root level. This is one example in which the technical expertise reaches the HH doorsteps. Local government's support to COSTFORD is its strength.

CASE STUDY 8: DA (HYBRID)

Background: Development Alternatives (DA) was established in 1982. It is a research and action organisation, designing and delivering eco-solutions for the poor and the marginalised. It has both national and international experience in the field of addressing poverty challenges, cost effective and environment-friendly construction technologies.

Figure I.9: DA technology jackarch & MCT roof & CSEB wall, Hyderabad

DA Group was set up, comprising five organisations. The non-profit Societies, such as the flagship entity Development Alternatives and TARA (Technology and Action for Rural Advancement) are responsible for research, innovation, policy, incubation of green businesses and technical support services. The for-profit companies, such as DESI Power, TARA Machines and TARA Enviro are responsible for implementing the work of the DA Group at scale in business mode, all under the overall brand name of TARA.

The key elements: DA promotes a wide range of technologies for rural housing. Among some of their technologies are Compressed Stabilized Earth Block (CSEB), Micro Concrete Tiles (MCT), Ferrocement Channel (FC) roofing, etc. DA has a strong component of skill building in all the technologies they use in rural housing. It has local level centres (e.g., Jhansi) in rural areas. DA technologies are based on reduction of energy intensive cement, steel, bricks, etc. which also reduces emission of CO_2.

– *How was greening achieved? Was there cost saving as well?*

Use of low energy intensive materials has been the main focus of DA. Use of CSEB consumes less cement. Similarly, FC and MCT roofs are less cement-intensive materials due to the use of efficient structural form. The on-site process of erecting precast element is manual, which saves on energy and emission.

DA brought Vertical Shaft Brick Kiln (VSBK) Technology to Datia from China in 1996 and through intensive research, was adapted to Indian conditions. TARAgram Datia houses a centre for brick excellence, which provides technical support services to brick manufacturers. The success of this technology is boosted due to the availability of fly ash waste and sponge-iron waste near the site.

In general, DA technologies save money compared to brick, cement and steel intensive systems. The savings vary from place to place depending upon local circumstances. In APPEP, average saving of DA buildings were about 12 to 18 percent.

– *What and whose capacities were built and how?*

DA has training institutes. Apart from that it carries out on-site hands-on training of construction workers. They have produced a large number of skilled workers in many states. DA has been successful in developing a structured modular training methodology with quality assurance and targeted delivery. The courses were practical and applicable, yet based on research on management and organisations.

– *How were green outcomes defined and measured for monitoring?*

DA prepared useful energy handbook. However, there is a need for updating it in the light of latest information and knowledge. In the revised handbook, the boundary of the calculation method should be well-researched by involving subject experts.

Selection of DA technologies are based on parameters; a) unit cost, b) labour intensity, c) embodied non-renewable energy, d) embodied renewable energy, e) emission of CO_2.

– *How was innovation supported and sustained?*

DA has been funded by various agencies from time to time. They have a international collaboration which also generates funds for their research and innovation. DA generates money from consultancies as well. One scientist at DA is devoted to research on various aspects of energy-efficient technologies. DA has used FC roofing in its own building in Delhi.

– *How can these lessons be up-scaled?*

While DA technology has been successfully been implemented in many housing projects, it is yet to gain a wider acceptance. One of the issues in up scaling has been that the stabilized mud technologies are yet to be accepted by the engineering departments. There is a need for including this technology in the building codes. While MCT is an excellent roofing material, it is yet to arrive at a structurally efficient understructure on which the tiles sit and are tied.

Table I.8: Summary of Development Alternatives

Examples	**Key element**	**How the above was achieved? e.g.**				
DA		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
	Development Alternatives is a research and action organisation, designing and delivering eco-solutions for the poor and the marginalised.	Use of low energy intensive materials such as, CSEB, MCT, FC roofing, etc. DA brought Vertical Shaft Brick Kiln (VSBK) Technology from China & adapted to Indian conditions. In APPEP, average saving of DA buildings were about 12-18%.	DA carries out on-site hands-on training of construction workers. They have produced a large number of skilled workers in many states. DA has structured modular training	DA has energy handbook, which needs updating. Selection of technologies based on; a) unit cost, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) emission of CO_2.	DA is funded by various agencies, it has international collaboration . DA generates money from consultancy as well. Scientist in DA is devoted to research on various aspects of energy efficient technologies	While DA technology has been successfully been implemented in many housing projects, it is yet to gain a wider acceptance. DA technologies could be up-scaled if they are included in BIS codes

