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Poverty-Environment Action *for Sustainable Development Goals*



A COST BENEFIT ANALYSIS OF CLIMATE ADAPTATION OPTIONS SUPPORTED BY THE ADAPT PLAN PROJECT

Final Report
for
**A Cost Benefit Analysis of Climate Adaptation
Options Supported by the ADAPT PLAN Project**

Prepared For
**The Poverty Environment Action for the Sustainable
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Programme and The United Nations Environment**

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ABBREVIATIONS AND ACRONYMS

ADAPT- PLAN	:	Implementing Urgent Adaptation Priorities through Strengthened Decentralized and National Development Plans
ADCs	:	Area development committees
BCR	:	Benefit cost ratio
CBA	:	Cost benefit analysis
CoBRA	:	Community based resilience analysis
COMSIP	:	Community Savings and Investment Promotion
EBCR	:	Economic benefit cost ratio
EES	:	Energy efficient stoves
EIRR	:	Economic internal rate of return
ENPV	:	Economic net present value
ENRM	:	Environment and natural resource management
ERR	:	Economic rate of return
FGD	:	Focus group discussions
GEF	:	Global Environment Facility
LDCF	:	Least Developed Countries Fund
NPV	:	Net present value
PEA	:	Poverty-Environment Action for Sustainable Development Goals
TEVETA	:	Technical, Entrepreneurial and Vocational Education and Training Authority
TORs	:	Terms of reference
UNDP	:	United Nations Development Programme
VDC	:	Village development committee
VSL	:	Village savings and loans

EXECUTIVE SUMMARY

Introduction

This report presents findings of a cost benefit analysis (CBA) of climate adaptation options supported by the Implementing Urgent Adaptation Priorities through Strengthened Decentralized and National Development Plans (ADAPT- PLAN) project. This assignment was part of a continuous undertaking within the Poverty-Environment Action for Sustainable Development Goals (PEA) project implemented by the Ministry of Economic Planning, Development and Public Sector Reforms to assess gaps, achievements and effectiveness of projects through targeted gender desegregated data generation and analyses. The PEA project seeks to leverage agricultural production and gender equality to help build resilience of households to shocks and to address food security and poverty alleviation through the sustainable management of the environment and natural resources of the country.

The ADAPT-PLAN project was implemented against a background of environmental and natural resource degradation and increased climate variations. Increased climate variations experienced in the form of prolonged dry spells, droughts, floods, and temperature variability, compounded the stress on the natural resource base, in turn negatively affected the performance of sectors such as water and irrigation, agriculture, natural resources and energy, thereby aggravating poverty, food security and malnutrition especially for the already

vulnerable population in marginal areas. The project was implemented by the Environmental Affairs Department from 2014 to 2019 with the aim of establishing and demonstrating the institutional framework required to mainstream adaptation into development planning at national and local levels in the agriculture, water and forestry sectors in three case-study districts of Nkhata-Bay, Ntcheu and Zomba. A major proportion of project funds were spent on practical, field-level adaptations which reached out to 8,465 households following a participatory process that saw the development and implementation of community adaptation plans. The interventions implemented under this project were: Village savings and loans (VSL) scheme, irrigation scheme, fish farming, beekeeping, fruit production, catchment conservation, water supply, tailoring, community bakery, livestock production, and introduction of energy efficient cookstoves.

The aim of the CBA was to assess the efficiency and impacts of the interventions implemented by the ADAPT-PLAN project on community livelihoods. The impact of the interventions on the environment and natural resources were also assessed. The CBA had the following major tasks:

- a) Collect and analyze data at national and district levels including at selected project sites using appropriate methods and approaches;
- b) Prepare analytical framework outlining the methodology for CBA to assess best

value for money for climate adaptation interventions;

- c) Compile and present at a validation workshop, a draft report of the results including recommendations for improved design and implementation of Environment and Natural Resource Management (ENRM) projects based on the results; and
- d) Revise the draft report by incorporating key inputs from the validation workshop and submit a final report.

The following were the key deliverables of the assignment:

- a) An Inception Report with a detailed methodology, analytical framework; sources of information and procedures to be used for carrying out the assignment including a proposed timeline of activities and submission of deliverables;
- b) Draft cost-benefit analysis report with recommendations;
- c) Validation workshop at which to present the findings and get client and stakeholder input;
- d) A final CBA Report;
- e) A policy brief providing recommendations and guidelines for formulating and executing community based, climate adaption ENRM projects.

Methodology

CBA is the principal analytical framework used to evaluate public expenditure decisions. The broad purpose of CBA is to help social decision-making and to increase social value or, more technically, to improve allocative

efficiency. Thus, it helps government and society to allocate scarce productive resources efficiently. The CBA was divided into two scenarios: financial and economic. Financial CBA focused on net returns to a group or an individual person and valued all the inputs (costs) and outputs (benefits) at market prices while economic CBA focused on net returns to society at large. Three CBA measures were used namely: net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR). To capture the distribution of the net benefits between women and men, the NPV was disaggregated by gender using the number of women and men participating in a particular intervention. One project from each category of interventions in each of the three districts was selected and analyzed. A total of 24 projects were analyzed. The analysis comprised the following steps:

- Identifying the costs and benefits of the interventions and determining their monetary values;
- Computing the three CBA measures using 6% social discount rate for a time span of 15 years (from 2015 to 2030);
- Analyzing the sensitivity of the results to changes in social discount rate and;
- Making recommendations based on the analyzed results.

Both qualitative and quantitative data were used for the analysis. The data were obtained from primary and secondary sources. Secondary data were sourced from project reports and other documents while primary data were collected through consultative meetings that were held at national and

district levels, and focus group discussions (FGDs) and in-depth interviews conducted at community level.

Key findings

Results of the CBA were mixed. Some interventions were both financially and economically viable, others were only economically efficient while some were both financially and economically inefficient based on NPV, BCR and IRR indicators.

Two irrigation schemes were financially and economically viable. One scheme used groundwater extracted through boreholes using solar energy and stored in water tanks while the other used gravity-fed water from a perennial river. Because of their low investment cost, the schemes were financially and economically viable. One solar-powered integrated irrigation scheme was neither financially nor economically viable. This scheme had some barriers that made its huge investment costs not to be offset by its benefits. However, this intervention has potential to reduce smallholder farmers' vulnerability to climate change and enhance their livelihoods once its associated barriers are dealt with.

Results from the analysis showed that fish farming was not financially viable. But when the value of additional knowledge in fish farming was included, fish farming became economically viable for Nkhata Bay and Zomba districts. Results for Ntcheu district were not financially and economically viable. Thus, all the three fish farming interventions were not financially viable and only two interventions were economically efficient. These results reflect a general problem in fish farming in

Malawi and are not unique to the ADAPT-PLAN project. The major limitation affecting the productivity of smallholder fish farmers is the use of low-quality inputs such as recycled fingerlings and poor quality feed. Smallholder farmers should therefore be encouraged to use high-quality fingerlings and fish feed to ensure profitability of the interventions.

All the three beekeeping interventions were found to be financially and economically viable. All the three CBA measures were higher under economic CBA than financial CBA. This justifies the need for government to continue funding beekeeping enterprises because they lead to increased net benefits to the community and provide other social and environmental benefits such as additional knowledge, pollination and forest conservation. Therefore, beekeeping represents one of the most financially and economically viable alternative sources of income with great potential to reduce deforestation while leveraging food security and poverty reduction at the household levels.

Livestock production was another financially and economically efficient intervention. Analysis of the three livestock interventions revealed that they were all profitable investments that provided good returns on investment. Therefore, livestock production is another excellent alternative source of income which could lead to reduced reliance on forest resources and build resilience to climate change among rural communities.

VSLs were implemented in almost all the interventions as a complementary activity. All producer groups were encouraged to

form savings and loans associations where proceeds from their group projects could be deposited for members to borrow at an interest rate, before they were shared to the group members. This arrangement provided a means for the members (and in some cases the wider community) to find easy access to capital for growth of their individual business enterprises while maintaining financial reserves for the group enterprise. The project made capital injections into the VSLs and this ensured positive average returns. All the three village savings banks that were analyzed were financially and economically viable. Thus, the integration of the different project interventions with a village savings bank was an innovation that improved the members' access to savings and loan services. In a country where the vast majority of the population lacks access to such services, this represents a substantial benefit to the participants. Moreover, VSLs enhanced the sustainability of the associated interventions and growth of the group's as well as individual's economic activities, after project support.

Banana production was another intervention that represented an efficient allocation of invested public funds. The intervention was financially and economically viable and had great potential for community impact through the pass on practice of suckers to group members and other groups. It, therefore, represented a viable alternative source of income with great potential to increase community impact and reduce the gender gap in agricultural productivity while leveraging food security and poverty reduction at the household levels.

Another intervention that was financially and economically viable was a community bakery. Only one community bakery intervention was implemented in the project. It was implemented as an alternative source of income for the community. A community bakery therefore represents an efficient intervention which can be scaled out to other areas for diversification of income.

Another intervention that was implemented as an alternative source of income for a community was tailoring. Only one tailoring group was supported by the project. CBA results for the tailoring group showed that although the intervention was not financially viable, it was nonetheless economically viable. The invested resources far outweighed the revenues generated by the enterprise. However, when the economic benefit of training was accounted for, the benefits outweighed the costs. Training in tailoring had enabled some members to gain economic independence. Thus, from the financial perspective no private investor would be willing to support this intervention. However, from the economic point of view the intervention had some social benefits which increased its efficiency and justified the need for government's support.

The project also supported the provision of water through installation of boreholes. Apart from the value of the water from the boreholes, the installation of the same had other benefits such as reduced time and distance for water collection (time saving), reduced water borne diseases (health benefits), additional knowledge in borehole management and reduced harassment of young girls and women. Results from the

analysis showed that investment in a rural borehole water supply system is financially not viable. This explains why private investors do not invest in rural water supply projects. However, economic CBA results showed that the investment was economically cost-efficient. The additional social and health benefits far outweighed the costs. These results reinforce earlier findings by World Bank Africa Gender Innovation Lab, UN Women, and the UNDP-UNEP Poverty-Environment Initiative on reducing the gender gap as a strategy for alleviating poverty. Poor access to portable water is one of the drivers of gender productivity gap in Malawi and the provision of improved access to safe water can be one of the solutions for closing this gap.

The project implemented a number of catchment conservation interventions in all the three project districts. Three such interventions were analyzed. One intervention combined catchment conservation with citrus fruit production. This was financially and economically viable. The other two interventions incorporated tree seedling production. These interventions were not financially attractive but economically viable due to the inclusion of environmental benefits of catchment conservation such as soil and water conservation, flood control and carbon sequestration. This justifies the use of public funds for catchment conservation projects.

Only one group implemented an intervention on the use of energy efficient cookstoves. This intervention aimed at reducing forest degradation through use of improved cookstoves. This intervention was not financially viable. However, when social and environmental benefits of the intervention

were included, it became economically viable. The intervention had valuable social and environmental benefits such as improved health, savings in time and money, and conservation of forests and associated ecosystem services. It, further, helped to reduce emissions that contribute to global climate change. Moreover, labour-saving technologies such as energy-efficient and environmentally friendly improved cookstoves have the potential to reduce women's unpaid labour and domestic work burdens, save time and facilitate increased crop production, thereby reducing the gender gap in agricultural productivity.

Implementation of the interventions were positively influenced by initial capacity building, commitment of beneficiaries to participate in the intervention, availability of adequate and suitable land, incorporation of a pass on approach, integration of VSL into group interventions, and women and youth involvement. The general challenges affecting performance of interventions were associated with poor access to reliable markets, low prices of produce, high cost of inputs, low quality of equipment, lack of storage and processing of produce, inadequate water supply for irrigation and fish farming, and inadequate training in business management, marketing and record keeping. In addition, fish and livestock production encountered challenges due to high costs of feed, and inadequate support for fishpond and animal kraal construction. Untimely commencement of the interventions which culminated into inadequate implementation period was a general problem for interventions in Ntcheu. Notwithstanding the challenges,

the interventions were successful; and represented good use of public funds in supporting diversified and strengthened livelihoods of vulnerable communities in the project area.

Policy implications and recommendations

The analysis was restricted to the climate adaptation options supported by the ADAPT-PLAN project, and as such the sample size is low to generalize the results at national level. Nevertheless, the following policy recommendations were identified based on the key findings:

Promoting production related interventions

Since local communities rarely have access to sufficient financial resources to invest in financially viable enterprises, there is need to scale-up production related interventions through support from government and development partners.

Supporting catchment conservation interventions

Despite providing environmental benefits to the general public, catchment conservation interventions were not financially viable. Therefore, there is need to provide public financing and incentives to support implementation of catchment conservation initiatives.

Improving yield from fish farming

The major limitation affecting the productivity of fish farming is the use of recycled fingerlings or fingerling brood stock and lack of access to affordable formulated feed. There is, therefore, need to incorporate production

and use of high-quality fingerlings and fish feed in fish farming interventions to ensure their profitability.

Improving siting of irrigation water supply systems

There was inadequate water supply for one integrated irrigation scheme due to low water aquifer and sharing of water among irrigation farming, fishpond and domestic use. There is need to improve integrated irrigation systems through appropriate siting to match with aquifer and utilization levels.

Promoting value addition and transportation of produce

Most of the interventions produce perishable products and hence they are sold at highly discounted prices due to lack of processing, storage, packaging and transportation facilities. There is need to incorporate processing, storage, packaging and transportation facilities in production interventions.

Improving access to reliable markets

- Conduct market research at the design and planning stage of the intervention in order to identify reliable markets for the beneficiaries.
- Improve transport infrastructure in hard to reach project areas to open up to favourable markets.
- Promote certification of produce in order to increase market access, share and penetration.

Enhancing capacity building

- Promote the continuity of capacity building to induct new members, refresh and keep members up to date on current practices

to ensure effective and sustainable implementation of the interventions.

- Conduct training in community-based natural resources management with particular emphasis on sustainable resource utilization and management, benefit sharing processes, and conflict resolution mechanisms to improve natural resources management and governance.

Linking women participation to gender gap reduction in agricultural productivity

Promote women participation in community-based interventions to enhance their income, food and social security thereby reducing gender inequalities in agricultural productivity and increasing their share of economic and social gains including worth creation.

Increasing yield through irrigation systems

- Implement irrigation interventions concurrently with improved crop management through use of fertilizers, early maturing varieties and increased cropping cycles for irrigation farming.
- Provide government and/or development partner's support to irrigation farming due to high establishment costs.
- Promote lower cost irrigation systems such as gravity fed and solar technologies to decrease the cost of production.

Providing incentives to households engaged in catchment conservation

Provide incentives to households that implement catchment conservation to ensure sustainability of the intervention and the general benefit of the community.

INTRODUCTION

This report presents findings of a cost benefit analysis (CBA) of climate adaptation options supported by the Implementing Urgent Adaptation Priorities Through Strengthened Decentralized and National Development Plans (ADAPT- PLAN) project. This assignment was part of a continuous undertaking within the Poverty-Environment Action for Sustainable Development Goals (PEA) project implemented by the Ministry of Economic Planning, Development and Public Reforms to assess gaps, achievements and effectiveness of projects through targeted gender disaggregated data generation and analyses. The PEA project seeks to leverage agricultural production and gender equality to help build resilience of households to shocks and to address food security and poverty alleviation through the sustainable management of the environment and natural resources of the country.

1.1 Situational background and context

The environment plays a very significant role in influencing social and economic development of Malawi at both household and national levels. It is estimated that approximately 80% of Malawians depend on environmental and natural resources for their subsistence and household incomes. A study commissioned by the Ministry of Finance and Economic Planning and Development on overcoming poverty in Malawi through sustainable pathways found that non-farm

activities constituted the largest income share (about 65%), followed by income from environmental and natural resource (ENR) products such as charcoal, fuelwood, honey, mushrooms (18%) and agricultural produce (17%). These resources are degrading at alarming rates on account of unsustainable use largely arising from high population growth rates, poverty, agricultural expansion, inappropriate management practices and low capacities for governmental enforcement of rules and regulations. For instance, there is a clear two-way complex cause and effect relationship between Malawi's poverty levels and ENR utilization and degradation. On the one hand, poor households depend on ENR for their livelihoods, and on the other hand, the country's high poverty rate, estimated at 50.7% contributes to ENR degradation.

Malawi's deforestation rate ranges between 1.0% and 2.8% (Ministry of Natural Resources, Energy and Environment, 2010). The percentage cover of forests decreased from 41% in 1990 to 35% in 2008. Soil erosion was estimated at 20 tons per hectare per annum which translated into average yield loss ranging from 4.0% for low impact to 11.3% for high impact areas (World Bank, 1992; Bishop, 1995). It was estimated that if soil erosion was addressed in Malawi between 2005 and 2015 a total of 1.88 million people could have been lifted out of poverty. Unsustainable resource use costs Malawi an estimate of US\$191 million, or 5.3% of GDP every year (Yaron et al., 2011). However, sustainable management of

natural resources such as land, soil nutrients, forests, water and fisheries could contribute to poverty reduction and building resilience among the rural vulnerable communities. In addition, a sustainably managed and clean environment is essential for human health.

Furthermore, the Malawi economy relies heavily on rain-fed agriculture. It is estimated that approximately 90% of the population is dependent on rain-fed agriculture, 60 percent of whom are food insecure on a year-round-basis. Climate sensitive rain-fed agriculture is a major contributor to the national gross domestic and foreign exchange earnings and supports the livelihoods of over 80 percent of Malawians who are involved in primary and secondary agricultural activities. Climate extremes and weather events severely erode the resilience and adaptive capacity of individuals and communities through declining yields and food insecurity. Apart from incremental change in temperature and precipitation, the trend in Malawi has also been an increase in weather-related disasters such as floods and droughts. The geographical coverage of flood-prone districts increased from 9 before 2001 to 14 in 2010.

In addition to floods, Malawi experienced droughts during the 1978/79, 1981/82, 1991/92 and 1993/94 crop growing seasons. In 2015 there were both drought and floods, and further drought a year later. In terms of costs, droughts and floods caused irreversible and damaging effects on crop and livestock production in the affected areas. It was estimated that Malawi loses on average 4.6% of the maize production each year due to droughts and in the southern region where about one-third of the maize is grown, 12% is

lost due to flooding.

Increased climate variations experienced in the form of prolonged dry spells, droughts, floods, and temperature variability, have compounded the stress on the natural resource base, in turn negatively affecting the performance of sectors such as water and irrigation, agriculture, natural resources and energy, thereby aggravating poverty, food security and malnutrition especially for the already vulnerable population in marginal areas. Malawi's narrow economic base, with increased climate variations and high dependence on rain-fed agriculture makes the country highly vulnerable to the adverse impacts of climate change and extreme weather events which if unchecked will continue to trigger poverty shocks and reduce ability of the people to cope with climatic disasters.

It was against this background that the Government of Malawi, through the Ministry of Natural Resources Energy and Mining with support from Global Environment Facility (GEF)-Least Developed Countries Fund (LDCF) and United Nations Development Programme (UNDP) implemented the ADAPT PLAN project. The project was developed after the realization that there was significant political will and commitment to addressing climate change in Malawi but that significant barriers and challenges existed in mainstreaming adaptation into development planning. These barriers included: weak institutional structures, technical capacity challenges and knowledge gaps.

The project was implemented by the Environmental Affairs Department from 2014

to 2019 with the aim of establishing and demonstrating the institutional framework required to mainstream adaptation into development planning at national and local levels in the agriculture, water and forestry sectors in three case study districts of Nkhata Bay, Ntcheu and Zomba.

1.2 ADAPT PLAN project brief

The goal of the project was for all government spending to contribute to resilience-building

and adaptation in Malawi. Its main objective was to reduce the vulnerability of rural communities to the adverse impacts of climate variability and change in the country. The project had two specific objectives, namely: reduce vulnerability to the adverse impacts of climate change, including variability, at local, national, regional and global level; and increase adaptive capacity to respond to the impacts of climate change, including variability, at local, national, regional and global level. Three outcomes defined the

Table 1. Interventions undertaken by ADAPT-PLAN project in Nkhata Bay, Ntcheu and Zomba districts

Intervention	Description	District			Total
		Ntcheu	Zomba	Nkhata Bay	
Village savings and loan scheme	Number of savings and loans schemes operationalized	20	17	51	88
Irrigation scheme	Number of irrigation schemes developed	2	3	5	10
Fisheries	Total number of fish ponds developed	5	12	18	35
Bee keeping	Total number of beekeeping groups established	3	15	17	35
Fruit production	Total number of banana groups established	No activity	No activity	30	30
Fruit production	Total area (hectares) planted with citrus plants	No activity	5	450	455
Fruit production	Total area (hectares) planted with mango plants	No activity	13	No activity	13
Tree nursery	Total number of tree nurseries established	18	64	19	101
Catchment conservation	Area (hectares) conserved with vetiver grass	No activity	30	30	60
Catchment conservation	Total area (hectares) planted with trees	74	700,000	257,000	957,074
Catchment conservation	Total number of bamboo seedlings planted	3,000	8,500	No activity	11,500
Water supply	Number of bore holes/water pumps developed	4	21	11	36
Tailoring	Total number of households benefited through tailoring	No activity	No activity	20	20
Community bakery	Number of community bakeries established	No activity	No activity	1	1
Livestock production	Total number of livestock groups established	7	6	33	46
Energy-efficient technology	Total number of households adopted energy-efficient cookstoves	No activity	927	No activity	927

Source: ADAPT-PLAN Terminal Evaluation Report

project's output, activities and interventions.

