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**Performance Audit  
Report on Irrigation  
Systems**

**October 2022**

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སྒྲུབ་

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## **DISCLAIMER NOTE**

The audit was conducted in accordance with the International Standards of Supreme Audit Institutions (ISSAIs). The review was confined to the irrigation systems implemented by the Department of Agriculture, Dzongkhags, and Gewogs. The audit was based on the audit objectives and criteria determined in the audit plan prepared by the Royal Audit Authority and the findings are based on the information and data made available, field visits to some Dzongkhags and Gewogs.

This is also to certify that the auditors during the audit had neither yielded to pressure, nor dispensed any favour or resorted to any unethical means that would be considered a violation of the Royal Audit Authority's Oath of Good Conduct, Ethics, and Secrecy.



རྒྱལ་ཁབ་ཚུལ་ཞིབ་དབང་འཛིན།

ROYAL AUDIT AUTHORITY

*Bhutan Integrity House*

Reporting on Economy, Efficiency & Effectiveness in the use of Public Resources



RAA/DPCA (TAD-Irrigation)/2022-23/1872

Date: 19 October 2022

Secretary  
Ministry of Agriculture and Forests  
Thimphu

Secretary  
National Environment Commission  
Thimphu

**Subject: Performance Audit Report on Irrigation Systems**

Dear Sir,

Enclosed herewith please find the **Performance Audit Report on Irrigation Systems**. The Royal Audit Authority (RAA) conducted the audit in line with the mandate enshrined in the Constitution of the Kingdom of Bhutan and the Audit Act of Bhutan 2018. The audit was also conducted in the context of Performance Auditing following the RAA's Performance Audit Guidelines, which is in line with the International Standards of Supreme Audit Institutions on performance auditing (ISSAI 3000).

The overall audit objective is to ascertain the economy, efficiency, and effectiveness in the development and management of reliable, adequate, and sustainable irrigation systems and supported by the following sub-objectives:

- To ascertain whether a proper institutional framework is in place for efficient and effective planning and development of reliable irrigation systems;
- To assess whether adequate irrigation facilities are provided; and
- To assess the economy and efficiency in managing the irrigation facilities to ensure sustainability.

The report has been prepared based on the review of Acts, Regulations, Policies, Plans, analysis of secondary data, and discussion with relevant officials of the Department of Agriculture, Watershed Management Division, National Environment Commission Secretariat, Dzongkhag Agriculture and Gewog Extension Officials, Water Users Associations, and Tshogpas.

The report contains shortcomings and deficiencies as well as recommendations aimed at improving the planning and development of irrigation systems.

The draft report was issued on 6<sup>th</sup> July 2021 for factual confirmation, comments and feedback on the audit findings and on the applicability and relevancy of the recommendations provided. Since the Department of Agriculture has only provided responses for recommendations, responses received had not been incorporated in the report.

In line with the Audit Act of Bhutan 2018, the audited agencies are required to submit responses to the Final Audit Report in the form of a Management Action Plan. The Management Action Plan should specify the action plans for implementation of the recommendations with a definite timeframe aimed to address the underlying causes of the findings. Further, as specified by Section 55 (16) of the Audit Act of Bhutan 2018, the audited agencies concerned are required to submit a signed Accountability Statement for the implementation of the recommendations provided.

The RAA will follow-up implementation of the recommendations based on the Management Action Plan and Accountability Statement. Failure to comply will result in taking appropriate actions, which may include suspending audit clearances to the official(s) accountable.

*Therefore, the RAA would like to request the agencies concerned to submit a Management Action Plan for implementation of recommendations with definite timeframe on or before **21 November 2022** along with the signed Accountability Statement (format attached). In the event of non-submission, the RAA shall invariably fix the overall supervisory accountability on the head of audited agencies in line with Section 55(17) of the Audit Act of Bhutan 2018.*

We take this opportunity to acknowledge the officials of the audited entities for rendering necessary cooperation and support which facilitated the timely completion of the audit.

Yours sincerely,



(Tashi)

**Auditor General of Bhutan**

**Copy to:**

1. Hon'ble Lyonchhen, Royal Government of Bhutan, Thimphu;
2. Hon'ble Gyalpoi Zimpon, Office of Gyalpoi Zimpon, Thimphu;
3. Hon'ble Speaker, National Assembly of Bhutan, Thimphu;
4. Hon'ble Chairperson, National Council of Bhutan, Thimphu;
5. Hon'ble Opposition Leader, National Assembly of Bhutan, Thimphu;
6. Hon'ble Chairperson, Public Accounts Committee, National Assembly of Bhutan, Thimphu (enclosed five copies);
7. Secretary, Ministry of Finance, Thimphu;
8. Director, Department of Agriculture, Ministry of Agriculture and Forests, Thimphu;
9. Dzongdags, Dzongkhag Administrations (20 Dzongkhags);
10. Chairpersons, Dzongkhag Tshogdus (20 Dzongkhags);
11. Chief Engineer, Agriculture Engineering Division, Department of Agriculture, Thimphu;
12. Assistant Auditor General, Policy and Planning Division, RAA, Thimphu; and
13. Assistant Auditor General, Follow-up and Clearance Division, RAA, Thimphu.

*"Every individual must strive to be principled. And individuals in positions of responsibility must even strive harder."  
- His Majesty the King Jigme Khesar Namgyel Wangchuck*

## TITLE SHEET

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2. AIN	:	<b>17665</b>
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## ACRONYMS

ACMIS	: Agency-built Community Managed Irrigation System
ARDC	: Agriculture Research and Development Centre
BWSIS	: Bhutan Water Security Index System
CARLEP	: Commercial Agriculture and Resilient Livelihoods Enhancement Programme
CMIS	: Community Managed Irrigation System
DAMC	: Department of Agriculture Marketing and Cooperatives
DEO	: Dzongkhag Environment Officer
DLIDP	: Dry Land Irrigation Development Project
DoA	: Department of Agriculture
DoFPS	: Department of Forests and Park Services
DT	: Dzongkhag Tshogdu
EIIP	: Existing Irrigation Improvement Project
ESI	: Essential Structural Improvements
EU	: European Union
FSAPP	: Food Security and Agriculture Productivity Project
FY	: Financial Year
FYP	: Five Year Plan
GAFFSP	: Global Agriculture and Food Security Program
GCCA	: Global Climate Change Alliance
GCF	: Green Climate Fund
GDP	: Gross Domestic Product
GEF	: Global Environment Facility
GoI	: Government of India
GoI PTA	: Government of India, Project Tied Assistance
GT	: Gewog Tshogde
ICWMP	: Integrated Crop and Water Management Project
IFAD	: International Fund for Agricultural Development
ISSAI	: International Standards of Supreme Audit Institutions
IWRM	: Integrated Water Resource Management
JICA	: Japan International Cooperation Agency
LDAMP	: Land Development and Agriculture Mechanisation Project
LDCF	: Least Developed Countries Fund
LG	: Local Government
M&E	: Monitoring and Evaluation
MCA	: Multi Criteria Analysis
MoAF	: Ministry of Agriculture and Forests
MoEA	: Ministry of Economic Affairs
NCHM	: National Center for Hydrology and Meteorology
NEC	: National Environment Commission
NHIDP	: New Hill Irrigation Development Project
NIDP	: New Irrigation Development Project
NIMP	: National Irrigation Master Plan
NIP	: National Irrigation Policy

