PDNA AND RECOVERY PLANNING GUIDELINES ADAPTED TO THE IRRIGATION SECTOR IN SRI LANKA

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Table of Contents

List of Tables

List of Figures

Content of the Tool Kit for executing the PDNA

Abbreviation

ADB	Asian Development Bank
ARPA	Agriculture Research and Production Assistant
BBB	Build-back-better
BOP	Balance of Payments
BOQ	Bill Of Quantities
BTL	Bund Top Level
CBG	Criteria Based Grant
CBSL	Central Bank of Sri Lanka
DA	Department of Agriculture
DAD	Department of Agrarian Development
DaLA	Damage and Loss Assessment
DCB	Decentralized Capital Budget
DG	Director General
DMC	Disaster Management Center
DRF	Disaster Recovery Framework
DRM	Disaster Risk Management
DRPM	Deputy Resident Project Manager
DRR	Disaster Risk Reduction
DS	Divisional Secretary
ERD	External Resource Department
EU	European Union
FC	Finance Commission
FPS	Flood Protection Scheme
FSL	Full Supply Level
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GN	Grama Niladhari (Village Headman)
GRM	Grievance Redress Mechanism

HFL	High Flood Level
ICB	International Competitive Bidding
ICT	Information and Communication Technologies
ID	Irrigation Department
IMF	International Monetary Fund
LG	Local Government
NBD	National Budget Department
NCB	National Competitive Bidding
NPA	National Procurement Agency
NPD	National Planning Department
MASL	Mahaweli Authority of Sri Lanka
MDTF	Multi Donor Trust Fund
M & E	Monitoring and Evaluation
PDNA	Post-Disaster Needs Assessment
PIDs	Provincial Irrigation Departments
PIP	Public Investment Plan
PSDG	Province Specific Development Grant
RPM	Resident Project Manager
SWES	Salt Water Exclusive Scheme
TA	Technical Assistant
TO	Technical Officer
TOR	Terms of Reference
TWC	Technical Working Committee
UN	United Nations
UNDP	United Nations Development Program
UNDRR	United Nations Office for Disaster Risk Reduction
WB	World Bank Group

Terminology

Adaptation: The adjustment in natural or human systems in response to actual or expected climatic or other stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Audit: An official examination and verification of accounts and records to analyze the legality and regularity of project expenditures and income, in accordance with laws, regulations, and contracts, such as loan contracts and accounting rules. It also may analyze the efficient and effective use of funds.

Baseline data: Initial information collected during a post-disaster needs assessment, including facts, numbers, and descriptions of the pre-disaster situation. This information will permit a comparison between the pre and post-disaster situations.

Build Back Better (BBB): The use of the recovery, rehabilitation, and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies, and the environment.

Design guidelines and specifications: A set of associated standards intended to control aspects of the design, construction, materials, alteration, and occupancy of structures that are necessary to ensure human safety and welfare, including resistance to collapse and damage.

Capacity: The combination of all physical, institutional, social, and/or economic strengths, attributes, and resources available within a community, society, or organization that can be used to achieve agreed goals. Also includes collective attributes such as leadership and management.

Capacity building: the process by which individuals, groups, and organizations build their knowledge, abilities, relationships, and values to solve problems and achieve development objectives.

Climate change resilience: The ability to resist, absorb, adapt to, and recover from meteorological changes attributed directly or indirectly to human activities that alter the composition of the global atmosphere or the natural climate variability. See also “Resilience.”

Community: A social group of any size whose members reside in a specific locality, share government, and often have a common cultural and historical heritage

Disaster: A situation or event that overwhelms local capacity, necessitating a request to a national or an international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction, and human suffering.

Disaster risk management (DRM): Systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies, and improved coping capacities to lessen the adverse impacts of hazards and the possibility of disaster.

Disaster risk reduction (DRR): Concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters. Results of DRR include reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness.

Early warning system: The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare and act appropriately; and in sufficient time to reduce the possibility of harm to or loss of life or livelihoods, injury, damage to property, and damage to the environment. A people-centered early warning system comprises four key elements. They are (a) knowing the risks; (b) monitoring, analyzing, and forecasting the hazards; (c) communicating or disseminating alerts and warnings; and (d) developing the local capacities to respond to the warnings. The term "end-to-end warning systems" is used to emphasize that warning systems need to span all steps from detecting hazards to the community's response.

Efficient recovery: Stabilizing lives and livelihoods to return to normal; and rapidly restoring critical social, physical, and productive infrastructure and service delivery.

Effective recovery: Achieving the intended outcomes of medium- to long-term recoveries such as the rehabilitation and reconstruction of damaged infrastructure and the re-creation of sustainable livelihoods and income-generating opportunities.

Empowerment: Authority given to an institution, organization, or individual to determine policy and make decisions.

Ex-post measures: Actions taken after a disaster has occurred to seek to mitigate or repair all damages caused by the disaster.

Exposure: People, property, systems, or other elements present in hazard zones that thereby are subject to potential losses.

Annotation: By its nature, the irrigation infrastructure is exposed to flood hazards created by monsoon rains and climatic depressions. The number of irrigation schemes managed by each institution of the irrigation sector and the magnitude of such schemes and the spread area of infrastructure determines the scale of exposure to a flood event.

Flood: General and temporary condition of partial or complete inundation of normally dry land areas from (a) the overflow of inland or tidal waters, (b) the unusual and rapid accumulation or runoff of surface waters from any source, or (c) mudflows or the sudden collapse inland of shoreline.

Hazard: Natural process or phenomenon or human activity that has the potential to cause property damage, loss of livelihoods and services, social and economic disruption, and/or environmental degradation

Annotation: Probabilistic flood hazard is the likelihood of occurring a flood event that could damage irrigation infrastructure and its operations.

Infrastructure: Systems and networks by which public services are delivered. These services include water supply and sanitation, energy, and other utility networks, and transportation networks for all forms of travel.

Livelihoods: The ways in which people earn access to the resources that they need, individually and communally, including food, water, clothing, and shelter.

Losses: Include the decline in output in productive sectors and the lower revenues and higher operational costs in the provision of services. Also considered losses are the unexpected expenditures to meet emergency needs. Losses are expressed in current values.

Loss assessment: An assessment that analyzes the changes in economic flows that occur after a disaster and over time, valued at current prices.

Mitigate/mitigation: The use of reasonable care and diligence to minimize damage; to take protective action to avoid additional injury or loss; to lessen or limit the adverse impact of hazards and disasters.

Monitoring: Ongoing task of collecting and reviewing program-related information that pertains to the program's goals, objectives, and activities.

Needs assessment: Process for estimating (usually based on a damage assessment) the financial, technical, and human resources needed to implement the agreed program of recovery, reconstruction, and risk management.

Node: The central location for staff and materials during a disaster event.

Nonstructural measure: Any measure not involving physical construction that uses knowledge, practice, or agreement to reduce risks and impacts, particularly through policies and laws, public awareness-raising, training, and education. See also "Structural measures."
Off-budget financing: Could not be managed directly by the national government or is not comprised in its budget.

On-budget financing: Within the national government's control, including own source revenue as well as external funding and loans.

Partners: Donor community or any group or individual taking part and sharing the responsibility of the reconstruction and recovery process. In contrast, see "Stakeholders.

Policy: Principle or protocol to guide decisions and achieve rational outcomes.

Post-disaster needs assessment (PDNA): A multisectoral assessment that measures the impact of disasters on the society, economy, and environment of the disaster-affected area.

Preparedness: The knowledge and capacities developed by governments, professional response and recovery organizations, communities, and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent, or current hazard events or conditions.

Prior measures (ex-ante): Actions taken in advance of a disaster in the expectation that they will either prevent or significantly reduce the impacts of a possible disaster.

Project outputs: Results of a project that are measurable at the immediate point of project completion.

Preliminary assessment: Assessment that provides immediate information on needs, possible interventions, and resource requirements. May be conducted as a multisectoral assessment or in a single sector or location.

Reconstruction: Restoration and improvement, where possible, of facilities, livelihoods, and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. Focuses primarily on the construction or replacement of damaged physical structures, and the restoration of local services and infrastructure

Recovery: Decisions and actions taken after a disaster to restore or improve the pre-disaster living conditions of the affected communities while encouraging and facilitating necessary adjustments to reduce disaster risk. Focuses not only on physical reconstruction but also on the revitalization of the economy and the restoration of social and cultural life.

Recovery framework: Pragmatic, sequenced, prioritized, programmatic, yet living (and flexible) action plan that ensures resilient recovery after a disaster.

Rehabilitation: The restoration of basic services and facilities for the functioning of a community or a society affected by a disaster.

Relief: Provision of assistance or intervention immediately after a disaster to meet the life preservation and basic subsistence needs of the persons affected. While concerning irrigation infrastructure, taking immediate precautions to reduce the risk of failure or further damages is carried out during the relief phase.

Residual risk: The risk that remains in unmanaged form, even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained. The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response, and recovery together with socioeconomic policies such as safety nets and risk transfer mechanisms.

Resilience: The ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential structures and functions. Resilience is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need.

Resilient recovery: Builds resilience during recovery and promotes resilience in regular development. Resilient recovery is a means to sustainable development. See also "Resilience," "Recovery," "Disaster risk management," and "Disaster risk reduction."

Response: The provision of emergency services and public assistance during or immediately after a disaster to save lives, reduce health impacts, ensure public safety, and meet the basic subsistence needs of the people affected. See also "Humanitarian relief."

Risk: The combination of the probability of an event and its negative consequences.

Stakeholders: Groups who have any direct or indirect interest in the recovery interventions, or who can affect or be affected by the implementation and outcomes. The term includes groups undertaking, managing, reporting on, affected by, promoting, and funding the interventions. Stakeholders include vulnerable segments of the population and local governments that are in direct dialogue with communities.

Structural measure: Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems. See also “Nonstructural measures.”

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This 1987 Brundtland Commission definition does not address questions regarding the meaning of the word “development” and the social, economic, and environmental processes involved. Disaster risk is associated with unsustainable elements of development such as environmental degradation. Conversely, disaster risk reduction can contribute to sustainable development by reducing losses and improving development practices.

Underlying Risk: Processes or conditions, often development-related, that influence the level of disaster risk by increasing levels of exposure and vulnerability or reducing capacity.

Annotation: Underlying disaster risk drivers (also referred to as underlying disaster risk factors) include poverty and inequality, climate change and variability, unplanned and rapid urbanization, and the lack of disaster risk considerations in land management and environmental and natural resource management, as well as compounding factors such as the limited availability of technology, unsustainable uses of natural resources, declining ecosystems

Vulnerability: Characteristics and circumstances of a community, system, or asset that make it susceptible to the damaging effects of a hazard.

Vulnerable groups: Groups or members of groups who are particularly exposed to the impacts of hazards. Examples are displaced persons, women, the elderly, the disabled, orphans, and any group subject to discrimination.

Chapter 1 Introduction

1.1 Background

Analyzing the consequences and impact of a disaster on a number of sectors in order to identify recovery needs and create an extensive, multisectoral recovery strategy is known as a post-disaster needs assessment (PDNA). In addition to macroeconomic, human, and social development, finance, and several cross-cutting themes (government, environment, disaster risk reduction, gender, employment, and livelihood) that are addressed across all sectors, the PDNA process focuses on three main sectors: social, productive, and infrastructure (of which irrigation is a sub-sector).

Infrastructure for irrigation supports the sustainability of the agriculture sector (productive), the environment sector, and the social sector while also enhancing the irrigation sector. To avoid double counting and to guarantee that the data gathered at the sector level enhances the irrigation sector's priority needs and is well-integrated into the PDNA process's results, it is crucial to note that from the outset of the irrigation sector's PDNA, it will be necessary to hold consultations with assessment teams from other sectors, such as agriculture and social livelihoods.

1.2 Irrigation sector overview

One of the most frequent natural hazards to the agriculture industry is drought. In Sri Lanka, irrigation system development began in the first century B.C. as a way to control water in the water-rich wet zone and to lessen the impact of drought on agricultural operations in the water-scarce dry zone.
Minor, medium, and Major irrigation schemes, respectively, are those that enable less than 80 hectares, between 80 and 400 hectares, and more than 400 hectares of irrigation. Irrigation reservoirs, also known as irrigation tanks, and diversion weirs, sometimes known as Anicuts, are the two fundamental forms of irrigation schemes. Trans-basin canals are a group of river diversion plans that move extra irrigation water from one basin to nearby basins with less water. By storing diverted water in irrigation tanks, utilizing water controllers (such as an Anicut), and producing hydropower when available, river diversion programs give farmers irrigation facilities.

To safeguard people and property from significant flooding disasters, the British monarchy began building Flood Protection Schemes (FPS) for key rivers about 100 years ago. Since then, various local governments have maintained this work. In order to prevent irrigated agriculture from being contaminated by seawater during the high tide period, salt water exclusion schemes (SWES) were built throughout the coastal strip.

Flooding is a seasonal occurrence that has negative effects, mostly on irrigation systems and the agricultural industry. Sometimes a single upstream injury can shut down the entire downstream process, which has a big impact on food security. The PDNA technique's essential steps speed up the recovery process after any substantial flood danger. In order to tackle a crisis situation, the irrigation sector community of practice's (CoP) knowledge garnered from seasonal flood dangers can be further developed. The PDNA approach evaluates the entire scope of a hazard's effect and impact on infrastructure in the irrigation sector and generates an effective and sustainable recovery strategy for deploying financial and technical resources.

1.3 Management of irrigation schemes

Twelve (12) State sector organizations, including the Irrigation Department (ID), Mahaweli Authority of Sri Lanka (MASL), the Department of Agrarian Development (DAD), and nine (9) Provincial Irrigation Departments (PIDs) that represent nine provinces of the nation, have been in charge of managing the irrigation sector's routine operations, maintenance, and developments, including disaster management. The management of Sri Lanka's irrigation sector is not permitted in the private sector.

Those irrigation institutes are responsible for managing irrigation systems, flood protection Schemes, and salt water exclusion Schemes as follows:

1. The Irrigation Department manages about 100 large irrigation schemes, nearly 250 minor irrigation schemes, and more than 235,000 acres of irrigation facilities. Additionally, ID oversees flood protection schemes and saltwater exclusion schemes.

2. To provide irrigation facilities for more than 101,000 ha, the MASL manages the Mahaweli River Diversion Scheme and Uda-Walawe Irrigation Scheme, which comprise irrigation tanks and regulators such as Anicuts.

3. The PID (Northern Province) manages 10 major irrigation schemes, 43 medium irrigation schemes, and almost 28,000 hectares of irrigation facilities. Furthermore, salt water exclusion schemes are also managed by PID (Northern Province).

4. The PID (Eastern Province) manages 32 medium irrigation schemes, 8 large irrigation schemes, and roughly 12,000 hectares of irrigation facilities. Additionally, salt water exclusion schemes are also managed by PID (Eastern Province).

The DAD and the PIDs oversee more than 25,000 minor irrigation systems (tanks and anicuts) that provide irrigation facilities for more than 260,000 acres.

1.4 Purpose of the PDNA Guide to the Irrigation Sector

The overarching purpose of the PDNA Guide is to provide enhanced support to the government in post-disaster need assessment and planning for recovery following a more coordinated approach among the institutions of the irrigation sector. The guide's more immediate objective is to offer a framework for the irrigation sector that has been agreed upon and is in line with global best practices[1].

This guide strengthens present need assessment practice as a practical and action-oriented process focusing on quality, reliability, and inclusiveness by:

1. Facilitating quick decision-making and implementation
2. Providing a predictable and coherent approach to assessment and planning
3. producing a consistent estimation of recovery needs;
4. Adapting to international best practices
5. Following a cost-effective approach by assessing priority needs;
6. Improving the credibility of assessments and recovery strategies
7. Looking for financing opportunities for recovery and reconstruction.

[1] *The ADB Knowledge and Support Technical Assistance (KSTA) March 2020 for Building Disaster-Resilient Infrastructure through Enhanced Knowledge provides financial assistance for this assignment.*

The methodologies used to assess the effects and impact of disasters on irrigation infrastructure are expanded upon in this guide. It makes it easier to carry out thorough assessments of the effects of disasters on the farming community, others involved in agro-based industries, communities protected by current flood protection schemes, and state agencies engaged. The Guide uses these evaluation results to highlight the recovery needs of irrigation infrastructure as well as the supporting needs of irrigated agriculture production, national food security, social well-being, and environmental factors. Perspective, a recovery strategy to fully and sustainably fulfill recovery requirements.

1.5 Audience

The PDNA Guide is primarily designed to support irrigation professionals who are involved in the planning and execution of PDNA in irrigation infrastructure, as well as the heads of Sri Lanka's irrigation institutions who are in charge of directing and coordinating the PDNA process. Specifically, it is intended for:

1. Senior government officials are in charge of requesting national and international assistance for an assessment of the disaster in the irrigation sector and the subsequent recovery and reconstruction efforts.
2. Senior managers from multilateral organizations in the country who would be required to set up and coordinate a post-disaster need assessment and recovery process
3. Government representatives from several sector ministries who are in charge of risk reduction, disaster recovery, and response

1.6 Limitations

The PDNA Guide emphasizes a more comprehensive assessment of post-disaster needs and recovery planning. The methods and procedures recommended in the next chapter of the guide, in particular, are intended to provide an example of one possible way to maintain coordination among the irrigation institutions and other national-level state agencies involved in the decision-making process for grant release.

The more complex assessment procedures created and utilized by UN agencies or the WB are not intended to be replaced by the PDNA Guide. International standards, however, offer a comprehensive strategy and orientation for evaluation and the start of the recovery planning process that would be helpful to a large audience. To design irrigation sector-specific recovery strategies and programs regarding overall impact, governmental agencies, donors, and International Finance Institutions (IFIs) may need to do such an assessment.

1.7 The Objectives of the PDNA

The main goal of conducting a PDNA is to assist irrigation institutions in assessing the full extent of a disaster's impact on the irrigation infrastructure and, based on these findings, producing an actionable and sustainable Recovery Strategy for mobilizing financial and technical resources and receiving international assistance. The main objective of a PDNA is to assist irrigation institutions in assessing the full impact of a disaster on the irrigation infrastructure and services and to produce actionable and sustainable recovery strategies based on the results, enlisting the aid of financial and technical resources as well as receiving international support. More specifically, a PDNA sets out the following subobjectives:

1. Support government-led assessments and initiate recovery planning processes using a coordinated platform for irrigation sector entities that integrates the UN system's and other participating international donors' and financial institutions' combined efforts.
2. Evaluate the effect of the disaster on:

   - Irrigation infrastructure and assets
   - Disrupted service delivery and access to goods and services;
   - Disrupted decision-making process and governance;

1. Assessing needs to address underlying risks and vulnerabilities to reduce risk and Build Back Better (BBB)
2. Estimating the damage and loss caused by the disaster to the irrigation Sector, including an assessment of its macro-economic consequences;
3. Identify all recovery and reconstruction needs.
4. Create the recovery strategy, recovery interventions, expected outputs, and cost of recovery and reconstruction that will serve as the foundation for a comprehensive recovery framework.

The PDNA Guide includes the essential aspects of the Damage and Loss Assessment (DaLA) method and process for conducting a comprehensive assessment of damages, losses, and needs, which will lead to the formulation of a Recovery Strategy.

1.8 Deliverables of the PDNA

The PDNA produces the following four core deliverables:

1. Presenting the overall effect and impact of the disaster on the irrigation sector, the recovery needs, as well as the explicit impact on cross-cutting themes, with a gender perspective, environmental considerations, risk reduction, and governance.
2. A Recovery strategy provides a strategy for recovery actions within the irrigation sector and is armed with clear objectives and interventions; directs it toward expected results; and defines the timeframe as well as the cost for the recovery process.
3. Provides the basis for effective resource mobilization in support of the country's recovery process.
4. Provides an outline for a country-led implementation mechanism for recovery.

1.9 Guideline Principles

The PDNA is guided by the following core principles[2] :

1. Acknowledge the national ownership of PDNA and ensure that it is a demand-driven and government-led process, with the fullest possible leadership and engagement of irrigation institutions in assessment, recovery planning, and implementation, and at the level of technical expertise.
2. Support local ownership and the fullest possible engagement of local authorities and community-based organizations in the planning and execution of recovery, and build specific capacities where needed.
3. Provide coordination at all stages of the process and at all levels, ensuring collaboration and partnership between the UN agencies, donor partners, and other stakeholders engaged in the PDNA.