CASE STUDY 9: AUROVILLE EARTH INSTITUTE

Figure I.10: Mud building: Pondicherry

Background: The Auroville Earth Institute (AEI), previously named the Auroville Building Centre/Earth Unit, is in a mission to bring awareness about earth architecture and technologies, and it covers worldwide examples from past to present. AEI has been able to demonstrate the possibilities of the earth as a building material. It has government approval for the use of Compressed Stabilized Earth Block (CSEB) especially for disaster resistance.

The Key elements: Auroville promotes CSEB with cement stabilization as walling material. Their stabilized rammed earth wall is not only cost effective (in some areas) and environment friendly, it has immense aesthetic appeal. Among the roofing systems FC, different types of domes and vaults in stabilized compressed earth block are notable.

– How the above was achieved? e.g.

– *How was greening achieved? Was there cost saving as well?*

The following are promoted by Auroville as green technologies

- Stabilised rammed earth foundations with 5 percent cement
- Stabilised rammed earth walls with 5 percent cement, rammed manually
- Composite plinth – step plinth with CSEB, plinth beam with reinforced concrete cast in U-shape
- Composite columns – round hollow CSEB with reinforced cement concrete
- Composite beams and lintels – U-shaped CSEB with reinforced cement concrete
- Wide variety of CSEB (17 moulds available for producing about 75 different types of blocks)
- Various vaults with CSEB
- Stabilised earth mortars and plasters

All the above materials have inherent quality of greenness in terms of consumption of energy and emission intensive materials such as cement and steel. While there is ample evidence that these technologies are cost effective, data in this regard was not available.

– *What and whose capacities were built and how?*

The various courses held in Auroville aimed to introduce and promote the technology of stabilised earth. The AURAM equipment for earth construction and the technologies taught have been developed by the Auroville Earth Institute. Generally training courses are restricted to 30 people. The courses consist of both theory and practical classes.

The quality of training and the study materials produced by AEI is of very high standards. The hallmark of AEI's training is high quality finish of products - thus making even buildings look aesthetically pleasing.

AEI has trained many architects and engineers from different parts of the country as well as from abroad. Many construction workers have been trained at AEI whose presence is visible in the rural areas of Tamil Nadu. To date, the Earth Institute has trained over 6,700 people from 67 countries (about 550 per year). It has also been given two international and 11 Indian awards for its excellence in building and architecture[4].

- *How were green outcomes defined and measured for monitoring?*

AEI uses greenness indicators such as, embodied energy and emission of GHG, etc. It emphasis the use of local materials that reduces transportation cost, energy and emission. However, AEI does not provide information on the way they measure greenness of CSEB, FC, etc. It may be noted that the analysis of rates of different construction technologies provided by AEI could be used to calculate the degree of greenness with the help of an appropriate tool.

[4]Transfer Of Earth-Based Technologies, The Earth Institute – Auroville, Tamil Nadu, Documentation Of Best Practice, March 2011, Researched and Documented By: OneWorld Foundation India

– *How was innovation supported and sustained?*
Over the past decades, Auroville has received support from a considerable number of governmental and non-governmental agencies, foundations, corporate donors and private contributions in India and abroad. AEI does research on earth-based materials and technologies which are cost and energy effective. These technologies were disseminated through training courses, seminars, workshops, publications and consultancies within and outside India.

– *How can these lessons be up-scaled?*
Many engineers, architects and construction workers are attracted to their training programmes. It needs institutes like HUDCO's rural building centres to disseminate information and knowledge about green technologies on a wider scale.