NIWRMP : National Integrated Water Resource Management Plan  
NKRA : National Key Result Area  
O&M : Operation and Maintenance  
RAA : Royal Audit Authority  
RBC : River Basin Committee  
RDCCRCP : Rural Development and Climate Change Response Programme  
RGoB : Royal Government of Bhutan  
RNR : Renewable Natural Resources  
SDG : Sustainable Development Goal  
USD : US Dollar  
WB : World Bank  
WBC : Wangchhu Basin Committee  
WBMP : Wangchhu Basin Management Plan  
WMD : Watershed Management Division  
WSIDP : Wet Subtropical Irrigation Development Project  
WUA : Water Users Association  
WUG : Water Users Group



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# EXECUTIVE SUMMARY

Bhutan is predominantly an agrarian society and the agriculture sector is the main driver for the primary sector (agriculture, livestock, forestry) growth. In 2020, the primary sector contributed 19.2% to Gross Domestic Product (GDP) (National Accounts Statistics 2021). Understanding the significance of the agriculture sector to GDP and sustenance of livelihood of the majority of the population, priorities have been given to food self-sufficiency and food security in the Five-Year Plans (FYPs). Food production and food security are intrinsically linked to water availability and water security. Although Bhutan has one of the highest per capita water resource availability with 94,500 m<sup>3</sup>/capita/ annum (Bhutan Water Fact 2018), accessibility to water sources for irrigation and drinking at community level remains a challenge because of geographical terrains and climatic conditions.

In order to attain the broad agriculture sector goals of food security, the Ministry of Agriculture and Forest (MoAF) developed the National Irrigation Policy (NIP) envisioning a stable and productive agriculture sector with dynamic and sustainable irrigation systems and National Irrigation National Plan (NIMP) to present a 15-year action for the development of climate adaptive irrigation systems and irrigated agriculture in the country.

The RAA conducted the performance audit of ‘Irrigation Systems’ as mandated by the Constitution of the Kingdom of Bhutan and Audit Act of Bhutan 2018. The audit was conducted following the Performance Audit Guidelines, which is in line with the International Standards of Supreme Audit Institutions (ISSAIs). The performance audit of irrigation systems was conducted with an overall audit objective to ascertain the economy, efficiency, and effectiveness in the development and management of reliable, adequate, and sustainable irrigation systems.

The RAA conducted the performance audit in the Department of Agriculture (DoA) as the main agency primarily covering the period from the financial year 2017-18 to 2019-20. The audit also consulted other relevant agencies including National environment Commission (NEC). The team visited implementing agencies particularly Dzongkhags and Gewogs and also irrigation schemes selected from a list prepared by the Department.

The RAA has noted inadequacies and deficiencies of which, significant findings are briefly highlighted below:

- i. Inadequacies in institutional structures to implement Integrated Water Resources Management (IWRM) thereby impeding effective development and management of irrigation systems in the manner envisioned by the policy.
- ii. Non-implementation of IWRM approach at river basin level due to non-constitution of River Basin Committees for all major river basins. Although the Wangchhu Basin Committee was established and the river basin management plan was developed for the Wangchhu river basin, the management plan was not integrated or aligned with the FYPs. As a result, the main objective of implementing the IWRM approach at the river basin level for water security could not be achieved.

- iii. Water User Associations (WUAs) are yet to be established for all irrigation schemes. Due to which, the policy and legislative intents of ensuring farmer-centric irrigation development and strengthening the ownership of irrigation facilities at the grass-root level will remain a long-term endeavour.
- iv. The NIMP, a 15-year action plan and roadmap for the development of irrigation systems in the country, developed as required by the NIP 2012 was not integrated with the FYPs. As a result, the strategies such as improvement and development of new irrigation schemes envisaged in the plan were not implemented which has led to the derailment of NIP and NIMP objectives.
- v. Non-enforcement of multidisciplinary feasibility studies of irrigation projects to ensure long-term viability resulting in several cases of defunct, damaged, abandoned, and poor-quality irrigation schemes.
- vi. There were inadequacies in research and development of irrigation technologies leading to instances where pilot projects of a few researches were unsuccessful and failed to serve the purpose.
- vii. There were also issues related to quality, design, improper development and management of irrigation infrastructure undermining the overall functionality, usefulness and sustainability of the irrigation systems.
- viii. There is no comprehensive irrigation inventory maintained either at DoA or Dzongkhags and Gewogs. The Irrigation System Atlas developed in 2015 was not updated since 2015. Absence of comprehensive information on the Irrigation Systems has impeded proper planning, monitoring and management of the irrigation schemes.
- ix. Some customary water allocation practices still exist in distribution of irrigation water and such practices result in an inequitable distribution of water and deprive certain sections of water users of having equal access to irrigation water although the Water Act provides an equal right to water resources to every citizen.

In order to improve the development and management of irrigation systems, the RAA has made eight recommendations and some are highlighted below:

- i. The National Environment Commission should expedite the operationalisation of the National Integrated Water Resource Management (NIWRM) Plan in order to provide institutional systems and a coordinated approach to planning and development of irrigation systems across the country as well as facilitate the integration of functions and priorities of various stakeholders.
- ii. In order to ensure the sectoral growth and development of irrigation, the DoA should review the NIP & NIMP and further develop a way forward strategies for the implementation to realise the national goals of achieving food self-sufficiency and security.

- iii. DoA should institute appropriate mechanisms to enforce the requirement of conducting multi-disciplinary feasibility studies before implementing irrigation schemes in order to achieve the policy objective of NIP in ensuring sustainability and proper utilisation of the irrigation schemes.
- iv. To enforce the spirit of the Water Act which grants equal rights to all citizens, there is a need to review the existing system of allocation of irrigation water to users. If it shows to be discriminatory, appropriate strategies must be developed and enforced.
- v. As intended by NIP and NIMP, DoA should continue to explore and adopt appropriate technology for sustainable irrigation infrastructure and build capacity to address the challenges of steep terrains, and soil conditions resulting in disruptions in the sourcing, channelising, damages, leakages, and insufficiency of water.
- vi. DoA should facilitate the establishment of WUAs formally and institutionalise the system of operations and management involving the users and formalise mechanism of coordination, backstopping and monitoring to support the policy objective of promoting farmer-centered approach.
- vii. Since having a comprehensive inventory of irrigation systems is imperative for the overall strategic development of irrigation infrastructure in the country, DoA should take a lead role in updating comprehensive information on irrigation systems through a standardised format and oversee the compliances at various levels.

The inadequacies were mainly due to lack of institutional structures and mechanism in implementing an integrated approach for water resources management, derailment of FYPs from the NIP and NIMP, non-enforcement of carrying out the multi-disciplinary feasibility studies prior to the implementation of irrigation schemes, and non-maintenance of a comprehensive information on irrigation schemes.



# CHAPTER 1 ABOUT THE AUDIT

## Mandate

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The Royal Audit Authority (RAA) conducted the ‘Performance Audit of Irrigation Systems’ as mandated by Article 25 of the Constitution of the Kingdom of Bhutan to audit and report on the economy, efficiency, and effectiveness in the use of public resources.