4. Support and strengthen national and local capacities to lead and manage recovery and reconstruction.
5. Ensure transparency and accountability in the PDNA process as well as in post-disaster recovery and reconstruction.
6. Integrate DRR measures into the recovery process to enhance the resilience of affected populations and countries in the event of future disasters.
7. Ensure the participation of the affected farmer community and the community living in the flood-prone areas protected by existing Flood Protection Schemes in the assessment of needs and priorities and the recovery process.
8. Ground recovery in the principles of sustainable development.
9. Build on national development strategies as required.
10. Monitor, evaluate, and learn from practice.

1.10 Structure of the PDNA Guide

Chapter 1 is an introduction to the guide and outlines the objectives, deliverables, and principles for participation and coordination of the assessment.

Chapter 2 provides the framework for a common approach to assessment and planning as well as guidance on the development of a Recovery Strategy based on the assessment results.

Chapter 3 guides the PDNA process. This includes suggestions regarding measures for the planning, preparation, and implementation of a PDNA. The chapter includes a section with a brief guide for the Government and a more detailed section for the tripartite partners.

[2] *Post-Disaster Needs Assessment Guidelines, Volume A (GFDRR 2013).*

Chapter 2 Conducting a PDNA for the Irrigation Sector

2.1 Disaster Management as a Cyclic Process

The prevalent method of “reactive response to a sudden hazardous event” reduces the damage caused by hazards and accelerates an organization’s recovery from them, but it considers that disasters may occur before management responds, and, as a result, management may respond only after the disaster has occurred. A proactive risk management method recognizes prospective hazards before a potentially risky event occurs and devises strategies to avoid or reduce the risk. This guideline utilizes an international approach to disaster risk management (DRM) as a cyclic process that emphasizes the relationship between the pre- and post-disaster phases of the cycle (Figure 2.1), as well as the interactions among the reaction, recovery, mitigation, and preparation phases.

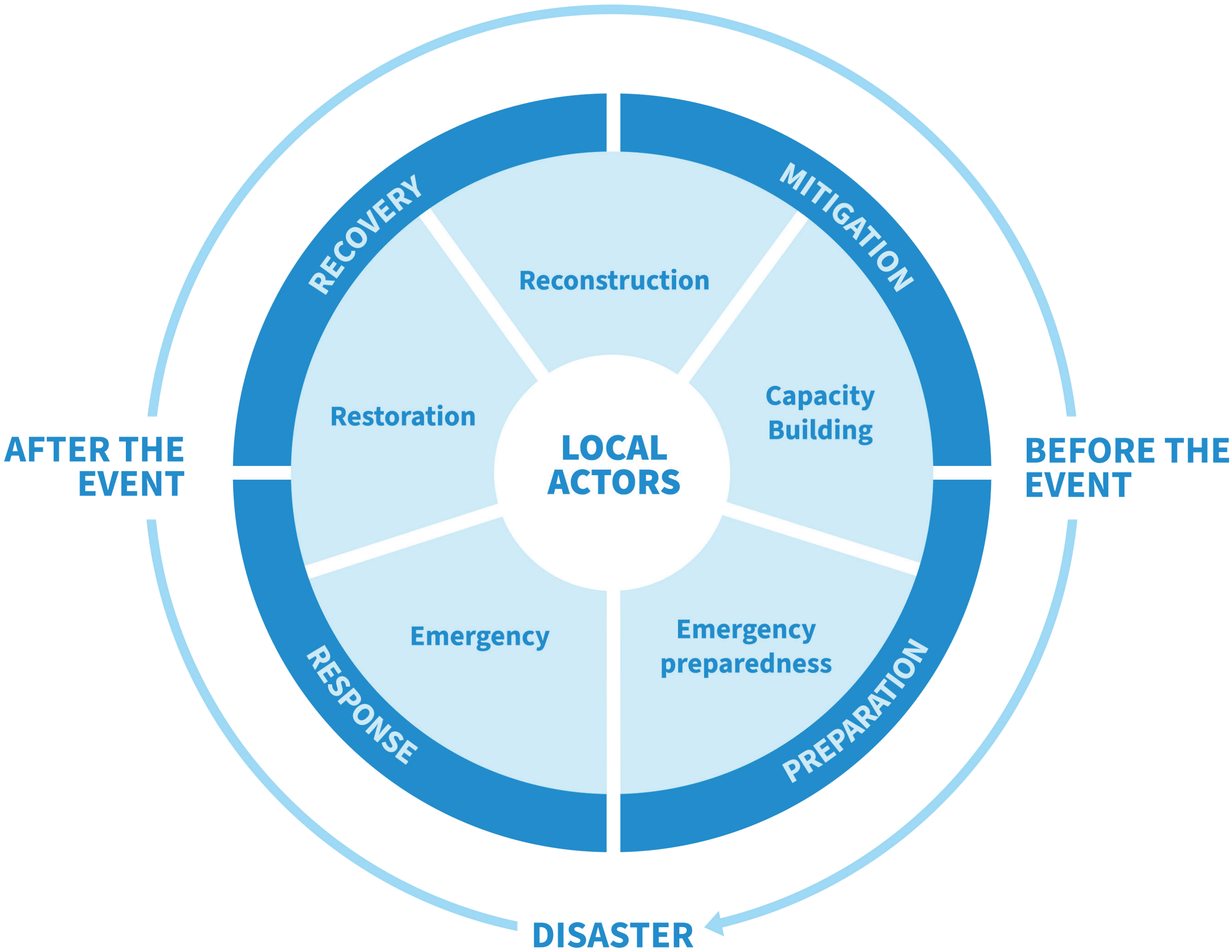


Figure 2.1 Disaster Risk Management (DRM) Cycle Source: The guide to engaging local actors in Disaster Recovery Frameworks (2019) [3]

[3] *https://www.gfdrr.org/sites/default/files/publication/Engaging%20Local%20Actors%20in%20Disaster%20Recovery%20Frameworks%20-%20Final.pdf*

2.2 The Approach of the PDNA for the irrigation sector

The irrigation sector PDNA is designed to be a guiding tool to assist government institutions, international development organizations, and donor partners in planning for resilient post-disaster recovery. A PDNA for the irrigation sector consists of the following main elements:

1. Comparison of pre-disaster baseline data and post-disaster impact data and information;
2. Assessment of the disaster's effects in terms of damage and loss;
3. Assessment of the disaster's impacts; and
4. Preparation of a recovery strategy that determines the recovery needs for the irrigation sector.

A comprehensive assessment of the irrigation sector will integrate quantitative and qualitative primary data as well as Planning Preparedness. that includes:

1. Quantifying the extent of physical damage to infrastructure and assets caused by the disaster
2. Additional expenses incurred for rehabilitation and operations during the disaster were a loss.
3. Re-establishment cost of a governance system disrupted by the consequences of a disaster as a loss
4. The cost of taking immediate precautions and early actions to minimize the risk, in addition to the cost of taking long-term measures to minimize the risk, is a loss.
5. To assess the implications of irrigation infrastructure damage and loss of livelihoods for the farmer community and others engaged in agricultural and related industries as cross-sectoral losses and the impact on national food security
6. To assess the implications of such damage and loss on the livelihoods of the community living in the flood-prone areas protected by existing Flood Protection Schemes.

The assessment of the cross-cutting sectors' implications will enhance the priority of the irrigation sector's needs and avoid duplication among sector needs complemented by each other.

2.3 Pre-disaster Baseline Information

As government entities, all movable assets (instruments, vehicles, machines, and tools) and immovable assets (residential units) are to be inventoried in detail, including key information such as purchasing or sanctioning dates, value, etc. As a common practice, most immovable assets in the irrigation sector are not included in the inventories. The non-availability of an inventory register of irrigation infrastructure delays post-disaster damage assessment.

Example

When the dam of Kantalai Irrigation Reservoir burst on April 20, 1986, devastating downstream infrastructure, the process for determining rehabilitation needs was greatly hindered because there was a lack of inventory.

Furthermore, using the inventory register and engineering drawings, it was simple to assess the damage to the residential units of the irrigation sector following the Tsunami on December 26, 2004. A pre-disaster baseline dataset can be generated from an "inventory register" of irrigation infrastructure, which could be upgraded by including the status of irrigation structures and the cost of construction before disaster strikes. It is useful to make a comparison between pre-disaster and post-disaster conditions in order to evaluate the magnitude and scale of the disaster. Hence Developing pre-disaster baseline datasets and updating the status of the infrastructure are essential for rapid and effective post-disaster needs assessments and the planning of recovery frameworks seeking financial assistance.

2.3.1 Pre-monsoon meeting

Pre-monsoon meetings are conducted by each irrigation institution to plan the seasonal cultivation pattern. At this meeting, considering the conditions of the irrigation infrastructure, storage capacity of irrigation tanks, estimated inflow from monsoon rains, and irrigation system management, possible cultivation patterns are recommended for the seasonal cultivation, enabling farmers to make a collective agreement for a feasible and sustainable cultivation pattern.

The cultivation meeting does not, however, include any preparedness programs before a severe flood event, prior to a severe flood event, or during a severe flood event. The Disaster Recovery Framework (DRF) is a practice-based, results-oriented instrument that constructs disaster recovery policy principles for the irrigation sector's organizational strategies in order to institutionalize these policy principles and establish an appropriate financial mechanism. Before convening the seasonal cultivation meeting with farmer institutions, only operational-level organizations will be able to prepare for implementation during pre-monsoon meetings. The institutionalized DRF policy principles can be implemented with the assistance of farmer institutions and by taking corrective action, followed by performance monitoring and evaluation. In addition, a DRF for the irrigation sector unites sector organizations, farmer institutions, donors, development partners, and other community initiatives in the short, medium, and long-term recovery timeframes.
Although cultivation meetings are held by operational-level units of the twelve (12) irrigation agencies along with farmer institutions and other state sector organizations providing supportive services, inter-coordination among all such agencies from the operational level to the national level is required for the preparatory works and implementing arrangements since DRF addresses the recovery of irrigation schemes or the irrigation sector of the entire nation.

2.3.2 Establishing pre-disaster baseline information

In the current country context, damage assessment of irrigation infrastructure following a flood event is performed as a routine practice by technically qualified people at the operational level of sector agencies using their experience. The primary requirement of the irrigation institution, as determined by such an assessment, is the rehabilitation of damaged structures. The losses are reimbursed by the funds that are accessible or resources allocated for other purposes, as applicable. Though irrigation infrastructure directly improves the productivity of agriculture and agro-industry and indirectly improves the sustainability of other sectors such as the environment, health, education, and nutrition, among others, such information is not provided by irrigation sector agencies to prioritize the importance of irrigation infrastructure recovery at the national level.

As described in the global approach, maintaining an updated pre-disaster baseline dataset becomes a decision-supportive tool for assessing the damage, loss, sustainable recovery needs, and recovery priorities of the post-disaster need assessment (PDNA) in a consistent manner. A common platform for managing institutional data on irrigation infrastructure is essential to streamlining irrigation sector data.
The qua
lity of the damage and loss assessment (DaLA) performed by operational-level employees and the auxiliary data of cross-sectional sectors is critical to the national-level or institution-level planning process of identifying and distributing financial resources. The worth of financial resources provided for the recovery process based on the DaLA method determines the production of precise engineering estimates prior to commencing implementation.

However, the impacts of flood events ranging from typical monsoon flood events to severe flood risks cause damage to irrigation infrastructure on a variety of dimensions in the irrigation sector. As a result, during the disaster recovery process, the inventory data of pre-event baseline information serves as a guiding tool to support irrigation staff decisions. Furthermore, it creates a reference database for possible future disasters.

2.3.3 General Information Guide for Pre-Disaster Baseline Information

What type of general information is to be included in the pre-disaster baseline information?

To determine the status of the irrigation system affected by a hazardous event, the respective irrigation institutions must be equipped with technical information such as the type, scale, capacity, functionality, and command area of the system.

The PDNA process will be legally initiated in the case of an extreme disaster event for which the government declares a disaster emergency. A disaster will almost certainly cause infrastructure damage to all sorts of irrigation schemes overseen by the majority of the irrigation institutions. Furthermore, it causes numerous damages and losses in other sectors as well. Administrative information regarding the irrigation institution that controls impacted irrigation schemes is required when carrying out post-disaster actions for a common PDNA.

The financial resources are released by the Budget Department through the line ministries. Thus, administrative details such as the implementing agency and the ministry, administrative districts or divisions, etc. shall be included as general information in the baseline database. Pre-disaster baseline information furnishes preliminary data to initiate a recovery proposal or any other development proposal.

Topographical information, technical features, and attributes of damaged irrigation schemes are needed for mapping and clustering physical damages at the district, province, and national scales to make assessments meaningful and to ensure simple recovery. The same kind of pre-disaster baseline information is relevant for a hazard, even on a smaller scale.

The agricultural service area that is directly facilitated by the irrigation tank and anicut and indirectly protected by the salt water exclusion schemes and flood protection schemes is required to determine the magnitude of the irrigation scheme's service and the needs of the agriculture sector and other social sectors. As a result, knowledge of the command area is required.

Flood events are experienced seasonally. Irrigation tank bunds, flood protection dams, or river gauges are calibrated to identify extreme flood events based on their probability of occurrence. The severity of extreme flood events is a measure of when the actual flood level reaches the safe margins (FSL, HFL, and BTL) of the designed flood level of the irrigation structure. Thus, information on flood levels concerning safe parameter levels of the irrigation structure is necessary. Flooding occurs on a seasonal basis. The calibration of irrigation tank bunds, flood protection dams, and river gauges is used to identify extreme flood occurrences based on their probability of occurrence. The severity of extreme flood events is gauged by when the actual flood level arrives at the threshold margins (FSL, HFL, and BTL) specified for the specific irrigation structures. As a result, information on flood levels pertaining to the irrigation structure's threshold values is required. The required information is shown in Figure 2.2.

Technical Information	• Type of Irrigation System (Tank, Anicut, Trans basin/Feeder canal, Flood Protection Schemes, Salt Water Exclusion Schemes) • Scale (Major Medium. Minor) • Functionality (Fully, Partially. Not) • Capacity
Service Information	• Command Area of the irrigation scheme • Protected area of the Salt Water Exclusion Scheme • Flood prone area of the Flood Protection Scheme
Administrative Information	System Management Information (Irrigation Institution. National level, Regional Administrative Unit, Operational Unit, Public Administration Division, Province, District. District Engineer of Agrarian Development
Topographical Information	Location, Public Administration Division, Province, District, Agrarian Development Center
Hazard Information	• Peak Flood Level • Vulnerability of peak flood level (Below HFL Between HFL and BTL Above BTL)

Figure 2.2 Required information in a pre-disaster baseline information

Why does the pre-disaster baseline dataset need a common format for all irrigation institutions?

1. At present, twelve (12) irrigation sector institutions are operating under three different government ministries, and the subjects of these ministries have changed several times in the past.
2. Regardless of irrigation institution management hierarchy, all twelve institutions:
   a) manage similar-type irrigation schemes;
   b) use the same design codes, engineering principles, and base data;
   c) achieve one common goal of delivering irrigation water to the farmer community; and
   d) use the same water management principles. As a result, the pre-disaster baseline data has common features and characteristics.

General information about the pre-disaster baseline dataset in a common format is illustrated in Table 2.1.

Table 2.1 General information of pre-disaster baseline dataset.

1	**Technical and Service Information**		
	Name of the Scheme		
	Type		
	Category	**(Major/Medium/Minor)**	
	Command area (ha)		
	Capacity (for Tank in MCM)		
	Beneficiaries	**Farmer families/families protected by FPS**	
	Functionality at present	**Fully/Partially/Not - Functioning**	
	Any other details (if required)		
2	**Administrative Information**		
	Managing Agency		
	National-level coordination by		
	Regional Administration by		
	The operation, maintenance, and construction Division		
3	**Topographical Information**		
	Coordinates (GPS/Metric/Tank)		
	Operational division of Engineer or DTO of DAD		
	Province		
	District		
	DS Division		
4	**Hazard Information**		
	Occurrence of extreme flood events	**Year**	**Month**
	Observed Peak-Flood	**Below HFL/ Between HFL and BTL/Above BTL**	

2.3.4 Technical information guide of pre-disaster baseline data

Table 2.2 depicts the key technical information about irrigation schemes that is fundamentally necessary for the baseline database. The pre-disaster baseline dataset can be used as an inventory registration of the irrigation scheme at this level. The most recent reconstruction costs prior to the disaster are also included in the database, which will not be included in the inventory.

Table 2.2 Structural information of pre-disaster baseline dataset

Structural Components		Pre-Disaster status and rebuilding cost		
1	Major Tank	Unit	Functionality (G/A/P*)	Cost (LKR)
a	**Head Works**			
	Bund	1 km		
	Riprap	1 km		
	Bund Road	1 km		
	Spill	01 No		
	Sluice -RB	01 No		
	Sluice -LB	01 No		
	Other structures			
b	**Conveyance System**			
	Main Canal			
	Lined Canal RB/LB	1km		
	Earthen Canal RB/LB	1km		
	Regulator	1No		
	Turn out structure	1No		
	Drops/Other structure	1No		
c	**Branch canal**			
	Lined Canal RB/LB	1km		
	Earthen Canal RB/LB	1km		
	Regulator	1No		
	Turn out structure	1No		

	Drops/Other structure	1No		
d	**Distribution Canal**			
	Lined Canal RB/LB	1 km		
	Earthen Canal RB/LB	1 km		
	Regulator	1No		
	Turn out structure	1No		
	Drops/Other structure	1No		
d	**Field Canal**			
	Earthen Canal	1 km		
	Farm Turnout	1No		
	Sub Total 1			
2	**Administration/Operation asset**			
	Unit Office building			
	Field staff quarters			
	Any other			
	Sub Total 2			
	Sub Total 1+2 (Total Damage)			

2.3.5 Ancillary data and information

Previous disaster recovery data and information will be beneficial in the post-event stage. The identification of financial sources will be guided by previous financial information. Disaster recovery policies, procedures, and circulars serve as a guide for determining the scope of the recovery plan. Past recovery information will aid in understanding the scope of past recovery actions. Table 2.3 depicts the critical information necessary during the recovery period. This information should be updated during the pre-monsoon meeting.

Table 2.3 Ancillary data and information

Ancillary data and information as pre-disaster baseline information

1. **Potential financial strategies for recovery**

   The financial resources utilized to recover from earlier hazardous occurrences may be extended to meet current needs. Furthermore, including recovery needs in continuing development financing may help address short-term needs. For example, the Green Climate Fund's (GCF) project for "strengthening the resilience of smallholder farmers in the Dry Zone to climate variability and extreme events through an integrated approach to water management" could provide opportunities for the recovery of irrigation infrastructure damages in dry-zone schemes. The critical information needed to meet the GCF objectives can be incorporated into the recovery plan's financial mechanism. Such records relating to similar prior incidents that were included in the pre-disaster baseline information may aid in the allocation of funds for the current catastrophe.

2. **Information on development policies and strategies for recovery**

   From the recovery planning stage to the implementation stage, information on recovery policies, procedures, standing orders, emergency operation plans, national disaster management plans, and international recommendations is useful. Before commencing recovery planning, the recovery planning team must be fully aware of and competent about the content of such papers, guidelines, application processes, formats, constraints, and so on. The incorporation of such materials into a single guidance tool will make recovery planning easier.

3. **Past recovery information**

   In general, the preparation of detailed engineering estimates will begin after the requested financial resources are approved. Further additional damages may be added to the recovery needs even during the fund processing period of the recovery plan that has already been submitted, as monsoon rains produce flood threats periodically. Occasionally, urgent damages would have been repaired with adequate funds. The inclusion of records linked to past construction activities in the pre-disaster baseline information will provide the recovery planning team with a detailed picture of the irrigation infrastructure's construction history and the exact requirements.

2.4 Disaster Effect and Impact on the Irrigation Sector

Disaster Effect:

Disaster Effects are the "immediate results brought about" by the disaster, which are normally reported just after it has occurred. The disaster effects of the irrigation infrastructure sector involve:

1. Damage to the infrastructure of the irrigation schemes and other assets;
2. Disruption to governance and decision-making processes;
3. Disruption to service delivery and access to goods and services;
4. Increased risks and vulnerabilities of irrigation systems

The effects of the irrigation infrastructure sector are assessed in monetary terms based on:

1. The engineering judgment about the extent of physical damages to the irrigation infrastructure and other assets;
2. The losses experienced during and after the disaster for excess expenditures incurred in addition to normal operations: re-establishing governance and decision-making procedures identified as having a high operational cost
3. The resumption of (a) production complemented by irrigation infrastructure and service delivery; and (b) access to goods and services;
4. The additional expenditure incurred for taking safety precautions to control the potential risk that would be increased by the disaster against the stability of the irrigation infrastructure

Disaster impact:

Disaster impacts are the long-term consequences of the immediate effects of disasters, with a focus on macroeconomic impact and human and social development impact. The disaster impact study examines the macro, medium, and long-term effects in quantitative terms, as well as an estimate of economic performance. It assesses the possibility of temporary macroeconomic imbalances as well as the potential for temporary declines in employment, income, and well-being for impacted individuals and households.