The three outcomes were:

- a) Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level;
- b) Diversified and strengthened livelihoods for vulnerable people in target areas;
- c) Mainstreamed adaptation in broader development frameworks at country level and in targeted vulnerable areas.

A major proportion of project funds were spent on practical, field-level adaptations which reached out to 8,465 households (of which 5,084 were female-headed households), following a participatory process that saw the development and implementation of community adaptation plans. Approximately, 65% of the costs were associated with the procurement of goods to support tangible adaptation activities under outcome (b). This CBA focused on the interventions implemented under this outcome. Table 1 presents a list of interventions implemented in the three districts. The interventions cut across the three sectors of agriculture, water and forestry and are classified into 12 categories.

1.3 Scope of the cost-benefit analysis

The CBA focused on climate adaptation interventions supported by the ADAPT-PLAN project. It aimed at assessing their efficiency and impacts on the livelihoods of communities. The CBA had the following major tasks:

- a) Collect and analyze data at national

and district levels including at selected project sites using appropriate methods and approaches;

- b) Prepare analytical framework outlining the methodology for CBA to assess best value for money for climate adaptation interventions;
- c) Compile and present at a validation workshop, a draft report of the results including recommendations for improved design and implementation of Environment and Natural Resource Management (ENRM) projects based on the results; and
- d) Revise the draft report by incorporating key inputs from the validation workshop and submit a final report.

1.4 Deliverables

The following were the key deliverables of the CBA:

- a) An Inception Report with a detailed methodology, analytical framework; sources of information and procedures to be used for carrying out the assignment, including a proposed timeline of activities and submission of deliverables;
- b) Draft cost-benefit analysis report with recommendations;
- c) Validation workshop at which to present the findings and get client and stakeholder input;
- d) A final CBA Report;
- e) A policy brief providing recommendations and guidelines for formulating and executing community based, climate adaption ENRM

projects.

1.5 Structure of the CBA report

The report is structured as follows:

- Executive summary
- Introduction
- Methodology
- Findings
- Conclusions and recommendations
- Annexes

METHODOLOGY

This section presents the analytical framework, CBA key steps and an approach that was used in this analysis.

2.1 Analytical framework

CBA is the principal analytical framework used to evaluate public expenditure decisions. The broad purpose of CBA is to help social decision-making and to increase social value or, more technically, to improve allocative efficiency. Thus, it helps government and society to allocate scarce productive resources efficiently.

The CBA was divided into two scenarios: financial and economic. The financial analysis focused on net returns to a group or an individual person and valued all the inputs (costs) and outputs (benefits) at market prices. It included taxes and subsidies but excluded externalities. The main goal of the financial analysis was to examine the financial returns to project participants in order to demonstrate that they had enough financial incentive to participate. In this case, an intervention was initially evaluated as a public enterprise from a purely commercial perspective, accounting only for the benefits and costs that accrue to the enterprise itself and that affected its profitability.

Unlike a financial analysis which focused on net returns to a group or an individual person, economic analysis focused on net returns to society at large. It used economic (shadow, efficiency or accounting) prices that excluded

transfer payments (taxes and subsidies) to reflect the value of the project to society. Externalities (positive and negative) and other non-marketed goods and services were also included and quantified in monetary terms. The economic analysis was therefore carried out to assess the efficiency of the interventions in terms of their net contribution to the national economic and social welfare.

Three CBA measures were used namely: net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR). NPV is the present value of revenues or benefits minus the present value of costs. Projects are accepted when NPV is positive and from a group of compatible investments, ranking is in order of highest NPV. Thus, NPV measures the magnitude of net benefits and is of interest mostly to the direct beneficiaries of the interventions. Beneficiaries are motivated to participate in a project that yields highest NPV. One weakness of NPV is that it compares the present value of costs of projects over identical life spans. Thus, efficiency of projects with different life spans cannot be compared using NPV. To capture the distribution of the net benefits between women and men, the NPV was disaggregated by gender using the number of women and men participating in a particular intervention.

NPV assumes that investment funds are available without restrictions. But funds are limited and need to be allocated efficiently. A more efficient allocation of limited funds is achieved by using BCR. BCR is the present

value of revenues or benefits, divided by the present value of costs. Investments are acceptable if the BCR exceeds unity. From a group of compatible investments, selection of projects is in order of highest BCR.

IRR is the maximum interest rate charged on investment funds at which an investment could break even. It is the rate of discount which makes discounted cost equal to discounted revenue (or NPV = 0). Thus, IRR refers exclusively to the investment's internal ability to generate a rate of return and is therefore a measure of return on investment. An investment is worth undertaking if its IRR is greater than the market rate of interest. Furthermore, from a group of compatible investments, ranking is in order of highest IRR. In this analysis, IRR was used to check whether the benefits from an intervention were less than the value of an alternative use of the resources involved, hence capturing the opportunity cost of invested resources.

For economic CBA, economic net present value (ENPV) captured the magnitude of net economic benefits while economic benefit cost ratio (EBCR) captured the ratio of economic benefits over economic costs. The economic internal rate of return (EIRR) or economic rate of return (ERR) captured the social opportunity cost of invested resources.

2.2 Key CBA steps

The CBA of the ADAPT-PLAN project followed 7 key systematic steps. Step 1 focused on determining whose benefits and costs to count (specifying standing). The accounting stance was from the standpoint of vulnerable rural communities who were the target beneficiaries of the interventions.

Step 2 specified the set of interventions to be considered. One project from each category of interventions in each of the three districts was selected. Thus, in each district, one

Table 2. List of interventions assessed in each district

Intervention	District		
	Ntcheu	Zomba	Nkhata Bay
Village savings and loan scheme	Tithandizane	Chitamambeta	Movya
Irrigation scheme	Linungwi	Ngwelero	Sasasa
Fisheries	Linungwi	Ngwelero	Njiri
Beekeeping	Linungwi	Nambira	Movya
Fruit production	-	-	Takondwa
Catchment conservation/fruit production	-	-	Kapiri
Catchment conservation/tree nursery	Mkumphira	Muonekera	-
Water supply	Linungwi	-	Chigwere, Kamphomombo, Longwe and Chapukwa
Tailoring	-	-	Usisya
Community bakery	-	-	Chikomo
Livestock production	Kasinje	Takondwa	Mwawi
Energy-efficient technology	-	Chiswamafupa	-
Total	7	7	10

project intervention was assessed in each category. The selection criteria included any one of the following: uniqueness of the intervention, data availability, period of operation, and degree of vulnerability to climate variability. These criteria ensured that the interventions that were selected were reasonably representative. A total of 24 projects were selected. The total number of beneficiaries in these interventions was 538 members of which 59% were women (Annex 1). Table 2 presents a list of projects that were selected in each district per category.

Step 3 identified the costs and benefits of the interventions. The costs included investment (fixed) costs, operational (variable) costs and social¹ and environmental costs. Fixed costs were associated with beneficiaries' training, land acquisition, equipment and installation, initial inputs (fingerlings, banana suckers, seedlings, cloth and cash capital), project planning, implementation and monitoring. Variable costs took into consideration of the following: operations and maintenance, inputs (raw materials and supplies), monitoring and security, and replacement of short-life equipment. Social costs were assessed by the net loss of social benefits incurred due to the introduction of a particular intervention and environmental costs were assessed by environmental degradation (water quality deterioration, soil and land degradation, and pollution) caused by the interventions. Benefits included direct (tangible) and social and environmental (intangible) benefits. Tangible benefits are financial gains resulting

1 A social cost is a net loss of social benefit incurred due to the introduction of a particular project or intervention, such as failure by a community to access a natural resource (e.g. firewood) previously enjoyed by the community without the project.

from the sale of produce while intangible benefits are ancillary gains, attributable to implementation of an intervention, which are difficult to measure such as knowledge acquisition, and gains from environmental and natural resources conservation. The "with and without" scenario was used in identifying the costs and benefits. Only costs and benefits resulting from the interventions were identified and those that would have still taken place even without the interventions were ignored. Thus, only incremental costs and benefits arising from the interventions were considered. A list of relevant costs and benefits of the different interventions are presented in Annexes 2 and 3, respectively.

Step 4 determined the monetary value of the costs and benefits. For financial CBA market prices were used for the valuation of costs and benefits. Annex 4 presents the costs and benefits of the interventions that were used in this analysis. To convert financial costs and benefits into economic prices, the market prices of some inputs and outputs were initially adjusted by excluding taxes and subsidies. Wages for unskilled labour were adjusted using a shadow wage rate (0.50). Furthermore, financial costs and benefits were converted to their equivalent economic prices by using the conversion factor approach whereby a standard conversion factor² (0.85) was used. Market prices (for those items that were not adjusted) or adjusted prices of nontraded items were multiplied by the standard conversion factor, and this reduced them to their appropriate economic value.

2 A standard conversion factor is derived by taking the ratio of the value of all exports and imports at border prices to their value at domestic prices. The use of this approach is best explained by Gittinger (1982) – Chapter 7: Determining economic values.

The values of the conversion factor and the shadow wage rate were selected because they are standard for Malawi³ and other developing countries. For non-marketed goods and services, benefit transfer⁴ was used where possible. Operation and maintenance costs were valued as a percentage of the capital cost of the investment. Given the different nature of the interventions, different percentages were used for different interventions. Knowledge acquisition was valued by adapting the methodology used by Abelson (2007) who carried out a cost benefit analysis of adult and community education. Abelson (2007) used different percentages of the training cost to reflect its usefulness to the beneficiaries. Benefits of the training were divided into three categories: benefits of training to the individual, household and community. In this analysis, a training was valued at 10% of the cost if it only benefited the individual. A training that benefited both the individual and household was valued at 20% of the training cost, while 30% was used to value a training that benefited the individual, household and community.

Step 5 computed the three CBA indicators for a time span of 15 years⁵(from 2015 to 2030).

³ Same values were used for CBA of the Malawi Integrated Rural Water Supply and Sanitation Project for Ntchisi and Mzimba [<https://www.afdb.org/en/documents/document/malawi-integrated-rural-water-supply-and-sanitation-project-for-ntchisi-and-mzimba-project-completion-report-pcr-26007>]

⁴ A practice used to estimate economic values for nonmarketed products and services by transferring information available from studies already completed in one location or context to another. This can be done as a unit value transfer or a function transfer

⁵ 15 years is the lifespan for most of the interventions. Using different lifespans for different interventions could have made it difficult to compare efficiencies of the interventions. Moreover, increasing project lifespan has little effect on CBA

NPV and BCR were calculated using a 6% social discount rate. There is no agreed social discount rate for use in the evaluation of social and environmental projects in Malawi. However, since a social discount rate reflects either social time preference for money or social opportunity cost, it has to be lower than the market (private or commercial) discount rate. Indeed, to arrive at a suitable social discount rate, the market rate has to be adjusted for taxes, transaction costs and risks. In this analysis, a 6% social discount rate was used, as justified by Maradan (2017). Apart from being used by OECD countries and in other CBAs in Africa, this rate is lower than Malawi's current minimum bank lending rate of 12%⁶. The analysis adopted a time span of 15 years because some of the interventions such as boreholes have a 10 to 15-year life span.

Step 6 analyzed the sensitivity of the results to changes in discount rates. The resilience of the results was tested by reducing the discount rate to 3% and by increasing the discount rate to 12% (the current market discount rate). Ideally, a reduction in discount rate should lead to an increase in NPV and BCR values. Thus, a lower discount rate can make an intervention that was economically not viable to be viable. Similarly, a higher discount rate leads to a reduction in NPV and BCR values. An increase in the discount rate can, therefore, make an intervention that was economically profitable to be unprofitable.

results because the longer the period the lower the discounted values.

⁶ The rate at which commercial banks borrow from the central bank [12% as of 7th November, 2020]. Malawi banking rates are displayed at <https://www.rbm.mw/Statistics/BankRates>

The final step (step 7) highlighted key policy implications and recommendations based on the analysis results. The recommendations focused on how the efficiency of the interventions could be increased when replicating and scaling up the projects.

2.3 Approach in data collection

Both qualitative and quantitative data were collected from primary and secondary sources. The key quantitative data for this analysis included: investment (fixed) costs; operating (variable) costs; social and environmental costs (negative externalities); direct benefits (revenue); and social and environmental benefits (positive externalities). Secondary data were sourced from project reports and other documents while primary data were collected through consultative meetings, focus group discussions (FGDs) and in-depth interviews.

2.3.1 Document review

The key project documents that were reviewed are presented in Annex 5. These documents were a major source of quantitative and qualitative data which were used to develop financial and economic CBA. In addition, related literature was reviewed so as to validate the methodology used, understand the context under which the interventions were implemented and to relate the results of this analysis to other similar studies.

2.3.2 Primary data collection

Primary data for this analysis was collected from national and district level professionals

and community members. At the national level, consultative meetings were held with key stakeholders who were involved in the design and implementation of the project. Key information collected at this level included: general background information on the project and interventions; investment costs; anticipated outputs; and challenges that were encountered and how they were resolved. The guide for national consultative meetings is included in Annex 6.

At the district level, consultations were held with implementing partners and those responsible for project monitoring. Selection of interventions to be analyzed was made at this level. Data collection focused on investment costs, operating costs, social and environmental costs, number of participating beneficiaries (by gender and youth categories) and direct and other benefits of a selected intervention under each category (Annex 7).

At community level, FGDs were conducted with members of project implementation committee and some beneficiaries of the selected interventions. The FGDs solicited information on project management, gender roles, costs, cost sharing (by gender and youth categories), benefits, benefit sharing (by gender and youth categories), impact on livelihood, impact on environment and natural resources, overall rating (success or failure as perceived by the group) of the intervention and challenges and possible solutions. Annex 8 lists the people that were consulted while Annex 9 is a sample of the FGD guide for project implementation committee members and beneficiaries.

In addition to FGDs, in-depth interviews were

held with some direct project beneficiaries. The interviews focused on documenting individual beneficiaries' experiences in participating in the intervention, benefits obtained and their impact on livelihoods. The impacts on livelihoods were assessed qualitatively based on members' experiences with and without the interventions. Annex 10 presents an itinerary for data collection.

FINDINGS

This section starts with a presentation of institutional governance of the groups involved in the intervention. Thereafter, results of the CBA are presented by category of intervention as follows: Irrigation, fish farming, beekeeping livestock production, village savings and loans, fruit production (banana), community bakery, tailoring, water supply, catchment conservation and energy efficient stoves. Under each intervention results are presented for all the three districts where applicable. The presentation starts with a general background and performance of the intervention followed by CBA results and discussion. Presentation of CBA results is followed by disaggregation of the interventions, then results on sensitivity analysis, and finally limitations of the exercise.

On institutional governance, ADAPT-PLAN through the district councils undertook community mobilization in assisting local communities to identify possible interventions of interest based on their priority needs. Membership to these groups was on voluntary basis. However, gender mainstreaming and youth inclusion were prioritized in group formation. The groups formed committees with clearly defined structures as follows: chairperson, secretary, treasurer and committee members. Deliberate efforts were taken to put women in decision making positions. These groups were legitimately formed and recognized by the area development committees (ADCs) and the village development committees (VDCs).

To ensure effective performance of the interventions, the groups had well established locally agreed institutional arrangements or rules and regulations. These institutional arrangements were related to equal sharing of roles and responsibilities (cost of managing the intervention), conflict resolution and management mechanisms, and equitable benefit sharing. In addition, various penalties were instituted to ensure compliance to the agreed rules and regulations within a group. For instance, in Ngwelero, absenteeism to a meeting attracted a penalty of K200.00. Clear institutionalization of the groups ensured effective operationalization and sustainable implementation of the interventions. A case in point was noted where communities reported that there was willingness and smooth community participation, reduced violation of rules and regulations and equitable access to and control of the benefits from the proceeds of the interventions.

3.1 Irrigation farming

Irrigation farming was an intervention implemented in all the three districts, namely, Nkhata Bay, Ntcheu and Zomba. The aim of the intervention was to improve food security, enhance income levels and ensure community resilience to climate shocks. Major activities involved in implementation of the intervention included awareness meetings with communities, land surveying, design of the scheme, compilation of bill of quantities, engagement with local

contractor, training, peer visits, and irrigation operation and maintenance. The project was responsible for designing and construction of the scheme and providing technical support and advice to communities. Communities involved in irrigation farming took part in the construction works of the scheme. The major stakeholders in the intervention consisted of community members, local leaders, members of the ADC, extension agents, district council and UNDP. This section presents the current status of the irrigation intervention in three districts.

3.1.1 Nkhata Bay irrigation intervention

In Nkhata Bay district, the irrigation intervention selected for this study was practiced in Chikondo village, Traditional Authority M'bwana in Usisya. This intervention was carried out within Sasasa scheme. The intervention targeted 50 members of the community on a 68 ha of land. At the time of the study, there were 86 farmers comprising 62 female and 24 male members who cultivated on a 40-ha piece of land which was divided into 0.1 ha plots. The scheme was gravity fed from a perennial stream which further acted as a source of water for domestic use for the community.

Analysis of information revealed various impacts emanating from implementation of the intervention on farmers' livelihoods and the environment and natural resources. The major positive impacts on farmers' livelihoods included increased economic empowerment, food security for households and health and nutritional benefits. Farmers

generated increased incomes through sales of farm produce (maize and vegetables - onions, tomatoes, leafy vegetables and peas) from the irrigation scheme. Farmers reported that they constructed better houses (brick and iron sheet roofed) and easily paid school fees for their wards which significantly contributed to increased school attendance⁷. In addition, one farmer reported that he purchased a motorcycle using some of the proceeds he accrued from irrigation farming.

In terms of food security, farmers reported that as a result of irrigation farming, there were increased yields from 3 bags of 50 kg to 12 bags of 50 kg per 0.1 ha plot per harvest. Consequently, there has been a significant rise in availability of and accessibility to food at household level throughout the year. This implies that irrigation farmers are safer from effects of food and nutrition insecurity compared to those who did not practice irrigation farming.

However, farmers reported that irrigation farming was labour intensive as it demanded guarding against monkeys, domestic animals and theft. It was also reported that irrigation farming competed with other equally important socioeconomic activities e.g. fishing. Irrigation farming also had notable impacts on environment and natural resources management. For instance, it contributed positively on catchment conservation. Initially, farmers engaged in the charcoal business within the water catchment area. However, with the advent of irrigation farming, local communities stopped charcoal

⁷ There were many factors that contributed to increased school attendance like a school feeding program and as such increased school attendance was not included in the CBA.

production activities which contributed significantly to reduced deforestation, soil and nutrient loss. The extent of reduction in charcoal production was not reported and therefore could not be quantified in this study. Moreover, unsustainable charcoal production is illegal in the country. It is estimated that in Malawi, 20 tons of soil/ha/annum are lost (World Bank, 1992; Bishop, 1995) due to deforestation. It was reported that with irrigation farming, farmers sold farm produce as an alternative source of income to charcoal business. Furthermore, Sasasa irrigation scheme experienced optimal utilization of land and water resources. Farmers harvested more than once in a year due to availability of water for irrigation. Despite the positive contribution of this intervention on environment and natural resources, some potential negative impacts could be expected in the long run. For instance, the application of fertilizers in irrigation farming in Sasasa has potential to cause water eutrophication in Lake Malawi⁸. In addition, the application of insecticides to reduce the infestation of pests, e.g. *Zonocerus elegans (amnunkhadala)*, has the potential to cause water pollution.