Table I.9: Summary of Auroville Earth Institute

Examples	Key element	How the above was achieved? e.g.				
	How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?	
	Auroville Earth Institute (AEI), is in a mission to bring awareness about earth architecture and technologies, and it covers worldwide examples from past to present.	Following green technologies are promoted by AEI- Stabilized rammed earth foundations & walls with 5 % cement, Stabilized rammed earth rammed manually, various vaults with CSEB	Training courses held in AEI aim to introduce and promote the technology of stabilised earth. AEI courses consist of both theory and practical classes. To date, the Earth Institute has trained over 6,700 people from 67 countries	AEI uses greenness indicators such as, embodied energy and emission of GHG, etc. AEI does not provide information on the way they measure greenness of CSEB, MCT, FC, etc.	AEI's innovation supported by a number of governmental and non-governmental agencies, foundations, etc. in India and abroad. AEI does research on earth-based technologies which are cost and energy efficient	AEI attracts many engineers, architects and construction workers to their training programmes. It needs mechanism like HUDCO rural building centre for up scaling greenness

CASE STUDY 10: APPEP

Project Background: DFID and Government of Andhra Pradesh jointly initiated a project on search for cost effective and environment friendly construction technologies to construct more buildings within budget. A nationwide search (Resource Mapping) for cost effective and environment friendly technologies was launched. Most of the sources of the research were the shelter sector. In the process, eleven different roofing systems, six types of walling systems and three types of foundations were identified. In Ranga Reddy District of Andhra Pradesh, 56 buildings were constructed by adopting all the identified technologies. The buildings were completed by the middle of 1996.

Subsequently, an evaluation was mounted between 14th October and 23rd November of 1998. A multi-disciplinary team consisting of national and international experts examined all the buildings. They undertook an extensive field study and studied architectural designs, construction methods and Cost Effectiveness in terms of maintenance and above all social acceptance and replicability. Following the evaluation, minor corrections were made with the help of the communities. The entire experience of constructing new buildings and repair were rigorously documented and published[5].

The key elements: A nation-wide survey identified various options of technologies, which were short-listed on the basis of the following criteria:

- durability
- availability of materials and skill
- energy consumption

[5]Vidyalayam and Vidyalayam Revisited, Bonner Roger and Das P K by DFID in 2000

- cost
- income generation
- acceptability
- maintenance requirements

The project had created a database to provide a menu of 11 roofing, 6 walling and 3 foundation systems. Reliable information on the Life Cycle Cost and environmental impacts was developed. This project provided a unique opportunity to observe the aging of a variety of materials and technologies in one consistent setting – being built in the same time, located in the same climatic zone, having same end usage and constructed under the same degree of supervision. The cost of Intervention at this stage would provide reliable information on the Life Cycle Cost and environmental impacts.

How the above was achieved? e.g.

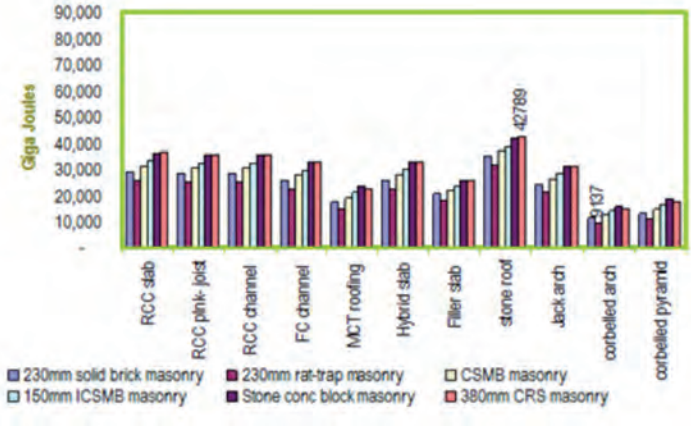
– *How was greening achieved? Was there cost saving as well?*

At the planning stage, locally available materials and human resources were identified through resource mapping exercise across the country. Pioneering institutes, NGOs, research institutes were visited for data collection on various construction technologies. Eminent personnel, like Laurie Baker, were interviewed to acquire knowledge on cost-effective and environment-friendly technologies. A year's rigorous research helped in identifying cost-effective and green technologies for various regions of India.

Existing government (Andhra Pradesh) school designs and technologies were examined and redundant specifications were eliminated without compromising strength and durability. Care was taken to make sure that the embodied non-renewable energy of the adopted technologies and emission of CO_2 were low. The use of renewable energy was encouraged. The brick fields in Ranga Reddy district were run by using rice husk as fuel and the residue that came out of the kiln was partly recycled in brick making and the rest used as manure.