To measure the impact on macroeconomic variables[4], analyses are usually made of the post-disaster performance on the gross domestic product (GDP[5]) and the balance of payments (BOP[6]). The impact on GDP refers to the temporary negative consequences of disaster losses on economic performance as well as the beneficial effects of the reconstruction program on construction and other industries.

Agriculture contributes significantly to the Sri Lankan economy in terms of GDP, foreign exchange earnings, and government revenue. There is potential to improve the agriculture sector's GDP by enhancing coordination of farm services and input supply for food crops, introducing better land use practices, promoting research, science, and technology, and extending services. For example, at present, the agriculture sector only contributes around 7.5% of GDP; the majority of the agriculture sector's contribution to GDP (5.3%) comes from crops, especially paddy; the fisheries sector accounts for 1.4% of GDP; and the livestock sector accounts for 0.8%. The Central Bank of Sri Lanka (CBSL) compiles GDP and BOP (balance of payments) data for Sri Lanka on a quarterly and annual basis, as shown in Box 1.

[4] *The macro-economic effect reflects the manner in which the disaster modifies the main economic variables of the affected country (and includes fiscal impacts, implications for Gross Domestic Product growth, the Balance of Payments, etc.). (modified from UN ECLAC/R. Jovel, 2007)*

[5] *GDP is one of the measures of national income and output for a given country's economy. GDP is defined as the total market value of all final goods and services produced within the country in a given period of time (usually a calendar year).*

[6] *Balance of Payment: The difference between the monetary value of exports and imports in an economy over a certain period of time A positive balance of trade is known as a trade surplus and consists of exporting more than is imported; a negative balance of trade is known as a trade deficit or, informally, a trade gap.*

Box 1

GDP includes all private and public consumption, government outlays, investments, and exports minus imports that occur within a defined territory. GDP determined using Expenditure Approach measures the value of goods and services produced in terms of the expenditure or consumption by the various institutional sectors namely; Households (HH), General Government (GG), Financial Corporations (FC), Non – Financial Corporations (NFC), and Non–profit Institutions Serving Households (NPISH).

For compiling National Account Estimates, in each quarter administrative data are collected from about 250 organizations. Apart from that, data are also collected through, censuses, surveys, administrative reports, annual reports, research reports, etc. However, there are instances where the required data are not available at the time of releasing National Account estimates. For certain economic activities, it takes a year or more to obtain finalized data required for the calculation of National Account Estimates.

For example, there are two paddy cultivation seasons in Sri Lanka: Maha (Wet) and Yala (Dry). Harvesting of the Maha and the Yala seasons are taken place from February to April and August to September respectively. The value added of rice growing is estimated and is used in respective quarters in GDP Estimates as final production statistics are not available for respective quarters. Final real output/production data will only be available when the harvesting is over in the entire country. Then only the final quarterly and annual value added of rice growing sub-economic activity can be calculated in respective quarters (Department of Census and Statistics:

http://www.statistics.gov.lk/FAQ/CompilationOfGDPCompliesWithInternationalStandards-DCS)

The balance of payments for Sri Lanka is a statement of all economic transactions of Sri Lanka residents with residents of the rest of the world during a specific period. All entities operating in the geographic territory of Sri Lanka, including Foreign Currency Banking Units of commercial banks and Duty-Free Zones, are included. Sri Lanka’s balance of payments follows the recommendations of the sixth edition of the IMF “Balance of Payments Manual” (“BPM6”) except that imports are included on a CIF (cost, insurance, and freight) basis rather than FOB (free on board). The balance of payments of Sri Lanka is compiled using several sources including customs declarations, an International Transactions Reporting System (ITRS) for data from the banking system, administrative records of the government, CBSL, and commercial banks, and surveys carried out by the CBSL and other agencies. Thus, estimation of the agriculture food production sector’s contribution to the BOP is rather difficult.

The difference between pre- and post-disaster levels could be used to determine the disaster’s impact on human development, which is assessed both qualitatively and quantitatively as appropriate. It seeks to quantify not only income but also life by considering many indicators such as the Multidimensional Poverty Index and the Gender Inequality Index, among others. The influence on human development refers to the long-term impact of the disasters on human life quality. As illustrated in Box 2, the United Nations Human Development Index for Sri Lanka is a composite statistic that includes life expectancy, educational attainment, and income level, but it could also include the impact of disasters on people’s lives.

Box 2

The HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living. A long and healthy life is measured by life expectancy. The knowledge level is measured by mean years of education among the adult population, which is the average number of years of education received in a lifetime by people aged 25 years and older; and access to learning and knowledge is measured by expected years of schooling for children of school-entry age, which is the total number of years of schooling a child of school-entry age can expect to receive if prevailing patterns of age-specific enrolment rates stay the same throughout the child's life. Standard of living is measured by Gross National Income (GNI) per capita expressed in constant 2011 international dollars converted using purchasing power parity (PPP) rates.

(Human Development Report 2015: Sri Lanka.
https://www.undp.org/sites/g/files/zskgke326/files/migration/lk/Sri-Lanka-Explanatory-Note.pdf)

For instance, the disaster's impact on human development can be predicted from indicators including:

1. the number of children attending school (damaged canal crossings and agriculture roads interrupt the mobility of schoolchildren);
2. the number of women and men who lost their livelihoods (lost harvest in the agriculture sector will decrease grain supply to agro-based industries in the industry sector, affecting employment opportunities);
3. the number of families that do not have access to safe water (polluted water in the home garden wells);
4. the number of families whose health care is being affected (mosquito breeding in newly created water logs); and
5. the level of access to basic services such as education and health care before and after the disaster.

2.5 Damage and Loss Assessment of the Irrigation Sector

Damage and loss assessments must be completed within two weeks of the disaster in order for damage, loss, and recovery data to be acceptable. The PDNA Guidelines indicate that the exercise should take 6–12 weeks; the majority of cases reviewed were done in 3–4 weeks[7]. Delays in completing PDNA may result in missed opportunities to receive financial and other resources from donors. Empirical judgment is preferable at this stage to a detailed analysis of damaged buildings. However, most assessments are based on existing institutional capacities. After institutionalizing disaster recovery policy principles into the organizational strategies of irrigation sector entities, the capacity-building process is able to start. The operational staff in Sri Lanka's irrigation institutions are generally engineers or engineering assistants with adequate technical capacity for damage assessment. Following the same concepts, the twelve irrigation agencies will employ different formats and techniques during the damage and loss assessment stage. Capacity building for technical staff on international best practices will provide consistent methodologies and forms for damage and loss assessment, eliminating unnecessary delays. Thus, capacity training of operational staff is crucial since it can speed up the assessment process by ensuring consistency of data and comparability.

Prior to the disaster, the irrigation structure inventory, which includes the most recent rebuilding costs, could be extended to assess the damage to the irrigation system. The management and technical data are sufficient to identify the scheme and analyze the irrigation infrastructure damage. Irrigation sector losses are defined as high operating expenses incurred in addition to routine operations for disaster operations. The agricultural production sector suffered a loss as a result of the cultivation loss. Water is provided by the irrigation sector as a supplementary service to agriculture. However, recovering from agricultural losses prioritizes irrigation infrastructure recovery needs over social and environmental recovery needs.

2.5.1 Damage Assessment Guided by Pre-Disaster Baseline Information

The pre-disaster baseline information for irrigation infrastructure is an inventory data collection of irrigation structures, including their functional state and the most recent rebuilding cost. This should be expanded to incorporate provisions for damage assessment. This would make the recovery planning process simple, consistent, and rapid.

Damage is assessed in physical units (for example, the length of a dam or canal, kilometers of road, square meters of dwellings, a particular number of typical structures, etc.). The damages reflect the demolition or partial destruction of irrigation structures.

Case 1: Fully damaged structure (destruction): The structure is destroyed and must be replaced. The cost of preparing the site by removing debris from the damaged structure will be included.

Case 2: Partial damage: The engineer will decide whether the partially damaged structure needs to be replaced or can be repaired without replacement. It is based on the engineer's judgment about the stability of the damaged structure.

Example: Figure 2.3 depicts a scenario in which half of the structure is considered to be damaged (roughly) in a hazardous event; this might be the upper or right-side half of the spillway structure with control gates. Because the damage emerged as a geometrical fraction (say 50%) that is not comparable to the 50% of the rebuilding cost, the rebuilding cost cannot be approximated to the 50% of the rebuilding cost that prevailed immediately before the hazardous event. This is the situation when financial and physical improvement are tracked separately. As a result, the engineer will decide regarding the type of reconstruction (small repair, rehabilitation, or replacement), and the cost will be calculated appropriately.

[7] *[1] PDNA: Lessons from a Decade of Experience (2018) https://reliefweb.int/report/world/post-disaster-needs-assessment-pdna-lessons-decade-experience-2018*

Figure 2.3 Damage assessment of partially destroyed irrigation structure

The cost of rebuilding irrigation infrastructure is independent of observable damage, and the engineer estimates the cost of damage at the PDNA. As indicated in Table 2.4, the rebuilding cost that prevailed prior to the hazardous event is provided in the pre-disaster baseline dataset as guiding information for the costing engineer to make a consistent judgment about the rebuilding cost (a guesstimated cost on an empirical basis). Annex 1 illustrates the detailed damage assessment formats that involve irrigation tanks, anicuts, river diversions schemes, FPSs, SWESs, and buildings.

Table 2.4 Sample damage assessment guided by pre-disaster baseline dataset

1		Structural Components							
	Major Tank	Rebuilding cost			Rehab. or Re-construction cost				
		Pre-Disaster			Post-disaster damage				
		Unit	Fun	Cost LKR	Unit	Dam.	Fun.	Guess.	Re.
a	**Head Works**								
	Bund	1 km							
	Riprap	1 km							
	Bund Road	1 km							
	Spill	01 No							
	Sluice -RB	01 No							
	Sluice -LB	01 No							
	Other structures								
b	**Conveyance System**								
i	Main Canal	1 km							
	Main Canal RB (Lined)	1 km							
	Main Canal RB (Earthen)	01 No							
	Regulator	01 No							
	Turn out structure	01 No							
ii	Branch canal								

c	**Distribution Canal**								
d	**Field Canal**								
	Sub Total 1								
2	**Asset (Administration/ Operation)**								
	Unit Office building								
	Field staff quarters								
	Any other								
	Sub Total 2								
	Sub Total 1+2 (Total Damage)								

Abbreviation:
Fun. – Functionality (Good/Average/Poor)
Dam. – Damage (Fully/Partially)
Guess. Cost – Guesstimated Cost
Re. – Remarks

2.5.2 Disaster Loss Assessment of the Irrigation Sector

Similar to damage assessment, loss assessment can also be physically carried out after disaster strikes. However, provisions included in the pre-disaster baseline information at the planning stage would make the process easy, consistent, and fast. Loss assessment could also be done in the post-disaster phase. Provisions incorporated into the pre-disaster baseline information at the planning stage would make the procedure simple, consistent, and quick.

The losses incurred by irrigation institutions during and after the disaster are the costs of operations in addition to routine operations, such as:

1. Re-establishing governance and decision-making processes;
2. Re-establishing service delivery and access to goods and services, which are identified as high operational costs,
3. The additional expenditure incurred for reducing risk includes establishing early warning measures at the preparedness phase, taking immediate precautions at the response stage, and taking early recovery measures during the recovery phase to control the potential risk that may increase.
4. In certain cases, the immediate precautions and early recovery measures will be continued for a longer period until permanent measures are taken.

Because the irrigation industry contributes to the national economy through agriculture, a lost harvest (or potential harvest) caused by a hazardous event is accounted for by the agriculture sector. Similarly, the social sector accounts for relief assistance supplied to the impacted farming community. (Sector classification is shown in Figure 2.4.) The probable losses incurred by the irrigation sector are listed in Table 2.5.

In some cases, temporary measures are required to be implemented until permanent remedies can be implemented. For example, Temporary access roads, culverts, and bridges need to be rehabilitated to ensure the accessibility of the public as well as responders. However, PDNA must be completed within 15 to 45 days of the disaster, and a preliminary figure must be added as a long-term maintenance expense.

c. the additional expenditure incurred for reducing risk: taking early warning measures at the preparedness phase; taking immediate precautions at the response stage; and early recovery measures taken during the recovery phase to control the potential risk that may increase.

d. In certain cases, the immediate precautions and early recovery measures will be continued for a longer period until permeant measures are taken place
Since the irrigation sector contributes national economy through the agriculture sector, lost harvest (or potential harvest) caused by a hazardous event is accounted for by the agriculture sector. Similarly, relief services provided to the affected farmer community are accounted for by the social sector (Sector classification is shown in Figure 2.4). The probable losses incurred by the irrigation sector are listed in Table 2.5.

There are situations that temporary measures taken are needed to be maintained until permanent measures are taken place. For example, temporary access roads, culverts, or bridges are provided to streamline the mobility of public needs. However, PDNA shall be completed soon after the disaster (within 15 to 45 days from the disaster) and a provisional sum shall be included as a long-term maintenance cost.

Table 2.5 Probable losses incurred in the irrigation sector

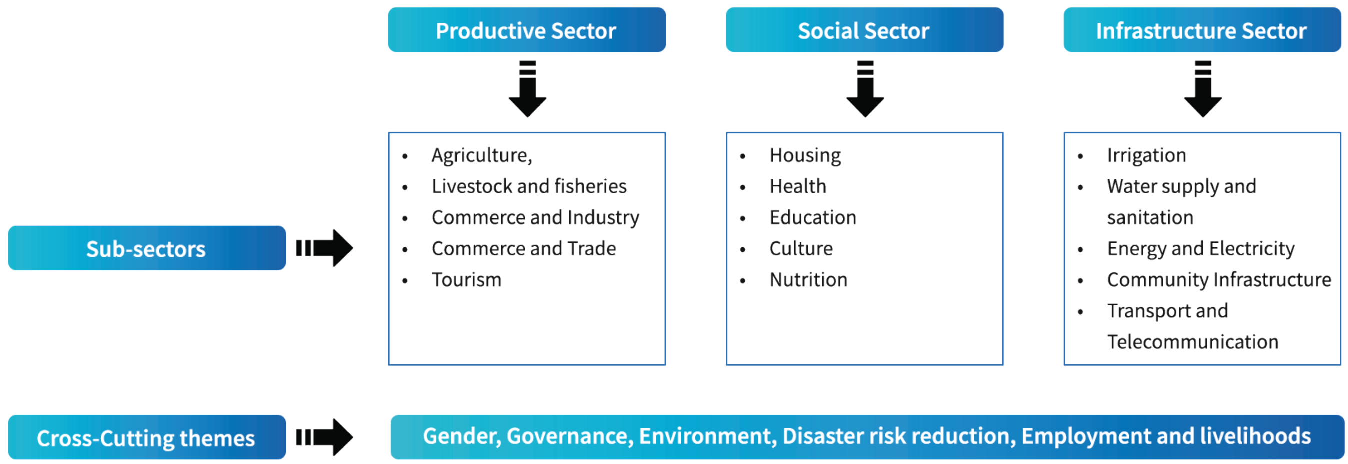
Type of Loss	Possible temporary measures (Irrigation sector)	Anticipated expenses for taking temporary measures (LKR)		
		Imminent a hazardous event	During a hazardous event	Followed by a disaster
a. The cost of reestablishing governance and decision-making procedures.	Rectifying interruption to a communication network and other internal utility services		√	
	The formalizing decision-making process to arrange operational works	√	√	
	Hiring transport, machinery, and equipment for emergency operations	√	√	√
	Expert consultation including hiring additional staff			

b.	Providing temporary access by rehabilitating damaged sections of by-pass		√	√
	Providing temporary transport as necessary		√	
	Making temporary arrangements to provide irrigation water deliveries (e.g. providing coffer dams)		√	√
	Making temporary arrangements to close a breached part of a spillway, anicut, or any other structure to re-start service delivery		√	√
c. Cost for reducing the potential risk that may increase during and post disaster phase	Public awareness by starting early warning (preparedness stage)	√	√	
	Placing sandbags where unusual seepage appears to control damages (response phase)	√	√	√
	Placing sandbags at either side of breached sections (dams, canal bunds) to control further damages as an early recovery (recovery phase)		√	√
	Cleaning sand barriers formed at sea-outfall of rivers to drain out stagnant upstream flood water (response phase)		√	√
	Cleaning debris stuck between piers of canal/river structures to reduce upstream floods (response phase)		√	√
Subtotal				
Total High Operational Cost (imminent+ during+ post)				

2.5.3 Damage and loss in Cross-sectional Sectors

The cross-cutting themes are common in all sectors. Apart from the irrigation sector's damage and loss assessment, an indication of damage and loss experienced in other complementary sectors as cross-sectional data will reduce duplication.

Figure 2.4 depicts a typical sector classification in the PDNA process.



The diagram illustrates a typical sectors that are commonly assessed in the PDNA process, but subject to the variations as necessary.

Figure 2.4 Typical sector classification in the PDNA process

Furthermore, such knowledge will raise the priority of restoring irrigation infrastructure. For example, a burst tank will have a direct impact on the agriculture sector, the inland fishing community, aquaculture (environment), groundwater users (depletion of water levels in home garden wells and agro-wells), a water supply system that pumps water from the breached tank, and so on. This additional information will help prioritize irrigation infrastructure for recovery. A few examples of damages and losses related to other sectors are listed in Table 2.6.

Table 2.6 Examples of damage and loss incurred in cross-sectoral areas

	Damage/Loss	GN Division	Extent/ No	Sector	Sub-sector
1	Damaged paddy area (Ha)			Productive	Agriculture
2	Damaged non-paddy area (Ha)			Productive	Agriculture
3	Loss of harvest (or potential loss)			Productive	Agriculture
4	Affected paddy mills			Productive	Industry
5	Affected agro-industries			Productive	Industry
6	Interruption to safe water (provided water source is irrigation scheme)			Infrastructure	Water supply

7	Interruption to electricity (provided water source is irrigation scheme)			Infrastructure	Electricity
8	Obstruction to Public transport (provided public road aligned over-irrigation bund)			Infrastructure	Transport
9	Environmental damage (depletion of water table, pollution of environment)			Social	Environment
10	Damaged houses of the farmer community			Social	Social Service
11	Affected farmer families			Social	Social Service
12	Affected males, females, and disabled persons in farmer families			Social	Social Service
13	Affected school children of farmer families			Social	Service Education

2.6 Disaster Risk Assessment of the Irrigation Sector

The disaster risk is a probabilistic function of the hazardous event, the vulnerability of the irrigation infrastructure, and its exposure to the hazardous event that determines the degree of potential loss or damage to the irrigation infrastructure and its operations over a particular period of time. The capacity of irrigation institutions and their staff participating in disaster recovery influences their preparedness to handle the event while reducing risk. Furthermore, the farming community's and other stakeholders who may be impacted by the irrigation infrastructure's ability to deal with the situation helps to risk reduction. The risk level of irrigation infrastructure is determined as a function of the likelihood of hazards, exposure, vulnerability, and capacity[8] .

Even after successful disaster risk reduction measures have been implemented, it is vital to take actions to maintain the residual risk that remains unmanaged. Because irrigation infrastructure is vulnerable to floods caused by monsoon rains and climatic depressions, security measures are built into irrigation infrastructure design criteria to reduce residual risk to a minimum. Irrigation institutions can update the requirements for design by upgrading design specifications based on climate change dynamics over the last few decades. The Irrigation Department design guidelines are used by all irrigation institutions in Sri Lanka. The residual risk can be minimized by improving irrigation staff capacity for irrigation system planning and design. Poor communities may encroach on irrigation canals or river reserves and settle without regard for their vulnerability to recurrent flood dangers. Before relocating them from dangerous areas, it is required to instruct them on how to stay safe throughout the rainy season. However, the chance of damage to the spillway structure, spill tail canal, canal system, and irrigable area in the flood-prone area along the main river course occurring after each flood occurrence has been significantly increased.

A sample risk assessment of minor irrigation schemes located in the flood-prone wet zone, those located at the tail end of the tank cascades in the dry zone, and the major and medium irrigation schemes located upstream is illustrated in Table 2.7.