There were a number of factors which influenced implementation of this intervention. The key positive factors included group cohesion and trust among farmers, and availability of adequate land and water for irrigation. In addition, the benefits accrued from the intervention acted as a motivation factor for effective participation of farmers in undertaking irrigation farming. On the contrary, farmers expressed dissatisfaction in the intervention due to frequent bursting

⁸ Considering the size of the irrigated land, this is unlikely to occur.

of plastic pipes at the intake. Another factor that negatively affected the intervention was inadequate markets for farm produce, exacerbated by poor access to the area.

Regardless of the factors constraining implementation of irrigation farming in Sasasa, farmers rated the intervention as very successful (80%). The rating is consistent with both financial and economic analysis results of this intervention. This is evidenced by improved livelihoods of the beneficiaries. To this end, this has a multiplier effect as more community members are willing to join the scheme.

3.1.2 Ntcheu irrigation intervention

Irrigation farming in Ntcheu was implemented in Yesaya II village, Traditional Authority Masasa. This irrigation scheme was located within the Linungwi Integrated Water System. The integrated water system comprised fish farming, borehole water provision, irrigation and catchment conservation. The irrigation farming intervention which commenced in 2017, initially targeted 200 farmers to cultivate 16 ha of land which was provided by Group Village Head Yesaya II. Due to inadequate amount of water for irrigation, the number of participating farmers was reduced to 80 comprising 45 female and 35 male members. Out of these, 40 members were youths. The farmers were to cultivate on a 10-ha piece of land. However, with continued persistence of water problems, the remaining number of active farmers with access to water dropped to 16 consisting of 9 men and 7 women where 5 were youths. The remaining farmers expressed willingness

to continue participating in irrigation farming if the water situation improved. As was the case with Sasasa scheme, the cultivated area was divided into 0.1 ha plots. The project started with 2 boreholes that were used to pump water using solar energy. In 2018, a third borehole was drilled. However, due to reduced water levels in the aquifer, only one borehole was functional at the time of the study.

Like Sasasa irrigation scheme, the Linungwi Integrated Water System had potential impacts on farmers' livelihoods and the environment and natural resources. Improved household income and food security were reported to be the notable positive impacts on farmers' livelihoods as a result of the intervention. This was demonstrated through increased availability of food particularly vegetables for household consumption and sale within the area. If the water supply were improved in the integrated water system, the scheme could produce substantial amounts of farm produce as the soils appeared to be fertile.

Some positive impacts on environment and natural resources management were noted. Since the intervention in Yesaya II village was implemented following an integrated approach, communities were able to combine, irrigation farming with fish farming, water supply and catchment conservation. This approach enabled communities to maximize use of water resources while increasing agricultural production for a given land management unit. Furthermore, the use of cement blocks instead of burnt bricks, in construction of irrigation canals, potentially contribute significantly towards reduction of forest and environmental degradation.

Approximately, 3 m³ of firewood is needed to produce 1000 bricks (Sampe and Pakiding, 2015). Use of firewood in traditional brick making is, therefore, assumed to be energy-inefficient and has negative effect on forest degradation.

Implementation of the intervention was positively influenced by the appropriate planning and design of the activities. Local communities expressed satisfaction with the aims and objectives of the intervention despite the challenges faced due to inadequate water availability. Farmer training in irrigation farming and provision of resources as an initial investment played an important role in the successful execution of the project. On the contrary, delayed disbursement of project funds derailed timely commencement of intervention activities leading to delayed and/or failure to realise targeted benefits⁹. In addition, lack of battery for solar power storage to enable pumping during night times was one of the drawbacks contributing to inadequate water supply at the scheme. On water scarcity, community members were of the view that an increase of boreholes from 3 to 5 would help to increase water supply. It was also suggested that water could be tapped from a nearby river which is located to the south of the scheme.

In terms of project success, local communities scored the scheme at 50%. This implied that the intervention was barely successful. The reasons for such a rating included: inadequate water supply due to low water aquifer and sharing of water among irrigation

⁹ Delays in commencement of project intervention increase the chances of making a project financially unviable since idle project funds lose value with time and may accrue interest if borrowed.

farming, fishpond and domestic use. It was also pointed out that storage tanks were insufficient to satisfy the water demand.

3.1.3 Zomba irrigation intervention

Zomba was also implementing irrigation farming within Ngwelero area, in Mateketa village, Traditional Authority M'biza. Ngwelero Irrigation Scheme started in 2016 with an initial beneficiary target of 100 smallholder farmers to cultivate a 10-ha piece of land (0.1 ha/farmer). However, the scheme started with 60 farmers due to shortage of water to satisfy the entire scheme. As it was the case with Linungwi Integrated Water System, Ngwelero Irrigation Scheme was supplying water to only 20 members. The project had 2 boreholes that were supplying water using solar energy during day time only at a rate of 3 litres per second. A total of 16 solar panels were installed by the project. Fourteen of the panels were dedicated to water pumping where 2 of them were being used for charging phones (at a cost of K50.00 per phone) and providing lighting to the office premises.

Irrigation farming in Ngwelero showed significant impacts. In terms of peoples' livelihoods, it had been noted that the intervention was positively contributing to economic empowerment, food security and health and nutritional benefits at household level. One farmer reported producing 12 bags of maize each weighing 50 kg from a 0.1 ha plot in 2019. Despite success stories on peoples' livelihoods, irrigation intervention in Ngwelero was perceived to be labour intensive. During focus group discussions, farmers indicated that they spent more time

guarding against theft and crop damage by livestock than attending to their normal household chores.

It was reported that irrigation farming positively contributed to catchment conservation through reduced charcoal production on the nearby forest hills. However, the reduction in charcoal production was not be quantified and valued because more details about the practice were not given¹⁰. There were a number of factors behind the reported successes. The positive success factors included, but not limited to, community willingness to engage in irrigation farming, availability of land as well as the perceived benefits. In contrast, just like Linungwi, Ngwelero irrigation scheme suffered from inadequate water supply exacerbated by use of small water tank capacity and unavailability of solar batteries.

Generally, the intervention was perceived as successful. Communities rated the intervention at 60% owing to good irrigation farming infrastructure which the project provided. However, inadequate water supply was the major setback.

3.1.4 Financial and economic cost benefit analysis of irrigation schemes

Irrigation schemes require huge amounts of money for installation of irrigation equipment and operation and maintenance of the scheme. For instance, installation of the gravity-fed irrigation scheme in Nkhata Bay

¹⁰ The actual reduction in charcoal production was not reported because unsustainable charcoal production is illegal in the country and as such the respondents were uncomfortable to disclose more about this activity.

cost close to MK15 million (US\$20,000)¹¹ and the scheme in Zomba cost MK78 million (US\$104,000), while the integrated irrigation scheme in Ntcheu cost approximately MK180 million (US\$240,000). Other costs included: operation and maintenance of irrigation system (valued at 1% of capital cost for gravity-fed irrigation¹² and 3% for solar-powered irrigation¹³), security guard for crops and the irrigation system, and farming costs. Non-monetary costs related to irrigation farming included opportunity cost of land and water. In Nkhata Bay for instance, the opportunity cost of the land that was used for irrigation was the forgone net benefit from cassava cultivation. Cassava flour is used for preparing a staple food for the people of Nkhata Bay. However, cassava is not grown under irrigation farming in Sasasa area. Irrigation farming has potential to generate environmental externalities such as water quality deterioration; water logging; and soil degradation as a result of pollution due to use of chemicals. These environmental externalities were not reported during FGD and there was no evidence of their occurrence. However, there is still need to put up measures to monitor them.

The CBA in irrigation interventions considered the fact that all plots in the irrigation schemes were of 0.1 ha in size. In some cases, where there was land and water scarcity (Ntcheu as an example), no individual was allowed to cultivate on two or more plots and in other

11 Rate: 1US\$ = MK750

12 Source: Noubondieu et al., (2018) Costs and benefits of solar irrigation systems in Senegal. Dakar, FAO. 28 pp. Licence: CC BY-NC-SA 3.0 IGO. <http://www.fao.org/3/ca2209en/CA2209EN.pdf>

13 Source: Economics of irrigation - Food and Agriculture Organization <http://www.fao.org/3/W7314e/w7314e0h.htm>

cases where land and water were abundant (Nkhata Bay), an individual was allowed to cultivate on more than one plot. Before the land was earmarked for irrigation an agreement was signed in relation to land tenure rights, whereby the owners of the land were assured that they would still maintain ownership of the land. Individuals that owned land used by landless farmers received a plot fee while landless farmers got land on lease by payment of an annual fee. Members of the irrigation schemes also paid a once-off membership fee and annual water fees.

FGDs revealed that a plot (0.1 ha) of land generated on average an income of about MK150,000 per year. Other non-monetary benefits included increased food security, poverty reduction and additional farming knowledge. In the absence of a project impact assessment, increased food security was estimated and valued using statistics from national surveys and studies. Using food access as a measure of food security, and percentages of low food security¹⁴ (15% for Nkhata Bay and Ntcheu, 4% for Zomba) from the national integrated household survey (Malawi Government, 2017), the number of group members who would have experienced low food security without the intervention was calculated. Based on information from the FGDs, it was assumed that with the intervention, all beneficiaries experienced high food security¹⁵. Increased food security was therefore valued by the product of the

14 Households might have been concerned about not having access to enough food, they reduced the quality and the variety of the food consumed but quantity of food intake and normal eating patterns were not disrupted.

15 Households did not experience any concern about accessing enough food and did not alter the quality, variety, and quantity or eating patterns.

number of households who would have been food insecure without the project and a value of the survival minimum expenditure basket for food. The minimum expenditure basket for food was estimated per month and per household by WFP (2020) and varied per region (MK30,000 for Nkhata Bay, MK32,000 for Ntcheu and MK33,000 for Zomba).

Poverty reduction was also measured and valued using statistics from national surveys and studies. First, the number of group members who would have been poor without the intervention was calculated. This was calculated using the district poverty incidence estimated by IFPRI (2019). The percentage poverty incidence for Nkhata Bay district was 58%, Ntcheu 54% and Zomba 56%. Second, the number of people out of poverty due to the intervention for each group was calculated. It was assumed that with the intervention, poverty was reduced by 5% (Schuenemann et al., 2018) per group. Third, poverty reduction was valued by multiplying the number of people who were out of poverty due to the intervention, by the poverty line (MK164,191.00 per person per year) estimated by IFPRI (2019).

Additional knowledge in irrigation farming was valued at 30% of the training cost because it benefited the individual farmers, their households and the general community through increased food supply. Financial and economic CBA results for the irrigation intervention in the three districts are presented in Table 3.

The results showed that Sasasa and Ngwelero irrigation schemes represented cost-effective investments both financially and economically while Linungwi irrigation scheme was not a viable investment. Sasasa had the least investment costs being a gravity fed scheme whose water source was from a perennial stream. Moreover, it had the greatest potential area for cultivation (40 ha). The water used for irrigation had no opportunity cost because it was residual water after extraction of domestic water supply and hydroelectricity generation¹⁶. One major constraint that negatively affected the profitability of the intervention was the opportunity cost of land. The best alternative use of the land earmarked for irrigation

¹⁶ No individual or activity was deprived of water following the introduction of the irrigation scheme.

Table 3. Financial and economic CBA results for irrigation intervention

CBA TYPE	CBA MEASURE	DISTRICT		
		Nkhata Bay (Sasasa Scheme)	Ntcheu (Linungwi Scheme)	Zomba (Ngwelero Scheme)
Financial	NPV (MK)	104,213,575.65	(72,942,520.42)	530,504.98
	NPV (Female)	75,130,717.33	(37,089,417.16)	318,302.99
	NPV (Male)	29,082,858.32	(35,853,103.26)	212,201.99
	BCR	1.50	0.61	1.005
	IRR	21%	-7%	6%
Economic	ENPV (MK)	109,736,869.89	(55,412,606.24)	9,972,504.42
	ENPV (Female)	79,112,627.13	(28,175,901.48)	5,983,502.65
	ENPV (Male)	30,624,242.76	(27,236,704.76)	3,989,001.77
	EBCR	1.52	0.65	1.10
	ERR	26%	1%	9%

farming was cassava production. Cassava has low production cost because its cuttings are used as planting materials. In addition, it does not require the use of fertilizer and is not labor-intensive. Nevertheless, cassava productivity is high (22 mt/ha) with a market price of MK116/kg¹⁷. It is also a staple food with cultural and bequest values. Thus, the opportunity cost of land was high (estimated at MK1,276,000 per hectare per year) and this may explain the slow adoption of irrigation farming in the project area. Ngwelero was solar-powered scheme with a focus on crop production. Although its establishment cost was higher than Sasasa, it still operated efficiently as the benefits outweighed the costs. Linungwi was an integrated scheme combining, crop production, water supply and fish farming. However, the combined benefits from these interventions failed to outweigh the cost of the intervention estimated at approximately MK180 million (US\$240,000).

The differences between the financial and economic results were due to use of economic prices and the inclusion of benefits from increased food security, poverty reduction and additional farming knowledge in the economic analysis. The differences in benefit sharing between women and men was due to gender composition of the group. The group was dominated by women who shared 72% of the total net benefits.

Results for Linungwi irrigation scheme conform to those by Schuenemann *et al.* (2018) who evaluated the returns to irrigation arising from both economic and biophysical impact channels, with the aim of understanding

determinants of profitability of irrigation in Malawi. It was noted that the profitability of irrigation farming in Malawi hinged on low irrigated yields that fall far from expectations due to insufficient input use and crop management techniques. However, it was found that nonmonetary benefits of irrigation regarding increased food security, reduced poverty, and vulnerability to climate change made investments in irrigation worthwhile in improving the livelihoods of smallholder farmers. Chafuwa (2017) and Schuenemann *et al.* (2018) further found that irrigation farming increased household welfare by almost 4% and reduced poverty by more than 5% relative to a case without irrigation. It was emphasized that the question for Malawi was not so much on whether to invest in irrigation infrastructure or not, but rather on how to implement irrigation expansion successfully. It is recommended that implementation of irrigation interventions should be done concurrently with improved crop management through use of fertilizers, early maturing varieties and increased cropping cycles for irrigation farming.

3.2 Fish farming

Like irrigation, fish farming was practiced in Nkhata Bay, Ntcheu and Zomba districts. The aim of the intervention was to improve food security, enhance income levels and ensure community resilience to climate shocks. Major activities involved in implementation of the intervention were community mobilization, fish farmer training, pond site appraisal, pond excavation and construction, pond filling, pond stocking, pond management, fish harvesting and selling. In this intervention,

¹⁷ Kanyamuka *et al.* (2018) and FAOST [http://www.fao.org/faostat/en/#data/QC]

major stakeholders were communities, local leaders, members of the area development committee, extension agents, district council and UNDP. Through the District Fisheries Office, the project provided technical support and advice to local communities. The communities involved in fish farming took part in pond construction and management. The subsections below present the current status of fish farming intervention in the three districts.

3.2.1 Nkhata Bay fish farming intervention

Fish farming in Nkhata Bay was carried out in several areas. This report focused on fish farming being conducted at Chigwere by Njiri fish farming club. The fish farming club was located at Kayiwonanga village, Traditional Authority Nyaluwanga in Nkhata Bay. Fish farming at Chigwere started in 2017 where 36 members were initially targeted. However, some members left the club for other socio-economic activities such that, at the time of the study, the club had 9 members comprising 5 women and 4 men. Njiri fish farming club had two fish ponds covering 320 m² (0.032 ha) and 330 m² (0.033 ha). So far, harvesting of fish had been done once in one of the fish ponds where 60 kg of fish were harvested in 2019. The other fish pond was also due for harvesting.

On a positive note, each of the 9 members owned a fish pond as a result of fish farming training that was received. While there had been insignificant amount of fish harvests, members of the club expressed optimism that the future held potential for improved

nutrition and food security, and economic empowerment. However, communities reported that fish farming at Chigwere was time consuming as it required guarding against theft and predation, over and above consistent fish feeding. It was reported that MK20, 000 would be paid per month if the community employed a watchman. Furthermore, being a labour demanding intervention, fish farming competed with other economic activities. Thus, the opportunity cost of labour used in fish farming was valued by the forgone gains in non-farm activities.

Apart from improving livelihoods of farmers, fish farming also positively contributed to environment and natural resources conservation. The intervention improved catchment conservation through reduced charcoal production in the surrounding forests. However, with persistent application of inorganic fertilisers, there was potential for increased eutrophication into the surrounding river systems.

Both positive and negative key factors influencing implementation of fish farming as an intervention were reported. The positive factors included trustworthy and honesty among group members; good relationship between group members and extension agents. In addition, the site provided continuous flow of water which was easily replenished. In contrast, lack of fencing around the pond, harvesting gear, exchange visits and markets were reported to be the major setbacks of the intervention.

In spite of some negative impacts, members of the club scored the intervention as very successful (80%). The reasons given

for this scoring ranged from being able to harvest, sell and share income, and share fingerlings among members and with the wider community. Markets and pricing of fish were reported to be main challenges in implementing the intervention.

3.2.2 Ntcheu fish farming intervention

In Ntcheu district, fish farming intervention was conducted in Yesaya II village, Traditional Authority Masasa. Fish farming, which started in 2019, was one of the interventions being carried out in the Linungwi Integrated Water System. The intervention had targeted 30 beneficiaries consisting of 10 men and 20 women. The initial plan within the intervention was to construct 2 ponds of 500 m² (0.05 ha) each. Each pond was to be assigned to 15 people. While fish pond excavation was done using manual labour in Nkhata Bay, in Ntcheu a contractor was hired to assist the group in digging the ponds using an excavating machine. However, this machine did not complete the excavation of the fish ponds due to mechanical failure. The machine was eventually collected for repair but did not come back to complete the excavation as promised. The task was completed by the group members themselves, and as a result, only one pond was successfully constructed. This created uncertainties on the future of the project implementation as some members were discouraged. It was reported that due to project implementation uncertainties and unfulfilled project promises, 6 youths dropped out from the group. During data collection, the group consisted of 8 men and 16 women.

While scarcity of water in the area deterred fish farming, it was reported that there was increased demand for fish farming amongst the community around the scheme. Nevertheless, the positive impacts of this intervention permitted diversification to other related interventions such as irrigation farming, borehole water supply and formation of village savings and loans (VSL) groups. This diversification paradigm was expected to yield into food security and economic empowerment among group members.

Although communities had not yet started fish harvesting, their participation in the intervention was beneficial to environmental and natural resource conservation in the area. At the time of the study, there was maximum utilization of the little water that was available. In addition, it was reported that charcoal production activities had also been reduced following farmers' involvement in fish farming activities.

In implementing the intervention, trust and honesty among group members, and good relationship between group members and the extension agents, were critical success factors for fish farming activities. However, lack of locally based project designs and plans, and scramble for water among interventions (particularly irrigation, fish farming and domestic use) were major shortfalls and constraints for the successful implementation of the projects. In addition, communities lamented that one fish pond was inadequate to sustain demand and that fish feed was expensive to make. Furthermore, encroachment of livestock into fishpond area and unfulfilled promise to construct two fishponds were other demotivating

factors among farmers. The group members, however, reported that the intervention was generally very successful (75%). This rating was mainly based on their anticipated high yield from their fishpond¹⁸.

3.2.3 Zomba fish farming intervention

Like irrigation, fish farming was undertaken in Mateketa village, Traditional Authority M'biza. The project commenced in 2016. The initial targeted number of beneficiaries was 35 where 16 were women and 19 men. In total, there were 18 members, comprising 7 women and 11 men. There were 2 ponds of 270 m² (0.027 ha) and 441 m² (0.044 ha) where MK360,000.00 and MK88,000.00 worth of fish were harvested in 2018 and 2019, respectively. In 2018, a total 145 kg of fish was harvested, implying a productivity of 2.04 metric tonnes per hectare, which was above the average productivity for most smallholder farmers in Malawi. Productivity for most smallholder farmers is low, averaging about 1 metric tonne per hectare compared to a potential of 6 tonnes per hectare. This ultimately inhibits the profitability of the sector and holds back commercialization (UKaid, 2020). The significant drop in revenues of fish harvested in 2019 compared to 2018 happened because of market failure. It was reported that farmers harvested their fish with an expectation that there would be a readily available market for the fish. However, this market did not materialize. Consequently, fish being highly perishable, was sold at a highly discounted price. As

¹⁸ There was ample evidence that the fishpond had abundant fish stock.

a solution to this challenge, there is need to include processing and storage facilities for fish in such interventions. Solar driers could be ideal in fish drying to minimise perishability.