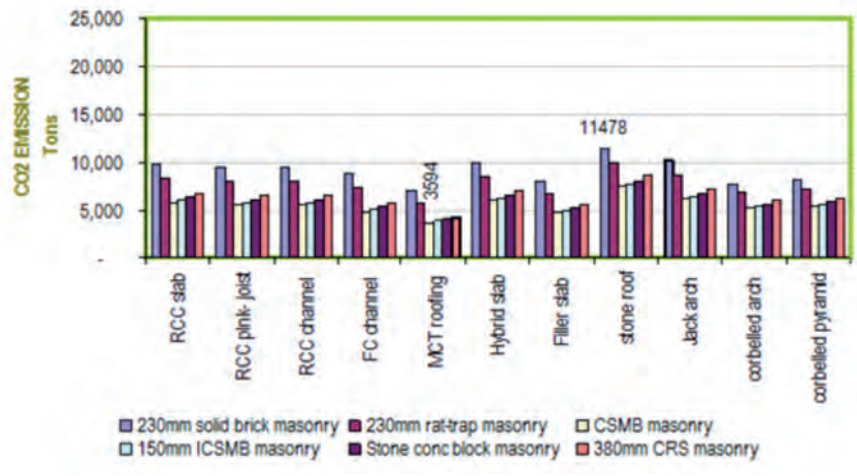
A robust database was generated on measuring greenness of various technologies. The following two Figures show the range of embodied non renewable energy and CO_2 emission of different types of walling and roofing combinations. In APPEP the cost savings ranged between 10 to 35 percent of the cement, steel and brick intensive construction

Figure I.11: Pattern of embodied non-renewable energy of various walling and roofing systems if 1,068 rooms (25 sq m) are built



RCC-reinforced cement concrete, FC- ferrocement, MCT- micro-concrete tiles, CSMB- cement stabilised mud block, ICSMB – interlocking cement stabilised mud block, SCB- stone concrete block, CRS–coursed rubble stone

Figure I.12: Pattern of CO_2 emission of various walling and roofing systems if 1,068 rooms (25 sqm) are built



– *What and whose capacities were built and how?*

A team of experts were drawn on from COSTFORD, CBRI, DA, etc. to train Panchayati Raj engineers. It was a six-week programme followed by an examination and certification. Right after the training, the government engineers started on cost-effective and environment-friendly school buildings. During implementation the masons and the contractors were given hands-on training. These are still the biggest asset of the Panchayati Raj Engineering Department for the implementation and maintenance of education infrastructure in Andhra Pradesh.

- *How were green outcomes defined and measured for monitoring?*

A mathematical model was developed by considering the following indicators to balance cost effectiveness and greenness of technologies.

1) unit cost of construction - lower the better
2) income multiplier effect - higher the better
3) labour intensity- skilled semi skilled and unskilled; higher the better
4) embodied non-renewable energy - lower the better
5) embodied renewable energy - lower the better
6) embodied waste energy - higher the better
7) CO_2 emission - lower the better

This model has been tested in Bangladesh, Myanmar, Iraq, South Africa and Sri Lanka. In its present form, the model is robust enough to be used in any context.

- *How was innovation supported and sustained?*

DFID funded the innovation part of the project. The end-products were published in a simple and graphical format for easy understanding of the technologies and tools to measure socio-economic and environmental impacts.

– *How can these lessons be up-scaled?*

A book titled Vidyalayam was published by DFID, which had all the required data for assessing suitability of technologies in a particular context. There was a significant impact of this project in many parts of India. Right after the innovation in Ranga Reddy district, the Secretary to the Ministry of Health and Family Welfare, Orissa, requested DFID to pay a consultant to construct three cost-effective and environment-friendly primary health care units funded by the state government. This was implemented within 18 months.

The biggest impact of APPEP was on District Primary Education Programme (DPEP). Under DPEP 69,000 education buildings and 53,000 additional classrooms were constructed. Most of them were based on cost-effective and environment-friendly technologies.