[8] *Terminology illustrates the terms in italic letters*

Table 2.7 Sample of a risk matrix

	Tank bund	Anicut	Spillway	Field canal
Risk Factors	**Irrigation Department**			
Exposure	High	High	High	Low
Vulnerability of infrastructure	Low	low	Moderate	Moderate
Likelihood of Hazardous flood event	Low	High	Likely	Rare
Coping capacity	High	High	Moderate	Moderate
Risk level	**Low**	**High**	**High**	**Low**
	Tank bund	**Anicut**	**Spillway**	**Field canal**
	Mahaweli Authority of Sri Lanka			
Exposure	High	High	High	Low
Vulnerability of infrastructure	Low	low	Moderate	Moderate
Likelihood of Hazardous flood event	Low	High	Likely	Rare
Coping capacity	High	High	Moderate	Moderate
Risk level	**Low**	**High**	**High**	**Low**
	Department of Agrarian Development			
Exposure	High	High	High	Low
Vulnerability of infrastructure	Low	low	Moderate	Moderate
Likelihood of Hazardous flood event	Low	High	Likely	Rare
Coping capacity	High	High	Moderate	Moderate
Risk level	**Low**	**High**	**High**	**Low**
	Provincial Irrigation Departments			
Exposure	High	High	High	High
Vulnerability of infrastructure	Moderate	Moderate	Moderate	Moderate
Likelihood of Hazardous flood event	High	High	High	Moderate
Coping capacity	Moderate	Moderate	Moderate	Moderate
Risk level	**High**	**High**	**High**	**Moderate**

2.7 Data and Collection Methods

The PDNA of the irrigation sector limits the assessment of damaged irrigation infrastructure in order to request financial assistance. Because losses are characterized as unanticipated expenditures to fulfill emergency demands, irrigation sector agencies recoup such costs from operating and maintenance funds or transfer funds from other unspent financial votes without seeking funds. The losses incurred are indicated in the year-end expense reports. The irrigation sector agencies only investigate post-disaster needs for damaged infrastructure, which are subsequently followed by seasonal floods. Agriculture, agro-industry, social, environmental, inland fisheries, nutrition, and other cross-sectors rely on irrigation water delivery, and such sectors cannot function until damaged irrigation infrastructure is restored. As a result, the irrigation sector's priority is determined by the knowledge of the other cross-sectors, which is supplemented by irrigation infrastructure. However, the irrigation sector does not collect damage and loss information from cross-sectoral areas in the need assessment, which is a major disadvantage for prioritizing irrigation infrastructure recovery needs. Therefore, there is a need for improved communication and collaboration between the irrigation sector and other cross-sectoral areas to ensure a comprehensive understanding of the overall needs. Additionally, incorporating a system for collecting damage and loss information from these areas can greatly enhance the prioritization process for irrigation infrastructure recovery.

Presently, data is collected for assessing irrigation infrastructure damage through:

1. Field inspection by technical staff
2. Carrying out walk-through surveys with the farmer community (beneficiaries)
3. Referring to engineering drawings
4. Referring to blocking out plans (BOPs),

In addition to the above data collection methods, the following data collection methods can also be used for collecting data and information required for prioritizing irrigation infrastructure recovery related to the sectors complemented by the irrigation sector:

1. Institutional publications
2. Annual Reports
3. Corporate Plans
4. Consultation with other stakeholders and cross-sectoral agencies
5. Establishing lateral communication among cross-sectors
6. Establishing a digital platform for sharing data

Data and information compiled under different sectors, as shown in Figure 2.4, will avoid duplication.

2.8 Building Back Better Concept

The Building Back Better (BBB) concept applies to the rehabilitation and reconstruction phases following a disaster by integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, as well as the revitalization of livelihoods, economies, and the environment. This approach aims to create more resilient communities that are better equipped to withstand future disasters. BBB also emphasizes the importance of involving local communities in the planning and implementation of recovery efforts.

BBB is associated with an increase in initial reconstruction expenses. In the long run, the benefits of BBB far outweigh the costs of avoiding sporadic and ad hoc repairs. For example, in irrigation infrastructure, a lined canal will extend the life of a breached earthen canal that has fallen numerous times owing to scouring. Furthermore, BBB can also improve the overall efficiency and effectiveness of the infrastructure, leading to higher productivity and reduced maintenance costs over time. Therefore, investing in the BBB is a wise decision for any organization looking to achieve long-term sustainability and success.

Nonstructural components of BBB include improving regulations and adapting institutional arrangements, such as established digital monitoring systems, communication systems, and data collection systems, so that they may better respond to future disasters. Except for a few exceptions, all irrigation systems in Sri Lanka provide water using gravitational force, which is an irreversible process. Irrigation infrastructure operations that integrate digital measuring and communication will reduce the overuse of water, a scarce resource.

2.9 Recovery Strategy of the Irrigation Sector

The Sri Lanka Disaster Management Act No. 13 of 2005 established the Sri Lankan legal framework for disaster management and disaster resilience in the country. Further, the Government of Sri Lanka is a signatory for the implementation of the Sendai Framework for Disaster Risk Reduction. All DRR activities are formulated under the four priority areas below and follow the 13 guiding principles.

Following a hazardous event, the irrigation sector conducts a damage and loss assessment to identify and prioritize recovery needs. It is important to involve the irrigation sector and cross-cutting sector stakeholders in the prioritization process to ensure that their perspectives and needs are taken into account. Additionally, regular review and updating of the priorities can help ensure that they remain relevant and effective over time.

The irrigation sector recovery strategy, as depicted in Figure 2.5, outlines the framework of:

1. Irrigation sector priority recovery needs
2. inputs or interventions required, expected outputs, and the intended outcome;
3. recovery costs

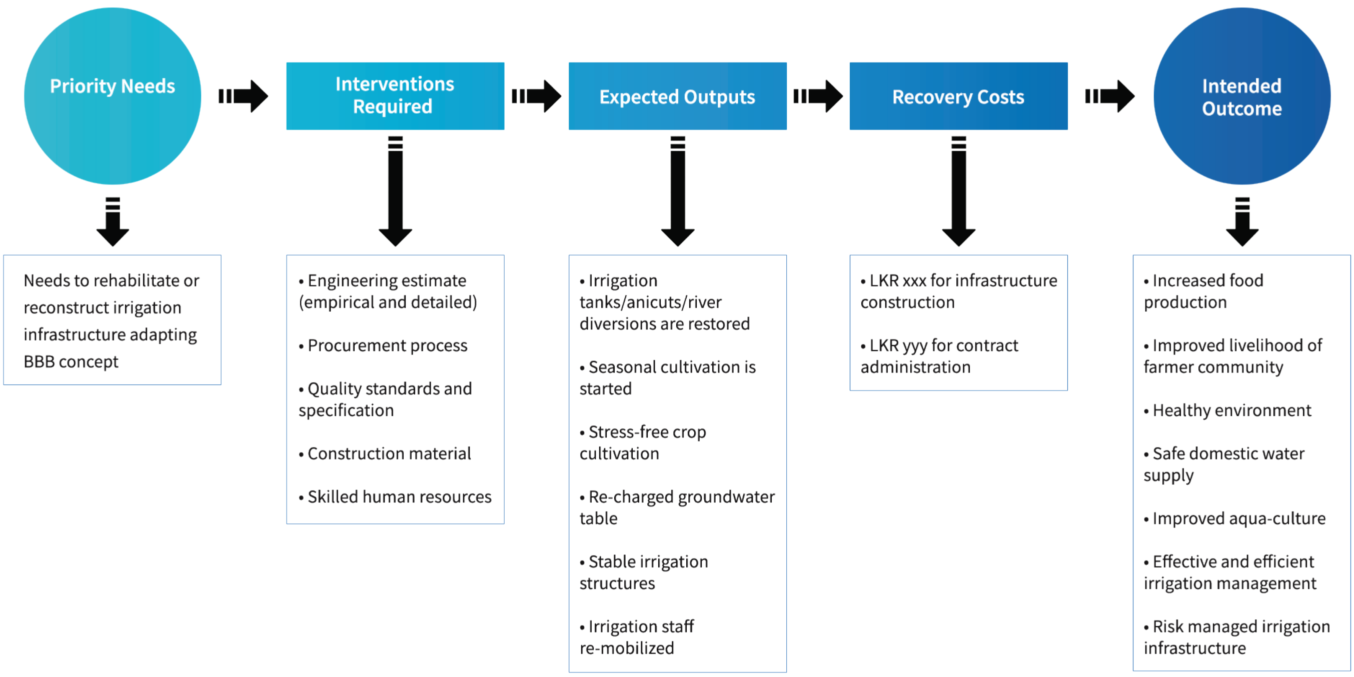


Figure 2.5 Elements of the irrigation sector recovery strategy

The recovery strategy is a crucial component of disaster management as it helps to ensure that the irrigation sector can rebuild and recover from the impacts of disasters. By providing a comprehensive framework for recovery, the strategy helps to ensure that resources are used effectively and efficiently to support long-term recovery efforts. The Recovery Strategy leads to the formulation of a detailed recovery framework that includes information on policy and institutional arrangements, financing mechanisms, and recovery monitoring and evaluation systems. The primary objective of irrigation sector recovery is to restore irrigation infrastructure and, hence, operationalize the irrigation water management system. This major objective enables the impacted farmer community and others to engage in agro-based enterprises, thereby improving their overall well-being and ensuring national food security. The recovery strategy establishes the vision for recovery and determines prioritized interventions as well as the outcomes and costs of recovery within a defined time period. The assessment leads to a comprehensive recovery framework.

The Recovery Strategy aims to accomplish the following key objectives:

1. Mobilize stakeholders towards a common purpose of irrigation sector recovery.
2. Facilitate coordination among irrigation institutions and other state agencies.
3. Establish common parameters, focusing on irrigation infrastructure.
4. Identify irrigation sector priorities based on the assessment results.
5. Establish a calendar of recovery actions.
6. Establish the guiding principles of good practice related to the irrigation sector.
7. Promote government ownership of the recovery process.
8. Promote an equity-based, participatory, and inclusive recovery process.
9. Contain the fundamentals for reducing risks and building back better.
10. Provide an estimate of the cost of recovery.
11. Provide the basis for a recovery framework that will lead to a detailed implementation plan, including specific objectives for the irrigation sector, sectoral projects contributing to the irrigation sector, and partners, among others.
12. Serve as a tool for resource mobilization with donors, including donor relations.
    It is critical to determine the methods and capacities required to restore irrigation infrastructure to its full potential in order to lead productive irrigated agriculture and creative lives for the impacted community, as well as their demands and interests, including risk protection.

The irrigation sector recovery strategies need to answer the following questions:

1. What are the main recovery needs of irrigation infrastructure that supports farmers and others involved in agro-based businesses through irrigated agriculture, as well as the community living in flood-prone areas protected by existing flood protection schemes?
2. What recovery interventions will address the aforementioned needs, and what are the overall resource requirements?
3. What recovery outputs will meet these needs, and what are the overall resource requirements?
4. Given the foregoing, what are the broad anticipated outcomes and the staging and timing required to achieve them?

2.9.1 The Elements of Recovery Needs

The examples in Box 3 illustrate that infrastructure damages cannot be judged based on the magnitude of the damage to the infrastructure, and as a result, even minor damage to the infrastructure sector can disrupt complete service delivery to the cross-sectors it supports.

Furthermore, when it comes to service delivery to other cross-sectors, each infrastructure service scheme is viewed as a unified network that cannot be divided into its components.

Box 3

The recovery needs of a sub-sector, like agriculture, can be classified based on the scale or magnitude of potential harvest damage as well as losses incurred for the re-preparation of farm beds by removing silt deposited after a severe flood hazard. Recovery needs of a sub-sector, like housing, are within the social sector and can be characterized based on the type of damage, such as partially damaged provided the undamaged section is fit for use, damaged roof, unfit for use, and so on.

The recovery needs of an infrastructure sub-sector, such as the road sub-sector, cannot be classified based on the scale or magnitude of the damage. For example, if a section of a culvert across a major road is broken after a flood, it prevents access to the township, marketplace, schools, hospitals, offices, and so on. Similarly, the same flood incident may cause damage to a lengthy length of the wearing surface, inflicting more damage but decreasing mobility.

When a small portion of the transmission line and a large portion of the distribution system of the pipe-borne water supply scheme are damaged, priority can be given to repairing the water distribution line as the damage is higher compared to the transmission line. However, until the small part of the transmission line is repaired, no water can be transmitted to the distribution system. Therefore, it is important to ensure that both the transmission line and distribution system are repaired in a timely manner to avoid any disruptions in the water supply.

Likewise In the irrigation infrastructure sector, though the entire canal system is rehabilitated, irrigation water cannot be delivered until a small repair is made to the water-controlling unit of the sluice gate of the headworks.

The PDNA classifies early recovery needs, reconstruction needs, and medium/long-term recovery needs as shown in Figure 2.6.

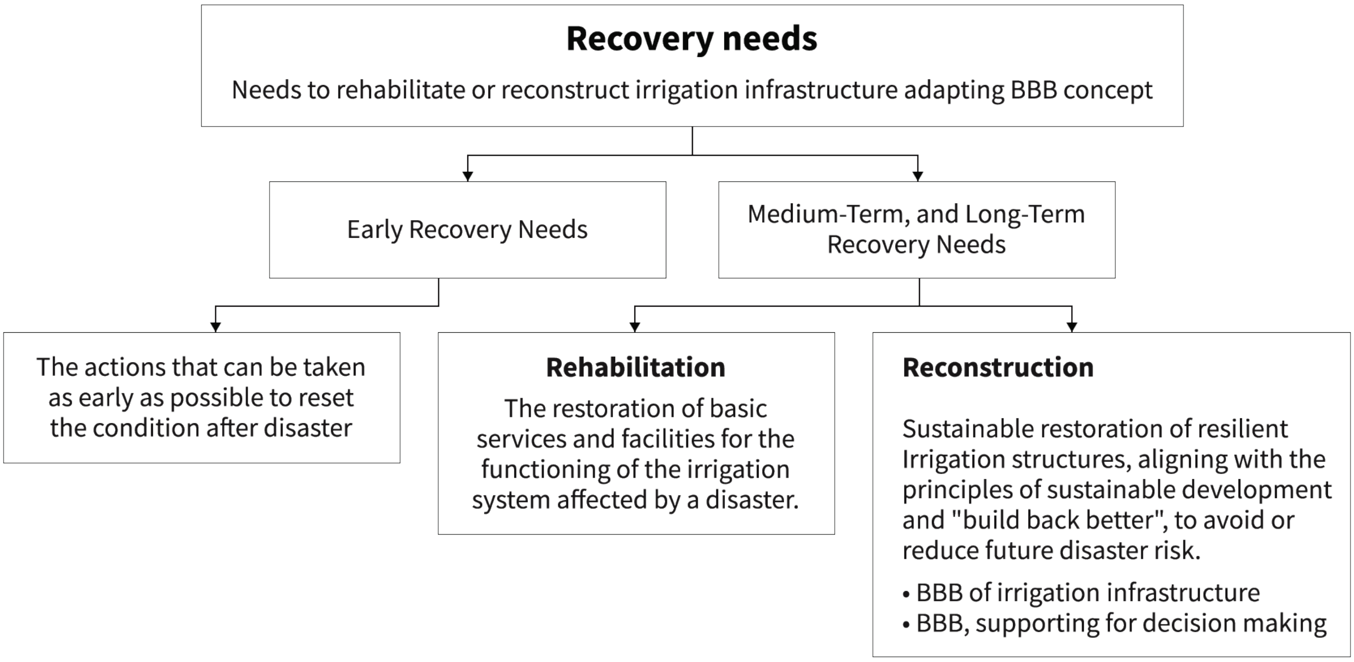


Figure 2.6 Classification of recovery needs

Based on the data provided by the DaLA as negative effects and impacts of the disasters, the PDNA procedure is used to determine recovery needs. In order for the farmer community and other stakeholders to resume farming and agro-based activities, the recovery implementation determines: (a) the delivery of irrigation water to the farm gate; and (b) the safety of the community living in a flood-prone area, as well as their properties, which are protected by a flood protection scheme, with the least amount of risk. In order to prevent or lower the risk of future disasters, the global recovery strategy also adheres to the principles of sustainable development and "Build Back Better."

Recovery activities under various phases (preparation, response, recovery, and mitigation) of the disaster management cycle, as shown in Figure 2.1, may overlap in terms of implementation.

For example, during a high flood, it appears there is an unusual water leak at the downstream embankment of a Flood Protection Dam (previous warning). Sandbags are used in the response phase to reinforce the weak embankment and take immediate protective measures. Similar sandbag placement can be used as an early recovery measure to control further damage when an irrigation canal embankment is breached without prior notice. This can be done until a permanent or semi-permanent solution is implemented. Immediate and early recovery measures include clearing sand formation at river outfalls to drain out stagnant flood water at the upstream river section and providing temporary bridges, culverts, or by-pass access to restore human mobility and transportation across an irrigation service road.

Long- and medium-term recovery encompass the processes of rehabilitation and reconstruction. The irrigation infrastructure is being repaired, restoring it at least to the level of performance it had prior to the disaster. The replacement of damaged structures is the main focus of reconstruction. To avoid or lower the risk of future disasters, the disaster recovery and reconstruction process is in line with "Build Back Better" and sustainable development principles. The disaster recovery needs are formulated into four components while adapting to the BBB concept as indicated in the international guidelines[9] .

1. The reconstruction of damaged infrastructure and physical assets
2. The resumption of (a) production complemented by irrigation infrastructure and service delivery; and (b) access to goods and services;

3. The restoration of governance and decision-making processes in the irrigation institutions
4. The reduction of disaster risk

The disaster recovery plan needs to be formulated under four components that are aligned with the irrigation infrastructure, as illustrated in Table 2.8.

Table 2.8 Recovery needs that are aligned with the irrigation infrastructure

Component	Description
Restoration of physical assets and irrigation infrastructure that have been damaged	The financial needs (or requirements) for reconstruction following disasters are determined using quantitative estimates of the destruction of irrigation structures and other physical assets that must be rebuilt and restored to the level before the disaster. The estimated values of damage, as determined empirically during the PDNA, are used to define the reconstruction needs. Private or public-sector organizations may be the owners of the destroyed assets. Then, the additional requirements associated with the "building back better" concept are added to the damage figures. Therefore, reconstruction needs are calculated as the sum of: Value of Damage + Cost of Quality Improvement +Technological Modernization + Relocation, when needed +Disaster Risk Reduction Features + Multi-Annual Inflation The quality improvement includes stability improvements (rehabilitation or replacement of the entire structure). Sometimes the location of the structure may shift (relocation). Modernized structures are introduced, adapting to advanced technology
Reinstatement of (a) production supported by irrigation infrastructure and service provision; and (b) access to goods and services	Resuming the production of goods through irrigation infrastructure means increasing costs to improve service delivery while still delivering irrigation water to the farm gate at the same level as before the disaster. The goal of restoring service delivery is to raise the standard of fundamental services to that of before the disaster or higher (delivery efficiency). This goes along with the "reconstruction" of physical assets mentioned above. Instrumentation supports making priceless and deadline-bound decisions, as well as implementation and service from experts, in the context of the irrigation sector. Both structural and non-structural supports are included. Resumption of access aims to restore access to services and goods that meet needs, considering both the increased costs for accessing goods and services for populations affected by disasters as well as the increased costs

[9] *Post-Disaster Needs Assessment Guidelines, Volume A (2013), GFDRR*

	of service providers as a result of the disaster. In addition to the irrigation structures, access to goods and services is made possible by bunds, service roads for public transportation, tractor crossings, cattle crossings, footbridges, small bridges across large canals, and others.
Restoration of the governing and decision-making processes	Restoration of governance and social processes aims to revitalize and improve: 1. irrigation institutions, other related institutions, 2. Policies, public administration, and governance procedures are crucial for the restoration of irrigation infrastructure in order to provide the community of farmers with the essential services they need to survive. It refers to the requirement for institutions in the irrigation sector to have their leadership and management capabilities restored or strengthened, including decentralized local capacities, human resources, information systems, capacity-building training, etc. The costs for the restoration of governance and social processes are calculated as follows: 1. Costs for additional human resources with improved technical skills and capacities of service providers to undertake the recovery; 2. Costs for replacing lost records and upgrading documents for the various public services; Costs for addressing governance and social cohesion issues if disrupted
Reducing Risks	In addition to estimating the need to rebuild irrigation infrastructure more effectively (which is described in the point above under the heading “reconstruction”), the cost of incorporating risk reduction measures is also estimated for the following: 1. To address immediate risks, 2. Initiatives to reduce residual risks and vulnerabilities to future disasters, such as safer infrastructure with consideration of updated hydrological parameters, hazard and risk maps, technical expertise, technologies, and practices that build resilience; 3. Preparedness capacities of the irrigation institutions and farmer institutions to manage the impact of future disasters; The additional costs to BBB of reducing risks and increasing preparedness are calculated as follows: 1. Costs for addressing immediate risks; 2. Costs for upgrading preparedness measures in the irrigation sector; 3. Costs for further studies or assessments, technologies, practices, technical expertise, etc. required to facilitate implementation of building back better approaches; 4. Cost of specific measures to strengthen disaster risk reduction

2.9.2 Vision and Guiding Principles

Stakeholder consultation results in the development of a post-disaster recovery vision, which is then incorporated into the recovery strategy. Prioritizing recovery needs requires an understanding of how the impacted area and sectors will look following the recovery process. During the consultative process, the post-disaster recovery vision is jointly developed, ensuring the Recovery Strategy has the endorsement of important stakeholders.