Some positive impacts of the intervention on livelihoods of beneficiaries in Ngwelero area were reported. The major impacts included improved nutrition and food security, and economic empowerment at household level. The income realized from fish sales (MK20,000.00 per beneficiary) had the potential to reduce food insecurity period from 5 months (FEWS NET, 2019) to three (3) months. It was reported that apart from inclusion of fish in diets, farmers generated income through fish sales. Some of this income was used to purchase food items such as maize at household level. In terms of environment and natural resources, communities reported that through implementation of fish farming, there had been an increase in water conservation, achieved through the construction of fishponds. In addition, community involvement in fish farming provided an alternative source of income to charcoal production.

The major key success factors which positively influenced implementation of the intervention were the favourable/suitable site factors for the location of the fishponds and the good relationship that existed between group members and extension agents. However, expensive fish feed, lack of harvesting gear, favourable markets, and well-designed fish ponds to ease maintenance and operational costs, had negative effects on implementation of the project. This added to the overall total cost of implementing the

activities. Regardless of the challenges faced, farmers ranked the fish farming intervention as successful (70%). The main reasons for such a score were that communities shared income realized through fish sales, and that fish farming had great potential to change their livelihoods.

3.2.4 Financial and economic cost benefit analysis of fish farming

Three different types of fishponds were analyzed for profitability. Njiri fishponds in Nkhata Bay are fed by water from a stream, while Linungwi fishpond obtained groundwater extracted through boreholes using solar energy and stored in water tanks. Ngwelero fishponds relied on groundwater that naturally filled the ponds without using energy for extraction.

The major investment cost in fish farming was associated with farmer training, pond excavation and construction while the major operational costs were fish feeding, pond management and protecting the fish from predators and thieves. Pond excavation and construction in Nkhata Bay and Zomba was done by the group members while in Ntcheu the group was partially assisted by the ADAPT – PLAN project because the ground was too hard for manual digging. Total investment cost for Njiri fishponds was estimated at MK9 million. Fish farming had other non-monetary costs associated with the opportunity cost of labour, land and water. The opportunity cost of labour used in fish farming was valued by the forgone gains in non-farm activities. The opportunity cost of land and water was estimated by assuming that the

best alternative use of land and water was irrigation farming. The forgone net benefit of using the land for fish was estimated at MK500,000 per hectare per year.

Benefits from fish farming included increased income from fish sales, increased supply of fingerlings and additional fish farming knowledge. Estimates of fish yield from Zomba were used to project fish productivity in Ntcheu. Additional knowledge in fish farming was valued at 20% of the training cost because it only benefited the farmers and their households. The financial and economic analysis results of the three fisheries' interventions are presented in Table 4.

Results from the analysis showed that fish farming was not financially viable. But when the value of additional knowledge in fish farming was included, fish farming became economically viable for Nkhata Bay and Zomba districts. Results for Ntcheu district were not financially and economically viable. Thus, the results reflect a general problem in fish farming in Malawi and are not unique to the ADAPT-PLAN project. The intervention had great potential to become a viable alternative source of income if mechanisms of increasing fish yield while reducing costs were adopted.

Yield from fish ponds in Malawi is generally low. The major limitation compromising the productivity of smallholder farmers is the use of low-quality inputs. Most smallholder farmers use recycled fingerlings or fingerling brood stock because they are not able to access affordable and high quality fingerlings. Similarly, most of the farmers have no access to affordable formulated feed and resort to use of locally sourced manure, rice or maize

Table 4. Financial and economic CBA measures for fish farming by district and gender

CBA TYPE	CBA MEASURE	DISTRICT		
		Nkhata Bay (Njiri)	Ntcheu (Linungwi)	Zomba (Ngwerelo)
Financial	NPV (MK)	(4,096,202.67)	(6,973,525.26)	(9,305,236.68)
	NPV (Female)	(2,275,668.15)	(4,649,016.84)	(3,618,703.15)
	NPV (Male)	(1,820,534.52)	(2,324,508.42)	(5,686,533.52)
	BCR	0.67	0.37	0.43
	IRR	-2%	-17%	-8%
Economic	ENPV (MK)	1,836,755.71	(652,271.72)	200,386.62
	ENPV (Female)	1,020,419.84	(434,847.81)	77,928.13
	ENPV (Male)	816,335.87	(217,423.91)	122,458.49
	EBCR	1.15	0.93	1.02
	ERR	9%	4%	6%

bran. In addition, there is no operational mechanism for certifying the quality of inputs, both fingerlings and feed. Furthermore, limited research funds reduce the scope to develop innovative, cost-effective production technologies, including feed formulation and genetic improvement of the traditional strains of the local species. Moreover, existing rules and legislation do not permit the introduction to the country of fast-growing exotic species that would enhance the industry's productivity and viability. There is general consensus that the introduction of exotic species may not be environmentally benign (UKaid, 2020). Thus, to increase productivity farmers should be discouraged from using recycled fingerlings and be encouraged to use improved locally made fish feed (as was the case in Zomba) rather than relying on manure/fertilizer, rice husks and maize bran.

Distribution of benefits between women and men, and composition of women in the fish farming interventions were mixed. In Zomba (Ngwewero fish farming group) the group was dominated by men (7 women and 11 men) while in Ntcheu (Linungwi fish farming group) women dominated (16 women and 8 men).

In Nkhata Bay (Njiri fish farming group) the group was marginally dominated by women (5 women and 4 men). These differences in gender composition explained the differences in benefit sharing between men and women. Thus, gender mainstreaming in fish farming needs further promotion to remove the traditional mentality that fishery enterprises are largely male domain so that more women access benefits from similar interventions thereby reducing the gender gap in agricultural productivity.

3.3 Beekeeping

Beekeeping intervention was implemented in Nkhata Bay, Ntcheu and Zomba districts just like irrigation and fish farming. This intervention sought to improve food security, enhance income levels and promote forest conservation. Major activities involved in implementation of the intervention were site identification, hanging of bee hives, protection (i.e. patrolling to prevent theft), harvesting and selling of honey and maintenance of beehives. Similar to other interventions, major stakeholders were communities, local

leaders, members of the area development committee, extension agents, district council and UNDP. Technical support and advice were provided to communities by the project through the District Forestry Office. The communities were responsible for beekeeping management activities. The subsections below provide details on beekeeping activities in Nkhata Bay, Ntcheu and Zomba.

3.3.1 Nkhata Bay beekeeping intervention

Beekeeping was conducted in John Chiumia village, Traditional Authority Kabunduli. The intervention was implemented by Movya community group which started in 2016. Apart from beekeeping, Movya group implemented other interventions which included catchment conservation, piggery and village savings and loans (VSL) scheme. For beekeeping, the intervention targeted 10 beneficiaries. At the time of data collection, the group had 19 members comprising 10 female and 9 male members. The project provided the group with 26 beehives in 2016, but there were 40 beehives out of which 35 were colonised at the time of the visit. Since 2017, the group had been harvesting and selling honey and bee wax.

Improved household incomes were the major impact of beekeeping intervention on community livelihoods within the Movya group. It was reported that since the group started harvesting and selling honey, there had been a positive shift in economic status of the people. For instance, using the proceeds from honey production, one lady reported that she had been able to pay for a

passport for her husband to travel to South Africa. The intervention also registered positive impacts on environment and natural resources. For example, there was improved forest management and conservation in sites where beehives had been hung. In addition, local communities had improved control and access to forest resources to enable sustainable harvesting of non-timber forest products such as medicines, mushrooms and fruits.

The key success factors for the implementation of beekeeping intervention were availability of project and local forest resources. Generally, willingness of the community to engage in the beekeeping industry also contributed to the success of the intervention. However, poor linkages to markets and the high cost of bottles for packaging honey were the major challenges affecting the intervention. In addition, uncontrolled forest fires, predation (by *Chiuli* and ants), and theft of honey were reported to have negatively affected the project. Nevertheless, Movya beekeeping group rated the intervention as very successful (85%). The major reason for this score was attributed to acquisition of knowledge and skills in business management such as VSL, improved livelihoods and sustainable forest conservation.

3.3.2 Ntcheu beekeeping intervention

Aside from irrigation and fish farming, beekeeping intervention was also practiced in Yesaya II village, Traditional Authority Masasa. Beekeeping started in 2019 with a target of 20 members (10 women and 10

men) as beneficiaries. At the time of data collection, there were 15 members (5 women and 10 men) of whom 12 (4 female and 8 male) members were youths. There were 42 beehives, where only 5 had been colonised. However, honey harvesting had not yet started at the time of the visit.

Honey harvesting, though had not yet commenced, it was reported that the prospects of having improved livelihoods through income generation from honey were high since some of the beehives had been colonized. It was reported that communities only collected non-timber forest products in designated sites away from areas where beehives were located. This enabled improved conservation of the forest resources where beehives were hung. Availability of project resources and willingness of the community to venture into beekeeping intervention were the major success factors. However, delayed commencement of the intervention coupled with lack of some equipment (such as a honey extractor)¹⁹ were the major negative factors that influenced the smooth implementation of the intervention. This implies that there was a cost overrun for three (3) years potentially costing the investment income amounting to MK720, 000.00 per beehive. In addition, poor quality of beehives due to use of wet timber for their construction also contributed to delayed colonisation of beehives.

Despite some negative factors affecting implementation of the intervention, communities rated beekeeping as very

successful (80%). The reasons for such a rate were attached to anticipated high yields, acquisition of knowledge and skills in business management such as VSL and sustainable honey harvesting techniques (i.e. non-use of open fire).

3.3.3 Zomba beekeeping intervention

In Zomba, beekeeping was practiced by the Nambira beekeeping club located in Mateketa village, Traditional Authority M'biza. The club was also involved in forest conservation, VSL and irrigation farming activities. The beekeeping intervention commenced in 2016 with an initial target of 18 members, comprising 8 female and 10 male members. Four of the members were youths. At the time of data collection, the membership remained unchanged. It was reported that the club had hung 14 beehives in 2017 and harvested 80 bottles of 500 ml of honey in 2018.

Following commencement of honey harvesting, there were positive impacts on the community's livelihoods. Through honey sales, club members realised more income than before. For every kilogramme of honey harvested, the communities realised MK3,000 above their base income. In addition, the incomes realised from honey sales were invested in other equally important interventions that further improved people's livelihoods in the area.

As was the case with Movya group, the intervention registered positive impacts on the environment and natural resources in the area. Members of the club were motivated to conserve forests and other natural resources

¹⁹ The honey extractor was delivered to the group a week after the visit. The extractor that was initially procured for the group had a technical problem and had to be returned to the supplier for a replacement.

since beekeeping depended on the same resources i.e. hanging of beehives. Further, improved control and access to forest resources were reported to be remarkable successes of the intervention.

Resource provision by the project, self mobilisation and willingness of the community to engage in beekeeping were significant factors that positively influenced implementation of the intervention. In contrast, poor access to markets and the high cost of bottles for packaging honey were noted to be the major challenges affecting implementation of the beekeeping intervention. In terms of scoring of the intervention, the club rated it as very successful (90%). The club members attributed this rating to the substantial amount of income acquired through honey sales and for the gains made in forest conservation.

3.3.4 Financial and economic cost benefit analysis of beekeeping

Beekeeping is not a high investment intervention. Major investment costs were associated with procurement of beehives, bee suits, and honey extractors while the major operational costs were associated with maintenance of beehives and procurement of packaging materials such as bottles. Maintenance costs of beehives were estimated based on actual costs obtained during focus group discussions. When professionally managed, beekeeping has no major indirect (unintended) costs. However, if not well managed, it can lead to bush fires and injury or death due to bee stinging. None of these costs were reported during data

collection. Revenue for beekeeping was quite high. For instance, one beehive can yield 30 kg of honey which is sold at MK3,000.00 per kg. A farmer can also generate revenue through the sale of beeswax.

Other benefits of beekeeping include; additional knowledge in business management (through training), pollination and forest conservation. Additional knowledge in business management was valued at 30% of the training cost. The training benefited the individuals, their households and the community at large because it covered technical aspects of beekeeping, business management, gender mainstreaming and leadership skills. The rental cost of commercial honey-bee colonies for pollination in South Africa was used as a proxy for the value of pollination service by bees. The value was adapted from Allsopp *et al.* (2008) and a rental fee of MK15,000 per beehive per season was used. Beekeeping also led to forest conservation due to reduced charcoal production since the intervention represented an alternative source of income. Limited access to some parts of the forest due to fear of the bees coupled with the general appreciation of the forest as an alternative source of income also contributed to forest conservation. Forest conservation was valued by taking one third of the annual salary of a Forest Guard on the assumption that bees contributed to forest protection (which is a job of the Forest Guard). Financial and economic CBA results for sampled beekeeping interventions in the three districts are presented in Table 5.

Table 5 shows that all beekeeping interventions were financially and economically viable at

Table 5. Financial and economic CBA results for beekeeping intervention by district

CBA TYPE	CBA MEASURE	DISTRICT		
		Nkhata Bay (Movya Group)	Ntcheu (Lunungwi Group) ¹	Zomba (Nambira Group)
Financial	NPV (MK)	7,428,865.97	5,185,907.38	3,596,864.83
	NPV (Female)	3,909,929.46	1,728,635.79	1,541,513.50
	NPV (Male)	3,518,936.51	3,457,271.58	2,055,351.33
	BCR	1.57	1.44	1.56
	IRR	16%	13%	15%
Economic	ENPV (MK)	22,898,784.47	16,106,678.97	12,646,144.47
	ENPV (Female)	12,051,991.83	5,368,892.99	5,419,776.20
	ENPV (Male)	10,846,792.64	10,737,785.98	7,226,368.27
	EBCR	2.99	2.63	2.63
	ERR	39%	30%	39%

6% discount rate. Overall, all the three CBA measures were higher under economic CBA than financial CBA. The differences arose because economic CBA included benefits associated with acquisition of knowledge and skills through training and bees' contribution to pollination, and forest protection. Ntcheu district registered lower financial and economic measures than the other districts because the analysis used conservative projections of benefits since the intervention was implemented in the final year (2019) of the ADAPT-PLAN project.

The results justify the need for government to continue funding beekeeping enterprises because they lead to increased net benefits to the community and provide other social (such as adult training) and environmental benefits. Therefore, beekeeping represents one of the most financially and economically viable alternative sources of income with great potential to reduce deforestation while leveraging food security and poverty reduction at the household levels. However, most of the honey produced under the project was not certified by the Malawi Bureau of

Standards for quality assurance. If honey was certified, it could have access to the national and even international markets. There is need to promote certification of honey by engaging appropriate institutions such as Malawi Bureau of Standards and Ministry of Trade during the design and implementation phases of the interventions.

In terms of gender, membership of the groups was dominated by men in Ntcheu (5 women, 10 men) and Zomba (6 women, 8 men) while in Nkhata Bay women marginally dominated the group (10 women, 9 men). The differences are reflected in the benefit shares as presented by the distribution of NPVs by gender which assumes equal distribution of benefits to each member as indicated by the beneficiaries during focus group discussions. These results are a reflection of the situation in the agricultural sector where women farmers are less likely to grow cash or export crops than men who grow and sell these crops to the market for higher incomes. The results point to the need for reducing gender gap in beekeeping through consented efforts and strategies to ensure that men should not

dominate this highly profitable and beneficial intervention.

3.4 Livestock production

Livestock production was also another intervention in Nkhata Bay, Ntcheu and Zomba districts whose aim was to improve nutrition and food security and to enhance income levels of local communities. Interventions in livestock production involved poultry, goat rearing and piggery. However, this analysis focused on goat rearing and piggery. Major activities carried out under this intervention were farmer training, land identification and acquisition, kraal construction, stocking and management of livestock. Like other interventions, major stakeholders in livestock production were communities, local leaders, members of the area development committee, extension agents, district council and UNDP. While field staff provided technical support, the project provided livestock and construction materials. Group members were responsible for construction of the kraals and general pig management in their local communities. The status of the intervention in the three districts, as at data collection, is outlined below.

3.4.1 Nkhata Bay livestock intervention

Mwawi piggery group was located in Chigwere village, Traditional Authority Nyaluwanga. Piggery as an intervention started in 2018 with a targeted membership of 26 beneficiaries. During the time of the study, there were only 4 members, 2 of whom were women. The beneficiaries had received 20 pigs as initial

stock from the project. Over time, the pigs reproduced 86 piglets where group members shared 36 amongst themselves and the rest were passed on to another community group. At the time of data collection, only one pig had been sold.

This intervention showed some positive impacts on livelihood and environment and natural resources. Some of the notable impacts were sharing of pigs and improving social status through ownership of pigs. Thus, potential economic empowerment was ensured. For instance, in 2019 the group income per capita was estimated to be MK198, 461.00. On environment and natural resources, members noted that application of manure produced from pigs had improved soil fertility in their farms. Piggery provided an important alternative socioeconomic activity that contributed positively to forest conservation.

The success of the project hinged on the pass on programme that proved to be key on the diffusion of the intervention amongst local community. However, the setbacks to successful implementation of the intervention were; inadequate support from project on kraal construction (1 kraal was still incomplete at the time of the visit) and inadequate feed for pigs. All in all, the intervention was perceived as successful with a rating of 75%. The remaining percentage was due to inadequate support from the project on kraal construction.

3.4.2 Ntcheu livestock intervention

Livestock production was also undertaken by Kasinje Livestock Production Youth group

located in Kasinje village of Traditional Authority Ganya. The youth group started rearing goats in 2019. The main activities under this intervention were beneficiary identification, capacity building on goat management, distribution of goats for breeding, distribution of drug boxes for animal health care, youth mobilisation and kraal construction and management. Initially, the intervention started with 15 youths comprising 7 male and 8 female members. At the time of the study, there were 75 goats (60 does-female goats and 15 bucks-male goats) issued to the youth with each one receiving 5 (1 buck and 4 does) goats. In addition, the group received 1 drug box for animal health services.

Both positive and negative impacts of goat rearing intervention were reported. Positive impacts of goat rearing on beneficiaries' livelihoods included improved income and food security amongst the youth. In addition, the intervention contributed significantly in enhancing the social status of the youth. Ownership of goats appeared to uplift one's status in society and provided economic security. The negative impacts of the intervention on beneficiaries' livelihoods were high costs associated with kraal construction, drug administration and paying shepherds and litigation costs. In terms of impacts of the intervention on environment and natural resources, the goat droppings were used as organic manure. It was also reported that browsing caused retarded plant growth particularly of agricultural crops. In addition, a large amount of wood (poles) was utilized in kraal construction. This might have contributed to increased forest degradation.

Thus, utilization of bamboos in kraal construction could be an ideal alternative.

Team work and cooperation among the members were the major factors which positively affected the project success. Having regular meetings coupled with adherence to their constitution contributed positively towards achieving the intended objectives of the intervention. The negative factors affecting implementation of the intervention were lack of adequate extension services, lack of diversification of enterprises, and lengthy period taken in a pass on initiative²⁰. Elements of dependency syndrome among some group members regarding construction of goat kraals were also reported. However, the intervention was highly applauded to be very successful (80%). The youth group reported that this intervention was the first of its kind for them to receive such support.

3.4.3 Zomba livestock intervention

Takondwera Youth Club in Zomba was also involved in the piggery intervention. The club was located in Ntawanga village, Traditional Authority Mwambo. The intervention started in 2019 with 16 members (10 female and 6 male members). At the time of the study, it was found that membership of the club was intact. The club received 3 pigs which later produced 12 piglets. It was further reported that in 2018 there was a disease outbreak that affected the pigs. Two piglets died from

²⁰ An initiative which attempts to spread the benefits over time from primary to secondary recipients. For example, when a farmer receives an animal, there is an obligation to donate the first offspring (usually female) from that animal to another farmer. That farmer then inherits the same obligation to relay, and so on. In this way, the number of households who benefit from livestock increases significantly over time.

the disease. This prompted members of the club to share the piglets amongst themselves to reduce further spread of the disease.

It was envisaged that piggery would yield into positive economic empowerment of the youths after sale of live animal or meat products. Feeding pigs, however, was generally expensive during lean periods (particularly between December and February). With regard to the environment and natural resources management, the intervention contributed positively to reduced charcoal production. In addition, soil fertility and moisture content improvements through use of manure was also reported.

Guaranteed ownership of pigs through the pass on programme was a key factor for the success of the intervention. On the other hand, lack of training in business management, late implementation of the intervention and inadequate provision of inputs (few piglets, no feed and no construction materials) were setbacks towards the successful implementation of the intervention. Further, disease outbreak was another constraint to the success of piggery.

The youth club considered the intervention to be successful (75%) regardless of the shortfalls reported. The scoring given emanated from issues of inadequate support on kraal construction and delayed project inception. However, engagement of the youth in such productive activities was a plus to the intervention.