Having said all these, it must be noted that the influence on IAY was rather low. One of the reasons for this could be that under DPEP, the state project directors were proactive in promoting green and cost effective technologies. Whereas, the main promoter of the same in IAY lost on two accounts, a) lack of drive at *Zila Parishad* level, b) technology did not reach the doorsteps of the IAY beneficiaries, c) the possible promoter, the HUDCO rural building centres, were already non-existent by then.

Table I.10: Summary of Andhra Pradesh Primary Education Project

Examples	**key element**	**How the above was achieved? e.g.**				
		How was greening achieved Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
APPEP	DFID & Government Andhra Pradesh jointly initiated a project on search for cost effective & environment friendly technologies to build more schools within budget. 56 buildings were constructed by adopting the identified technologies. The project had created a database on cost effective & green technologies	Resource mapping conducted across the country to acquire knowledge on cost effective and environment friendly technologies. Embodied non renewable energy of the adopted technologies and emission of CO_2 were low. The use of renewable energy was encouraged.	Panchayati Raj Engineering Department engineers were trained. Right after the training, the government engineers started the cost effective and environment friendly school buildings. During implementation the masons and the contractors were given hands-on and on job training	Following indicators were considered to measure cost effectiveness & greenness of the technologies -unit cost -income multiplier effect -labour intensity - embodied non-renewable energy - -embodied renewable energy- CO_2 emission – This approach has been tested in several countries	DFID had funded the only the innovation part of the project. The end products were published in a simple and graphical format for easy understanding of the technologies and assessing the socio-economic and environmental impacts.	A book Vidyalayam was published by DFID which had all the required data for assessing suitability of technologies. Inspired by APPEP, the Ministry of Health and Family Welfare, Orissa constructed three cost effective and environment friendly primary health care units. The biggest impact of APPEP was on District Primary Education Programme (DPEP).

All the summaries of the case studies have been put together in the following Table I.11.

Table I.11: Summary Obserbations of 10 Cae Studies

Examples	Key element	How the above was achieved? e.g.				
		How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
CS1 South Africa: Venda Shelter	Vernacular based construction project. use of local materials recycling of shower water and kitchen waste application of local art forms through shelter.	Rammed earth and thatch roof. Mud and thatch local materials Thatch is grown everywhere and earth is available as well. Local timber glue was used as lacquer, to insulated to wall surface. It had saved about 40% with respect to RCC and brick intensive systems	The traditional construction workers were trained to use some of the modern construction tools and A local sculptor, who was blind, had been training the local people in this trade.	There was no attempt to carry out such exercises. balancing issues – socio-economic and environment.	This had been an individual's effort and was not supported by any government or international donors.	People had closely watched out the performance of the building for a while and then started adopting some of the new techniques used in this project
CS2 Eastern Cape	Sustainable school and shelter for the poor people; use of labour intensive & environment friendly technologies. School Community based construction	Reduced transport cost and energy and emission, Use of stabilized mud block out of local soil called Sabunga , Roof with locally available thatch and blue-gum poles, Blue gum, a fast growing tree and hence, renewable. Local people trained for block making	First of all, ECATU was trained by Van De Lewis. local school dropouts were identified by the SMC, trained by VAN De Lewis and ECATU jointly.	The indicators were a) unit cost of construction, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) emission of CO_2,	Government of EC termed this as Bantwana model With their own money, they have been replicating Bantwanana type buildings in Maluti and other areas of EC	In five years, local people have started adopting these systems in their own shelters. The force behind this was local government's support and ECATU as a local level production cum resource centre.
CS3 Bangladesh	Traditional building materials combined with modern knowledge on construction technologies.	Bamboo as structural members, rammed straw-reinforced mud walls. These materials are recyclable or renewable & locally available. Bamboo, fast growing renewable material is excellent in every aspect. It is among the top few green systems	The local craftsmen were trained. The same people were involved in construction of the building so that they could assimilate the knowledge and carry forward to adopt the same systems in rural housing.	There was no such reporting on this issue.	Use of beams with a bunch of bamboo was the major innovation. It was a privately funded project. Did not gain popularity in govt. sectors	With strong political will, harvesting bamboo, Local training institutes to be established. few buildings could be constructed in Dhaka in the government buildings
CS4 Mannar Sri Lanka	Identifying cost effective and environment friendly disaster safe design and construction technologies; creating local level employment. creating a local level construction material market	Resource mapping (search for local materials and skills) conducted in all the 42 project villages . Stub footing in stone and cement, locally produced concrete blocks Clay tiles on timber. Appropriate roofing system was evolved.	RTR engineers trained at Colombo, the local community members were informed about the innovations. on-site training was conducted where masons & carpenters from other project sites took part.	Parameters for evaluation of technologies were a) cost & ease of maintenance, b) labour intensity, c) minimum embodied non renewable energy, d) use of renewable, e) reduced CO_2 emission.	The entire exercise was funded by RTR. The masons, carpenters and the trained engineers are using the innovations done in the pilot projects.	There is a strong political will On exit of the pilot projects, The next step would be to establish a local level production cum resource centres to support individual HHs to build and maintain their own shelters.
CS5 NARGIS, Myanmar	Integrating disaster risk reduction (DRR) with rural and urban planning and developmental works in shelter. addressing the priority of actions HFA III, focus on "build back better".	Promoting owner driven shelter programme. ABC (anchor,bracing, coonections) was the essence of disaster safety; use of timber, bamboo, tiles with RCC stubs programme viewed as a great opportunity for income generation as well as skill development.	Capacity building of communities, carpenters, masons and top level management- many were trained after NARGIS Manuals prepared for disaster safe green; affordable housing. ICS materials were distributed widely in coastal areas	Indicator type 1: Greenness, cost and livelihood; Indicator type 2: 12 parameters of comfort of shelters; Indicator type 3: seven indicators of disaster safety; This project had considered most of the aspects of rural housing	Funded by donors and supported by government. For design check a consortium was established small production units established by INGOs	Model for up scaling shelter movement is in place; Small decentralized production cum training centres key to the success; UN-HABITAT appointed Asian Institute of Technology to establish the above