The vision for post-disaster recovery acts as a road map for the recovery procedure. It gives the stakeholders the broad direction and "end state" they desire to accomplish through the recovery process. The vision statement needs to be concise and comprehensively express the hopes and expectations of the nation and the affected population, as well as the changes they hope to see as a result of the recovery interventions.

The following key points are used to establish a vision for the irrigation sector's recovery.

Advantages of a Recovery Vision:

- A recovery vision enables the government to convey its recovery priorities and build national or subnational consensus around them.
- The vision becomes the starting point around which the entire recovery process will be formulated.
- The post-disaster recovery vision ensures the support of key stakeholders for the recovery strategy.

Characteristics of a vision:

- The vision usually reads as short as a single sentence.
- It results from a cohesive work of consultation and analysis to ensure that all relevant stakeholders are committed to it.
- The Recovery Vision is framed with the aim of "ensuring recovery and reconstruction programs that reinforce irrigation infrastructure resilience to disasters".
- The vision is also implicit in the goal to "reduce damage from floods and economic losses (food security) in the future".

Further, the vision shall be aligned with the outcome of the Sendai Framework for Disaster Risk Reduction for 2015–2030[10] ; in a broader sense, it calls for "substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries."

According to the DRF Guide (2020)[11] the core elements to consider when formulating a recovery vision are:

1. **Ensuring that the vision is developed at the highest level of government:** Without agreement at the highest level on the vision, it will be hard to leverage the needed resources, build up the capacities, and support the implementation of recovery.
2. **Carrying out stakeholders' consultations for a common recovery vision:** The government can invite groups of internal and external stakeholders (including reconstruction partners).
3. **Ensuring alignment with development programs:** The government's broader, longer-term development goals for the irrigation sector must be consistent with the recovery vision. By bridging both pre-existing development gaps and new development gaps brought on by the

disaster, the vision can provide a strategic continuum between pre- and post-disaster development planning.

4. **Incorporating resilience and BBB into the recovery vision**
5. **Optimizing recovery across sectors:** The recovery vision should, whenever possible, include other sectors (such as the social and agricultural sectors), as they may have been impacted by the disaster and have a part to play in recovery and reconstruction.
6. **People-focused.**

"To build improved irrigation management systems to ensure cross-sectoral needs by delivering irrigation water" can be a vision statement for the recovery of the irrigation sector. As the Irrigation Department oversees flood protection plans, the vision may be further expanded by the addition of "to protect communities affected by flood disasters."

2.9.3 Guiding Principles for Recovery

To improve the efficacy of recovery, promote coordination among stakeholders, and increase the transparency and accountability of the various actors, guiding principles for recovery are established. The principles are used in the planning and execution of the recovery interventions as well as in the overall Recovery Strategy. Prior to the PDNA, these guidelines should be established to ensure their application in the Recovery Strategy and programmatic response.

Successful disaster recovery experiences from around the world have in common the adoption of at least three crucial principles for recovery planning (DRF Guide, GFDRR, Revised Version, March 2020)[12] :

1. Converting adversity into opportunity
2. Building Back Better, and
3. Prioritizing the inclusive recovery of vulnerable groups
4. **Converting Adversity into Opportunity**

As governments and populations realize they need to be better prepared to respond to future disasters, crises can be a catalyst for change and an opportunity for the development of sustainable solutions. The affected farmer community, other interested parties, and government institutions coordinate their efforts to find the answers required for better planning by conducting walk-through surveys along the irrigation infrastructure in post-disaster contexts. The affected farmer community will benefit from the recovery plan's employment opportunities during implementation.

How does adversity become an opportunity for disaster recovery in the irrigation infrastructure?

1. It makes for a better understanding of flood risk due to the vulnerability of irrigation infrastructure faced by irrigation institutions and the farmer community;
2. It reduces the vulnerabilities of irrigation schemes in future disasters and builds the resilience of irrigation infrastructure.
3. It makes for better preparedness for the next disaster.
4. It mainstreams disaster risk management into policies, planning decisions, and legislation.
5. It prioritizes investments that could support resilient communities.
6. It realizes resilient recovery before a disaster occurs, and
7. It identifies the need for campaigns for irrigation sector agencies to highlight integrated

[10] *Sendai Framework for Disaster Risk Reduction 2015–2030, United Nations*

[11] *Disaster Recovery Framework Guide, Revised Version, March 2020. Source: GFDRR*

[12] *https://reliefweb.int/report/world/disaster-recovery-framework-guide-revised-version-march-2020*

disaster risk management practices.

8. It increases government intervention in food security through enhanced irrigation efficiency and sustainability of existing irrigation schemes.
9. It improves irrigation infrastructure and assures reliable irrigation water management practices for the farmer community and other stakeholders engaged in the agro-based industry.
10. **Building Back Better**

In Section 2.6, the BBB concept is defined. Costs for reconstruction initially rise when BBB is present. The long-term advantages of BBB far outweigh the short-term expenses by preventing sporadic and unplanned repairs. BBB also includes nonstructural aspects like policy enhancement and institutional configuration adaptation to digital monitoring, communication, and data collection methods so that these can better prepare for future disasters. BBB, through the use of the recovery of the irrigation sector, integrates disaster risk reduction measures into:

1. Restoration of irrigated agriculture;
2. Revitalization of the livelihood of the farmer community, economies, and the environment; and
3. Increased resilience of irrigation infrastructure
4. Prioritizing Inclusive Recovery for Vulnerable Groups

The agriculture industry employs almost one-third of Sri Lanka's workforce. It is estimated that communities involved in agriculture, including paddy cultivation, make up about 70% of the rural population. In 2019, the agriculture sector's share of the overall GDP was 7.4%. The contribution of women was 28.4% of this total. The irrigation system is still battling with:

1. Creation of a sustainable irrigated agriculture infrastructure sector to ensure food security that is capable of generating healthy income levels for the farmer community;
2. Providing indirect benefits to improve the livelihood of other stakeholder communities
3. Enhancing the sustainability of the surrounding eco-system by re-charging sub-surface water table; and
4. Providing direct or indirect benefits to other sectors (e.g., the drinking water sector pumping water from irrigation reservoirs, hydropower generation using irrigation water discharge, the social sector, and industry sector protection by flood protection bunds)

Due to the lack of resilience of irrigation infrastructure against seasonal flood risks, the livelihood of those who depend on irrigated agriculture, the environment, and other sectors is constantly at risk. So, irrigation infrastructure, including flood protection bunds, can be a concern in the aforementioned priority areas.

2.9.4 Prioritization of Irrigation Infrastructure Recovery Needs

Once the list of problems has been created, it should be prioritized to help the process run more smoothly. While dealing with the most important issues, the less important ones can be put on the list to be dealt with later. Prioritizing and organizing the requirements at the irrigation sector level (i.e., the national level) is crucial. Post-disaster settings are characterized at the sector level by a concentration on the needs of the irrigation sector as well as related cross-sectoral needs and scarce resources. Therefore, it is necessary to address recovery needs and the interventions that go along with them in stages, starting with the ones that are most urgent. It is acknowledged that factors like priorities at the national and local levels, technical feasibility of interventions, resource availability, and environmental factors, among others, influence how needs are prioritized. Regular stakeholder consultations at the local, state, and federal levels are advised as part of the process to be used for prioritizing and sequencing needs, as well as donor consultations if practical.

As such, some key considerations to help facilitate prioritization are:

1. To ensure that it addresses the effects and impacts of the disaster.
2. To consider the gap between the pre-disaster and post-disaster conditions
3. The key guiding principle related to irrigation infrastructure is that recovery and reconstruction protect communities engaged in farming and agro-based activities from future disaster risks.
4. It requires restoring national food security.
5. It requires reducing the risk.
6. Any other social and environmental concerns

Assessment of irrigation scheme levels is done at the operational level. Since irrigation water is delivered using gravity force in all irrigation systems (with the exception of a few lift irrigation projects), Even in lift irrigation schemes, irrigation water is lifted from the source and then transported by gravity to the farm gate. After canals pool, water is released for drainage and irrigation systems near coastal locations.

The irrigation sector is a subsector of the infrastructure sector (Figure 2.4), and it complements other sectors, particularly the agriculture sector (productive) and the community protected (including assets) from FPSs (social sector). It enhances the peasant community's standard of living through the agriculture sector and the environment sector, which represent cross-sectors. The irrigation sector assures national food security and mitigates drought at the macro level. Without restoring irrigation infrastructure, it is impossible to extend its benefits to other sectors. Therefore, it is obligatory to meet irrigation infrastructure requirements.

Table 2.9 Key considerations for prioritizing needs

Level of prioritizing	Key considerations
National level	The service provided by the irrigation sector, as measured by the area of farmland benefited and the number of farm families benefited (both factors are interrelated),At the national level, the total affected farm area of the complete irrigation sector is considered before allocating funds among irrigation institutions. Taking into account social life, flood protection schemes are given top priority. When irrigation water is delivered to farmland, nearly forty percent is used by the crop through evaporation and transpiration, while the remaining sixty percent is used by downstream water consumers and the groundwater table, which sustains the environment. Thus, environmental concerns must be appropriately acknowledged.

Irrigation scheme level	Irrigation water is stored in irrigation reservoir headworks to mitigate the impact of drought. In order to use irrigation water more efficiently, the headworks of an Anicut or a river diversion regulate irrigation water. The Headworks of Salt Water Exclusion (SWES) safeguard irrigation systems from Salt water Exclusion. As it is an irreversible process, when irrigation water is discharged from the headwork, it must be utilized by downstream users. If any canal structure close to the canal's head is damaged, irrigation water can be delivered downstream by blocking a portion of the command area and adopting temporary measures. If any canal structure close to the tail-end is damaged, irrigation water can be delivered to other areas by blocking the part of the command area and taking temporary measures. Communities residing in flood-prone areas that are vulnerable (including their assets) are protected by FPSs' headwork structures. For the safety of the headwork structure of the tanks, excess water is discharged through the spillway during extreme flood events, threatening downstream canal structures close to the valley and human settlements at downstream locations.

The above facts reveal:

1. Disaster risk recovery reduction (DRR) of headwork increases the social safety of downstream settlers, the safety of irrigation structures closes to the flood-prone area, and the communities living within the flood-prone areas protected by FPSs;

2. Disaster risk recovery of the canal system reduces the harvest losses of the command area and contributes to the food security and social livelihood of the farmer community and others whose livelihoods are supported by irrigated agriculture.

2.9.5 Interventions, Outputs, and Outcomes of the recovery strategy

The required interventions refer to the inputs and activities necessary to address the identified recovery requirements at the implementation stage (recovery strategy) and transform them into outputs. Interventions may consist of programs, initiatives, or policies that address the priority need and sustainably promote recovery. They are significant in terms of what they ultimately lead to (outcomes) and reflect what is implemented. Rebuilding a damaged structure would be an example of a high-priority recovery need, while procurement and construction are examples of critical interventions or inputs.

Recovery interventions are devised for the irrigation sector and incorporated into the Recovery Strategy, along with their implementation timelines, as well as the responsible irrigation institution and implementation partners, if any. According to international guidelines, interventions are designed for short-term (disaster events up to six months), medium-term (six to eighteen months), and long-term (eighteen months to five years) recovery timeframes. However, according to the current government strategy, it will take at least a year to disburse the funds. In selecting interventions, it is essential to evaluate their impact on the affected farmer community and other stakeholders, as well as their implementation feasibility, including government and donor support and political implications, among others. Outputs are the specific goods and services that result from the processing of inputs via recovery activities. Therefore, outputs pertain to the conclusion (rather than the execution) of activities and are the sort of outcome over which managers have a great deal of control. The intended outcomes are the actual or intended changes in calamity conditions that the recovery interventions are designed to facilitate. Table 2.10 illustrates an example of an infrastructure recovery strategy for irrigation systems.

Table 2.10 Priority needs, interventions, outputs, costs, and outcomes

Priority Needs	Interventions / Inputs Required	Expected Outputs	Recovery Costs	Intended Outcomes
Rehabilitation of spillway of irrigation tank Water storage at the full supply level Assured water deliveries to the farmer community Successful seasonal cultivation without water stress Recharged ground water table Re-commissioned domestic water supply scheme Optimized unmanaged risk Irrigation system operationalized	Engineering estimate incorporating BBB concept Quality standards and specification Procurement process following NPA guidelines Construction material, machinery, Construction Administration Removing obstacles for flood water storage Exposure to flood hazards	Restoration of irrigation tank Seasonal cultivation started by 100 farmer families Stress-free Irrigated water received by 100 ha of farmland Safe drinking water received by 100 families Safe environment. Re-charged Garden wells and agro-wells Stable spillway Re-mobilized Irrigation staff	LKR xxx for spillway construction LKR yyy for contract administration	Increased food production and ensure food security The improved livelihood of the affected farmer community and poverty reduction Healthy community in terms of safe water Improved quality of domestic activities benefitted from recharged dug wells Improved domestic agriculture benefitted from recharged agro-wells Risk-managed irrigation scheme Sustainable environment

2.10 Recovery Costs

After identifying recovery priorities and their corresponding interventions, outputs, and final intended outcomes, costs are calculated. As shown in Table 2.8, costs are typically calculated for each of the expected outputs and intended outcomes included in the recovery strategy.
The PDNA team initially estimates the cost of outputs for the irrigation infrastructure on an empirical basis. Several interventions can meet the requirements of other sectors. By supplying irrigation water, a crucial input for agricultural production, the irrigation infrastructure sector has been a facilitator for the agriculture sector. The proposed interventions, outputs, and expenditures are primarily geared towards the irrigation infrastructure sector and the agricultural productive sector. In addition, the social sector requirements are met by the irrigation infrastructure. Since the recovery costs are limited to components of the irrigation infrastructure development, there will be no double tally. During the assessment and planning phases, the various sector teams must communicate to facilitate sector coordination. The unit cost of replacement and contract administration costs can be utilized to estimate recovery and reconstruction costs. The unit cost is the agreed-upon cost of a cost schedule used by irrigation institutions for development planning. In addition, there would be a standard unit cost increase to account for improved construction or risk reduction measures. In practice, additional items are included in the estimate of recovery to enable the reconstruction of improved or risk-reduction measures.

The international guidelines stipulate the following considerations that should be made in estimating costs for building a better

1. The costs for BBB should be proportionate to the costs of recovery and reconstruction needs based on the impact of the disaster.
2. The costs for BBB should be realistically compared to the financial envelope pledged by the government and international development partners since most funds will be needed for physical reconstruction and compensation for losses.
3. The costs for BBB should be realistic based on the absorption capacity of the country and what is feasible to achieve over 3 years.

2.11 Recovery Strategy

The Recovery Strategy contains a description of the implementation provisions, including the following essential elements:

1. Partnerships, coordination among irrigation institutions and cross-sectors, and management
2. Cross-cutting themes;
3. Links to development
4. Resource mobilization;
5. Key assumptions and constraints

2.11.1 Partnerships, Coordination, and Management

The irrigation sector's recovery strategy describes critical partnerships between the National Planning Department, the Budget Department, the Disaster Management Center, and UN agencies. There must be coordination between twelve (12) irrigation agencies. In addition to soil investigations and hydraulic modeling, the Irrigation Department is responsible for updating structural design guidelines, hydrological design guidelines, and soil investigation guidelines. The Irrigation Department and the Meteorology Department are working together to share climate data. The Mahaweli Authority of Sri Lanka holds monthly sector coordination meetings (Water Panel) with all other stakeholder agencies benefiting from the river Mahaweli and other irrigated agricultural areas declared under MASL (such as the Uda-Walawe irrigation scheme across the river Walawe).

Under each irrigation scheme, farmer organizations are established and participate in seasonal cultivation meetings or project management committee meetings (for irrigation projects). All irrigation systems' field canals are maintained and operated by peasant organizations. Farmer organizations have been given permission to carry out small-scale construction projects for their respective irrigation systems using a single source selection method. Participation of farmer organizations in walk-through surveys with irrigation sector personnel to prioritize regular and post-disaster rehabilitation and reconstruction efforts Farmer organizations manage the system operations of all minor irrigation schemes administered by DAD and PIDs. This participatory approach enhances farmer dedication and coordination.

Each irrigation institution is responsible for the management arrangements for the recovery process. Each of the twelve (12) irrigation institutions is recognized for the engineering construction of the institution-managed irrigation infrastructure. ID and MASL are responsible for all of the main irrigation engineering designs.

The Recovery Policy outlines the essential planning and policy considerations that must be integrated into the DRF. This will include the recovery's guiding vision, principles, prioritization of recovery activities, best practices, and associated critical results.

In addition to the coordination among the institutions of the irrigation sector, there are connections between other sectors that necessitate intersectoral cooperation. For instance, the irrigation sector may necessitate the repair or reconstruction of irrigation infrastructure, which may impact the livelihoods of the social sector if the reconstruction process generates paid employment. Consequently, each sector must exchange its findings with the others and jointly determine inter-sector connections. This requires collaborating with teams from other sectors to develop coherent recovery interventions. This process would be facilitated by the coordination team, which has access to all sector assessment reports and can identify areas for collaboration.

2.11.2 Cross-cutting Themes

Since the irrigation infrastructure sector complements other sectors, disaster risk reduction is the central theme of disaster management and recovery. In addition, re-establishment of the irrigation sector's governance is a requirement for recovery. The environmental aspects of the irrigation industry are discussed in terms of groundwater recharge and aquaculture. Enhanced agricultural productivity impacts gender, employment, and subsistence. Moreover, the reconstruction phase creates employment opportunities for the surrounding community.

2.11.3 Links to Development

The Recovery Strategy would be useful for outlining how the recovery process could link up with and support the country's development goals and priorities. The irrigation sector recovery strategy, in collaboration with the agriculture productive sector, is directly linked with the national food security program, which is a broader strategic development objective of the national government.

2.11.4 Resource Mobilization

The preponderance of resources that support a country's recovery are mobilized in accordance with the recovery strategy. Under this strategy, a resource mobilization endeavor would be able to secure funds for the irrigation sector's recovery program. Since national resources are insufficient to meet the identified requirements, identifying a donor partner is a crucial component of the strategy. Following the fulfillment of the PDNA and the recovery strategy in accordance with international best practices, such an event could be organized. The donor's goals and objectives, as well as the strategy for resource mobilization, should be debated and determined by the government with the assistance of the PDNA Team. Under the direction of the government and the National Coordination Team, the donor conference could be organized. The strategy for resource mobilization should include advocacy and communication to raise awareness among policymakers, potential donors, key population groups, the media, and other stakeholders deemed essential audiences.

2.11.5 Key Assumptions and Constraints

1. The PDNA identifies the key assumptions that were made in order to complete the recovery process, as well as the main obstacles that are likely to be encountered during the recovery process and how they can be overcome. Among the principal assumptions are the following: Irrigation institutions would be a part of the recovery process and participate in it.
2. There would be no new disaster affecting the irrigation sector.
3. Irrigation institutions' administrative capacities would be able to incorporate the recovery into their functional and technical capacities;
4. As part of the recovery support, resources would be allocated to improve the functional and technical capacities of local agriculturists.