3.4.4 Financial and economic cost benefit analysis of livestock production

Both piggery and goat rearing required investment in animal housing in addition to the procurement of piglets and kids (young goats). The major operational costs in piggery included feeding, maintaining the animal house and controlling and treating animal diseases. Goats were usually managed by shepherds who took them out for browsing. As an example, in Ntcheu it was revealed that shepherds charge MK500 per goat per month. Goat rearing can also have an unintended cost associated with payments made when a goat trespasses into other people's gardens and destroys crops²¹. There was no opportunity cost of land used for animal housing because the kraals were constructed on idle bare land within the homesteads and its construction did not prevent other uses.

Unlike goats, pigs have a high mortality rate ranging from 10% to 20% mainly due to a viral disease - African swine fever (Edwards and Baxter, 2014). A 20% mortality rate was assumed in this analysis. However, goats have higher survival rates and are easy to manage and feed than pigs.

Revenue sources from goat rearing and piggery were from the sale of the animals and manure. Sale of milk was another source of income from goats. It takes 2 years for a pig to be fully grown. An average litter size of 6 has

²¹ Although it was reported that browsing caused retarded plant growth particularly of agricultural crops, no quantitative data was provided to reflect the extent of damage and as such the analysis did not capture environmental costs associated with browsing.

been assumed in each breeding season²². It has also been assumed that goats give birth to an average of 3 kids in a breeding season²³ but take 9 months to be fully grown. FGDs revealed that a fully grown goat could be sold at a minimum price of MK20,000 while a fully grown pig was sold at MK60,000. A standard bag²⁴ of manure was sold at MK500. Goat milk was sold at MK600 per litre. Financial and economic CBA results of livestock production are summarized in Table 6.

composition of the groups. Overall, no group was dominated by men. The results have shown that livestock production is an excellent alternative source of income which could lead to reduced reliance on forest resources and build resilience to climate change among rural communities.

3.5 Village savings and loans

Village Savings and Loans (VSL) association is

Table 6. Financial and economic CBA measures for livestock production by district

CBA TYPE	CBA MEASURE	DISTRICT		
		Nkhata Bay (Mwawi piggery)	Ntcheu (Kasinje Goat Production)	Zomba (Takondwera Piggery)
Financial	NPV (MK)	9,297,564.23	6,534,736.04	2,686,742.33
	NPV (Female)	4,648,782.12	3,485,192.56	1,679,213.96
	NPV (Male)	4,648,782.12	3,049,543.49	1,007,528.37
	BCR	1.46	1.53	1.29
	IRR	19%	24%	29%
Economic	ENPV (MK)	6,817,405.15	7,684,266.85	7,530,946.64
	ENPV (Female)	3,408,702.58	4,098,275.66	4,706,841.65
	ENPV (Male)	3,408,702.58	3,585,991.20	2,824,104.99
	EBCR	1.40	1.75	1.92
	ERR	22%	31%	38%

Financial and economic analysis of the three interventions revealed that they were all profitable investments. All the investments had positive NPV. Both BCR and IRR indicated that the interventions provided good returns on investment. The differences between financial and economic analysis results are due to the inclusion of the value of additional livestock management knowledge in the economic analysis. The differences in the distribution of benefits between men and women was a reflection of gender

- 22 Pigs have two breeding seasons in a year
 23 Goats have one breeding season in a year
 24 Equivalent to a 50 kg bag of maize

a group of people who meet regularly to save together and take small loans from those savings. The activities of the group run in cycle of one year after which the accumulated savings and the loan profits are distributed back to the members. The purpose of a VSL is to provide simple savings and loan facilities in a community that does not have easy access to formal financial services. VSL as an intervention, was carried out in all the project districts. VSLs were implemented in almost all the interventions as complementary activities. All producer groups were encouraged to form savings and loans associations where proceeds from their group projects could

be deposited for members to borrow at an interest rate, before they were shared to the group members. This arrangement provided a means for the members and in some cases the wider community²⁵ to find easy access to capital for growth of their individual business enterprises while maintaining financial reserves for the group enterprise. The aims of this intervention were to improve economic empowerment of group members and to strengthen their resilience against climate change and weather variability shocks. Major activities carried out under this intervention included community sensitization, group mobilization, capacity building on VSL operations, opening of bank account, receipt of seed money (capital injection), disbursement of shares among group members and group resources mobilisation to support VSL (e.g. beekeeping). Members of the group were only expected to share proceeds from the bank and not the capital injection from the project.

The major stakeholders in VSL management were communities, local leaders, members of the ADC, extension agents, non-governmental organisations, district council and UNDP. While Community Development Office provided technical support, the project provided seed money. Group members were responsible for management of their VSLs and also provided capital injection through member contributions (shares).

²⁵ It is not a common practice for VSLs to lend money to people who are not members of the association due to payment challenges. This unique case was only reported in Nkhata Bay and no specific details were given as regards to the number of nonmembers who borrowed, the amounts involved and what the money was used for. For Nkhata Bay, the village chief acted as a witness to the loan transaction of nonmembers.

3.5.1 Nkhata Bay VSL intervention

Just like in most of the interventions, Movya group was also implementing VSL activities to compliment catchment conservation, beekeeping and piggery. The intervention started in 2016 with an initial target of 10 members. At the time of the study, there were 19 members out of whom 10 were women. In 2016, the group received seed money from the project through Community Savings and Investment Promotion (COMSIP) amounting to MK200,000. The shares of the group in 2019 amounted to MK650,000.

Various benefits of the intervention on beneficiaries' livelihoods were reported. Members indicated that through VSL operations, they were able to buy iron sheets, farm inputs and pay school fees. In addition, the group revealed that the intervention increased food security status at household level. While the incomes realised from the VSL supported the other business interventions, they also provided opportunities for other necessary activities. For instance, proceeds from the VSL enabled purchase of fertilisers, construction of better houses and supporting of small-scale businesses.

The advent of VSL intervention in Movya, enabled community members to shift focus of economic activities from charcoal production to improved natural resources conservation through beekeeping initiatives. As a result, this had positive contributions on tree and forest conservation. Key success factors that affected the intervention included diversified linkages among business interventions i.e. beekeeping, piggery and VSL, good

organizational leadership, team spirit, trust, and conformity to provisions of the group constitution. However, the group members indicated that they were experiencing some shortfalls in accounting and book keeping skills. Low capital investment was also reported as a setback. Nevertheless, the intervention was rated as very successful (85%).

3.5.2 Ntcheu VSL intervention

Village Savings and Loans intervention was also implemented by Tithandizane group located in Phanga village, Traditional Authority Masasa. The intervention started in 2017 with 15 members consisting of 5 men and 10 women. This intervention was complemented by livestock production, principally goat production. In 2017, the group received a capital injection of MK218,100.00.

On beneficiaries' livelihoods, members indicated that through VSL operations, they were able to construct better houses, buy farm inputs, invest in personal businesses and reduce food insecurity. In addition, VSLs acted as buffers against risks and uncertainties. For instance, communities could cope in times of floods when their crops were washed away as they had money to buy food. Proceeds from VSLs enabled group members to divert from charcoal production to livestock rearing and other environmentally friendly enterprises.

The key success factors for the intervention reported by Tithandizane VSL club were similar to those recorded at Movya group in Nkhata Bay. Further, for Tithandizane VSL, the culture of savings was adopted and their capital base increased considerably such

that group members were able to manage their seed money. On the contrary, lack of frequent visits by extension workers was reported to have negatively affected the implementation of the VSL intervention. In spite of the challenges reported by the group, the intervention was still rated as fairly successful (65%). This rating was attributed to a number of reasons including, inadequate seed money and engagement in less profitable interventions (e.g. goat production).

3.5.3 Zomba VSL intervention

Just like in Nkhata Bay and Ntcheu, the VSL intervention was implemented by Chitamambeta Village Bank in Mulere village (within Sunuzi area), Traditional Authority Ngweleru. The intervention commenced in 2017 with an initial target membership of 25, out of which, 15 were women. Before engaging in VSL activities, Chitamambeta group was involved in afforestation activities at Sunuzi. At the time of data collection, there were 20 members comprising 5 men and 15 women. Their capital stock amounted to MK509,000.00.

Major impacts of the intervention on beneficiaries' livelihoods were increased income levels and improved social security. This enabled communities to buy iron sheets, farm inputs, pay school fees and invest in their personal businesses. The group indicated that some financial resources accrued from the VSL were used for forest establishment and conservation. In addition, implementation of VSLs motivated community members to change focus from charcoal production to alternative business ventures.

Adult literacy (particularly numeracy) and good relationship between project staff and group members were the key factors that positively influenced implementation of the intervention. However, lack of implementation of group action business plan and lack of educational visits to peer VSL groups had negative effect on the success of the intervention. In addition, nepotistic behaviours and elements of favouritism by local leaders in allocation of public afforestation works were reported. This culminated into sidelining of local group efforts in forest management. This behaviour demotivated some members of the group. This revealed the need for capacity building in Community-Based Natural Resources Management which could include issues of community participation, conflict resolution and benefit sharing mechanisms. Nevertheless, the intervention was rated as very successful, i.e. 80% due to the shortfalls highlighted.

3.5.4 Financial and economic cost benefit analysis of VSLs

Financial and economic analysis was carried out for the three village savings groups. The major fixed costs of the village savings groups were training costs, investment capital and planning, implementation and monitoring costs. Both the ADAPT-PLAN project and group members contributed to the investment capital of the village banks. Operating costs were minimal and mostly accounted for stationery.

Village savings banks generated income by lending money to group members and in

some cases (such as Movya group in Nkhata Bay) to members of the general community at interest rates of 20% and 30% per month, respectively. These rates, though high, are lower than those charged by other informal financial lenders locally called *katapira* who engage in usury. The money gained through these interest rates was shared to members of the group once towards the end of the year. Thus, the return on savings was financed primarily through interest paid on loans, in addition to the various fines levied during each savings cycle. Therefore, it was possible for a net borrower to actually pay more into the system than what was taken out in the final savings payout. However, it seemed reasonable to suppose that the borrower received some additional benefit from access to the loan and that the loan was put into other productive investment. Since there was an external source of funds entering the system, the average return was greater than zero percent even after subtracting various expenses for each group. This explains the importance of the capital injection made by the project into the groups.

Benefits from VSLs association included; increased income from dividends, increased household business outcomes, improved food security, improved housing and additional business and financial knowledge²⁶. Increased business outcome was estimated by using values from a study by Ksoll et al. (2016) who found that the median income from business increased by MK1,500 following membership to village savings bank in Northern Malawi. Improvement in food security was valued

²⁶ To avoid double counting, parameters that only accounted for change brought up by VSL membership were used to estimate benefits from VSL.

using estimates of increase in number of meals per day for VSL members calculated by Ksoll et al. (2016). The number of meals consumed per day for VSLs participants increased by 0.13, corresponding to one more meal per week or one extra meal in seven households (Ksoll et al., 2016). Similarly, improvement in housing was valued by the estimated increase in the number of rooms due to VSLs. The number of rooms increased by an average of 0.13 (Ksoll et al., 2016). Additional business and financial knowledge was valued at 30% of the training costs. Analysis results are reported in Table 7. There was no division of NPV by gender because the amount that an individual received depended on the shares (deposits) bought by that individual. There was variation in the number of shares between men and women and even amongst the women themselves.

and economic returns. It is important to note that the major advantage of joining a village bank is derived from having access to savings and loan services. In a country where the vast majority of the population lacks access to such services, this represents a substantial advantage to the participants. Thus, the integration of the different project interventions with a village savings bank was an innovation that ensured the sustainability of the interventions and growth of the group's as well as individual's economic activities, after project support. The major challenge was the sustainability of the village savings groups themselves since most of them were not linked to formal organizations such as Community Savings and Investment Promotion (COMSIP).

Table 7. Financial and economic CBA measures for village savings bank by district

CBA TYPE	CBA MEASURE	DISTRICT		
		Nkhata Bay (Movyva VSL)	Ntcheu (Tithandizane VSL)	Zomba (Chitamambeta VSL)
Financial	NPV (MK)	8,772,468.30	5,916,939.41	8,164,915.32
	BCR	3.93	3.56	3.87
	IRR	64%	49%	51%
Economic	ENPV (MK)	8,860,343.25	5,922,173.90	8,194,318.18
	EBCR	4.48	4.00	4.38
	ERR	54%	56%	59%

The results showed that all the three village savings banks were financially and economically viable. The differences between financial and economic analysis results are due to the inclusion of the value of additional business and financial knowledge in the economic analysis. The high values of BCR and IRR reflect the fact that VSL associations are low cost investments that yield high financial

3.6 Banana production

3.6.1 Tawonga banana club

Banana production was carried out as an intervention by Tawonga banana club in Nkhata Bay district. The club was located in Kamphomombo village, Traditional Authority Timbiri. The William banana variety was cultivated in the area. This intervention commenced in 2017 with the objectives of

building community resilience to drought and flood occurrences, improving soil and water conservation and enhancing economic status at household level.

To meet the objectives of the intervention, several activities were carried out. These included group sensitisations, intervention identification, training, land acquisition from the chief, land clearing, pitting, manure application and planting. Watering, weeding, mulching, disease and pest control, banana harvesting and selling were also conducted. The major stakeholders involved in implementation of the intervention included group members, village development committee, area development committee, banana traders, district council and UNDP. Group members took a leading role in implementation of the intervention while the district staff acted as facilitators (technical support and advice) and UNDP provided financial support. Initially, the group had 15 members comprising 4 men and 11 women. There were 12 members (4 men and 8 women) at the time of the visit. The group received 165 banana suckers from the project where 100 suckers were shared among group members. The remaining suckers (65) were planted on a communal farm of approximately 0.11 ha. From the first suckers, 65 were donated to a youth group around the area. Another, 75 suckers were given to Njaya club in the area. Furthermore, 432 suckers were shared to individual members of Tawonga group and the general community. Some of the money realized from banana sales was used to buy shares within the group's VSL.

Increased food security and economic empowerment at household level were

the major impacts of the intervention on livelihoods. For instance, members reported that they were able to pay for school fees and build better houses. Further, one farmer proudly reported that he procured a mini hydropower plant from banana proceeds. From the environmental perspective, banana plants improve soil and water conservation on farm. Banana plants also acted as wind breaks and provided mulch for the soil thereby reducing soil erosion.

Favourable climatic and edaphic factors, availability of land, willingness of club members to participate in banana production were the key success factors for the intervention. However, low banana prices (which were often determined by the buyers), lack of diversification to other interventions such as goat production (for manure) and lack of exchange visits hindered the effective implementation of the intervention. Overall, the intervention was rated as very successful (85%). The reasons for such a score were attributed to successes in pass on initiatives to individual club members which was extended to the wider community and generation of income among group members.

3.6.2 Financial and economic cost-benefit analysis of banana cultivation

Banana cultivation is not a capital- and labour-intensive investment. Major investment costs relate to land acquisition, land preparation, manure acquisition and application, acquisition of the planting materials (suckers), and planting and watering if suckers are planted during the dry season. Operational costs are minimal and include

plant management (weeding, deleafing, de-suckering, propping, disease and pest control) and harvesting.

The major sources of revenue were sale of the bananas and suckers. The average productivity of bananas was estimated at 32 tonnes per hectare and the average price per tonne was MK300,000²⁷. A bunch of bananas was generally sold at MK6,000 each, but there were instances where a bunch of bananas could cost as high as MK7,000 each. Bananas also produced a lot of suckers, yet the recommended banana density was 3 suckers per planting station. Thus, excess suckers were shared within the group, passed on to other groups or sold (though not recommended under the ADAPT-PLAN project). The results for financial and economic CBA of banana production are presented in Table 8.

economic CBA measures were as a result of the inclusion of training and soil and water conservation values in the economic analysis. There was good women representation in the group thereby contributing towards the reduction of gender gap in agricultural productivity. From a group of 12 members, 8 were women. This explains why women shared 67% of the net benefits. The crop is drought and flood resistant and contributes to soil and water conservation. The intervention had great potential for community impact through the pass on practice of suckers to group members and other groups. Thus, it represented a viable alternative source of income with great potential to increase community impact and reduce the gender gap in agricultural productivity while leveraging food security and poverty reduction at the

Table 8. Financial and economic CBA measures for banana production in Nkhata Bay

CBA TYPE	CBA MEASURE	DISTRICT
		Nkhata Bay (Tawonga Banana Club)
Financial	NPV (MK)	3,528,678.06
	NPV (Female)	2,352,452.04
	NPV (Male)	1,176,226.02
	BCR	1.39
	IRR	14%
Economic	ENPV (MK)	7,650,141.93
	ENPV (Female)	5,100,094.62
	ENPV (Male)	2,550,047.31
	EBCR	2.52
	ERR	33%

The results showed that banana production represented an efficient allocation of invested funds. It was financially and economically viable and suitable for income diversification. The differences between financial and

household levels.

3.7 Community bakery

3.7.1 Chikomo community bakery

Only one community bakery intervention was implemented in the project. This

²⁷ FAOST [<http://www.fao.org/faostat/en/#data/QC>]

intervention was implemented in Usisya area at Mzizimuwane village, Traditional Authority M'bwana in Nkhata Bay. The intervention started in 2016 with the aim of improving economic empowerment of local communities in order to enhance their livelihoods. The implementation of this intervention was achieved through community mobilisation, identification of the interventions through Cobra, training, bakery construction and financial resources provision. In the implementation of the intervention, the district staff provided training and technical support. UNDP constructed the community bakery (a building equipped with 2 ovens and solar power). Group members bought a 400 m² piece of land on which the bakery was constructed. In addition, the members took the initiative to connect the bakery to electricity from the national grid (ESCOM).

Stakeholders for the intervention were, therefore, bakery group, local leaders, district council and UNDP. Initially, the intervention targeted 25 beneficiaries comprising 19 women and 6 men. During FGDs it was revealed that the membership of the group consisted of 14 women and 4 men. It was further noted that the group was capable of baking about 1000 scones per day when demand was at peak particularly during meetings and ceremonies; for example, when there are Teacher Development Committee meetings and weddings.

The main positive impacts of the intervention on livelihoods were noted. The members of this club reported that they had experienced increased income levels at household level through sales of various bakery products. The increased income had further enabled

members to attain improved food security. Key informant interviews with the chairperson of the bakery group revealed that, using proceeds from the bakery, members were able to construct better houses, pay utility bills and school fees, and buy better clothes for family members. The proceeds were shared equally among all members of the bakery and invested in the VSL. Interestingly, it was further reported that members of the group had increased access to food throughout the year thereby increasing resilience to effects of climate change.

The key positive impact of the intervention on environment and natural resources was that implementation of the bakery activities motivated communities to change focus from charcoal production and selling to managing the bakery as an alternative business venture. Furthermore, although firewood was used in bakery operations, the bakery was installed with energy efficient ovens which demanded less firewood. Thus, the intervention did not pose any significant environmental concerns.

The success factors surrounding the intervention were related to the availability of a purposely built bakery infrastructure, existing social capital (improved relations, social cohesion and trust) and easy access to the markets. However, the success of the intervention was hampered by a number of factors which included high costs of firewood and high license fees (MK50,000 per annum). In addition, members reported that there was need for extra capital injection to improve packaging and transportation of bakery products to markets. The group rated the intervention as very successful with a score of 80% because it provided a source of income

Table 9. Financial and economic CBA measures for bakery intervention

CBA TYPE	CBA MEASURE	DISTRICT
		Nkhata Bay (Chikomo Bakery)
Financial	NPV (MK)	6,608,287.24
	NPV (Female)	5,139,778.97
	NPV (Male)	1,468,508.28
	BCR	1.22
	IRR	17%
Economic	ENPV (MK)	7,980,693.17
	ENPV (Female)	6,207,205.80
	ENPV (Male)	1,773,487.37
	EBCR	1.341618829
	ERR	21%

and contributed significantly to improved livelihoods at household level.

3.7.2 Financial and economic cost benefit analysis of a community bakery

Close to MK11 million was invested in Chikomo bakery. The investment comprised a bakery building with three rooms and ablution, two wood-fired ovens, trays and other materials. Members of the group were also trained in pastry. The opportunity cost of land was used to value the land on which the bakery building was constructed. Since the bakery was within a residential area, the best alternative was assumed to be a residential house. Thus, the forgone alternative was represented by annual net rental revenue for a standard house in the area. The group paid an annual license fee of MK50,000 to the district council. Major running expenses of the bakery included purchases of flour and firewood. An inspection of the financial records of the bakery, revealed that the group earned an average of MK45,000 per week operating for three days in a week. However, the group had potential to increase its earnings to MK100,000 per week if it

operated for six days in a week.