Further, Chapter 5, Section 69 of the Audit Act of Bhutan 2018 stipulates, ‘*The Authority shall carry out performance, financial, compliance, special audits and any other form of audits that the Auditor General may consider appropriate.*’

## Standards

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The RAA conducted this audit in accordance with the International Standards of Supreme Audit Institutions on Performance Auditing (ISSAI 3000). The RAA followed audit procedures as prescribed under RAA’s Performance Audit Guidelines 2019 to maintain uniformity and consistency of approaches in auditing.

## Audit Objectives

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The RAA conducted the ‘Performance Audit of Irrigation Systems’ with the overall audit objective to ascertain the economy, efficiency, and effectiveness in the development and management of reliable, adequate, and sustainable irrigation systems and supported by the following sub-objectives:

- i. To ascertain whether a proper institutional framework is in place for efficient and effective planning and development of reliable irrigation systems;
- ii. To assess whether adequate irrigation facilities are provided; and
- iii. To assess the economy and efficiency in managing the irrigation facilities to ensure sustainability.

## Auditing Approach Applied

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The audit adopted a combination of ‘**system-oriented**’ and ‘**result-oriented**’ approaches. The system-oriented approach was applied to understand the processes in the development and management of irrigations including the coordination mechanism instituted between multiple stakeholders involved. The result-oriented approach was used to assess the achievement of objectives of irrigation policies and targets identified in the national irrigation plans.

## Audit Scope

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The audit covered the aspects of planning, development, and management of irrigation systems executed by the Department of Agriculture (DoA), Dzongkhag, and Gewog Administrations. The audit team visited 151 irrigation schemes in 11 Dzongkhags (Bumthang, Dagana, Mongar, Paro, Pema Gatshel, Punakha, Tsirang, Trashigang, Trashy Yangtse, Trongsa, and Wangdue Phodrang) and these were selected based on the following criteria;

- i) Arable land (in acres)
- ii) Gross command area (in acres)
- iii) No. of household/ beneficiaries
- iv) Expenditure
- v) Number of defunct schemes
- vi) Frequency of media coverage

### **Audit Methodology**

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The RAA applied the following methodologies to gather information, analyse and derive conclusions:

- i. **Document Review and Content Analysis:** The RAA reviewed Water Act of Bhutan 2011, Bhutan Water Policy 2007, National Irrigation Policy 2012, Water Rules and Regulations 2014, 11<sup>th</sup> and 12<sup>th</sup> FYPs, National Irrigation Master Plan 2016, National Integrated Water Resource Management Plan 2016, Wangchhu River Basin Management Plan 2016, National Irrigation Policy Procedural Manual 1993, Irrigation Engineering Manual 2016 and other documents related to irrigations.
- ii. **Physical Inspections:** The RAA physically visited 151 irrigation schemes in 11 Dzongkhags covering 50 Gewogs to physically examine the conditions of irrigation schemes.
- iii. **Interviews and Discussions:** Interviews and discussions with agriculture officials and engineers of DoA, ARDC (Wengkhar and Bajo), and LGs were held during the field visits. The interviews and discussions were aimed at identifying and evaluating the current system and practices, internal control mechanisms, challenges, and deficiencies that are being encountered in the system.
- iv. **Data Analysis:** The RAA analysed the data using a simple MS Excel. Data was gathered from secondary sources.



## CHAPTER 2 INTRODUCTION

### Background

Attaining food security is one of the top priorities of Bhutan given its vulnerability to geo-economic conditions. Thus, in the 11<sup>th</sup> and 12<sup>th</sup> Five Year Plans (FYP), food self-sufficiency has been given special attention and accordingly identified as one of the National Key Result Areas (NKRA).

In the 11<sup>th</sup> FYP, food security and sustainability have been identified as NKRA-3 and the key performance indicator is cereal self-sufficiency, which includes rice. Similarly, in the 12<sup>th</sup> FYP, food and nutrition security has been identified as NKRA-8, which was linked to Sustainable Development Goal (SDG)-2 (Zero hunger), and the sustainable water (including irrigation water) was identified as NKRA-17, which was linked to SDG-6 (clean water and sanitation).

The National Irrigation Policy (NIP), which was developed in 1992, was revised and updated in 2012 envisioning a stable and productive agriculture sector with dynamic and sustainable irrigation systems that enhance food security and stimulate economic growth. The policy calls for a farmer-centered approach to sustainable irrigation infrastructure development and maintenance supported by an effective institutional collaboration at all levels. It also calls for various measures to ensure reliable and efficient water use for intensification and diversification of irrigated crop production in the country.

As per the Bhutan Water Fact 2018, Bhutan has one of the highest per capita water resource availability with 94,500 m<sup>3</sup>/capita/annum. However, accessibility of water sources for irrigation remains a national challenge which attributes to insufficient source management, inadequate infrastructural development and maintenance, and issues in the governance system.

Rice being a staple food in Bhutan depends heavily on quality irrigation systems. As such, the irrigation schemes in the country were developed with an emphasis on rice cultivation although it has wider use. Even though irrigation has been a priority of the government in the context of attaining food security, the irrigation sub-sector has always faced a low level of investment and inadequate focus within the RNR sector.

As per the agricultural land use statistics (2019), about 56,069 acres of land (21% of the total arable land) in the country is categorised as wetland which is distributed among Dzongkhags as shown in **Figure-1**. Out of the total area of wetland, 31,574 acres are currently under rice cultivation and the Dzongkhag wise distribution is presented in **Figure-2**.

Figure-1: Dzongkhag wise Distribution of Wetland (in Acres)

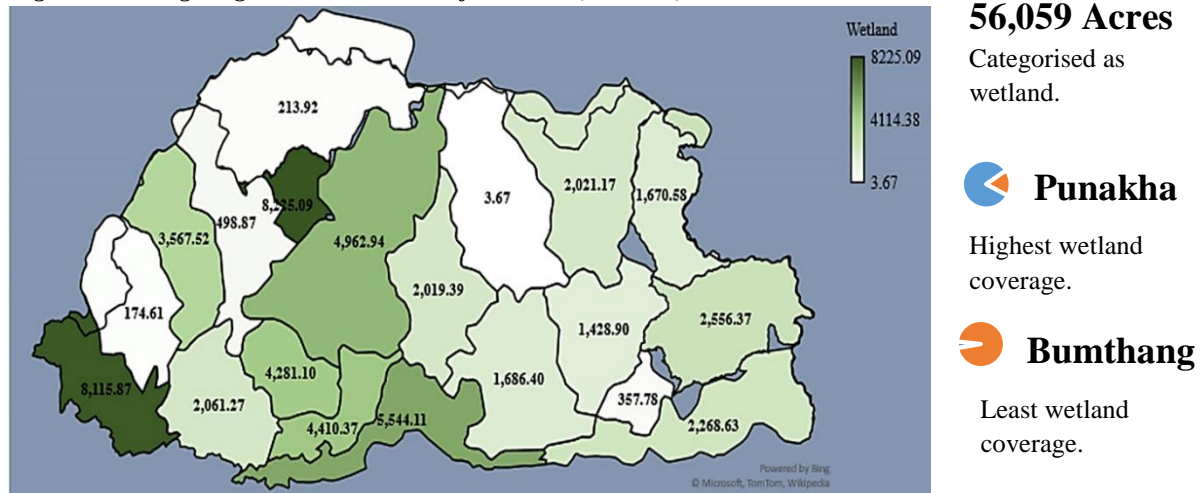
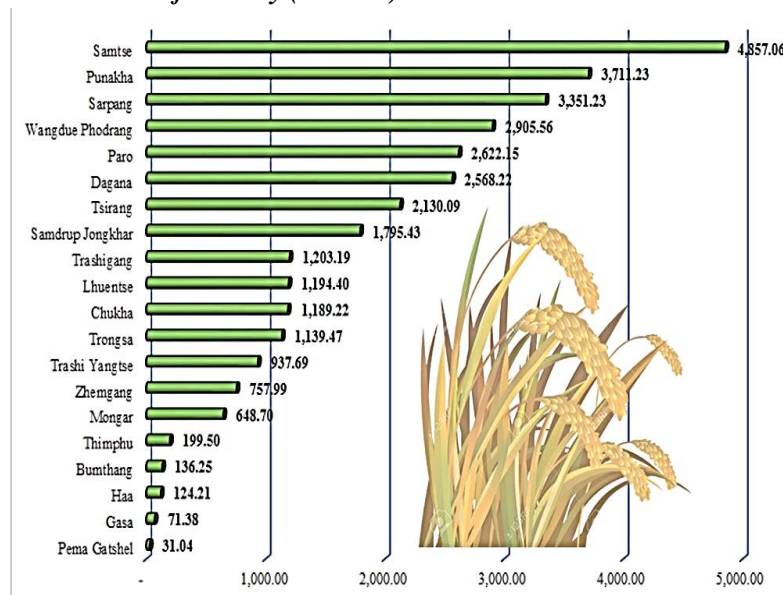