CS6 Northern Karnataka	Understanding pattern of living gender sensitive shelter Evolve a participatory process of design, technologies based on use of local building materials and skill; Poverty reduction through livelihood generation	Use of stub footing and cone foundations (for black cotton soil) ; use vertical reinforcements & band ; Stone wall 380mm thick, Roof: a) Cudappa stone roofing on precast RC joists, b) Shallow vault in brick.	A small group of young architects from SABALA and about fifteen masons and carpenters were trained as master trainers.	Parameters used a) low unit cost, b) maintenance, c) gender issues, d) low embodied non renewable materials, e) encourage renewable f) encourage using industrial/ agriculture waste, g) Low CO_2 emission	SDC had funded the project to develop a replicable model for rural housing in Karnataka. They supported all the innovations evolved through research and resource mapping	Interface with local Nirmithi Kendra for training and production; travelling mela on technology; Block and District level government engineers as partners . mobile unit for production - Nirmithi Kendra on wheel.
CS7 COSTFORD	COSTFORD promotes empowering &enabling poor & weaker sections of society to improve their living conditions by application of appropriate and people-friendly technologies & adopting participatory, transparent & gender-sensitive processes	By using Rat Trap, Jaali wall, Filler slab, arches, frameless door & window, bamboo, mud construction, etc. It eliminates structural redundancy and costly finishes. Saves least 15% of the brick, cement and steel intensive systems	It conducts capacity training for social workers, engineers, home-based women, architects, construction workers, etc. COSTFORD trains masons on job It also trains intern engineers	Greening is inbuilt in COSTFORD's entire process. However, it does not provide indicators & database on greenness of their technologies. COSTFORD is preparing Green Building Code.	COSTFORD is self sustaining. It has institutional clients financed by Local, State &/ or Centre. It also generates fund from consultancy fees from private buildings. Main inspiration and contributor to innovations is Laurie Baker.	COSTFORD has already up-scaled their technologies at grass root level. This is one example in which the technical expertise reaches the HH doorsteps. Local government's support to COSTFORD is its strength.
CS8 DA	Development Alternatives is a research and action organisation, designing and delivering eco-solutions for the poor and the marginalised.	Use of low energy intensive materials such as, CSEB, MCT, FC roofing, etc. DA brought Vertical Shaft Brick Kiln (VSBK) Technology from China & adapted to Indian conditions. In APPEP, average saving of DA buildings- 12-18%.	DA carries out on-site hands-on training of construction workers. They have produced a large number of skilled workers in many states. DA has structured modular training	DA has energy handbook, which needs updating. Selection of technologies based on; a) unit cost, b) labour intensity, c) embodied non renewable energy, d) embodied renewable energy, e) emission of CO_2.	DA is funded by various agencies, it has international collaboration . DA generates money from consultancy as well. Scientist in DA is devoted to research on various aspects of energy efficient technologies	While DA technology has been successfully been implemented in many housing projects, it is yet to gain a wider acceptance. DA technologies could be up-scaled if they are included in BIS codes
CS9 Auroville Earth Institute	Auroville Earth Institute (AEI), is in a mission to bring awareness about earth architecture and technologies, and it covers worldwide examples from past to present.	Following green technologies are promoted by AEI- Stabilized rammed earth foundations & walls with 5 % cement, Stabilized rammed earth rammed manually, various vaults with CSEB	Training courses held in AEI aim to introduce and promote the technology of stabilised earth. AEI courses consist of both theory and practical classes. AEI has trained over 6,700 people from 67 countries	AEI uses greenness indicators such as, embodied energy and emission of GHG, etc. AEI does not provide information on the way they measure greenness of CSEB, MCT, FC, etc.	AEI's innovation supported by a number of governmental and non-governmental agencies, foundations, etc. in India and abroad. AEI does research on earth-based technologies which are cost and energy efficient	AEI attracts many engineers, architects and construction workers to their training programmes. It needs mechanism like HUDCO rural building centre for up scaling greenness