Financial and economic CBA results of Chikomo bakery are presented in Table 9. In calculating the economic CBA, the annual business license fee was excluded as a cost since it represented a tax. The value of additional knowledge in bakery and business management was included as a benefit. Additional knowledge was valued at 30% of the training costs.

The results showed that the bakery was financially and economically viable based on NPV, BCR and IRR. These measures were higher under economic analysis than financial analysis because of the use of economic prices. In addition, value added tax paid on utilities and raw materials (wheat flour, baking powder, oil, etc.) was deducted from the cost under economic analysis before converting it to economic cost. Furthermore, economic analysis included the value of additional knowledge in bakery and business management acquired through training.

The difference between men and women in benefit sharing can be explained by the fact that there were more female members in the group than their male counterparts. The

group had 14 women and 4 men. Since the benefits from the bakery are shared equally amongst the members, a bigger percentage (78%) of the total benefits was shared by the women. The results imply that a community bakery represents an efficient business intervention which can be scaled out to other areas and adopted in other similar projects.

3.8 Tailoring

3.8.1 Usisya tailoring group

Tailoring as an intervention was carried out in M'bwana village, Traditional Authority M'bwana in Nkhata Bay. The intervention started in 2016 with the aim of alleviating vulnerability of local communities to climate change shocks and improve household incomes. The key activities in the implementation of the intervention were community mobilisation and group formation, and capacity building of the group through training in tailoring. In implementing the intervention, the group was responsible for identification of tailoring shop, payment of associated rental costs and undertaking tailoring activities. Training and technical support was provided by the project through the district council. UNDP supported the group with 15 electrical sewing machines and cloth and embroidery for training purposes.

The key stakeholders to this intervention were group members, local leaders (VDC and ADC), district council, TEVETA and UNDP. Initially, the intervention had 20 members. During the study, there were 10 members, comprising 6 women and 4 men. Of special interest, the group was predominantly (90%) youthful which was key for sustainability of

the intervention.

In terms of impacts of the intervention, FGDs revealed that the intervention had a modest contribution towards livelihoods of group members. Nevertheless, there was a shift of activity focus among community members from overreliance on tree and forest resources to tailoring. Apparently, training and provision of sewing machines were the main success factors that positively affected implementation of the intervention. However, inadequate knowledge on some sewing designs, high drop-out rate of group members, erratic and costly power supply, and lack of own and strategically located tailoring shop were the main issues of concern affecting the intervention. In addition, low income generated due to limited markets, was one of the concerns raised during FGDs. The limited market is aggravated by inaccessibility challenges to Usisya area. To make Usisya accessible to the markets, government should improve road infrastructure and the waterway. As a result of the above stated challenges, the intervention was rated as barely successful (50%).

3.8.2 Financial and economic cost benefit analysis of tailoring intervention

Approximately MK13 million was invested in this intervention. The investment includes 15 electric sewing machines and a 2 months training in tailoring for the group members. It had high operational costs owing to payments for rent, electricity, water and toilet facilities. After analyzing the group's financial records, it was estimated that the group earned on

Table 10. Financial and economic CBA measures for Usisya tailoring group

CBA TYPE	CBA MEASURE	DISTRICT
		Nkhata Bay (Usisya Tailoring Group)
Financial	NPV (MK)	(3,667,635.05)
	NPV (Female)	(2,200,581.03)
	NPV (Male)	(1,467,054.02)
	BCR	0.75
	IRR	1%
Economic	ENPV (MK)	1,162,656.76
	ENPV (Female)	697,594.06
	ENPV (Male)	465,062.70
	EBCR	1.10
	ERR	14%

average MK25,000 a week, working for three days in a week. For economic CBA a value for training was calculated at 30% of the total cost of training. Financial and economic CBA results for Usisya tailoring group are presented in Table 10.

CBA results for Usisya tailoring group showed that the intervention was not financially viable. The invested resources far outweighed the revenues generated by the enterprise. The cost of the 2-months training was one of the major cost components that made the intervention to be financially unprofitable. Indeed, when the cost of training was removed from the analysis, the intervention became financially viable. In the economic analysis when the benefit of training was accounted for, the intervention became economically efficient. Thus, the differences between the financial and economic results were due to the inclusion of economic benefit of training in tailoring and business management that the group received. During FGDs it was learnt that one member of the group decided to leave the group and was operating independently but within the same premises that the group operated. This signified the benefits of training in tailoring which enabled some

members to gain economic independence. Women had a bigger share (60%) because they were more than men. Tailoring was, therefore, an important intervention because it led to job creation and diversification while mainstreaming gender.

From the financial perspective no private investor would be willing to support this intervention. However, from the economic point of view the intervention had some social benefits which increased its efficiency and justified government's support. It can therefore be concluded that an intervention in tailoring that includes a component of training represents an efficient business intervention for improving rural livelihoods. Since private investors are unlikely to finance training in tailoring, public resources would be required to support such interventions.

3.9 Water supply

In Nkhata Bay district, the project drilled 4 boreholes in the following traditional authorities: Nyalubanga, Mankhambira, and Fukamapili. The 4 boreholes were drilled in 2017 and each borehole was serving an

average of 60 households²⁸.

Total cost of the boreholes was calculated from the average cost of drilling one borehole which was given as MK3,750,000 (US\$5,000) and the operation and maintenance cost of the borehole was estimated at 2.5% of the installation cost as used by ADB (2009) in the economic analysis of an integrated rural water supply and sanitation project in Malawi. The intervention trained borehole committee members on borehole operation and maintenance. The opportunity cost of land used for borehole drilling was the forgone net benefit of using that land for crop production. One environmental cost of a borehole is associated with reduction in the level of the water table. However, during FGDs and district consultative meetings, this was not highlighted as a problem in Nkhata Bay district.

The value of water from the boreholes that was used by the beneficiaries was estimated by multiplying the total number of households (60 x 4 = 240 households) by the annual willingness to pay for water. The monthly household water fee of MK200 was assumed to reflect the households' willingness to pay for water. The installation of the boreholes had other non-pecuniary benefits such as reduced time and distance for water collection (time saving), reduced water borne diseases (health benefits), additional knowledge in borehole management and reduced harassment of young girls and women.

The value of time saving resulting from the

²⁸ The water from the boreholes was for household/domestic use only. Livestock and crop production and other enterprises used water from rivers and unprotected wells.

installation of the boreholes was estimated from the additional income that could have been obtained as a result of the saving in time spent on collecting water. This was calculated based on the assumption that the average time spent fetching water was reduced from 1 hour to 30 minutes as revealed during FGDs. This implied that there was a 30-minutes time saving equivalent to Malawi minimum rural wage rate of MK84.14²⁹.

Health benefits were calculated in terms of health cost savings. For this purpose, one of the major incidences of waterborne diseases - diarrhea was considered. The following assumptions were made in relation to cost saving in Nkhata Bay:

- i) The prevalence rate for the incidence of diarrhea without the project was 14.5% (Malawi Government, 2012).
- ii) The incidence of diarrhea was reduced to 3.2% with the project (Malawi Government, 2017) and
- iii) The average medication cost was MK1,500/person/year (inclusive of transport and treatment according to FGDs of this study).

Additional knowledge in borehole maintenance was valued at 10% of the training cost because the knowledge gained from the training was of benefit to the community and not to the committee members as individuals or their households.

It was not possible to put a monetary value for reduced harassment of young girls and

²⁹ Ministry of Labor, Youth and Manpower Development, Malawi (2020). The beneficiaries did not indicate what they used the time saved for. But literature indicate that the time saved is mostly used for productive activities and leisure (and leisure has a value).

Table 11. Financial and economic CBA for borehole water supply

CBA TYPE	CBA MEASURE	DISTRICT
		Nkhata Bay (Borehole water supply)
Financial	NPV (MK)	(18,172,204.74)
	BCR	0.22
	IRR	-24%
Economic	ENPV (MK)	16,217,141.77
	EBCR	1.84
	ERR	24%

women. However, it was observed during FGDs that adolescent girls and young women were the primary water managers and users at a household level. Without the project, this group could have faced a lot of challenges in accessing water in streams and shallow unprotected wells. There was also a high likelihood of harassment by men and boys during the water collection trips. The introduction of the boreholes had reduced their vulnerability. Young girls and women had improved access to safe drinking water because of the intervention. The adolescent girls and young women felt liberated by the introduction of the boreholes.

Table 11 presents results of both financial and economic CBA for the intervention. The results showed that at 6% social discount rate, investment in a rural borehole water supply system is financially not viable. This explains why private investors do not invest in rural water supply projects. The economic CBA results showed that investment in water supply for rural households was economically cost-efficient. The differences between financial and economic results were due to the additional social and health benefits which far outweighed the costs. The main beneficiaries of the intervention were women because they are the ones mostly responsible for water collection. These results reinforce

earlier findings by World Bank Africa Gender Innovation Lab, UN Women, and the UNDP-UNEP Poverty-Environment Initiative on reducing the gender gap as a strategy for alleviating poverty. Poor access to potable water is one of the drivers of gender agricultural productivity gap in Malawi and the provision of improved access to safe water is one of the solutions for closing this gap.

3.10 Catchment conservation

Catchment conservation was one of the interventions implemented in Nkhata Bay, Ntcheu and Zomba districts. The aim of the intervention was to improve soil and forest conservation, contribute to food security and increase sources of income through integrated activities such as seedling, fruit and honey production. Major activities carried out under this intervention included training, land acquisition, land clearing, tilling, pitting, contour bands, planting of vetiver grass, planting of tree seedlings and fruits and manure application, watering and weeding.

The major stakeholders in catchment conservation were communities, local leaders, members of the area development committee, extension agents, district council

and UNDP. While field staff provided technical support, the project provided seed or seedlings. Group members took a leading role in catchment conservation activities while the district staff facilitated the implementation of the intervention and UNDP provided financial support.

3.10.1 Kapiri catchment conservation in Nkhata Bay

Kapiri catchment conservation was located at Chipimbinga village in Traditional Authority Kabunduli. The intervention commenced in 2015 with 16 members. At the time of data collection, the intervention had 14 members where 8 of them were men. It was learnt that 1 ha of land was conserved and planted with citrus trees (288 oranges and 362 tangerines) and vetiver grass. Although tangible benefits had not yet been realised, the intervention showed high potential to promote and strengthen food security and increase incomes at household level.

Catchment conservation had a duo positive impact on the environment and natural resources conservation. Vetiver grass was considered to be ideal for soil and water conservation, particularly in slope grades of Kapiri area. It was expected that fruit production would contribute to reduced charcoal production as an alternative source of income. The key factors that positively affected the project included favourable climatic and edaphic factors as well as willingness of the group members to participate in catchment conservation. However, lack of diversification to other interventions such as poultry production

(for organic manure) and lack of knowledge in grafting techniques negatively influenced the implementation of the intervention. Hence, the intervention was rated as fairly successful i.e. 60%. The reason for such rating was attributed to lack of fruit sales as trees had just started fruiting. Nevertheless, combinations of fruit trees and vetiver grass reduced soil erosion to very minimum levels in the steep slopes of Kapiri.

3.10.2 Catchment conservation in Ntcheu

Catchment conservation was also an intervention practiced in Ntcheu at Mkumphira village in Traditional Authority Ganya. The specific objectives of the intervention were to reduce deforestation and control flooding with an overall aim of protecting the catchment area. The intervention started in 2018 with 60 members comprising 30 male and 30 female members where 10 members were youths. The activities that took place at Mkumphira village were the following: nursery establishment (fencing, pot filling, manure application and sowing) and management (watering and chemical spraying), and woodlot establishment (clearing, pitting and filling, and tree planting), management (weeding) and forest protection from illegal harvesting. Interestingly, it was reported that meat and fish soup were used for pest management, particularly when controlling termites. At the time of the study, 65 members (40 women) were managing an area totaling to 6.1 ha under catchment conservation. In 2018 the members sold 6,000 seedlings at MK80.00 each. Thus, seedlings provided a source of income with potential to improve peoples'

livelihoods.

The intervention had various positive impacts on the environment and natural resources management. The major impacts included increased forest cover on the catchment and homesteads. The catchment area was also a source of non-timber forest products such as mushrooms. The success of the intervention could be attributed to a number of factors, viz: community willingness to participate in the intervention and availability of the resource support from the project. However, limited funds, uncontrolled bush fires, inadequate markets for seedlings and lack of diversification to other similar interventions such as beekeeping were setbacks. The intervention was rated at 80% which implied that it was very successful. The underlying reason for the rating was acquisition of knowledge in nursery and woodlot management by the members.

3.10.3 Muonekera catchment conservation in Zomba

Muonekera catchment conservation intervention was located at Muonekera village in Traditional Authority M'biza. The intervention started in 2018 with a target membership of 30 members comprising 15 female and 15 male members. During data collection, the membership increased to 45 where 25 members were women. Specifically, the intervention aimed at protecting the catchment area by reducing deforestation and controlling floods. The activities involved in this intervention were community mobilisation and trainings on management of forest regenerants, nursery establishment,

(fencing, pot filling, manure application and sowing) and management (watering), enrichment planting and forest protection. An overview of the status of the intervention showed that in 2019, 10,000 seedlings of various species were planted (enrichment planting) and 5,000 seedlings were shared among the members. Members of the group reported that they were promised incentives e.g. food or money during implementation of project activities. However, such a promise was never fulfilled.

The conservation was expected to be a source of honey as the Muonekera group also practiced beekeeping intervention. Honey production would, thus, help to improve nutritional and economic status of the community. Focus group discussions showed that the major positive impacts of the intervention on environment and natural resources were soil and water conservation. Since communities had already been practicing beekeeping, it was expected that honey production would be an alternative source of income, replacing charcoal production. In terms of key factors that positively affected the project, it was further revealed that availability of forest conservation area, willingness of group members to conserve natural resources and integration of beekeeping were success factors for the intervention. However, there was inadequate supply of tools and equipment from the project for the nursery. This negatively affected implementation of the intervention. Although the intervention was rated as successful (70%), the unfulfilled promises were a setback.

Table 12. Financial and economic CBA measures of catchment conservation

CBA TYPE	CBA MEASURE	DISTRICT		
		Nkhata Bay (Kapiri) ²	Ntcheu (Mkumphira)	Zomba (Muonekera)
Financial	NPV (MK)	13,317,296.05	(2,005,718.63)	(3,111,655.53)
	NPV (Female)	5,707,412.59	-	-
	NPV (Male)	7,609,883.46	-	-
	BCR	2.71	0.65	0.50
	IRR	20%	-5%	-12%
Economic	ENPV (MK)	13,465,126.41	4,661,733.51	6,219,214.46
	ENPV (Female)	5,770,768.46	-	-
	ENPV (Male)	7,694,357.95	-	-
	EBCR	3.2	1.89	2.17
	ERR	24%	31%	36%

3.10.4 Financial and economic CBA of catchment conservation

The major establishment costs for catchment conservation included; training, land acquisition for the tree nursery, labour, forest tools and equipment, and planting materials. Operating costs comprised management and protection of the conserved area, opportunity cost of land and replacement of short-life forest tools and equipment. There were no social and environmental costs associated with this intervention. There was an opportunity cost of land in Kapiri because the land was converted from a natural forest to an orchard farm. The opportunity cost of the land was estimated by the forgone net benefits of non-timber forest products that would have been obtained from the piece of land including firewood³⁰.

Kapiri conservation group in Nkhata Bay district combined catchment conservation with citrus fruit production while Mkumphira in Ntcheu and Muonekera in Zomba focused on tree seedling production for enrichment

planting. Thus, Kapiri's private benefits were using the projected revenue from sale of citrus fruits while financial benefits for Mkumphira and Muonekera were related to the sale (or sharing) of seedlings. Environmental benefits included; soil and water conservation, flood control and carbon sequestration. Soil and water conservation was valued at MK12,000 (US\$ 16) per hectare per year (Yaron *et al.*, 2011). The value for flood control was estimated at MK 13,185 (US\$ 17.58) per hectare per year (Brookhuis and Hein, 2015). The value of carbon sequestration as a service of conserved forests was estimated by assuming an annual net increase in carbon uptake of 1 tonne carbon per hectare per year arising due to the conservation intervention (Nijnik, 2005). A conservative price of MK4,500 (US\$ 6) per tonne of carbon was used to value the sequestered carbon³¹. Table 12 presents the financial and economic analyses of catchment conservation in Nkhata Bay, Zomba and Ntcheu districts. The sharing of benefits between women and men was

³⁰ A value of MK50,000 was used on the assumption of 0.5 tonnes of firewood per hectare per year priced at MK100,000 per tonne

³¹ Source: Ecosystem marketplace [<https://www.ecosystemmarketplace.com>].

Inflation calculator was used to adjust all the figures to account for inflation.

not presented for Ntcheu and Zomba districts because there were no direct benefits that were being shared.

The results showed that by combining catchment conservation with citrus fruit production, Kapiri catchment conservation was financially and economically viable. Kapiri had slight differences between financial and economic analyses results emanating mostly from the inclusion, in economic analysis, of soil and water conservation values and the value of additional knowledge and skills attained through training in fruit production. There were marked differences in benefit sharing between women and men, whereby men received 57% of the financial benefits. The differences were due to the fact that there were more men than women in the group.

Mkumphira and Muonekera were economically viable though not financially attractive. There were big differences between financial and economic analyses results. NPV, BCR and IRR values for economic analysis increased substantially as compared to those from financial analysis due to increase in the number and value of social and economic benefits associated with the intervention. Economic analysis included additional values for non-timber forest products, acquisition of new knowledge and skills in tree seedling production, soil and water conservation, flood control and carbon sequestration. The use of public finances to support these two interventions was justified on economic grounds. Thus, while these interventions were a good use of public funds, they were not financially beneficial to the members. This implies that catchment

conservation interventions that rely only on financial benefits from sale (or sharing) of tree seedlings may not be sufficiently attractive to members. This is quite different with the case of Kapiri where the participants financially benefited from the sale of fruits. It is therefore important to consider providing incentives to households that implement catchment conservation interventions, to ensure their continuity. Such incentives could include combining catchment conservation with income generating interventions such as fruit production or beekeeping. This is more also important because catchment conservation is usually dominated by women (as was the case with Ntcheu and Zomba districts) who are already disadvantaged when the gender gap in agricultural productivity is taken into account. Thus, providing such incentives would also help to reduce the gender gap.

3.11 Energy efficient technology

3.11.1 Chiswamafupa energy efficient group

This intervention was only implemented in Zomba at Chiswamafupa irrigation scheme in Mbalame village, Traditional Authority Mwambo. The intervention started in 2016 with the objective of reducing forest degradation through use of energy efficient stoves (EES) and improving cooking efficiencies at household level. The main activities involved were training of community members and construction of EES. Stove construction was done by group members. Training, technical support and advice were provided by the District Forestry Office in collaboration with the District Council. Initially, the intervention targeted 280 beneficiaries. At the time of

project inception, these beneficiaries were promised that there would be food and monetary incentives for construction of the stoves within the communities. However, such a promise was not fulfilled leading to high dropout of members from the intervention but no reason for failure to fulfill the promise was provided at the time of data collection. At the time of data collection, the intervention had 65 members, comprising 41 women and 19 men where 5 of them were youths. As such, there were 65 EES within the local community. The major stakeholders in this intervention were community members, local leaders, district council and UNDP.

Focus group discussions revealed that the key impact on livelihoods due to use of EES was decreased cost of firewood and thus increased savings at household levels which could be used to purchase other goods and services due to an income effect that increased the purchasing power of the households and their improved standard of living, all things being equal. It was also reported that use of EES provided clean energy while significantly reducing the cooking time. Further to livelihoods, there were remarkable environmental and natural resources management impacts of significance. For instance, there was a considerable reduction in the utilisation of fuelwood leading to improved forest conservation. However, since the construction of EES was associated with the use of sand and clay soils, there was potentially increased land degradation as a result of sand and clay mining.

The key factors that positively affected the project were social cohesion and willingness of the group members to adopt new cooking

technology. Nevertheless, unfulfilled promises related to provision of food, goats or money for forest conservation work, demotivated members of the intervention. The group rated the EES as being very successful (90%) because they were equipped with knowledge and skills to be able to effectively construct and use the stoves.