Figure-2: Dzongkhag wise Sown Area for Paddy (in Acres)

**31,574 Acres**  
Total wetland

**49,622,921 KG**  
Total paddy production for 2019.

**44%**  
Wetland sown with paddy.



(Source: 2019 Gewog Agriculture Statistics: in support of planning and developmental activities for agriculture sector, July 2020)

As mentioned in the National Irrigation Master Plan 2016 (NIMP), there are two types of irrigation in Bhutan:

- i) Community Managed Irrigation System (CMIS), and
- ii) Agency-built Community Managed Irrigation System (ACMIS).

The CMIS is the oldest form of irrigation system found in the country. It is the result of the farmers' undertaking whereby the irrigation systems are constructed and managed by the community themselves using their local knowledge and skills. The role of the government agencies in such types of irrigation systems is to support the repair, maintenance, and expansion work financed either through the Royal Government of Bhutan (RGoB) or donor projects. The involvement of the central agencies in developing CMIS is lesser as compared to the roles of Local Government (LG). On other hand, the ACMIS are the irrigation systems constructed by the government which are handed over and managed by the community.

## Existing Methods of irrigation

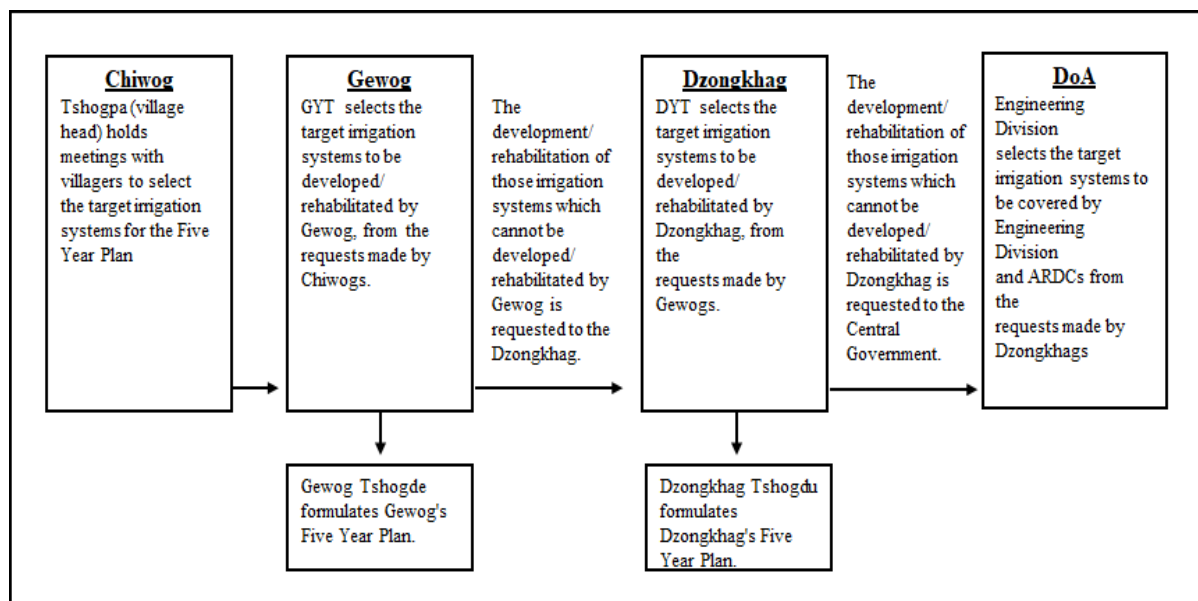
As per the RNR Census of Bhutan 2019, the following three methods of irrigation are currently found in Bhutan:

- i) **Surface irrigation:** It is a method where water is applied and distributed over and across the field or surface of the field by gravity. The majority of the rice cultivators in Bhutan follow this method of irrigation (89%).
- ii) **Sprinkler irrigation:** It refers to pipe networks through which water moves under pressure before being delivered to the crop via sprinkler nozzles. This is the second most common irrigation method found in Bhutan (9%).
- iii) **Localised irrigation:** It is a system whereby water is distributed under low pressure through a piped network, in a predetermined pattern, and applied as a small discharge to each plant. For example, drip and micro-irrigation. This is the third most common irrigation method in Bhutan (2%).

## The process flow of development and rehabilitation of irrigation systems

The procedure of developing or rehabilitating the irrigation systems among responsible institutions at different levels is illustrated in **Figure-3**:

**Figure-3: Procedure of developing and rehabilitating irrigation system**



As shown in **Figure-3**, the need for a new irrigation scheme or rehabilitation of the existing ones comes from the beneficiaries at the Chiwog level. On the requests made by the beneficiaries, Gewogs prioritise and select the irrigation systems to be developed or rehabilitated. If the development or rehabilitation works are beyond the technical and financial capacity of Gewogs, they are submitted to Dzongkhags. Further, if these works are beyond the technical and financial capacity of Dzongkhags, they are submitted to the DoA, to be executed centrally.

## Expenditure of development and rehabilitation of irrigation systems

Total Expenditure of Nu. 2,176.980 million over the last five financial years.

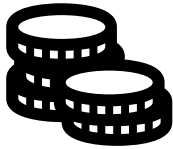
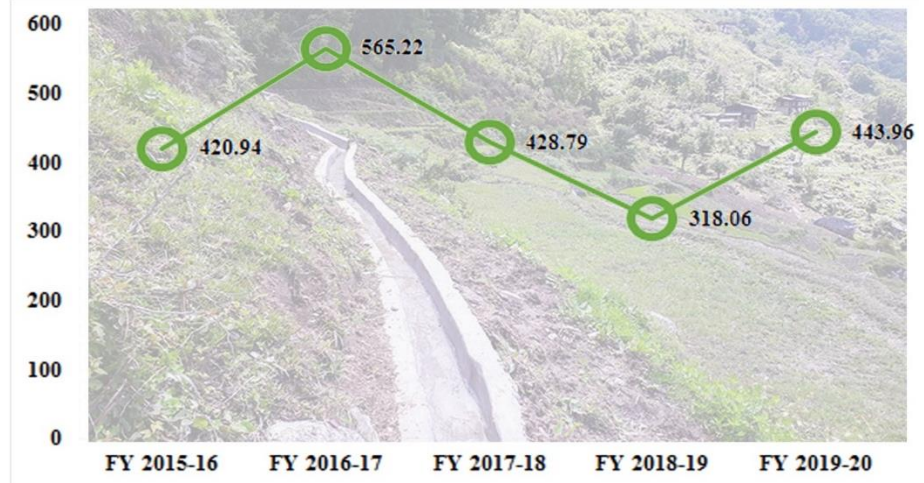


Figure-4: Expenditure incurred on irrigation



The expenditure is met from RGoB funding as well as financial assistance provided by external donors.