By carrying out column-wise comparison of Table I.11, the patterns of good practices have been put forward in Table I.12 under six heads. These will form the basis of recommending reinforcement of the existing IAY guidelines to make it more robust towards Greening Rural Development.

Table I.12: Pattern Emerged from the Case Studies that are Suitable to Greening IAY

Key element	**How the above was achieved? e.g.**				
	How was greening achieved? Was there cost saving?	What & whose capacities were built and how	outcomes defined and measured (e.g., specific indicators)	How was innovation supported and sustained?	How can these lessons be up-scaled?
- Recycling of shower water and kitchen waste - Encourage local art forms through shelter-rewards for good traditional art works - Use cost-effective & Environment friendly technologies. - Community based construction - Traditional building materials combined with modern knowledge. - disaster safe design and construction - Priority of actions HFA III - Participatory process of design - Homogenize existing database on cost effective & green technologies	- Resource mapping (search for local materials and skills) , Use local materials- reduce transport cost, energy and emission - Use of beams with a bunch of bamboo for large span, VSBK - Foundation: Stub footing, Stone wall 380mm thick - Wall: Rat Trap, CSEB, Stabilized Rammed earth, cement, concrete blocks - Roof: MCT, FC, Stone roofing, Filler slab, masonry vault, etc. - arches, Jaali as window / frameless door and window Disaster safety- ABC, Use vertical reinforcements & horizontal bands in seismic areas	- Encourage traditional skills, upgrade them to modern code & safety standards - Community awareness on green technologies - Capacity building of carpenters, masons and top level management- - Train government engineers - Disseminate ICT materials DA has structured modular training - AEI courses consist of both theory and practical classes.	- unit cost of construction - labor intensity, - income multiplier effect - embodied non renewable energy, - embodied renewable energy - emission of CO_2, - parameters of comfort of shelters; - seven indicators of disaster safety; - Update energy handbook, -	Individual's effort Government – education, healthcare, housing departments Donors INGOs NGOS generate fund from consultancy fees from private buildings. Many NGOs have in-house research wings	- People need time to adopt green technologies- must be supported by local government's & local level production cum resource centre - Local training institutes to be established. - Government buildings to adopt greenness - Local Nirmiti Kendra for training and production; - Travelling mela on technology; - Block and District level engineers as partners - Mobile unit for production - Technical support at HH doorsteps. - Include innovative technologies in BIS codes - APPEP influenced government of Orissa & (DPEP).

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United Nations Development Programme
55 Lodhi Estate, P.O. Box 3059
New Delhi - 110003, India
Tel.: +91-11-46532333, Fax: +91-11-24627612
Web.: www.in.undp.org
Email: info.in@undp.org