3.11.2 Financial and economic benefit analysis of energy efficient cookstoves

The major costs associated with this intervention included project planning, training in construction of improved cookstoves (including the actual construction) and monitoring of the intervention. Maintenance of the cookstoves was the only operating cost associated with this intervention. However, there were quite a number of non-marketed benefits associated with the use of improved efficient cookstoves in comparison with the traditional three-stone cooking fire. The private benefits were attributed to improved health, and savings in time and money at household level. In addition, the intervention contributed to conservation of forests and associated ecosystem services. It further helped to reduce emissions that contribute to global climate change. A benefit transfer method using unit net benefits estimated by a study carried out by Jeuland and Pattanayak (2012) was adopted. The study used Monte Carlo simulation analysis to estimate both private (financial) and social (economic) net benefits of different stove options (including the improved/efficient cookstove) relative to the traditional three-stone cooking fire. Net private benefits were estimated at an

Table 13. Financial and economic cost benefit analysis of efficient cookstove

CBA TYPE	CBA MEASURE	DISTRICT
		Zomba (Chiswamafupa efficient cookstoves group)
Financial	NPV (MK)	(3,638,215.57)
	NPV (Female)	(2,486,113.97)
	NPV (Male)	(1,152,101.60)
	BCR	0.22
	IRR	-14%
Economic	ENPV (MK)	1,489,559.16
	ENPV (Female)	1,017,865.43
	ENPV (Male)	471,693.74
	EBCR	1.35
	ERR	12%

equivalent value of MK150 (US\$0.2)³² per household per month and social net benefits were valued at MK825 (US\$1.1) per household per month (Jeuland and Pattanayak, 2012). Table 13 presents results of financial and economic benefit analysis of the improved cookstove intervention.

Results from the analysis showed that financial net benefits of the intervention were negative implying that this intervention was not financially viable. The private benefits associated with improved health, and savings in time and money at household level were outweighed by the costs. However, net economic benefits were positive, indicating that the intervention had valuable social and environmental benefits. Thus, the difference between financial and economic results is explained by the inclusion, in the economic analysis, of additional knowledge in construction of improved cookstoves and environmental benefits of the stoves.

The differences in benefits between men and women is a reflection of their representation in the group. The group had more women (41) than men (19). Moreover, labour-saving

technologies such as energy-efficient and environmentally friendly improved cooking stoves have the potential to reduce women's unpaid labour and domestic work burdens, save time and facilitate increased crop production, thereby reducing the gender gap in agricultural productivity³³. This supports the argument that households would always reap positive and huge nonmonetary benefits from the use of efficient energy technologies and as such policy-makers should prioritize and support their introduction and adoption.

3.12 Disaggregation of interventions by viability

The interventions were aggregated according to their financial and economic viability. Some interventions were both financially and economically viable, others were only economically efficient yet some were both financially and economically inefficient based on NPV, BCR and IRR indicators. Table 14 presents a disaggregation of interventions based on their financial and economic performances.

33 UN – Women. Policy Brief No. 11. The gender gap in agricultural productivity in Sub-Saharan Africa: Causes, costs and solutions.

32 Exchange rate: 1US\$ = MK750

Table 14. Disaggregation of interventions based on financial and economic viability

Financially and economically viable	Financially not viable but economically viable	Financially and economically not viable
Community bakery (Nkhata Bay)	Tailoring (Nkhata Bay)	Solar-powered integrated irrigation scheme (Ntcheu)
Gravity-fed irrigation scheme (Nkhata Bay)	Fish farming (Nkhata Bay, Zomba)	Fish farming (Ntcheu)
Solar-powered irrigation scheme (Zomba)	Catchment conservation (Ntcheu, Zomba)	-
Livestock production (Nkhata Bay, Ntcheu and Zomba)	Water supply (boreholes) (Nkhata Bay)	-
Beekeeping groups (Nkhata bay, Ntcheu and Zomba)	Energy efficient cookstoves (Zomba)	-
Village savings and loan groups (Nkhata bay, Ntcheu and Zomba)	-	-
Fruit production (Nkhata Bay)	-	-

All interventions that were financially and economically viable had low capital investment and operating costs but produced relatively high returns. Even if interventions are financially viable, they are not sufficiently profitable to motivate community members to invest in the interventions. One challenge is that local communities often do not have access to sufficient financial resources to make the initial investment. Another is that their personal discount rate may be very high due to, for example, their financial vulnerability. This justifies government and development partners' support for such projects.

The interventions that were financially not viable but economically viable had significantly high investment costs compared to their financial returns. However, these interventions had huge social and economic benefits that made them economically viable.

Their implementation was justified by their social and environmental contributions.

Solar-powered integrated irrigation scheme and fish farming interventions in Ntcheu were neither financially nor economically viable. These interventions had some barriers which made them economically inefficient. However, these interventions have potential to reduce smallholder farmers' vulnerability to climate change and enhance their livelihoods once their associated barriers are dealt with. These interventions should be supported along with their improvements in design and implementation.

3.13 Sensitivity analysis

Sensitivity analysis was carried out to determine how changes in discount rate affected the results. A lower discount rate

(3%) and a higher discount rate (12%) were used in the analysis. Ideally, a reduction in discount rate should lead to an increase in NPV and BCR. Thus, a lower discount rate can make an intervention that was not viable to be viable. Similarly, a higher discount rate leads to a reduction in NPV and BCR values. An increase in the discount rate can, therefore, make an intervention that was efficient to be inefficient. Results of the sensitivity analysis are presented in Annex 12. The analysis showed that changes in discount rate had some effect on the efficiency of some interventions. Ngwerelo irrigation scheme (Zomba) became financially and economically unprofitable at 12% discount rate with cut-off points of 7% and 10% discount rates respectively. Lunungwi fish farming (Ntcheu) became economically efficient at 3% discount rate (cut-off 3% discount rate) while Ngweleru fish farming (Zomba) became inefficient at 12% discount rate (cut-off point 7% discount rate). The improved cookstove intervention was economically inefficient at 12% discount rate (cut-off point 12% discount rate). Thus, for economic analysis of social and environmental projects, lower social discount rates should be used. It is, therefore, recommended that government and institutions that finance social and environmental projects should identify and recommend appropriate social discount rates to be used for economic analyses of their projects in the country. Such rates should be lower than the market interest rate.

3.14 Limitations

Data availability was the main challenge encountered during the analysis. It was

difficult to get financial data both at district and community level. At district level, only Ntcheu district provided complete data for all the interventions that were analysed. Nkhata Bay and Zomba districts provided data for some interventions. To deal with this challenge, some cost data were obtained at community level for specific interventions. In some cases, standard investment costs were used across the three districts.

At community level, it was equally difficult to get financial records of the interventions. Even though most of the committee members were trained in record keeping, only few kept their financial records. As a solution, the cost and revenue data were compared to those of related interventions for verification and triangulation. In some cases, the data were obtained through market enquiries and in other cases secondary data were used to fill up the gaps. Therefore, these limitations do not undermine the credibility of the results.

It has to be noted that the analysis was restricted to the climate adaptation options supported by the ADAPT- PLAN project, and as such the sample size is low to generalize the results at national level. Thus, the recommendations from the analysis must be understood with respect to this limitation.

CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Disaggregation of interventions based on financial and economic viability showed that all interventions that were financially and economically viable had low capital investment and operating costs but produced relatively high returns. The interventions that were financially not viable but economically viable had significantly high investment costs compared to their financial returns. However, these interventions had huge social and economic benefits that made them economically viable. Those that were neither financially nor economically viable, had huge investment and operational costs which were not offset by the measurable benefits. However, these interventions had important intangible benefits such as increased food security, reduced poverty levels, and reduced vulnerability to climate change.

Sensitivity analysis of the results to changes in discount rate showed that a lower discount rate made one intervention that was not viable to be viable. In contrast, an increase in the discount rate made one intervention that was efficient to be inefficient.

The interventions were positively influenced by initial capacity building, commitment of beneficiaries to participate in the intervention, availability of adequate and suitable land, incorporation of the pass on approach, integration of VSL into group interventions, and women and youth involvement. The general challenges affecting performance of

interventions were associated with limited access to reliable markets, low prices of produce, high cost of inputs, low quality of equipment, lack of storage and processing of produce, inadequate water supply for irrigation and fish farming, and inadequate training in business management, marketing and record keeping. In addition, fish and livestock production encountered challenges due to high costs of feed, and inadequate support for fishpond and animal kraal construction. Untimely commencement of the interventions which culminated into inadequate implementation period was a general problem for interventions in Ntcheu due to technical challenges³⁴. Notwithstanding the challenges, the interventions were successful; and represented good use of public funds in supporting diversified and strengthened livelihoods of vulnerable communities in the project area.

Interestingly, it was observed that the number of women participating in most of the interventions was higher than their male counterparts. The participation of women was key to the success of most interventions. This enabled women to have increased access to inputs, time-saving technologies and services thereby closing the gender and productivity gap within the local communities. Consequently, this contributed significantly to the improvement of women's

³⁴ For instance, it was mentioned that the initial site where the irrigation intervention was to be located was found to have inadequate water during implementation. The project had to be relocated to a new (current) site.

economic status as well as food and nutrition security. Most of women were also involved in planning and decision-making roles for the interventions.

4.2 Policy implications and recommendations

The following policy recommendations were identified based on the key findings of the analysis:

Promoting production related interventions

Based on findings from CBA, the interventions could be categorized as production, conservation and microfinancing-related investments. All interventions that were financially and economically viable were production related ones except VSLs which were service oriented. These interventions had low capital investment and operating costs while producing relatively high returns. Such interventions included: community bakery, gravity-fed irrigation, solar-powered irrigation, livestock production, beekeeping and fruit production. However, local communities rarely have access to sufficient financial resources to invest in these enterprises. In improving resilience and livelihoods from a financial and economic perspective, there is, therefore, a need to scale-up production related interventions through government and development partners' support for such projects.

Supporting catchment conservation interventions

Catchment conservation interventions were

financially not viable but economically efficient. Catchment conservation does not provide immediate financial benefit to the communities implementing the intervention. Moreover, the environmental benefits are for the general public. Therefore, there is need to provide public financing and incentives to support implementation of catchment conservation initiatives.

Improving yield from fish farming

Fish farming has high potential to improve community resilience from climate stresses and shocks despite being financially and economically inefficient in this study. Yield from fishponds in Malawi is generally low. The major limitation affecting the productivity of smallholder fish farmers is the use of low-quality inputs. Most smallholder farmers use recycled fingerlings or fingerling brood stock because they are not able to access affordable and high-quality fingerlings. Similarly, most of the farmers have no access to affordable formulated feed and resort to use of locally sourced manure, rice or maize bran. There is therefore, need to promote production of high-quality fingerlings and fish feed to ensure profitability of the interventions.

Improving siting of irrigation water supply systems

The integrated irrigation scheme was financially and economically not viable, due to water scarcity, among other reasons. There was inadequate water supply due to low water aquifer and sharing of water among irrigation farming, fishpond and domestic use. Siting of the irrigation scheme did not

match with aquifer and water demand levels. There is need to improve integrated irrigation systems through appropriate siting to match with aquifer and utilisation levels.

Promoting value addition and transportation of produce

Most of the agricultural produce such as fish and vegetables are highly perishable. Similarly, bakery products have short shelf-life. As such, these products are often sold at highly discounted prices. There is need to include processing and storage facilities for the products particularly the perishable ones. Furthermore, there is need to incorporate packaging and transportation facilities in production interventions.

Improving access to reliable markets

Beneficiaries faced challenges in accessing markets for their products. Often, these beneficiaries sold their produce at the farm gate or within the local markets where prices were generally low. In addition, lack of processing and storage, poor packaging and transportation, limited markets of produce contributed to low pricing of commodities. The following policy recommendations are proposed to improve access to reliable market:

- Conduct market research at the design and planning stage of the intervention in order to identify reliable markets for the beneficiaries. Most of the interventions were established without prior market research as a result it was difficult to link producers with prime customers who would buy produce at high prices. Such

produce included green maize, tomatoes, leafy vegetables, fish and bananas.

- Improve road network in hard to reach project areas to open up to favourable markets. A number of interventions were implemented in remote areas with poor road infrastructure. This acted as a barrier to reaching out to reliable markets. A typical example is Usisya where agricultural produce, and tailoring and bakery products were facing a market confinement. There is need to provide supporting infrastructure to increase the economic benefit of the interventions.
- Promote certification of produce in order to increase the market access, share and penetration. Most of the honey produced under the project was not certified by the Malawi Bureau of Standards for quality assurance. If honey was certified, it could have access to the national and even international markets. There is need to promote certification of honey by engaging appropriate institutions such as Malawi Bureau of Standards and Ministry of Trade during the design and implementation phases of the interventions.

Enhancing capacity building

Capacity building was one of the major components that supported effective implementation of the interventions. However, after ADAPT-PLAN project completion, most beneficiaries still demanded further training and refresher courses, particularly in business management and marketing. In addition, capacity building largely focused on

imparting skills in the implementation of the various interventions. By only emphasizing on implementation of intervention specific skills, some gaps in governance of natural resources management and utilization were noted. Consequently, some elements of favouritism and nepotistic behaviours in benefit sharing by some local leaders were reported at the time of the study. The following policy prescriptions are proposed to enhance capacity building:

- Promote the continuity of capacity building to induct new members, refresh and keep members up to date on current practices to ensure effective and sustainable implementation of the interventions. Opportunities for continuous capacity building should be created with relevant training institutions e.g. TEVETA, COMSIP and Community Development Offices.
- Conduct training in community-based natural resources management with particular emphasis on sustainable resource utilization and management, benefit sharing processes, and conflict resolution mechanisms to improve natural resources management and governance.

Linking women participation to gender gap reduction in agricultural productivity

Most interventions were dominated by women and included youths. These were identified as the most vulnerable groups within the local communities. The inclusion of these groups provided a dedicated work force and sustainability of the interventions.

This led to the success of the interventions and achievement of intended goal of strengthening community resilience. It is, therefore, recommended that women and youth involvement in community-based interventions should be promoted. Mainstreaming women's participation in projects' interventions particularly those that enhance income, food and social security is critical to the reduction of gender inequalities in agricultural productivity. It also ensures increased share of economic and social gains including worth creation for women.

Increasing yield through irrigation systems

Although irrigation technologies are generally associated with high capital and operating costs, they significantly increase crop yields. There is need to:

- Implement irrigation interventions concurrently with improved crop management through use of fertilisers, early maturing varieties and increased cropping cycles for irrigation farming.
- Provide government and/or development partners' support to irrigation farming due to high establishment costs.
- Promote lower cost irrigation systems such as gravity fed and solar technologies to decrease the cost of production.

Provision of incentives to households engaged in catchment conservation

Catchment conservation does not provide immediate financial benefit to communities. Moreover, the environmental benefits are for the general public. Financial benefits

arise from combinations of intervention such as fruit and/or beekeeping. Therefore, provide incentives to households that implement catchment conservation to ensure sustainability of the intervention and the general benefit of the community.

4.3 Lessons learnt

The following lessons were drawn from the CBA exercise:

- Cost benefit analysis is an important component for project appraisal because it unveils ways of improving project efficiency;
- Social discount rates that are lower than the market interest rate are appropriate for social and environmental projects.
- Timely baseline studies and project impact assessment provide vital information for cost benefit analysis;
- Timely commencement of interventions is key to achieving its intended objectives;
- Good financial record keeping is important for the provision of timely and reliable and accurate information for project analysis;
- It is important to monitor potential environmental effects of project interventions;
- Taxes and subsidies in project activities play a significant role in influencing community participation and financial profitability of interventions.

ANNEXES

Annex 1 : Group composition by gender including youth

Intervention	District	Group/Club	Total	Male	Female	Youth
Irrigation	Nkhata Bay	Sasasa	86	24	62	0
	Ntcheu	Linungwi	16	9	7	5
	Zomba	Ngwelero	20	10	10	0
Fish farming	Nkhata Bay	Njiri	9	4	5	0
	Ntcheu	Linungwi	24	8	16	0
	Zomba	Ngwelero	18	11	7	0
Beekeeping	Nkhata Bay	Movya	19	9	10	0
	Ntcheu	Linungwi	15	10	5	12
	Zomba	Nambira	18	10	8	4
Livestock	Nkhata Bay	Mawi	4	2	2	0
	Ntcheu	Kasinje Youth	15	7	8	0
	Zomba	Takondwera Youth	16	6	10	0
Village savings and loans	Nkhata Bay	Movya	19	9	10	0
	Ntcheu	Tithandizane	15	5	10	0
	Zomba	Chitamambeta	20	5	15	0
Banana	Nkhata Bay	Tawonga	12	4	8	0
Bakery	Nkhata Bay	Chikomo	18	4	14	0
Tailoring	Nkhata Bay	Usisya	10	4	6	9
Catchment conservation	Nkhata Bay	Kapiri	14	8	6	0
	Ntcheu	Mkumphira	60	30	30	0
	Zomba	Muonekera	45	20	25	0
Energy efficient stoves	Zomba	Chiswamafupa	65	21	44	5
Grand total			538	220	318	
Percent (%)			100	41	59	

Annex 2 : Inventory of project costs

Type of Intervention	Type of costs		
	Investment costs	Operating costs	Environmental costs
Irrigation farming	Farmer training	Maintenance of irrigation system	Environmental degradation
	Land	Security	
	Irrigation equipment and Installation	Farming costs	
	Farm equipment	Replacement of short-life farm equipment	
	Project planning, implementation and monitoring	Opportunity cost of land	
Fish farming	Farmer training	Pond protection	
	Land	Fish feed	
	Pond construction and supplies	Harvesting gear (rented)	
	Fingerlings	Replacement of short-life farm equipment	
	Farm equipment	Opportunity cost of land and water	
	Project planning, implementation and monitoring		
Beekeeping	Farmer training	Maintenance of beehives	
	Beehives	Bottles	
	Beesuit	Replacement of short-life farm equipment	
	Honey extractor		
	Other farm equipment		
	Project planning, implementation and monitoring		

Type of Intervention	Type of costs		
	Investment costs	Operating costs	Environmental costs
Livestock production	Farmer training	Animal management (veterinary services)	
	Construction of animal house	Feed and fodder	
	Initial animal stock	Maintenance of animal house	
	Farm equipment	Replacement of short-life farm equipment	
	Project planning, implementation and monitoring	Opportunity cost of land	
Village savings bank	Member training	Bank charges	
	Capital injection	Stationery	
	Cash safe/Bank account opening		
	Initial stationery		
	Project planning, implementation and monitoring		
Banana production	Farmer training	Crop protection	
	Land	Disease control	
	Farm equipment	Replacement of short-life farm equipment	
	Planting materials (suckers)	Opportunity cost of land	
	Project planning, implementation and monitoring		
Community bakery	Training	Bakery supplies/raw Materials	
	Land	Firewood	
	Bakery building	Utilities (water and electricity)	
	Bakery equipment	Maintenance of bakery equipment	
	Project planning, implementation and monitoring	Advertisement and marketing	

Type of Intervention	Type of costs		
	Investment costs	Operating costs	Environmental costs
Community tailoring	Training	Rent of building	
	Sewing machines	Utilities (water and electricity)	
	Tailoring supplies	Maintenance of sewing machines	
	Project planning, implementation and monitoring	Tailoring supplies/materials	
Water supply	Training (water committee)	Maintenance of borehole	
	Land	Opportunity cost of land	
	Borehole drilling and installation		
	Project planning, implementation and monitoring		
Catchment conservation	Training	Maintenance of equipment	
	Land	Planting materials	
	Equipment	Land management and protection	
	Planting materials (vertiver grass, bamboo, tree seedlings, fruit trees etc)	Opportunity cost of conserved land	
	Project planning, implementation and monitoring		
Energy efficient technology (stoves)	Training	Maintenance of cookstoves	Environmental degradation due to clay mining
	Building equipment (level, shovels, etc)		
	Rocket stoves		
	Project planning, implementation and monitoring		

Annex 3 : Inventory of Project Benefits

Type of Intervention	Type of benefits	
	Direct benefits	Environmental benefits
Irrigation farming	Increased income from produce sales	Employment creation (non-farm sector)
	Increased food supply	Reduced charcoal production due to alternative source of income
	Additional farming knowledge	
Fish farming	Increased income from fish sales	Water conservation
	Increased supply of fingerlings	Reduced charcoal production due to alternative source of income
	Increased food supply	
	Additional fish farming knowledge	
Beekeeping	Increased income from honey sales	Pollination
	Increased income from beeswax/candle sale	Forest conservation
	Health and nutritional benefits	
	Additional knowledge in business management	
Livestock production	Increased income from live animal sales	Reduced charcoal production due to alternative source of income
	Increased income from meat sales	
	Increased income from milk sales	
	Increased income from manure sales	
	Health and nutritional benefits	
	Additional knowledge in livestock production	
	Employment creation (builders, carpenters, traders, veterinary services, feed producers and non-farm services)	
Village savings bank	Increased income from dividends	
	Increased household business	
	Improved food security	
	Improved housing	
	Additional business and literacy knowledge	
Banana production	Increased income from banana sales	Wind break
	Increased supply of banana suckers	Water and soil conservation
	Health and nutritional benefits	
	Additional farming knowledge	
	Employment creation (non-farm sector)	