Nu. 2,176.98 million

Nu. 1,350.20 million

Nu. 826.78 million

62.02 % funded by the donors

Table-1: List of Donors

Source of Fund
World Bank
International Fund for Agricultural Development (IFAD)
Government of India, Project Tied Assistance (GOI PTA)
European Union (EU)
Japan International Cooperation Agency (JICA)
Helvetas
World Bank (WB)
Global Environment Facility (GEF)
Green Climate Fund (GCF)

## CHAPTER 3 AUDIT FINDINGS

### 1. INSTITUTIONAL ARRANGEMENTS

Section 15 (d) of Water Act of Bhutan 2011 mandates the Ministry of Agriculture and Forests for ‘*land-use and irrigation, watershed management, water resources in forests, wetlands and protection of catchment areas*’ as the irrigation is associated with water, land and environment, multiple legislations related to these areas govern the development of irrigation system in the country. Besides, there are also multiple governing authorities that need to be complied as shown in the **Table-2**.

*Table-2: List of legal instruments and management tools collectively determining the irrigation system*

Sl. No	Title	Year of adoption
1	Water Act of Bhutan	2011
2	Land Act of Bhutan (New)	2007
3	National Irrigation Policy	2012
4	Bhutan Water Policy	2007
5	Water Regulations of Bhutan	2014
6	National Integrated Water Resource Management Plan (NIWRMP)	2016
7	National Irrigation Master Plan (NIMP)	2015
8	Irrigation Engineering Manual	2016
9	NIP Procedural Manual	1993

On review of the existing institutional arrangements for the development of irrigation infrastructure, the RAA noted inadequacies and deficiencies which are discussed in the following paragraphs:

#### 1.1 Inadequacies in institutional structures to implement Integrated Water Resources Management

- a) The management of water resources is a multi-dimensional theme that involves multiple stakeholders including government and non-government agencies. Therefore, it is important to adopt a whole-of-government approach to integrate the programs, plans, and policies of all the sectors dealing with water so as to avoid duplication and overlaps and to achieve national priorities in managing water resources. The need for synergy of integration amongst different sectors is also recognised in the Water policy 2007.
- b) Recognising this importance, Section 6 of the Water Act of Bhutan 2011 stipulates that ‘*a National Integrated Water Resources Management plan shall be formulated for coordinated development, management, conservation and efficient use of water resources.*’ To effect this provision, the Water Act emphasises decentralising the authority of water governance within the river basins. For this purpose, the National

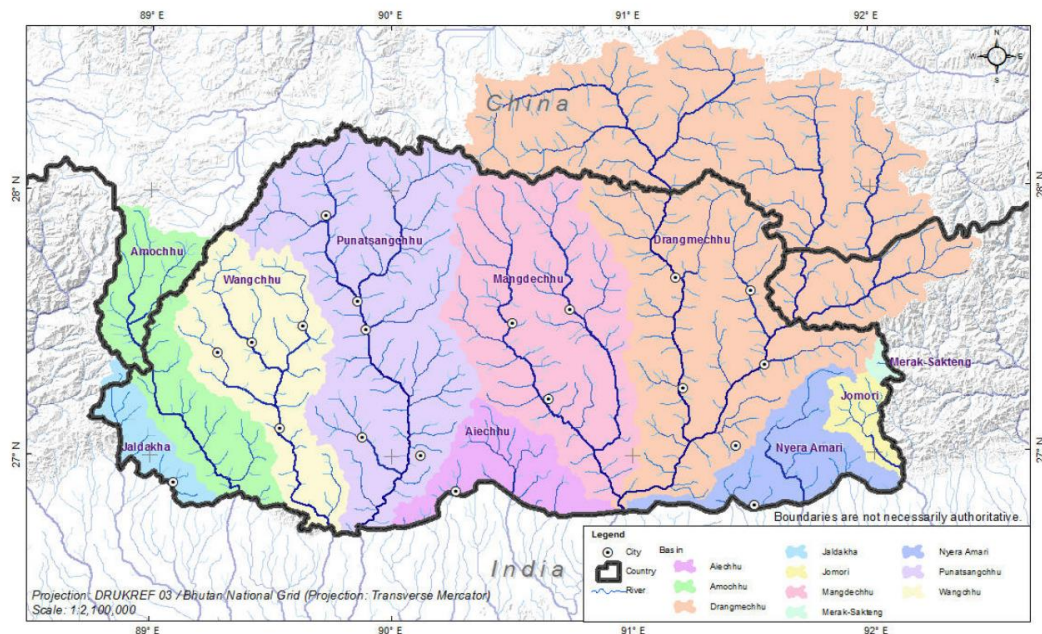
Environment Commission (NEC) is mandated to establish River Basin Committees (RBCs) for each river basin that will formulate and implement the IWRM Plans within their respective basin. The institutional design of IWRM emphasises enhancing coordination both at the national and river basin levels with minimal redundancy, incoherence, and gaps.

- c) The specific functions of the RBCs as per the Water Act of Bhutan 2011 and Water Regulations of Bhutan 2014 include promoting community participation in the protection, use, development, conservation, management, and control of water resources through River Basin Management Plans and rendering coordinated system for implementation of plans related to water management.
- d) NEC had developed the National Integrated Water Resources Management Plan (NIWRMP) in 2016 with the overall goal of establishing a framework and priorities for the implementation of integrated water resources management in the country. It establishes principles and mechanisms under which the agencies involved in the water sector can coordinate their respective plans and activities to achieve the common goal of ensuring water security.
- e) The NEC had established RBC only for the Wangchhu River Basin in 2016. The remaining four major river basins (Amochhu, Punatsangchhu, Mangdechhu, and Drangmechhu) currently do not have RBCs and the systems and structures are yet to be rendered, institutionalised, and implemented.
- f) Thus, the development and management of irrigation systems in the manner planned through IWRM remain thwarted by the absence of desirable institutional systems for integrated water resource management.

## 1.2 Non-implementation of the Integrated Water Resource Management approach

- a) Currently, there are five major river basins, viz. Amochhu (Toorsa), Wangchhu (Raidak), Punatsangchhu (Sunkosh), Mangdechhu and Drangmechhu (Manas) as depicted in **Picture-1**. As water is managed locally, implementing IWRM at the river basin level is recognised as an essential element and a comprehensive process for managing water resources more sustainably. Understanding this importance, the Wangchhu Basin Committee (WBC) was established, as a pilot basin, through an Executive Order issued on 14 April 2016 in accordance with the requirements of the Water Act of Bhutan 2011 and the Water Regulations of Bhutan 2014. The replication of IWRM in the remaining basins is to be undertaken only after the approach is effectively implemented in the Wangchhu Basin, learning the best practices.