Chapter 3 Preparation of Irrigation Sector PDNA

3.1 Introduction

The PDNA is an internationally recognized process that was devised with the assistance of UN agencies and international donor partners, among others, by compiling a vast amount of disaster management experience. As and when the President of the country declares a disaster on his or her own or with the advice of the National Council for Disaster Management (NCDM), or for an intensive type of disaster, PDNA is carried out as a government-led process for all affected sectors. As a severely affected infrastructure sector, the irrigation sector shall initiate the PDNA and recovery planning process. The preparation section of the PDNA includes the main outputs listed in Table 3.1:

i. Brief situation analysis
ii. Preparation of the PDNA plan

Table 3.1 Core outputs of the PDNA

Core Outputs	Description
Brief Situation Analysis	Write a brief situation analysis report providing an update on the disaster situation, including: Key data collected from a rapid assessment carried out by the field staff, available meteorological data, and past data about rehabilitation, among others; Consultations with all key stakeholders; Irrigation institutions' ability and capacity to provide leadership and technical and logistical support for the conduct of the PDNA and the requirement of hired staff
The PDNA plan (Based on standard PDNA content, adapted to local situation and agreed with government)	Scope of the PDNA: • Objectives of the PDNA: • Sectors and cross-cutting themes to be assessed by the PDNA, and the criteria for identification of the themes; • Geographic areas to be assessed • PDNA timeframe; • PDNA work plan. PDNA management arrangements: • Management structure and composition, especially of the Divisional Recovery Team, Institutional Coordination Team, and National Coordination Team, report writing, among others

3.2 Output 1: Brief Situation Analysis Report

The concise summary of the situation analysis includes the outcomes of the interviews, desk review, consultations, and capacity evaluation. Depending on the extent of the damage, the report may include the following sections:

1. The impact of the disaster on the irrigation infrastructure
2. Affected geographic areas, particularly those most affected;
3. Major post-disaster consequences;
4. Urgent needs requiring attention in the PDNA;
5. The inter-relationship within each irrigation institution, among irrigation institutions, and how overlaps may be addressed, as well as priority cross-cutting themes such as environment, risk reduction, and governance;
6. Information gaps that need to be filled;
7. Current and planned needs assessments and planning exercises;
8. Potential mechanisms for consultation;
9. Overview of current and planned response actions;
10. Current and potential funding available for the PDNA and/or recovery

3.3 Output 2: The PDNA Plan: Terms of Reference

The situation analysis constitutes the basis for developing the PDNA Plan. This plan outlines all the arrangements necessary to undertake a successful PDNA:

The PDNA defines:

1. The scope of the PDNA
2. The timeframe,
3. Management structure
4. Technical support and report writing

Each of these elements of the plan is outlined below.

3.3.1 Defining the Scope of a PDNA

The situation analysis will allow each irrigation institution to define the PDNA's scope and objectives. The situation analysis describes:

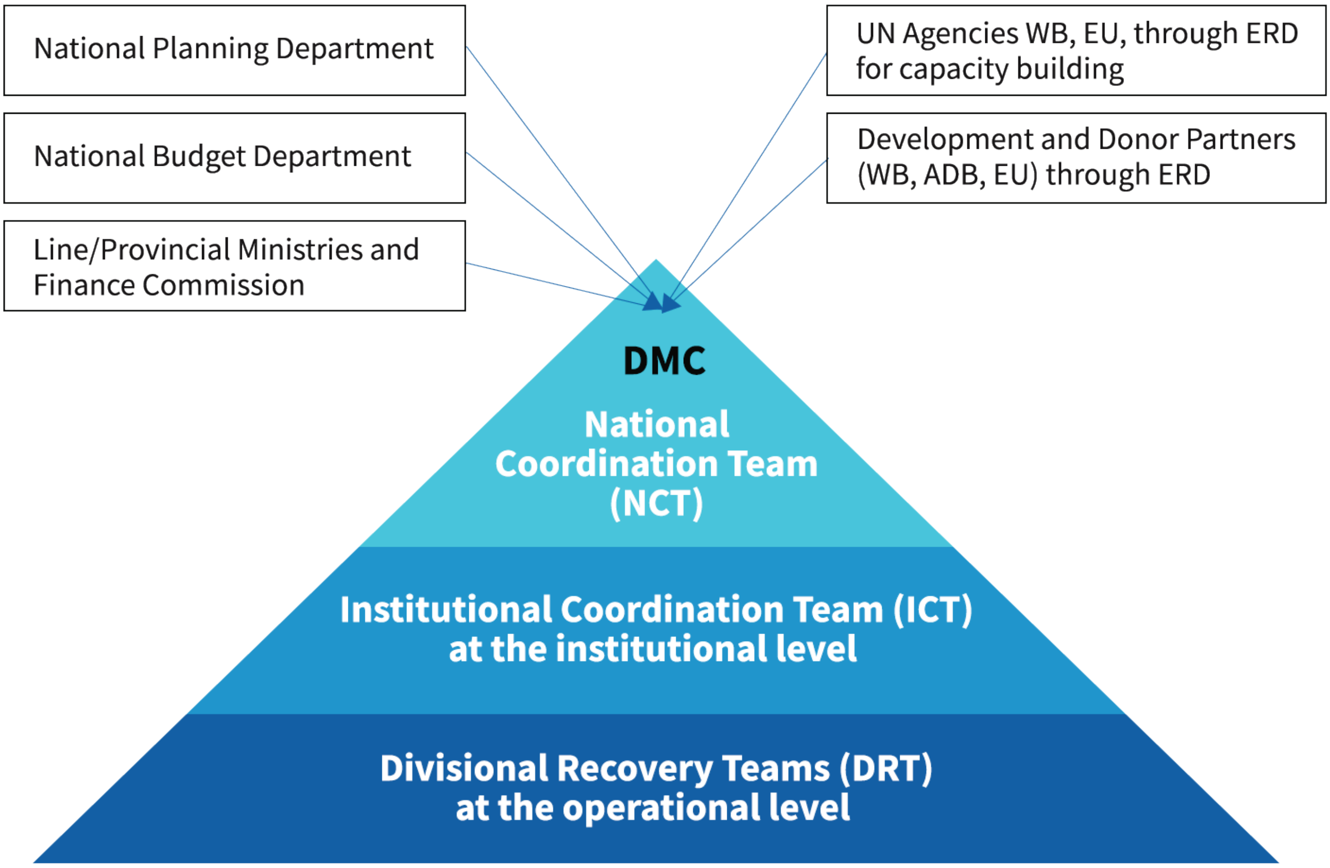
1. the cross-sectors to be included in the assessment;
2. the irrigation schemes and their geographical locations to be evaluated in accordance with official decisions;
3. the stakeholder organizations and individuals who would be involved in the assessment; and
4. the timeline for initiating and completing the PDNA.

The Time Period: The duration of a PDNA varies based on the scope and magnitude of the disaster, as well as other variables such as the availability of personnel and other resources. The conduct of the PDNA should be guided by the principle of timely delivery of the assessment.

3.3.2 The PDNA Management Structure

In designing the management structure, the teams representing the various levels of the management hierarchy should consider the pre-disaster and post-disaster coordination and management mechanisms that each irrigation institution already employs. Insofar as feasible, the management structure should be based on existing national capabilities, maximizing the utilization of available and experienced national and sector experts and government personnel. Figure 3.1 illustrates the proposed organizational structure.

Figure 3.1 Proposed management structure for disaster recovery



The Divisional Recovery Team (DRT): This team is comprised of operational-level engineers, engineering assistants, technical officers, and other field auxiliaries, such as drawing office assistants for the irrigation institutions. Each institution establishes DRTs at the division, district, or block level (the lowest operational level). Each DRT is assigned a focal point. Since disaster management is a cyclical process, the phase of disaster preparation occurs prior to the onset of monsoon rainfall. Therefore, it is recommended to form divisional recovery teams at the pre-monsoon meeting and to continue them as a routinely operating team, revolving members as needed.

The Institutional Coordination Team (ICT): This team is comprised of senior officers with the authority to coordinate all operational-level divisions. Each irrigation institution has the ability to establish an ICT. A focal point is designated as the institution's representative. As described, it is recommended to form the Institutional Coordination Team at the pre-monsoon meeting and to continue it as a regularly functioning team while changing its members as needed.

The National Coordination Team (NCT): A prominent representative of the government agency responsible for recovery and reconstruction leads the National Coordination Team. The DMC shall notify the main ministries of irrigation institutions as well as the ministries of provincial councils and local governments and invite irrigation institutions to participate in PDNA activities. The National Coordination Team of the DMC will direct cooperation and coordination within the PDNA. The DMC is the national agency charged with recovery and reconstruction, and the DG (DMC) shall be authorized to command the National Coordination Team.The twelve (12) irrigation institutions responsible for irrigation in Sri Lanka (ID, MASL, DAD, and the nine (9) PIDs) currently operate as separate entities, despite achieving the same objective in irrigation system operations and management, including system rebuilding and new development. A coordination mechanism that draws together all agencies for irrigation decision-making is not currently available. It is the responsibility of ministries that directly oversee irrigation institutions to facilitate this arrangement.

The DMC is Sri Lanka's primary agency for disaster management and is charged with implementing and coordinating national and sub-national-level programs to reduce disaster risk with the participation of all relevant stakeholders. Mitigation Research and Development, Planning Preparedness, Early Warning Dissemination for the Vulnerable Population, Emergency Response, and Coordination of Relief and Post-Disaster Activities in Collaboration with Other Key Agencies are the main activities of the DMC. In addition, disaster management committees were established in all district secretariats, divisional secretariats, and Grama Niladhari divisions (village headman divisions) throughout the nation. Nevertheless, this administrative network currently facilitates the public by coordinating other state agencies at the district level and below. The recovery plan containing national-level development proposals shall be coordinated and evaluated by a state agency tasked with coordinating the national development program rather than at the district level. Recommendation: The DMC should be strengthened as the national coordinating agency to coordinate twelve (12) irrigation institutions at the planning and implementation level with the NPD, NBD, and ERD as the national development plan's decision-making agencies.

The Disaster Management Center (DMC): The Sri Lanka Disaster Management Act No. 13 of 2005 was passed on May 13, 2005, and the DMC was established on August 1, 2005, in accordance with the Act. The Act mandated the establishment of two significant institutions, namely the National Council for Disaster Management (NCDM) and the Disaster Management Centre (DMC), under the National Council for Disaster Management (NCDM) as the lead agency on disaster risk management in the country in implementing NCDM's directives. This Act also establishes a framework for disaster risk management in Sri Lanka and takes a holistic approach to disaster management, resulting in a transition from response-based mechanisms to a proactive approach to disaster risk management.

The DMC is primarily responsible for the implementation of the National Disaster Management Plan and the National Emergency Operation Plan in accordance with the Act.

i. Ensuring that the various disaster management plans prepared by ministries, government departments, or public corporations conform to the National Disaster Management Plan;

1. Preparing and implementing programs and plans for disaster preparedness, mitigation, prevention, relief, rehabilitation, and reconstruction activities, and coordinating organizations that implement such programs and plans and obtain financial assistance from the Treasury for such activities; and a.
2. issuing instructions and guidelines to appropriate organizations, non-governmental organizations, district secretaries, and divisional secretaries regarding activities related to disaster management and initiating and implementing work programs in coordination with these organizations and secretaries.

Technical Support Functions: The PDNA requires assistance with a number of essential functions. Among them is technical support for essential functions like logistics procurement, information and communication technology (ICT), data compilation and management, geographic information system (GIS) and mapping, logistics arrangements, administration, financing, interpretation and translation, etc. Each irrigation institution is required to provide this assistance through its general and technical administration.

Report-Writing Function:

A key outcome of the PDNA is the report, which contains a recovery strategy and sector analysis. However, each irrigation institution and its members of the Institutional Coordination Team (ICT) are responsible for drafting the report. The final report will be written under the direction of senior National Coordination Team (NCT) members.

1. Compile and edit all institutional chapters;
2. Draft the overall PDNA report.
3. Incorporate irrigation institution feedback and complete the PDNA Report and Recovery Strategy.

Intervention of stakeholder agencies: The ERD will convene an internal meeting of UN agencies and development partners (typically the UN Office, EU, ADB, and World Bank) and government agencies. Representatives of the PDNA National Coordination Team will participate in the consultation meeting and define the objectives and roles of development partners within the coordination team and the respective sector teams. The NCT seeks assistance in resource sharing, including human (technical support), logistical, and financial resources. As this is a government-led process, the NBD will pay for the assessment, with assistance from development partners as required. In preparation for the assessment, the government may consult with UN agencies and development partners on the scope of the irrigation sector assessment, cross-sectoral requirements complemented by irrigation infrastructure, and other logistics.

Monitoring and evaluation (M&E): The progression of the PDNA and recovery process is monitored and compared to the expected outcomes. The ICTs conduct M&E at the institutional level, whereas the NCT is responsible for M&E at the national level. The duration is determined as necessary.

3.3.3 Roles and responsibilities of the PDNA Teams in the irrigation sector

A summary of the roles and responsibilities of each team is illustrated in Table 3.2.

Table 3.2 Roles and responsibilities of PDNA Teams

Coordination and Recovery Teams	Primary role and Responsibilities
National Coordination Team	Primary role: To coordinate with twelve (12) irrigation institutions and national-level decision-making agencies (NPD, NBD, and ERD) to more effectively manage irrigation infrastructure disasters through a clear comprehension of the roles and responsibilities of each stakeholder. It provides strategic direction for the PDNA at the national level in order to facilitate the provision of necessary resources and the realization of PDNA objectives by holding the following responsibilities: • To provide overall strategic direction for the PDNA. • To coordinate with institutional coordination teams • maintains communication and coordination with counterparts at the national level and with donor groups in the country. • Ensure the generation of a technically accurate and strategically sound PDNA report with comprehensive participation from key stakeholders. • Approve the draft and final report of the PDNA and Recovery Strategy for government submission and validation. • To lead and support the facilitation of resource mobilization for the Recovery Strategy's implementation, including inclusion in revised appeals and the organization of donor support.
Institutional Coordination Team	Primary role: To manage the PDNA planning, implementation, and coordination, as well as the development of the Recovery Strategy at the institutional level, by assuming the following responsibilities: • Arranging all preparations to support the PDNA (logistics, human resources, etc.); • supporting and facilitating the PDNA orientation and training workshop when the Divisional Recovery Team arrives; • Conduct training workshops for the Divisional Recovery Team by defining the objectives and expected results of the PDNA, the guiding principles, geographic areas, and cross-sectors to be coordinated, the methodology applied, and information collection instruments, as well as all other necessary arrangements; • To ensure a coordinated and consistent approach throughout the entire PDNA process, including field visits; • To ensure that all PDNA principles are accepted and adhered to; • To manage the budget, resources, work plan, and timeline of the PDNA;

	• To organize a consultation process for developing the recovery strategy; to ensure the necessary cross-sectoral, theme-based, and area-based consultation and analysis to provide a solid basis for the prioritization of recovery strategies across sectors; • Manage and supervise the drafting, validation, and final revision of the PDNA Report; • Coordinate with the National Coordination Team; • draft the recovery strategy for their respective irrigation institutions.
Divisional Recovery Team	Primary role: Responsible for implementing the PDNA and developing the divisional recovery plan. • To compile and integrate data on the effect and impact of disasters in accordance with the PDNA and Recovery Guide; • to choose the method of data collection; • To collect baseline field data and ancillary data as outlined in the PDNA and Recovery Guide; • To collect any other necessary primary data; • To process and analyze data and assessment results; • To write the unit assessment reports, including the proposed priority recovery requirements;

3.4 Arrangements for the PDNA execution

As soon as the need for a PDNA is confirmed, preparations should be made, particularly in the following areas:

1. Human resource arrangements
2. logistics arrangements
3. The budget and resource mobilization
4. The PDNA's training provisions

The necessary arrangements for each of these preparatory procedures are described.

Human Resource Arrangements: Personnel needs must be determined for the Divisional Recovery Teams, the Institutional Coordination Team, for technical support and report writing, as well as for government ministries or the National Coordination Team (as proposed), which may require additional support.

The irrigation sector PDNA would necessitate irrigation specialists identified by each irrigation institution. In addition to the methodology and scope of the assessment, personnel requirements are also determined by these factors. For instance, the number of field surveyors required to conduct on-site investigations of damaged structures In addition to sector-specific needs, personnel may also be required to assist with coordination, management, etc. Utilizing retired irrigation industry professionals is more convenient. Staff who may be required to support the PDNA process should receive adequate training in capacity-building.

Logistical Arrangements: Logistical considerations include office infrastructure or a functional location for PDNA personnel and management, the required transport and travel arrangements for conducting the PDNA, including tools and instruments required for field surveys, procurement, ICT, and similar arrangements. The extent of logistical support required depends on the magnitude of the disaster and the size of the afflicted area, as well as their accessibility and distance from the PDNA teams' central location.

For local transportation, logistical arrangements must be made. The government sector employs local drivers because they are familiar with local access roads. Other logistical considerations include communications, office apparatus and supplies, and provisions for data acquisition, translation, interpretation, printing, and distribution, as well as editing and formatting. These arrangements fall under the purview of individual irrigation institutions. Digitalized, updatable, pre-disaster baseline information shall be made available.

The PDNA Budget and Mobilizing Resources Estimating the PDNA's resource requirements and mobilizing the necessary resources to conduct the task is a significant undertaking. At this point, organizations are responsible for covering their participation costs. However, the next phase, the PDNA, necessitates an influx of resources. The department of the national budget should evaluate the following major budget lines and costs:

1. Human resources, management, and coordination needs;
2. Logistical arrangements;
3. Training/workshop expenses;
4. Consultative and planning activities;
5. Workshops, meetings, and conferences
6. Administration.

The PDNA Training: Training in the Development of Pre-Disaster Baseline Information, PDNA and Recovery Strategies, and the Disaster Recovery Framework are the three primary training sessions that enhance the capacity of the staff of irrigation institutions and other stakeholder agencies involved in the disaster management process. Each training session for a new group of senior officials from all twelve irrigation institutions, including NPD and NBD, will last approximately one and a half days. Such training sessions shall be incorporated into the institution's annual training program. The effectiveness of training sessions organized by one irrigation institution for the participants of other institutions will be enhanced by the participants' ability to share their sector-wide expertise. In addition, a one-day training program comprising the four modules listed below has been developed and made available.

- Module 1: Disaster Recovery Methodology
- Module 2: Preparedness for Recovery
- Module 3: Assessment of Post-Disaster Needs
- Module 4: Recovery Strategy Development Based on Post-Disaster Need Assessment

Given the diversity of participants in the PDNA, it is essential to organize a team-wide session to debate and agree upon a common strategy and work plan. The institutional coordination team may organize and lead a half-day workshop as a refresher session. The workshop would provide participants with an introduction to the PDNA methodology. It is possible to utilize pre-prepared training materials on the PDNA process, such as pre-disaster baseline data, damage and loss evaluation, recovery strategy, etc. prioritizing

3.5 Data collection and analysis

Desk review: In order to initiate the data collection process, the Divisional Recovery Team must collect and analyze quantitative baseline data regarding past enhancements to the irrigation infrastructure in question. Additionally, the team accumulates supplementary information regarding the command area, farmer families who benefit from the irrigation scheme, and the community protected by FPSs. This data helps to define the country's pre-disaster conditions and also provides the quantitative foundation for comparing pre- and post-disaster conditions. Preparedness and regular updates of pre-disaster baseline data reduce response time. The Divisional Secretariat can provide access to social data.

Primary data collection through field assessment The operational staff of the irrigation institutions, including engineers, engineering assistants, technical assistants, field assistants, water delivery and operation staff, and representatives of agricultural organizations, collects data on damage and loss. The irrigation field staff's familiarity with irrigation water management and construction activities qualifies them to carry out this task. In addition to the collection of secondary data, field visits are planned to acquire and validate the data. In addition, the farmer organizations have been in close and consistent contact with the irrigation personnel, and the validation procedure is straightforward. However, such a system has not been implemented for FPSs.

Prioritizing needs: The service provided by the irrigation sector is determined by the interrelated extent of farmland benefited and the number of agricultural families benefited. Locally damaged irrigation infrastructure decreases the farmers' income and consequently affects their ability to sustain themselves. Additionally, agricultural communities are indirectly impacted. These demands are evaluated by the social sector in order to organize relief services. The irrigation infrastructure's water storage or water regulation stabilizes the subsurface water table, thereby stabilizing the downstream environment. These effects are accounted for as cross-sectoral requirements in the social sector. As a subsector of the infrastructure sector, the irrigation sector prioritizes infrastructure restoration for its requirements. This is consistent with the "rehabilitation of irrigation infrastructure" section of the national development plan. However, if the recovery of damaged infrastructure is supported by the requirements of its complementary sectors, such as the agricultural economy, the restoration of rural livelihoods, and environmental sustainability, economic returns on rehabilitation investments are enhanced. Since all irrigation institutions operate as distinct entities, the National Coordination Team can conduct an assessment at the sector level.

Data analysis and compilation: After the field visits and desk evaluation have been completed, the PDNA team will need to consolidate, analyze, and interpret the collected data. Damages to the irrigation infrastructure are quantified by analyzing the cost of recovery. Restoring Back The PDNA's primary focus is on improving concepts. The loss information is analyzed in monetary terms and factored into the budget. Since the irrigation sector complements other sectors by providing irrigation water storage, regulation, and delivery, cross-sectoral data increases the importance of infrastructure requirements for irrigation. In addition, FPSs provide protection for humans, industries, transportation, and the environment, among others. to identify intersectoral connections and issues. The macroeconomic and human development data will then be aggregated, if available. This analysis is crucial to the success of the PDNA because it transforms data into credible and compelling evidence that informs national decision-makers and international donor partners about the recovery of the irrigation sector.