Type of Intervention	Type of benefits	
	Direct benefits	Environmental benefits
Community bakery	<p>Increased income from bakery product sales</p> <p>Health and nutritional benefits</p> <p>Additional knowledge in business and bakery management</p>	<p>Reduced charcoal production due to alternative source of income</p>
Community tailoring	<p>Increased income</p> <p>Additional knowledge in tailoring and business management</p>	<p>Reduced charcoal production due to alternative source of income</p>
Water supply	<p>Improved water supply</p> <p>Time saving in water collection</p> <p>Health benefits</p> <p>Reduction in harassment of young girls and women</p> <p>Additional knowledge</p>	
Catchment conservation	<p>Increased income from fruit/seedlings sales</p> <p>Additional knowledge</p>	<p>Ecosystem conservation/services (Environmental, biodiversity, forest, water and soil conservation)</p>
Energy efficient technology (stoves)	<p>Increased income from construction of improved cookstoves</p> <p>Additional knowledge</p>	<p>Reduced use of firewood leading to reduced deforestation</p>

Annex 4: Costs and benefits of analyzed project interventions

Name of intervention	Costs (MK)			Benefits (MK)
	Investment Cost	Operating Cost	Total Cost	
Chikomo Community Bakery	10,700,000.00	2,642,000.00	13,342,000.00	4,680,000.00
Sasasa Irrigation Scheme	13,430,000.00	39,607,416.67	53,037,416.67	15,000,000.00
Usisya Tailoring Group	13,356,321.00	298,908.03	13,655,229.03	1,300,000.00
Mwawi Piggery Group	9,480,000.00	539,500.00	10,019,500.00	1,820,000.00
Njiri Fish Farming Group	11,350,000.00	298,750.00	11,648,750.00	880,000.00
Movya Beekeeping Group	13,621,450.00	170,400.00	13,791,850.00	2,700,000.00
Movya VSL Group	3,503,500.00	2,000.00	3,505,500.00	1,507,550.00
Takondwa Banana Club	5,715,000.00	105,000.00	5,820,000.00	1,590,000.00
Linungwi Irrigation Scheme	174,725,000.00	7,107,375.00	181,832,375.00	15,000,000.00
Linungwi Fish Farming Group	10,720,000.00	361,250.00	11,081,250.00	650,000.00
Linungwi Beekeeping Group	13,170,000.00	212,640.00	13,382,640.00	900,000.00
Kasinje Goat Production Group	8,241,250.00	547,281.25	8,788,531.25	2,512,500.00
Tithandizane VSL Group	2,803,500.00	4,000.00	2,807,500.00	1,171,750.00
Ngweleru Irrigation Scheme	78,100,000.00	6,132,500.00	84,232,500.00	15,000,000.00
Ngweleru Fish Farming Group	15,000,000.00	287,500.00	15,287,500.00	860,000.00
Ngweleru Beekeeping Group	6,205,000.00	75,080.00	6,280,080.00	1,260,000.00
Takondwa Piggery Club	5,100,000.00	244,500.00	5,344,500.00	2,400,000.00
Chitamambeta VSL Group	3,458,500.00	2,000.00	3,460,500.00	1,568,000.00
Kapiri Catchment Conservation	8,000,000.00	42,500.00	8,042,500.00	400,000.00
Mkumphira Catchment Conservation	5,015,000.00	192,500.00	5,207,500.00	480,000.00
Muonekera Catchment Conservation	5,245,425.00	233,640.50	5,479,065.50	400,000.00
Nkhata Bay Water Supply	22,400,000.00	407,000.00	22,807,000.00	576,000.00
Chiswamafupa Cookstoves	9,217,930.00	15,543.20	9,233,473.20	117,000.00
Linungwi Integrated Water Supply	5,400,000.00	67,500.00	5,467,500.00	864,000.00

Annex 5 : List of documents reviewed

ADAPT-PLAN Project Document

2019 Project Implementation Report

A Baseline Study and Development of Monitoring, Evaluation and Learning Systems for ADAPT-PLAN Project report

Annual Progress Reports (2016,2017, 2018 and 2019)

Climate Public Expenditure and Institutional Review (CPEIR) Report.

Community Based Resilience Analysis (CoBRA) Assessment Report for Zomba, Ntcheu and Nkhata Bay districts in Malawi

Overcoming poverty in Malawi through sustainable environment and natural resource management: Identifying policy options to accelerate poverty reduction - Final report

Policy brief: Gender Innovation Lab - Costing the gender gap

Policy brief: Poverty-environment Initiative - A Review of Malawi Government policies on sustainable poverty reduction pathways

Policy brief: Poverty-environment Initiative - Evidence from macro-level empirical analyses

Policy brief: Poverty-environment Initiative - Evidence from micro-level empirical analyses

Poverty-environment Initiative - Identifying policy options to accelerate poverty reduction

Poverty-environment Initiative - Policy coherence to reduce poverty through environmental and natural resource sustainability

Terminal Evaluation Report – Implementing Urgent Adaptation Priorities through Strengthened Decentralized and National Development Plans- ADAPT-PLAN

Final Report UNDP Value Chain Mapping

Annex 6 : Bibliography

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Annex 7 : Guide for national consultative meetings

Target : The then, Project Manager for the Adapt Plan
The Poverty-Environment Action Project team
Ministry of Economic Planning and Development
Environmental Affairs Department

A. Please provide a brief background, breakdown of costs, and anticipated outputs for the interventions funded by this project as presented in the categories below:

District	Interventions
Nkhata Bay	<ol style="list-style-type: none"> 1. Irrigation schemes 2. Fish farming 3. Beekeeping for honey production 4. Village savings and loans scheme 5. Banana cultivar production 6. Community Bakery (Usisya) 7. Livestock production (goats, poultry and pigs) 8. Citrus fruits production 9. Tailoring 10. Catchment conservation 11. Water supply
Ntcheu:	<ol style="list-style-type: none"> 1. Irrigation schemes 2. Fish farming 3. Beekeeping for honey production 4. Village savings and loans associations 5. Livestock production 6. Tree nursery 7. Catchment conservation 8. Water supply
Zomba	<ol style="list-style-type: none"> 1. Tree nurseries establishment 2. Fruit production 3. Fish farming 4. Irrigation schemes 5. Village Savings and Loans Associations 6. Livestock production (goats) 7. Beekeeping 8. Catchment conservation 9. Water supply 10. Energy efficient technology

B. What tax and subsidy arrangements were put in place in the procurement of project inputs?

C. What are the major impacts of the intervention on environment and natural resources?

D. What challenges were encountered during implementation of the projects/interventions and how were they resolved?

Annex 8 : Guide for district consultative meetings

Target : Project implementation committee members
 District Council
 District Environmental Office
 District Forest Office
 District Agriculture Office
 District Community Development Office

A. Please provide status, investment costs, operating costs, social cost (negative externalities), number of participating beneficiaries (by gender), and direct and indirect benefits of each intervention implemented in the district as presented below:

District	Interventions
Nkhata Bay	<ol style="list-style-type: none"> 1. Irrigation schemes 2. Fish farming 3. Beekeeping for honey production 4. Village savings and loans scheme 5. Banana cultivar production 6. Community Bakery (Usisya) 7. Livestock production (goats, poultry and pigs) 8. Citrus fruits production 9. Tailoring 10. Catchment conservation 11. Water supply
Ntcheu:	<ol style="list-style-type: none"> 1. Irrigation schemes 2. Fish farming 3. Beekeeping for honey production 4. Village savings and loans associations 5. Livestock production 6. Tree nursery 7. Catchment conservation 8. Water supply
Zomba	<ol style="list-style-type: none"> 1. Tree nurseries establishment 2. Fruit production 3. Fish farming 4. Irrigation schemes 5. Village Savings and Loans Associations 6. Livestock production (goats) 7. Beekeeping 8. Catchment conservation 9. Water supply 10. Energy efficient technology

B. What are the major impacts of the intervention on beneficiaries' livelihood?

C. What are the major impacts of the intervention on environment and natural resources?

D. State the key factors that have influenced the success/failure of the project.

E. What challenges were encountered during implementation of the projects/interventions and how were they resolved?

Annex 9 : List of persons interviewed

No.	Name	Title	Phone No	Email
1	Mrs Nervou Mulungu Kulinji	Environmental District Officer - Nkhata Bay		
2	Mr D. Kamenya	District Fisheries Officer - Nkhata Bay	881248237	nevervmulungu@gmail.com
3	Mr M. Msomba	District Forest Officer – Nkhata Bay	882476375	
4	Mr W. T. Kalua	Assistant District Forest Officer – Nkhata Bay		
5	Mr James Botha	Assistant Irrigation Officer – Nkhata Bay	992158925	Jamesbotha95@gmail.com
6	Mr O. Maseko	Community Development Officer – Nkhata Bay	888315654	
7	Mr Golivati Gomani	Environmental Officer and Desk Officer for Adapt Plan – Lilongwe	999383651	ggomani87@gmail.com
8	Mr Donnex Mtambo	District Forestry Officer – Ntcheu	993295382	donemtambo@yahoo.com
9	Mr Onacence Nyirenda	District Water Development Officer – Ntcheu	999490706	onanyirenda@yahoo.co.uk
10	Mr Limbani Mzembe	District Irrigation Officer - Ntcheu	993866792	chilokotomzembe@yahoo.com
11	Mr Allan Katola	District Fisheries Officer - Ntcheu	999284385	allan_katola@yahoo.com
12	Mrs Beatrice Phiri	District Community Development Officer Ntcheu	993002217	beatsokophiri@gmail.com
13	Benard Nkwanda	Livestock Officer – Ntcheu	996917638	benardnkwanda@gmail.com
14	Ms Caroline Dzimbiri	District Monitoring Officer – Ntcheu	882064846	nafecarol@ymail.com
15	Mr Sam Kholomana	District Fisheries Officer – Zomba	999255077	Samkholomana02@gmail.co
16	Mrs Flora Mvuta	District Community Development Officer – Zomba	999369325	floramvuta@yahoo.com
17	Mr Patrick Makupete	District Forest Officer - Zomba	995693055	patrickmakupete@gmail.com
18	Mr Cleopas Lameck	SAURCO – Zomba	888720493	cleopaslameck@gmail.co
19	Mr Andrew Chipatala	Accounts Officer – Zomba	999931282	
20	Ms Sylvia Ambali	Environmental District Officer – Zomba	992445000	sylambali@gmail.com
21	Mr Great Munthali	Assitant District Forest Officer – Zomba	888144394	greatmunthali82@gmail.com
22	Mr Mwandilanga Kamasala	District Irrigation Officer - Zomba	999854319	
23	Mr Enock Chabwera	District Youth Officer - Zomba	996938674	Enockchabwera13@gmail.com
24	Mr Noel Shema	District Trade Officer - Zomba	999874502	chipondejoez@gmail.com

Annex 10 : Guide for focus group discussions

Target: Project implementation committee members

- A. Project background, activities and management
 - Provide a summary of the project background, activities and management.
 - Describe gender and youth roles in implementation of project activities.

- B. Costs
 - Provide information on fixed (investment) costs and variable (operating) costs for the project overtime.
 - Identify other indirect (social) costs associated with the project.
 - Describe how the costs are shared within the group (by gender and youth categories).

- C. Benefits
 - Provide information on benefits obtained from the intervention (direct and indirect; intended and unintended).
 - Describe how benefits are shared within the group (by gender and youth categories).

- D. Project impact
 - Indicate whether the project intervention has led to increased household income.
 - Describe how the project intervention has impacted on livelihoods.
 - Indicate the overall impact (negative, neutral, positive) of the project on beneficiaries' livelihood (food, health, education etc).
 - Describe how the project has impacted on the environment and natural resources.
 - Indicate the overall impact (negative, neutral, positive) of the project on the environment and natural resources (water, air, forestry, soil etc.).

- E. Project rating
 - Rate the success/failure of the project (very successful, partially successful or not successful).
 - Give reasons for your rating above.
 - State the key factors that have influenced the success/failure of the project.
 - Highlight any project challenges and possible solutions (in any).

Annex 11: Itinerary for data collection

Date	Day	Time	Activity
17 Aug	Monday	Morning	Nkhata Bay District Consultative Meetings:
18 Aug	Tuesday	Morning	Chikomo Community Bakery (Usisya)
18 Aug	Tuesday	Afternoon	Sasasa Irrigation Scheme
		Afternoon	Usisya Tailoring Group
20 Aug	Thursday	Morning	Mwai Piggery Group
		Morning	Njiri Fish Farming
		Afternoon	Movya Beekeeping Group
		Afternoon	Movya Savings Group
21 Aug	Friday	Morning	Kapiri Fruit Production and Soil Conservation Club
21 Aug	Friday	Afternoon	Takondwa Banana Club
21 Aug	Friday	Afternoon	Maula Water Supply
23 Aug	Sunday	Morning	Travelled to Ntcheu District
24 Aug	Monday	Morning	Curtesy call at District Forest Office
24 Aug	Monday	Morning	National Consultative Meeting by Zoom and phone
24 Aug	Monday	Afternoon	Ntcheu District Consultative Meeting
25 Aug	Tuesday	Morning/ Afternoon	Linungwi Irrigation Scheme Linungwi Fish Farming group Linungwi Water Supply
26 Aug	Wednesday	Morning/ Afternoon	Ngwelero Beekeeping group Ngwelero Catchment Conservation group Kasinje Youth Livestock production group Tithandizane Village Savings and Loan group
27 Aug	Thursday	Morning	Travelled to Zomba
27 Aug	Thursday	Morning	District Consultative Meeting
27 Aug	Thursday	Afternoon	Ngwelero Irrigation scheme Ngwelero Fish farming group Ngwelero Beekeeping group Muonekera Catchment Conservation group
28 Aug	Friday	Morning/ Afternoon	Takondwa Piggery Club Sinuzi Village Savings and Loan groups Energy efficient technology group Tree nursery production Fruit production
29 Aug	Saturday	Morning	Return to Mzuzu

Annex 12: Sensitivity analysis results

Annex 12. 1: Changes in discount rate - Financial analysis

Name of intervention	3% Discount Rate		6% Discount Rate		12% Discount Rate	
	CBA Measure		CBA Measure		CBA Measure	
	NPV (MK)	BCR	NPV (MK)	BCR	NPV (MK)	BCR
Chikomo Community Bakery	10,384,865.80	1.28	6,608,287.24	1.22	2,029,788.07	1.09
Sasasa Irrigation Scheme	155,964,590.60	1.63	104,213,575.65	1.50	42,140,461.39	1.27
Usisya Tailoring Group	(1,905,066.51)	0.88	(3,667,635.05)	0.76	(5,733,777.33)	0.57
Mwawi Piggery Group	12,101,826.40	1.49	9,297,564.23	1.46	6,344,196.67	1.45
Njiri Fish Farming Group	(3,111,437.37)	0.77	(4,096,202.67)	0.67	(5,045,816.25)	0.51
Movya Beekeeping Group	12,697,802.26	1.86	7,949,087.78	1.58	2,140,898.65	1.18
Movya VSL Group	11,742,051.93	4.62	8,772,468.30	3.93	5,057,669.68	2.97
Takondwa Banana Club	6,073,220.62	1.62	3,528,678.06	1.39	528,844.60	1.07
Linungwi Irrigation Scheme	(70,266,439.50)	0.68	(72,942,520.42)	0.61	(70,378,834.04)	0.51
Linungwi Fish Farming Group	(7,471,780.51)	0.42	(6,973,525.26)	0.37	(5,952,732.21)	0.29
Linungwi Beekeeping Group	9,301,056.80	1.69	5,185,907.38	1.44	649,742.81	1.07
Kasinje Goat Production Group	8,578,380.56	1.58	6,534,736.04	1.53	4,367,499.36	1.50
Tithandizane VSL Group	8,089,976.58	4.15	5,916,939.41	3.56	3,247,922.92	2.70
Ngwelero Irrigation Scheme	15,370,496.59	1.11	530,504.98	1.00	(16,562,232.16)	0.82
Ngwelero Fish Farming Group	(8,536,838.94)	0.51	(9,305,236.68)	0.43	(9,995,929.51)	0.31
Ngwelero Beekeeping Group	5,888,169.92	1.69	3,596,864.83	1.44	770,222.66	1.07
Takondwa Piggery Club	4,749,423.37	1.42	2,686,742.33	1.29	449,228.50	1.07
Chitamambeta VSL Group	11,112,180.87	4.53	8,164,915.32	3.87	4,533,308.23	2.92
Kapiri catchment conservation	20,174,476.63	3.46	13,317,296.05	2.71	5,068,824.74	1.71
Mkumphira catchment	(1,785,588.48)	0.73	(2,005,718.63)	0.65	(2,130,391.01)	0.54
Muonekera catchment	(3,165,071.67)	0.56	(3,111,655.53)	0.50	(2,879,151.87)	0.42
Nkhata Bay water supply	(19,037,762.51)	0.25	(18,172,204.74)	0.22	(16,490,331.11)	0.17
Chiswamafupa cookstoves	(3,597,727.89)	0.26	(3,638,215.57)	0.22	(3,603,225.96)	0.16

Annex 12. 2: Changes in discount rate – Economic analysis

Name of intervention	3% Discount Rate		6% Discount Rate		12% Discount Rate	
	CBA Measure		CBA Measure		CBA Measure	
	ENPV (MK)	EBCR	ENPV (MK)	EBCR	ENPV (MK)	EBCR
Chikomo Community Bakery	11,834,465.52	1.42	7,980,693.17	1.34	3,261,558.78	1.19
Sasasa Irrigation Scheme	158,150,776.85	1.62	09,736,869.89	1.52	51,063,722.18	1.34
Usisya Tailoring Group	9,567,095.99	1.70	5,826,740.02	1.45	1,162,656.76	1.10
Mwawi Piggery Group	10,162,117.55	1.49	6,817,405.15	1.40	2,830,227.56	1.24
Njiri Fish Farming Group	4,399,194.68	1.32	1,836,755.71	1.15	(1,161,535.50)	0.89
Movya Beekeeping Group	31,555,049.06	3.50	23,402,920.51	3.00	13,117,579.52	2.27
Movya VSL Group	11,766,821.09	5.26	8,860,343.25	4.48	5,211,309.03	3.39
Takondwa Banana Club	10,610,356.82	2.62	7,650,141.93	2.52	3,977,393.49	1.68
Linungwi Irrigation Scheme	(51,275,832.75)	0.72	(55,412,606.24)	0.65	(55,618,260.04)	0.54
Linungwi Fish Farming Group	572,887.77	1.19	(652,271.72)	0.93	(1,855,055.97)	0.76
Linungwi Beekeeping Group	23,387,063.44	3.06	16,106,678.97	2.63	7,531,303.35	1.97
Kasinje Goat Production Group	11,040,688.65	1.49	7,684,266.85	1.40	3,693,550.94	1.24
Tithandizane VSL Group	8,031,904.19	4.67	5,922,173.90	4.00	3,319,813.73	3.05
Ngwelero Irrigation Scheme	25,179,459.68	1.22	9,972,504.42	1.10	(7,889,408.99)	0.90
Ngwelero Fish Farming Group	2,701,536.25	1.19	200,386.62	1.02	(2,796,569.62)	0.76
Ngwelero Beekeeping Group	16,984,173.08	3.06	12,646,144.47	2.63	7,142,424.96	1.97
Takondwa Piggery Club	10,613,430.51	2.06	7,530,946.64	1.92	3,831,137.13	1.67
Chitamambeta VSL Group	11,068,360.69	5.14	8,194,318.18	4.38	4,638,788.18	3.31
Kapiri catchment conservation	19,627,239.31	2.42	13,465,126.41	2.17	6,006,830.91	1.77
Mkumphira Forest Conservation	6,603,846.65	2.10	4,661,733.51	1.89	2,304,081.47	1.56
Muonekera Forest Conservation	8,661,824.97	2.42	6,219,214.46	2.17	3,233,543.51	1.77
Nkhata Bay water supply	23,422,206.24	2.11	16,217,141.77	1.84	7,348,836.49	1.44
Chiswamafupa cookstoves	2,712,928.85	1.61	1,489,559.16	1.35	(12,201.68)	1.00

(Footnotes)

1 As honey production had not commenced during the time of the visit, the benefits were projected based on the number of beehives.

2 Benefits were estimated by the revenue to be obtained from projected fruit production and prices based on information from other similar orchards.



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