- b) The WBC was established as a coordinating body responsible for the preparation and updating of river basin management plans, integration of priorities in respective plans of Chukha, Haa, Paro, and Thimphu Dzongkhags, monitoring the implementation of plans and reporting on the level of water security in the basin. The WBC is composed of chairpersons of Dzongkhag Tshogdu, Dzongdags, Dzongkhag environment officers (DEOs) of Chukha, Haa, Paro, and Thimphu Dzongkhags and the Environmental Officer and Thrompon of Thimphu Thromde.



**Picture-1: Five Major River Basins (Source: NIWRMP 2016, NEC)**

- c) The specific functions of the RBCs as per the Water Act of Bhutan 2011 and Water Regulations of Bhutan 2014 are:
- i. To promote community participation in the protection, use, development, conservation, management, and control of water resources in its area of operation through education and other appropriate activities;
  - ii. To prepare a River Basin Management Plan for the basin;
  - iii. To monitor and report to the NEC on the effectiveness of policies and action in achieving sustainable management of water resources in its area of operation;
  - iv. To collect, manage and share such data as are necessary to properly manage the basin in coordination with the NEC;
  - v. To help resolve cross-sectoral and Dzongkhag trans-boundary issues relating to water resources in its area of operation; and
  - vi. To perform any such additional functions.
- d) In order to implement the IWRM approach at the river basin level and to cater to the competing demands of different users, the Wangchhu River Basin Management Plan (WBMP) was also prepared with the overall goal to increase and sustain water security for all purposes in Wangchhu basin through improved planning and coordination among agencies involved in water resources management. The plan was prepared with technical assistance from Asian Development Bank.

- e) The plan consists of interventions focused on the main thrusts of improving rural and urban drinking water supply and sanitation, rural water storage, irrigation development, and flood protection areas with an estimated cost of Nu. 112 billion spread over the 12<sup>th</sup>, 13<sup>th</sup>, and 14<sup>th</sup> FYPs (until 2033). With the implementation of interventions, the plan intends to increase the average score of water security of the Wangchhu basin from 3.34 (2016) to 3.60 (2033), assessed using the framework of the Bhutan Water Security Index System (BWSIS). Key Result Areas, KPIs, and interventions in the WBMP are identified in terms of four key dimensions of BWSIS viz. rural water security, economic water security, urban water security and drainage, and environmental water security. Additionally, targets and cost estimates are also set for these dimensions.
- f) While reviewing the WBMP, the RAA noted that till the date of audit, the progress of the WBMP was neither monitored nor assessed by the NEC, who is responsible for implementing the IWRM approach at the national as well as river basin level. Furthermore, due to vague integration of the WBMP with FYPs, it has become even more difficult to track the progress of activities of the plan from the FYPs. The Mid Term Review report of 12<sup>th</sup> FYP also does not reflect any implementation status of IWRM, which NEC has identified as one of the activities.
- g) The RAA noted that WBC conducted eight rounds of meetings till 2019 but none of the meetings had discussed the implementation of strategies or interventions identified in the WBMP.

Thus, the main objective of implementing the IWRM approach for ensuring water security and mitigating water-related risks at river basin level could be derailed if strategies or interventions envisaged in WBMP are not implemented through integration with FYPs. This could also result in disintegrated water resources management and ineffective and unsustainable delivery of water services.

### **1.3 Water User Associations (WUAs) are yet to be instituted for effective function**

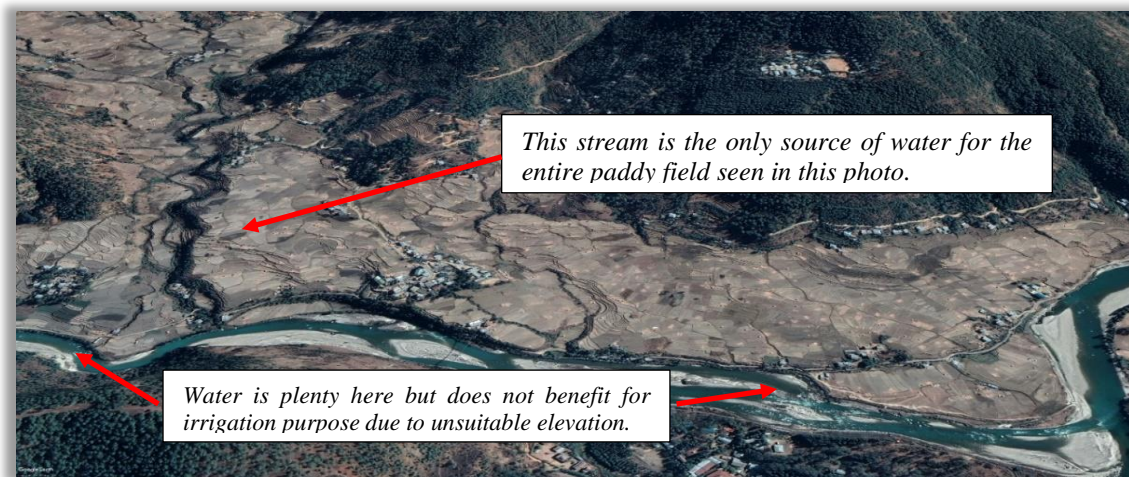
- a) The Water Act of Bhutan 2011 and its regulation require ‘*any group of beneficiaries using a water source for their water supply to form Water Users’ Association (WUA) to maintain water source and manage water supply services.*’
- b) Further, NIP also intends to strengthen the effective participation of beneficiaries at all stages of irrigation development (planning, implementation, operation, and management) through a farmer-centered approach. Accordingly, the DoA is entrusted to facilitate and support the formation of functional WUAs through capacity development and formalise regulatory systems by registration of WUAs with relevant agencies. The DoA, in collaboration with the Department of Agricultural Marketing and Cooperatives, Dzongkhag, and Gewogs, is also responsible for monitoring the functioning of WUAs. Apart from promoting present and future water security, WUAs are also responsible for sustaining the operation and maintenance of water facilities handed over to them.



- c) Despite having such requirements in the legislation with clear responsibilities delineated in the NIP, the RAA noted that WUAs are yet to be instituted for all water sources except for a few major irrigation schemes such as Neychechu Water User Group, Sergithang Gewog, Tsirang and Jhateykhola Water User Group, and Sergithang Gewog, Tsirang.
- d) In the existing practice of managing the irrigation water without WUAs, either Chiwog Tshogpas or a person appointed as a care-taker of the irrigation water (locally termed as *Chhu-Sump*, *Chhu-Nyer*, *Yuer-Poen*, *Dodam* etc.) are involved in monitoring the blockages, coordinating the major cleaning up of the canals, allocating the water to the beneficiaries based on their customary norms, and collecting the fines and penalties.
- e) In order for the WUAs to play an effective role in all levels of irrigation development and management, a formal rules and regulations to govern the operation is desirable. The policy intent of promoting a farmer centric approach to planning, operations and management of irrigation facilities may be thwarted besides, triggering challenges of sourcing of funds as a non-registered association for realising the objective of financial sustainability of the associations.
- f) Further, in absence of formal institution of WUAs, the policy and legislative intents of building strong ownership of the water resource at the grass root level will remain a long-term endeavor unless WUAs are formed and made operational.