3.6 Formulating an irrigation sector recovery strategy

The Recovery Strategy is a component of the PDNA and its primary objective. This section provides a concise summary of the procedure followed to develop the Recovery Strategy. The Institutional Coordination Team facilitates the development of the Recovery Strategy under the supervision of the National Coordination Team.

The steps to developing the Recovery Strategy are as follows:

1. Define the vision for irrigation sector recovery and the strategy for recovery actions within the irrigation sector;
2. Define clear objectives and interventions that point the way to expected results and help in defining the timeframe;
3. Define the priority of needs.
4. Define the cost of the recovery process;
5. Conduct stakeholder consultations with the national level (NPD, NBD, ERD, DMC), international agencies (UN agencies, donor partners), and irrigation institutions to present the Recovery Strategy and validate the priorities and needs of the recovery and reconstruction roadmap.

The core elements included in a Recovery Strategy are summarized in Table 3.3.

Table 3.3 Core elements included in the recovery strategy

Recovery Needs	Vision & Guiding Principles	Recovery Plan	Implementation Arrangements
The outline of recovery needs to be based on the results of the PDNA: • For reconstruction of damaged irrigation infrastructure and physical assets • For resumption of: (a) production complemented by the irrigation infrastructure, and service delivery; and (b) access to goods and services • For restoration of governance and decision-making	The agreed vision aligned with National development goals and guiding principles for the overall recovery process.	Outline of the results-based recovery plan: • Priority needs; • Interventions required; • Expected outputs; • Recovery Costs; • Intended outcomes	Outline of the arrangements for successful implementation of the Recovery Roadmap: • Partnerships, coordination among irrigation institutions and cross-sectors, and management; • Cross-cutting themes; • Links to development; • Resource mobilization; • Key assumptions and constraints

processes

- To reduce risk and
build back better

3.6.1 Drafting PDNA Report and Recovery Strategy

Once the PDNA is finalized and the Recovery Strategy is approved, it is the National Coordination Team's responsibility to consolidate the recovery plans produced by each irrigation institution. It is proposed that the team designated by the National Coordination Team compile recovery strategy reports prepared by each irrigation institution and finalize them as chapters of a single report that includes a sector summary.
For feedback and substantiation, the first draft should be shared with irrigation sector institutions and national-level state agencies (NPD, NBD, ERD, and DMC). This is essential not only for cross-checking and validation but also for reiterating the government's stewardship of the PDNA, the recovery strategy process, and the outcomes. All feedback should be incorporated into the final validated report, which should then be printed. The team designated by the National Coordination Team and endorsed by the National Government should complete the report on-site. The report should provide an integrated and coherent presentation of all assessment results and the recovery strategy. It should guarantee quality and reflect the agreements reached between the government and donors. This report is essential for resource mobilization and any donor conference that may be planned as part of the strategy to mobilize resources.

3.6.2 Towards a Recovery Framework

The framework for recovery discusses institutional arrangements, financial mechanisms, and implementation procedures. Through the development of a recovery framework, the recovery strategy developed during the PDNA exercise provides the basis for more comprehensive recovery planning. The Recovery Framework extends stakeholder engagement and the recovery planning process well beyond the PDNA by building on the PDNA's broad strategy.
It is suggested that the PDNA be conducted as efficiently as feasible in order to maximize its utility in guiding recovery. The relatively brief duration of the assessment does not permit a detailed recovery planning exercise, and the majority of constraints (such as the available financing envelope) cannot be determined until after the assessment results are known.

Annex 1: Sample Template: Pre-Baseline Information including provisions for damage assessment

1. General Information

1	**Technical and Service Information**		
	Name of the Scheme		
	Type		
	Category	**(Major/Medium/Minor)**	
	Command area (ha)		
	Capacity (for Tank in MCM)		
	Beneficiaries	**Farmer families/families protected by FPS**	
	Functionality at present	**Fully/Partially/Not - Functioning**	
	Any other details (if required)		
2	**Administrative Information**		
	Managing Agency		
	Name of the Scheme National-level coordination by		
	Regional Administration by		
	The operation, maintenance, and construction Division		
3	**Topographical Information**		
	Coordinates (GPS/Metric/Tank)		
	Operational division of Engineer or DTO of DAD		
	Province		
	District		
	DS Division		
4	**Hazard Information**		
	Occurrence of extreme flood events	**Year**	**Month**
	Observed Peak-Flood	**Below HFL/ Between HFL and BTL/Above BTL**	

2. Major Tank

Pre-Disaster Baseline Data: Guiding Tool for Damage Assessment							Post-Disaster Damage Assessment				
Structural Components				Rebuilding Cost (Pre-Disaster)			Post Disaster Damage				
				Unit	Functionality (Good/Average/Poor)	Cost (LKR)	Unit	Damage	Functionality (G/A/P)	Guesstimated Cost (LKR)	Remarks
1	**Major Tank**										
	1.1	**Headworks**									
		1	Bund	1 km							
		2	Riprap	1 km							
		3	Bund Road	1 km							
		4	Spill	01 No							
		5	Sluice-RB	01 No							
		6	Sluice-LB	01 No							
		7	Other structures	01 No							
	1.1	**Conveyance System**									
	1.2.2	**Main Canal**									
		1	Main Canal RB (Lined)	1 km							
		2	Main Canal LB (Lined)	1 km							
		3	Main Canal RB (Earthen)	1 km							
		4	Main Canal LB (Earthen)	1 km							
		5	Main Canal service road RB (Gravel)	1 km							

		6	Main Canal service road RB (Asphalt)	1 km							
		7	Main Canal service road LB (Gravel)	1 km							
		8	Main Canal service road LB (Asphalt)	1 km							
		9	Retaining walls (Concrete)	25 m							
		10	Retaining walls (RR Masonry)	25 m							
		11	Retaining walls (Gabion)	25 m							
		12	Regulators	01 No							
		13	Turn out structure	01 No							
		14	Bridges	01 No							
		15	Siphons	01 No							
		16	Bathing steps	01 No							
		17	Over crossings	01 No							
		18	Under crossings	01 No							
		19	Drainage outlets	01 No							
		20	Side spill ways	01 No							
		21	Other structures	01 No							
	1.2.2	**Branch Canal**									
		1	Branch Canal RB (Lined)	1 km							

		2	Branch Canal LB (Lined)	1 km							
		3	Branch Canal RB (Earthen)	1 km							
		4	Branch Canal LB (Earthen)	1 km							
		5	Branch Canal service road RB (Gravel)	1 km							
		6	Branch Canal service road RB (Asphalt)	1 km							
		7	Branch Canal service road LB (Gravel)	1 km							
		8	Branch Canal service road LB (Asphalt)	1 km							
		9	Retaining walls (Concrete)	25 m							
		10	Retaining walls (RR Masonry)	25 m							
		11	Retaining walls (Gabion)	25 m							
		12	Regulators	01 No							
		13	Turn out structure	01 No							
		14	Bridges	01 No							
		15	Siphons	01 No							
		16	Bathing steps	01 No							
		17	Over crossings	01 No							

		18	Under crossings	01 No							
		19	Drainage outlets	01 No							
		20	Side spill ways	01 No							
		21	Other structures	01 No							
	1.2.3	**Distribution Canals**									
		1	D Canal (Lined)	500 m							
		2	D Canal (Earthen)	500 m							
		3	Service Road	500 m							
		4	Turn out structures	01 No							
		5	Drop Structures	01 No							
		6	Other Structures	01 No							
	1.2.4	**Field Canals**									
		1	F Canal (Lined)	500 m							
		2	F Canal (Earthen)	500 m							
		3	Service Road	500 m							
		4	Turn out structures	01 No							
		5	Drop Structures	01 No							
		6	Other structures	01 No							

3. Medium Tank

Pre-Disaster Baseline Data: Guiding Tool for Damage Assessment							Post-Disaster Damage Assessment				
Structural Components				Rebuilding Cost (Pre-Disaster)			Post Disaster Damage				
				Unit	Functionality (Good/Average/ Poor)	Cost (LKR)	Unit	Damage	Functionality (G/A/P)	Guesstimated Cost (LKR)	Remarks
2	**Medium Tank**										
	2.1	**Headworks**									
		1	Bund	1 km							
		2	Riprap	1 km							
		3	Bund Road	1 km							
		4	Spill	01 No							
		5	Sluice-RB	01 No							
		6	Sluice-LB	01 No							
		7	Other structures	01 No							
	2.1	**Conveyance System**									
	2.2.2	**Main Canal**									
		1	Main Canal (Lined)	1 km							
		2	Main Canal (Earthen)	1 km							
		3	Main Canal service road (Gravel)	1 km							
		4	Main Canal service road (Asphalt)	1 km							
		5	Retaining walls (Concrete)	25 m							

		6	Retaining walls (RR Masonry)	25 m							
		7	Retaining walls (Gabion)	25 m							
		8	Regulators	1 No							
		9	Turn out structure	1 No							
		10	Bridges	1 No							
		11	Siphons	1 No							
		12	Bathing steps	1 No							
		13	Over crossings	1 No							
		14	Under crossings	1 No							
		15	Drainage outlets	1 No							
		16	Side spillways	1 No							
		17	Other structures	1 No							
	2.2.3	**Distribution Canals**									
		1	D Canal (Lined)	500 m							
		2	D Canal (Earthen)	500 m							
		3	Service Road	1 km							
		4	Turn out structures	1 No							
		5	Drop Structures	1 No							
		6	Other Structures	1 No							
	2.2.4	**Field Canals**									
		1	F Canal (Lined)	500 m							
		2	F Canal (Earthen)	500 m							
		3	Service Road	500 m							

		4	Turn out structures	1 No							
		5	Drop Structures	1 No							
		5	Other Structures	1 No							

4. Minor Tank

Pre-Disaster Baseline Data: Guiding Tool for Damage Assessment							Post-Disaster Damage Assessment				
Structural Components				Rebuilding Cost (Pre-Disaster)			Post Disaster Damage				
				Unit	Functionality (Good/Average/ Poor)	Cost (LKR)	Unit	Damage	Functionality (G/A/P)	Guesstimated Cost (LKR)	Remarks
3	**Minor Tank**										
	3.1	**Headworks**									
		1	Bund	1 km							
		2	Riprap	1 km							
		3	Bund Road	1 km							
		4	Spill	01 No							
		5	Sluice-RB	01 No							
		6	Sluice-LB	01 No							
		7	Other structures	01 No							
	3.2	**Distribution Canals**									
		1	D Canal (Lined)	100 m							
		2	D Canal (Earthen)	100 m							
		3	Service Road	500 m							
		4	Turn out structures	1 No							
		5	Drop Structures	1 No							
		6	Other Structures	1 No							

	3.3	**Field Canals**										
		1	F Canal (Lined)	100 m								
		2	F Canal (Earthen)	100 m								
		3	Service Road	500 m								
		4	Turn out structures	1 No								
		5	Drop Structures	1 No								
		6	Other Structures	1 No								

5. River Diversion Scheme (Trans-basin Canal)

Pre-Disaster Baseline Data: Guiding Tool for Damage Assessment							**Post-Disaster Damage Assessment**					
Structural Components				**Rebuilding Cost (Pre-Disaster)**			**Post Disaster Damage**					
				Unit	**Functionality (Good/Average/ Poor)**	**Cost (LKR)**	**Unit**	**Damage**	**Functionality (G/A/P)**	**Guesstimated Cost (LKR)**	**Remarks**	
4	**River Diversion**											
	4.1	**Headworks**										
		1	Diversion weir	1 No								
		2	Regulator RB	1 No								
		3	Regulator LB	1 No								
		4	Flank Bunds	500 m								
		5	Other structures	1 No								
	4.2	**Conveyance System**										
	4.2.2	**Main Canal**										
		1	Main Canal (Lined)	1 km								
		2	Main Canal (Earthen)	1 km								

		3	Main Canal service road (Gravel)	1 km							
		4	Main Canal service road (Asphalt)	1 km							
		5	Retaining walls (Concrete)	25 m							
		6	Retaining walls (RR Masonry)	25 m							
		7	Retaining walls (Gabion)	25 m							
		8	Regulators	1 No							
		9	Turn out structure	1 No							
		10	Bridges	1 No							
		11	Siphons	1 No							
		12	Bathing steps	1 No							
		13	Over crossings	1 No							
		14	Under crossings	1 No							
		15	Drainage outlets	1 No							
		16	Side spillways	1 No							
		17	Other structures	1 No							
	4.2.3	**Branch Canal**									
		1	Branch Canal (Lined)	1 km							
		2	Branch Canal (Earthen)	1 km							

		3	Branch Canal service road (Gravel)	1 km							
		4	Branch Canal service road (Asphalt)	1 km							
		5	Retaining walls (Concrete)	25 m							
		6	Retaining walls (RR Masonry)	25 m							
		7	Retaining walls (Gabion)	25 m							
		8	Regulators	1 No							
		9	Turn out structure	1 No							
		10	Bridges	1 No							
		11	Siphons	1 No							
		12	Bathing steps	1 No							
		13	Over crossings	1 No							
		14	Under crossings	1 No							
		15	Drainage outlets	1 No							
		16	Side spillways	1 No							
		17	Other structures	1 No							
	4.2.4	**Distribution Canals**									
		1	D Canal (Lined)	500 m							
		2	D Canal (Earthen)	500 m							
		3	Service Road	500 m							
		4	Turn out structures	1 No							

		5	Drop Structures	1 No							
		6	Other Structures	1 No							
	4.2.5	**Field Canals**									
		1	F Canal (Lined)	500 m							
		2	F Canal (Earthen)	500 m							
		3	Service Road	500 m							
		4	Turn out structures	1 No							
		5	Drop Structures	1 No							
		6	Other Structures	1 No							

6. Anicut (Diversion Weir)

Pre-Disaster Baseline Data: Guiding Tool for Damage Assessment							**Post-Disaster Damage Assessment**				
Structural Components				**Rebuilding Cost (Pre-Disaster)**			**Post Disaster Damage**				
				Unit	**Functionality (Good/Average/ Poor)**	**Cost (LKR)**	**Unit**	**Damage**	**Functionality (G/A/P)**	**Guesstimated Cost (LKR)**	**Remarks**
5	**Anicut**										
	5.1	**Headworks**									
			Regulator Structure	1 No							
			Gates	1 No							
			Flank Bunds	100 m							
			Turn-out structure RB	1 No							
			Turn-out structure LB	1 No							
			Other structures								

	5.2	**Conveyance System**									
	5.2.2	**Main Canal**									
		1	Main Canal RB (Lined)	100 m							
		2	Main Canal RB (Earthen)	100 m							
		3	Main Canal LB (Lined)	100 m							
		4	Main Canal LB (Earthen)	100 m							
		5	Main Canal service road RB (Gravel)	100 m							
		6	Main Canal service road RB (Asphalt)	100 m							
		7	Main Canal service road LB (Gravel)	100 m							
		8	Main Canal service road LB (Asphalt)	100 m							
		9	Retaining walls (Concrete)	25 m							
		10	Retaining walls (RR Masonry)	25 m							
		11	Retaining walls (Gabion)	25 m							
		12	Regulators RB	1 No							
		13	Regulators LB	1 No							

		14	Turn out structure	1 No							
		15	Bridges RB	1 No							
		16	Bridges LB	1 No							
		17	Siphons RB	1 No							
		18	Siphons LB	1 No							
		19	Bathing steps	1 No							
		20	Over crossings RB	1 No							
		21	Over crossings LB	1 No							
		22	Under crossings RB	1 No							
		23	Under crossings LB	1 No							
		24	Drainage outlets RB	1 No							
		25	Drainage outlets RB	1 No							
		26	Side spillways RB	1 No							
		27	Side spillways LB	1 No							
		28	Other structures	1 No							
	5.2.3	**Distribution Canals**									
		1	D Canal (Lined)	100 m							
		2	D Canal (Earthen)	100 m							
		3	Service Road	100 m							
		4	Turn out structures	1 No							
		5	Drop Structures	1 No							

		6	Other Structures	1 No							
	5.2.4	**Field Canals**									
		1	t F Canal (Lined)	100 m							
		2	F Canal (Earthen)	100 m							
		3	Service Road	100 m							
		4	Turn out structures	1 No							
		5	Drop Structures	1 No							
		c	Other Structures	1 No							

7. Flood Protection Schemes (FPS), Salt Water Exclusion Schemes, River Bank Protection, and Buildings

Pre-Disaster Baseline Data: Guiding Tool for Damage Assessment							Post-Disaster Damage Assessment				
Structural Components				Rebuilding Cost (Pre-Disaster)			Post Disaster Damage				
				Unit	Functionality (Good/Average/ Poor)	Cost (LKR)	Unit	Damage	Functionality (G/A/P)	Guesstimated Cost (LKR)	Remarks
6	**Flood Protection Schemes**										
		1	Pump house	1 No							
		2	Pumps	1 No							
		3	Flood Bund	1 km							
		4	Drainage Canals	1 km							
		5	Flood Control Regulators Regulators	1 No							
		6	Drainage Structures	1 No							
		7	Retaining Walls (Concrete)	25 m							

		8	Retaining Walls (Masonry)	25 m							
		9	Retaining Walls (Gabion)	25 m							
		10	Other structures	1 No							
7	**Salt Water Exclusion Schemes**										
		1	Sea water Control Regulators	1 No							
		2	Flood Bunds	100 m							
		3	Drainage Canals	100 m							
		4	Drainage Structures	1 No							
		5	Retaining Walls (Concrete)	25 m							
		6	Retaining Walls (Masonry)	25 m							
		7	Retaining Walls (Gabion)	25 m							
		8	Other structures	1 No							
8	**River Bank Protection**										
		1	Retaining Walls (Concrete)	50 m							
		2	Retaining Walls (Masonry)	50 m							
		3	Retaining Walls (Gabion)	50 m							
		4	Sheet Piling	50 m							
		5	Other structures	1 No							

9	**Buildings**										
		1	Residential Units	1 No							
		2	Office Units	1 No							
		3	Field Units	1 No							
		4	Any other	1 No							

Annex 2: Sample Templates for Loss Assessment

The following data shall be included in the pre-disaster baseline information for future use

Type of Loss	Possible temporary measures (Irrigation sector)	Anticipated expenses for taking temporary measures (LKR)		
		Imminent a hazardous event	During a hazardous event	Followed by a disaster
a. Cost incurred for re-establishing governance and decision-making processes	Rectifying interruption to a communication network and other internal utility services		√	
	The formalizing decision-making process to arrange operational works	√	√	
	Hiring transport, machinery, and equipment for emergency operations	√	√	√
	Expert consultation including hiring additional staff			

b. Re-opening of disrupted access to goods and services	Providing temporary access by rehabilitating damaged sections of by-pass Providing temporary transport as necessary Making temporary arrangements to provide irrigation water deliveries (e.g. providing coffer dams) Making temporary arrangements to close a breached part of a spillway, anicut, or any other structure to re-start service delivery		√ √ √ √	√ √ √
c. Reducing the potential risk that may increase	Public awareness by starting early warning (preparedness stage) Placing sandbags where unusual seepage appears to control damages (response phase) Placing sandbags at either side of breached sections (dams, canal bunds) to control further damages as an early recovery (recovery phase) Cleaning sand barriers formed at sea-outfall of rivers to drain out stagnant upstream flood water (response phase) Cleaning debris stuck between piers of canal/river structures to reduce upstream floods (response phase)	√ √	√ √ √ √ √	 √ √ √ √
Subtotal				
Total High Operational Cost (imminent+ during+ followed by)				

Annex 3 Sample Template: Cross-Sectoral data support for prioritizing needs

The following data shall be included in the pre-disaster baseline information for future use

	Damage/Loss	GN Division	Extent/No	Sector	Sub-sector
1	Damaged paddy area (Ha)			Productive	Agriculture
2	Damaged non-paddy area (Ha)			Productive	Agriculture
3	Loss of harvest (or potential loss)			Productive	Agriculture
4	Affected paddy mills			Productive	Industry
5	Affected agro-industries			Productive	Industry
6	Interruption to safe water (provided water source is irrigation scheme)			Infrastructure	Water supply
7	Interruption to electricity (provided water source is irrigation scheme)			Infrastructure	Electricity
8	Obstruction to Public transport (provided public road aligned over-irrigation bund)			Infrastructure	Transport
9	Environmental damage (depletion of water table, pollution of environment)			Social	Environment
10	Damaged houses of the farmer community			Social	Social Services
11	Affected farmer families			Social	Social Services
12	Affected males, females, and disabled persons in farmer families			Social	Social Services
13	Affected school children of farmer families			Social	Education

Annex 4 Ancillary data

The following data shall be included in the pre-disaster baseline information for future use

	Type of Ancillary data	Description
1	Potential financial strategies for recovery	The financial resources used to recover from previous natural disasters may be repurposed to meet current requirements. Possibility of incorporating recovery requirements with ongoing development funds may aid in meeting immediate recovery needs
2	Information on development policies and strategies for recovery	From the recovery planning phase to the recovery implementation phase, information on recovery policies, procedures, standing orders, emergency operation plans, national disaster management plans, and international guidelines is useful.
3	Expenditure incurred in the past	The documentation of previous construction activities will provide the recovery planning team with a clear picture of the construction history of the irrigation infrastructure.