#### 1.4 Non-development of comprehensive information on water resources

- a) Section 14 (a) of the Water Act of Bhutan 2011 delineates the responsibility of conducting an inventory on water resources to the Secretariat of the National Environment Commission. Further, one of the activities of NEC in preparing the NIWRMP, as specified under clause 108 of Water Regulations of Bhutan 2014, included conducting an inventory of water resources.
- b) NIP intends to increase the irrigated area and to improve irrigation water management and optimal utilisation of national water resources for crop production. A strategic approach to the development of irrigation infrastructure can be possible only if the available water resources in the country are mapped and its potentials are assessed.
- c) Agriculture is the biggest consumer of the country's fresh surface water through irrigation. Bhutan is known for its rich surface water with five major river basins yet the insufficiency of water for agriculture has become a frequently reported news in the media in recent times. The problem is that water is sufficient when aggregated at the basins level but it is scarce at individual watersheds level which serves as the main source of water for agriculture. **Picture-2** is the diagrammatic expression of how Bhutan faces water shortage for agriculture purposes despite being a water rich country.



**Picture -2: Example of Major River of the valley not benefiting the farmers (Photo: Google Earth image of paddy fields in Dzomi Gewog, Punakha)**

- d) Out of 151 irrigation schemes visited by RAA, 146 schemes (96.68%) have sourced their water from perennial and seasonal streams which become the third or fourth order tributaries of the major rivers. The types of water resources currently used for irrigation purposes in the country are shown in the **Picture-3**.



**Picture-3: Type or irrigation water sources currently being used.**

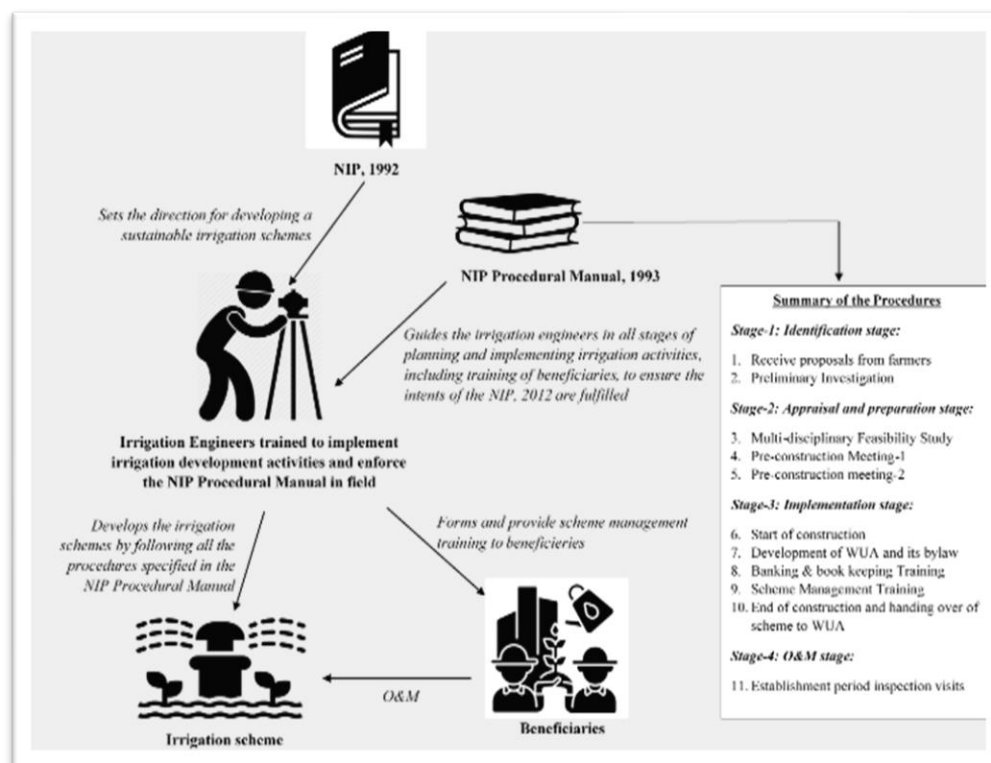
- e) The Watershed Management Division (WMD), DoFPS has divided the country into 186 watersheds, out of which 518,882 hectares of area are considered critical or degraded watersheds.
- f) A preliminary ‘water resource inventory’ was developed by NEC in 2018 in collaboration with other agencies. However, it also does not include springs, lakes, ponds, and any other water bodies, which are also water resources. Further, the inventory for all 186 watersheds has not been done and the information in the water resource inventory was intended to be used for reference and not for decision making or design purposes. A comprehensive inventory of water resources was recommended to establish a strong database.

- g) Furthermore, such water resources are not adequately mapped and documented to guide effective irrigation planning based on the reliability and demand of water across the country. There is no record of any major survey carried out to document the availability of the water resources at each basin level, mapping of the users, command area coverage, the feasibility of sourcing, etc.
- h) Due to the absence of comprehensive water resource information at the national level, the sustainable and strategic approach to planning and development of irrigation infrastructure would be impeded. There were cases where irrigation infrastructures were constructed but became non-operational due to unreliable water sources. The Maling Reservoir Tank in Korphu Gewog, Trongsa and Mangi Zing Water Reservoir Tank in Talo Gewog, Punakha are two examples of such instances amongst others.

### 1.5 Non-development of Procedure Manual for National Irrigation Policy 2012

- a) The first ever Irrigation Policy was launched in 1992 to lay a foundation for a sustainable irrigation development in the country. Subsequently, the Royal Government of Bhutan has developed the NIP Procedural Manual 1993 to operationalise the intentions cited in the Policy document. The Manual served as a practical field guide with detailed explanation of how to apply the NIP 1992 in practice as depicted in **Figure-5**.
- b) The NIP 1992 was revised in 2012 which required the updating of the NIP procedural Manuals to operationalise the policy. Despite having such requirements cited in NIP 2012, DoA has still not revised and updated the NIP Procedural Manual.
- c) The DoA has developed the Irrigation Engineering Manual 2016 which is a comprehensive document to be used in planning and designing irrigation schemes. The Irrigation Engineering Manual 2016 is intended to serve as overall guidance for all irrigation infrastructure planning and development through appropriate appraisals to design and construction to operation and maintenance. However, except for the centrally executed projects, the practices prevalent across the local governments were noted to be inconsistent with this manual. Because of the inconsistent practices, there were cases of improper planning and implementation of the irrigation projects in the local government compromising the lack of quality, usefulness, functionality, and sustainability of the projects. Further, there are no adequate monitoring mechanisms to ensure compliance to the manual.
- d) Had the Irrigation Engineering Manual been enforced, there could have been a consistent irrigation development process amongst the Dzongkhags, effective farmers' participation in irrigation developments, effective Water User Associations/Groups, and multi-disciplinary approach to irrigation development as intended by the NIP 2012.

Figure-5: Procedure to operationalise the NIP 1992 through the help of NIP Procedural Manual 1993.



## 2. PLANNING, DEVELOPMENT AND OPERATION

The DoA's mission is to 'achieve food and nutrition security, agriculture transformation through innovative and sustainable technologies, diversified and competitive economic/production options, inclusive and sustainable policies and programs.' One of the objectives is 'to develop functional farm infrastructures and facilities (irrigation channel, farm roads, post-harvest facilities, etc.)' in achieving its overall vision of 'a self-reliant, productive, diverse, resilient and sustainable agriculture food system'. Besides the range of Acts, the development of irrigation is guided by the NIP and NIMP.