Tool Kit for executing the PDNA process for the irrigation infrastructure sector

1. Sample TOR: For PDNA

1 Background

The Disaster Event and Characterization of Impact

A brief description of the disaster effects and the available preliminary impact figures.

This should include the irrigation infrastructure sector and complementing sectors and geographic areas, urgent needs and priorities, vulnerable irrigation structure, current and planned responses of the irrigation institutions, Government, and International partners

The role of line ministries, DMC for the assessment

If available, include a description of the disaster risk typology of the affected area and any information about previous/recent disaster events

2 Objectives of the Assessment

The primary objective of the PDNA is to assist irrigation institutions, national-level government institutions (NPD, NBD, ERD, and DMC), in-country representatives of UN agencies, and potential donors in assessing the impact of hazardous events and defining a strategy for recovery, including its financial costs: (a) to complete rehabilitation and reconstruction of irrigation infrastructure; (b) to restore irrigation water deliveries that will reestablish farmer livelihoods; and (c) to restore irrigation water deliveries that will reestablish agricultural production.

The specific objectives of the PDNA could be as follows are:

i Assess the damage and loss of irrigation infrastructure (including FPSs) caused by extreme climate events in order to develop a recovery strategy and early, medium, and long-term recovery and reconstruction requirements with costs and a timeline according to a predetermined sector format.

ii Ensure that recovery strategies incorporate concepts of disaster risk reduction, "building back better", environmental concerns, governance, gender, employment, and livelihood issues.

iii Estimate the overall impact of the hazardous event on the irrigation infrastructure that supports social protection, national economic development, and affected cross-sectors.

iv Recommend and define a strategy for Disaster Risk Management in the country by prioritizing needs

3 Deliverables of the PDNA

i A damage and loss report of the irrigation infrastructure caused by effects and impacts of hazardous events following a pre-agreed format by sector institutions and national-level decision-making institutions including DMC

ii A recovery strategy with early medium- and long-term needs by costs and timeline for the irrigation sector

iii A disaster risk management strategy adapting the Building Back Better concept

4 Coordination of the PDNA

The PDNA exercise will be led by the Government of Sri Lanka under the oversight of the NPD, NBD, ERD, DMC, Irrigation Institutions, and relevant line ministries. The PDNA is coordinated by National Coordination Team:

- The National Coordination Team will be formed with a team of technical experts representing NPD, NBD, ERD, DMC, Irrigation Institutions, relevant line ministries, and the Finance Commission. The DMC is recommended as the focal point of the National Coordination Team.
- The National Coordination Team supported by in-country representatives from the United Nations (UN) System, and donor partners will provide overall direction to the PDNA.

The Institutional Coordination Team of each irrigation institution performs institutional-level coordination.

5 Methodology for the Assessment

- The methodology adheres to international best practices for the assessment of the irrigation infrastructure damages and losses followed by seasonal extreme flood events.
- The methodology will include a comprehensive assessment of the effects and impact of the disaster from the irrigation scheme (including FPSs) to the state level, combining complementary impacts of agriculture sector productivity, the livelihood of farmer community, and others engage with agro-base industries representing the social sector and financial aspects of the effects of the disasters.
- The assessment will take into consideration early recovery requirements as well as longer-term rehabilitation and reconstruction needs.
- The assessment includes the identification of increased residual disaster risk of irrigation infrastructure and taking engineering measures to control the unmanaged risk.
- The assessment includes the identification of the capacity of irrigation staff and farmer organizations and taking management measures to strengthen the capacity of stakeholders
- The assessment will update the pre-disaster baseline information established on a common and digital format as agreed by all irrigation institutions incorporating newly observed data caused by the disaster.

The assessment will have the following phases:

i. Training phase:

A day workshop was organized and facilitated by the Institutional Coordination Team to enhance the capacity of the Divisional Recovery Team.

ii. Preparatory and Desk Review Phase:

The desk reviews will be carried out to analyze and compile all available baseline information for the irrigation sector, identify gaps in baseline data, and to also identify various data sources for the collection of both baseline and damage and losses data.

iii. Field Visits:

To update gaps in past data, collect present damage and loss data. The operational staff of the irrigation institutions including engineers, engineering assistants/technical assistants, field assistants, water delivery and operation staff, and representatives of farmer organizations will participate.

The team also collects ancillary data about the command area, farmer families benefiting from the irrigation scheme, and the community protected by the FPSs.

Social data can be collected from the Divisional Secretariat.

iv. Data Analysis and Development of sector reports:

The Field visit will be followed by a review and analysis of the data by Institutional Coordination Teams to prepare the draft institutional reports including impact, damage, losses, and needs.

- Costing of recovery analyzing damaged data of the irrigation infrastructure adapting the Building Back Better concept is the prime concern of the PDNA. The loss data is analyzed in monetary terms and incorporated for budgeting.
- Cross-sectoral data enhance the priority of irrigation infrastructure needs since the irrigation sector complements other sectors by providing irrigation water storage, regulation, and delivery.
- FPSs provide human protection, industry protection, transport protection, and environmental protection, among others. to identify linkages and issues that cut across sectors.
- The macroeconomic and Human development data will then aggregate subject to availability.

v. Final consultations and Report writing:

The Coordination Teams consolidate the reports and elements of the irrigation infrastructure of the Recovery Strategy produced by the respective irrigation institution, aided by the writer(s) and editor.

It is proposed to compile recovery strategy reports prepared by each irrigation institution and finalize them as chapters of one single report including sector summary by the team appointed by the National Coordination Team (Recommended national coordinating agency).

2. Sample TOR: National Coordination Team

1 Composition

Senior managers of NPD, NBD, ERD, and DMC (director-level Officers), line Ministries of the irrigation institutes and the Ministry of Provincial Councils and Local Government (Additional Secretary to director-level officers), Heads of Irrigation Institutions with Institutional Coordination Team leaders, and a representative of the Finance Commission are the key members. DG (DMC) is the team leader.

Decision-making support functions should include high-level representations that include NPD, NBD, ERD, DMC, line ministries of irrigation institutions, the Finance Commission, and Irrigation Institutions, specialists. The areas of expertise and the number of staff needed will depend on the context of the disaster.

2 Primary role

To coordinate with twelve (12) irrigation institutions and national-level decision-making agencies (NPD, NBD, and ERD) to manage irrigation infrastructure disasters more effectively through a clear understanding of the roles and responsibilities of individual stakeholders. Compiling institutional reports to make a consolidated single

3 Key Activities

i. To arrange capacity-building programs for the institutional staff who handled the disaster management activities (the trained staff may be transferred within or outside the organization from time to time) to maintain the ability to handle the disaster recovery process, including risk management and crisis management.

ii. To provide overarching central guidance and support services to keep the recovery program on its planned course.

iii. To ensure relatively quick delivery of reconstruction deliverables and meeting targets.

iv. To evaluate the recovery needs with the national development plan

v. To review the priorities, they need to be evaluated by the institutions focused on contribution to the national economy, social impact, environmental impact, and risk reduction.

vi. To coordinate with national agencies (NPD, NBD, and ERD), line ministries, the finance commission, heads of ID, MASL, and DAD, and representatives of each provincial institution for finalizing the implementing phase of the recovery program, specifying short-term, medium-term, and long-term activities.

vii. Compiling institutional reports to make a consolidated single report, including separate chapters for each institution

4 Reporting

The National Coordination Team will report to the government.

3. Sample TOR: Institutional Coordination Team

1 Composition

The Institutional Coordination Team consists of senior engineers who have the authority to coordinate all operational-level units, an accountant, and an information management officer as key officers.

Institutional Coordination Team functions at the regional or district level should include specialists in Engineering Planning and Design, Procurement, information management, and report writing. The areas of expertise and the number of staff needed will depend on the context of the disaster.

2 Primary role

To manage the PDNA planning, implementation, and coordination and the development of the Recovery Strategy at the institutional level.

3 Key Activities

i Engineering planning & Design (Engineers):
To supervise Divisional Recovery Team while assessing the stability of critical structures affected by disaster and proposing risk-minimized rehabilitation/reconstruction adapting the BBB concept

ii Procurement (Engineers): Purchasing office supplies and equipment that may be needed to support the PDNA Team

iii Finance (Accountants): providing financial services to support the payment of local staff, locally-contracted consultants, and governmental per diems, as necessary

iv Information management support (Information Management Officer):
To make available GIS services, manage the PDNA virtual workspace, facilitate the collection and processing of PDNA digital data, and support the drafting of the PDNA Report (A separate TOR is given below)

v PDNA Report writing (Engineer)
To write PDNA report at the irrigation institutional level and coordinate with the head of the institution and National Coordination Team

4 Reporting

The Institutional Coordination Team reports to the head of the irrigation institution and participates in National Coordination meetings with the head of the institution.

4. Sample TOR: Information Management Specialist

1 Composition

Information Management Units including GIS operations, organizational web portals, and other ICT activities are functioning and operating at each government organization. The required service for disaster operations can be obtained from IM units after conducting an awareness program.

The IM specialist would participate as a member of the Institutional Coordination Team.

2 Primary role

For compiling, maintaining, and updating the PDNA information included in the pre-disaster baseline information, Damage and Loss assessment data, cross-sectoral data, and other ancillary data and information. Handling GIS data as necessary

3 Coordination

i Establish partnerships and coordinate with key information stakeholders, identify information systems, and collect information of relevance to the PDNA from local, district level, regional level, and national officials.

ii Coordinate with other institutional teams as required to ensure common procedures that facilitate data collection and processing.

iii Participate in Institutional Coordination Team meetings

4 Day-to-day Tasks

i In collaboration with stakeholders, compile information on recent surveys and assessment

ii Provide GIS mapping support to the PDNA as needed

iii Coordinate the preparation of meeting materials (background documents, maps, data, etc.)

iv Manage contact lists and facilitate the sharing of data and information among the National Coordination Team, Institutional Coordination Team, Divisional Recovery Team, and cross-sectoral focal points

v Participate in PDNA training workshops and lead in training components of information management such as the use of the pre-disaster baseline data and damage and loss assessment

5 Reporting

The IM specialist would report to the head of the Institutional Coordination Team

5. Sample TOR: Divisional Recovery Team

1 Composition

The Divisional Recovery Team consists of operational-level engineers, engineering assistants and technical officers, and other field assistants, including drawing office assistants and Agriculture Research and Production Assistants of the DAD, as key members.

Divisional Coordination functions at the operational level should include specialists in engineering operations, field investigating, damage and loss assessment, contract and construction administration, drawing office work, data and information collection and compilation, and report writing. The areas of expertise and the number of staff needed will depend on the context of the disaster.

2 Primary role

To carry out the PDNA and prepare the divisional-level recovery plan.

3 Key Activities

i Engineering operations (Engineers):

To lead the Divisional Recovery Team by assigning duties and allocating resources while assisting the Coordination Team. Assessing the stability of damaged structures affected by disaster and proposing risk-minimized rehabilitation or reconstruction, adapting the BBB concept

To take immediate precautions during the relief phase and early recovery measures (short-term) during the response phase.

To carry out damage and loss assessments with team staff

To make engineering judgments about the damaged irrigation structures during the damage assessment phase

To guide team staff in preparing detailed engineering estimates after receiving financial resources and carrying out the procurement process

To implement a medium- or long-term recovery program by supervising the Divisional Recovery Team.

ii Field investigation, damage, and loss assessment (Engineering Assistants/Technical Officers):

To carry out a preliminary investigation of damaged structures during the PDNA period.
To collect data and information from farmer organizations (In DAD, this is the responsibility held by the Agriculture Research and Production Assistants),

To prepare an initial empirical estimation during the PDNA period.

To prepare detailed engineering estimates

To supervise construction, including rehabilitation and reconstruction.

iii Drawing Office Operations (Drawing Office Assistants):

To prepare engineering drawings and quantification

4 Reporting

The Divisional Recovery Team reports to the head of the irrigation institution and the Institutional Coordination Team

6. Schedule for the PDNA

	PDNA Activities	Dates
1	Mobilize sector teams	
2	Orientation Training on PDNA methodology	
3	Data collection and field visits	
4	Data analysis and initial findings	
5	Needs assessments and prioritization	
6	Draft irrigation institution reports submission to National Coordination Team	
7	Consultative meeting with national-level decision makers, and Institutional Coordination Team, to finalize the damage and need assessment, recommendations on recovery strategy, etc.	
8	Presentation of the irrigation sector findings to the Government (NPD)	

7. Sample Template 1: PDNA Report (Guide for completing this section is provided at the end)

Part 1: PDNA Assessment Report

1 Name of the Irrigation Institution

2 Participants in PDNA

3 Period of PDNA

4 Executive Summary

5 Introduction

i Overview of the irrigation infrastructure
ii Purpose of the PDNA
iii Main Objective of the PDNA
iv Specific Objectives of the PDNA
vi Implementation Arrangements for starting the recovery process

6 Assessment of Disaster Effect

i General description of the disaster event, its geographical scope, and affected sectors.
ii Effects on irrigation infrastructure and physical assets
iii Disruption to:
- production complemented by the irrigation infrastructure, service delivery; and

- access to goods and services

iv Effects on governance and decision-making processes

v Effects on Risks and vulnerabilities

7 The total value of the effects of the disaster

i Value of total/partial destruction of infrastructure and assets

ii Value of changes in production complemented from the irrigation infrastructure, service delivery

Value of changes to providing access to goods and services

iii Value of changes to re-establishment governance and decision-making processes

iv Value of changes to reduce Risks and vulnerabilities

8 Assessment of disaster impact

This section summarizes in qualitative terms the impact of the disaster based on the assessment of the disaster effects, the sector development plans, lessons from past experiences, and the emerging concerns that derive from the events.

i Macro-economic impact

ii Human development impact

9 Cross-Sectoral linkages

The irrigation sector, being classified as a sub-sector of the infrastructure sector, complements other sectors, mainly the agriculture sector (productive) and the community protected (including assets) from FPSs (Social sector).

i Agriculture sector

ii Social Sector

iii Other Infrastructure sectors

8. Sample Template 2: Recovery Strategy (Guide for completing this section is provided at the end)

Part 2: Recovery Strategy

1 Executive Summary

2 Introduction

Recovery vision and guiding principles

i Vision

ii Guiding Principles

3 Reconstruction and recovery needs including Build Back Better

Regional Basis: Irrigation Department, PID (Northern), PID (Eastern)

System Basis: Mahaweli Authority of Sri Lanka

District Basis: Other PIDs and DAD

NB. Cross-cutting issues, such as gender, age, etc., are to be considered under each heading where appropriate.

a) To repair or rebuild damaged infrastructure and physical assets: b) to restore to pre-disaster levels; and c) BBB for the reconstruction of infrastructure and physical assets where appropriate.

i Short-term needs
ii Medium-term needs
iii Long-term needs

The resumption of:

- production complemented by the irrigation infrastructure, service delivery; and
- access to goods and services
  Incorporating BBB where appropriate

i Short-term needs
ii Medium-term needs
iii Long-term needs

Re-establishment of governance and decision-making processes, incorporating BBB where appropriate

i Short-term needs
ii Medium-term needs
iii Long-term needs

To mitigate risks and vulnerabilities to future disasters incorporating BBB where appropriate

i Short-term needs
ii Medium-term needs
iii Long-term needs

4 Irrigation sector recovery strategy

Priority Recovery Needs	Interventions	Recovery Costs			Expected Outputs	Intended Outcomes
		Short Term	Medium Term	Long Term		
i						
ii						
iii						
iv						

5 Implementation Arrangements

i	Partnerships, coordination, and management arrangements to implement recovery
ii	Monitoring and evaluation
iii	Resource mobilization mechanisms
iv	

6 Assessment Methods

9. A brief guide for completing the template for the PDNA and recovery strategy report

Part 1: PDNA Assessment Report		
1	**Introduction**	
	i	Overview of the irrigation infrastructure: Pre-disaster baseline information provides such information as it includes information on sources and key documents used to determine pre-disaster conditions. Description of the Infrastructure and physical assets Description of benefits extended to the agriculture sector and agricultural community Risks and vulnerabilities of irrigation infrastructure, including existing preparedness plans Description of existing Governance and decision-making processes
	ii	Purpose of the PDNA. The purpose should include: Statement on the desired long-term recovery outcome in the sector (vision)
	iii	Main Objective of the PDNA. Refer section 1.7
	iv	Specific Objectives of the PDNA. Refer section 1.7
	v	Implementation Arrangements for Starting the Recovery Process (Detailing Resources, Forming Teams, etc.)

2	**Assessment of Disaster Effect**	
		General description of the disaster event, its geographical scope, and affected sectors
		Effects on irrigation infrastructure and physical assets: The damage assessment part of the DaLA will explain how a comparison can be made with pre-disaster baseline information. Damage: Value of total or partial destruction of infrastructure and assets
		Loss: Refer to Table 2.5 The value of changes in production is complemented by the irrigation infrastructure, service delivery, and access to services and goods. Value of changes to governance and decision-making processes (the operation cost incurred in addition to the cost incurred in the no-disaster situation) Value of changes to risks (cost incurred for taking immediate precautions to reduce the risk of vulnerable structures, if any, and cost incurred for taking early but temporary recovery actions that will be replaced in the future)
3	**Assessment of disaster impact**	
		This section provides a report on the aggregated economic (GDP and Balance of Payment) and human development impacts (Human Development Index). However, such national indicators are not evaluated focusing on a single event by the Central Bank or the Department of Census and Statistics. Impact assessment provides an analysis of the expected trend for the sector after the disaster and what could be the worst-case scenario, provided policy and programming measures are not considered. It identifies major challenges for the sector. This impact analysis is based on the assessment of the disaster effects, the sector development plans, lessons from past experiences, and the emerging concerns that derive from the events. The analysis of the impact of the disaster provides a medium- and long-term projection of the effects on the sector. The impact analysis forms the basis of the recovery strategy.
4	**Cross-Sectoral linkages**	
		The irrigation sector, a sub-sector of the infrastructure sector, complements the agriculture sector in terms of crop productivity by supplying irrigation water. The crop productivity will contribute to the livelihood of the agricultural community (the social sector), such as farmers and others engaging in agro-based industries. The FPSs protect the lives of the community (including their properties and other industries) from extreme flood events by reducing risk. Some irrigation infrastructure is used as access roads for public transport.

Part 1: PDNA Assessment Report		
1	Recovery vision and guiding principles Refer to section 2.9.2	
2	Reconstruction and Recovery Needs, including Build Back Better	
		I. This section defines the need for reconstruction and recovery: the need to restore and resume irrigation infrastructure to pre-disaster levels; the need to improve production, service delivery, and access to services and goods; and II. the need to strengthen DRM in the irrigation sector by improving the III. governance system and decision-making process. IV. mitigate future disaster risks and vulnerabilities All BBB interventions associated with the four headings listed above contribute to the resilience of irrigation infrastructure.
3	**The irrigation sector Recovery Strategy**	
		Prioritization and sequencing: This section describes the reconstruction and recovery requirements in terms of short-, medium-, and long-term priorities. It identifies the main interventions, outputs, and outcomes, as well as those interventions related to adapting BBB interventions. Consult Section 2.9.
4	**Implementation Arrangements**	
	i	This section describes and elaborates on recovery implementation partnerships, coordination, and administration arrangements.
	ii	This section proposes monitoring and evaluation mechanisms. It also includes a discussion of existing irrigation infrastructure development coordination mechanisms. It also describes potential mechanisms for resource mobilization.
	ii	This section provides a brief description of the recovery challenges (e.g., lack of financial resources) that may be encountered during the sector's implementation process and should be supported by key assumptions and constraints.
5	**Assessment methods**	
		This section provides a summary of the methods and sources used (primary and secondary data collection) and the analysis methodology. It also explains the methodology and assumptions used to estimate (empirically) the reconstruction and recovery requirements. Sections 2.3, 2.4, and 2.5 are relevant.