The NIP identifies eight broad policy objectives to provide clear direction on the measures that need to be adopted to increase the irrigated area and to improve irrigation water management and optimal utilisation of national water resources for crop production. As required by NIP, the NIMP was developed in 2016 to provide a 15-year action plan and roadmap for the development of climate adaptive irrigation systems and irrigated agriculture in the country to help attain broad agriculture sector goals of food and nutrition security and enhanced rural incomes.

The NIMP was designed with the four main components:

- (a) Infrastructure development focusing on building infrastructure through improvement of existing irrigation (EIIP) and development of new irrigation (NIDP);

- (b) The land development and agriculture mechanisation (LDAMP) consisting of three sub-components of land development, agricultural mechanisation and on-farm trail development;
- (c) Integrated crop and water management project (ICWMP) which integrates irrigation management into crop production system to optimise the agriculture productivity of an irrigation system and at the same time ensure sustainability of the developed irrigation infrastructure; and
- (d) Institutional development that encompasses DoA, local government, WUAs and private sector irrigation service providers.

The total investment under NIMP was estimated at USD 140 million for 15 years and started from FY 2016-17 coinciding with the second last year of the 11<sup>th</sup> FYP. The RAA's review of systems of operationalising long-term plans (NIMP) and NIP through Five Year Plans showed the following shortcomings:

### 2.1 Non-integration of NIMP into Five Year Plans

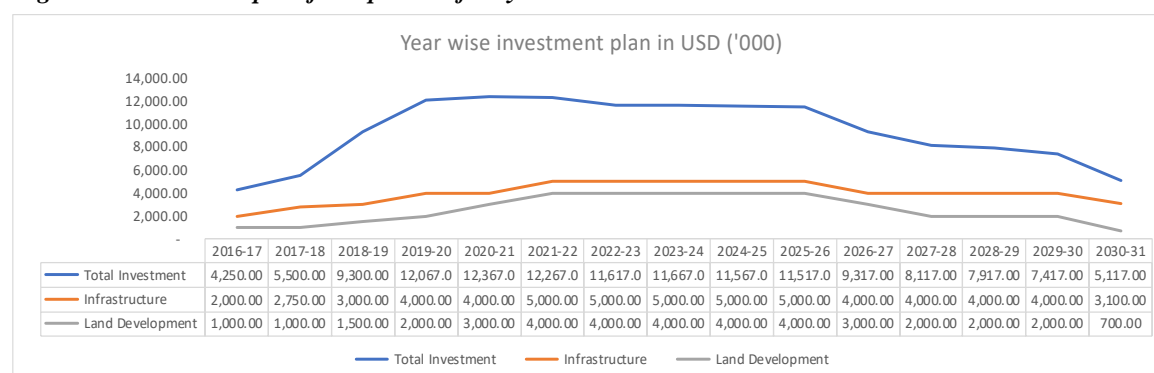
The NIMP projected the total cost of USD 140 million for the implementation of various programmes spread over 15 years from 2016-17 to 2030-31 as shown in **Table-3**.

**Table-3: Investment Cost**

Sl. No.	Key Component of NIMP	Cost (USD) (in '000)
1	Project Studies & Preparations	6,400.00
2	Infrastructure Development	59,850.00
3	Annual O&M of developed irrigation facilities	5,000.00
4	Land Development & Agriculture Mechanisation (LDAP)	38,200.00
5	Integrated Crop and Water Management Project (ICWMP)	17,400.00
6	Institutional Strengthening	5,750.00
7	Implementation Support Services	7,400.00
Total USD		<b>1,40,000.00</b>

- a) The investment plan shows a sharp rise from the third year i.e 2019-20 basically driven by two major projects; Infrastructure Development Project and Land Development & Agriculture Mechanisation Project representing about 70% of the total investment cost as shown in **Figure-6**.

**Figure-6: Investment plan for a period of 15 years**



- b) Review of budget allocations of corresponding financial years of 11<sup>th</sup> and 12<sup>th</sup> FYP, the RAA noted that the budget allocated for implementation of NIMP fell short of required investment as shown in **Figure-6**.

**Table-4: Showing activities and programmes related to Irrigation with budget outlay**

Agency	Activities	Programme	Indicative Outlay (Nu. in million)
<b>NEC</b>	Institutional strengthening of E-Flow	Strengthening Water Security and Enhancing Management	15.41
	Institutionalising NIWRMP	Strengthening Water Security and Enhancing Management	5.00
	Implementation of Water Act and Regulation	Strengthening Water Security and Enhancing Management	2.00
<b>MoAF</b>	Adopt Climate Smart irrigation and water efficient technologies (Install climate smart sprinkler irrigation system)	Climate Smart and Disaster Resilient Development	270.00
	Enhance cereal production(Paddy, hybrid maize and wheat (storage facilities, community based seed production)	Food and Nutrition Security	30.00
	Enhance agriculture infrastructure & farm mechanisation (New farm machineries and area brought under farm mechanisation)	Food and Nutrition Security	371.93
	School Agriculture (Programme Agriculture land developed)	Food and Nutrition Security	10.00
	Effective management of wetlands and watersheds (Habitat enrichment plantations, watershed assessment, water source management)	Sustainable Natural Resources Management and Utilisation	290.00
<b>MoEA</b>	Assess water availability of surface and groundwater	Risk Associated with Geo-hazards Assessed and Reduced	2.00
<b>NCHM</b>	National water resources assessment	Hydrology, Cryosphere and Water Resources Information and Early Warning Services	30.00
	Research and Development on hydrology, cryosphere and water resource	Hydrology, Cryosphere and Water Resources Information and Early Warning Services	2.00
<b>Total</b>			<b>1,028.34</b>

The total outlay for irrigation and environment related activities in the 12<sup>th</sup> FYP was Nu. 1,028.34 million reflected under different sectors as shown in the **Table-4**. These also include activities which are not directly related to irrigation development.

- c) As per the implementation plan, the requirement for funds for implementation of NIMP peaks through 2019-20 to 2025-26 corresponding to four years of 12<sup>th</sup> FYP and first three years of succeeding 13<sup>th</sup> FYP. The average annual allocation requirement is around Nu. 800 to 850 million (@Nu. 70 per USD).

- d) The NIMP envisaged direct and indirect benefits of investing in irrigation development in the country. The direct benefits relate to increase in yield and crop production and the indirect benefits of increasing employment opportunity, support to livestock development, food security and development of climate resilient agriculture system, all of these constituting aspirations of national development goals.
- e) Thus, if the investment requirement for irrigation development in the country is not matched by sustained financing, it may be unrealistic to expect the desired results in the offing. For irrigation development to be considered as an important instrument for harnessing the agriculture potential for economic development, it needs to ensure the sustainability of its finances. The NIMP could be derailed and policy objectives remain adrift if the implementation of programmes envisaged are not prioritised and implemented. And hence, the timeline set for achievement of food security is rendered not relevant and further pushed beyond.

## 2.2 Inconsistent performance measures and indicators

- a) NIMP prescribes a performance framework with performance measures, indicators and targets for monitoring activities, outputs, outcomes and goals of the plan which are directly related to irrigation development. This framework would have guided the formulation of National Key Result Areas and indicators for the successive FYs of the irrigation sector.
- b) On comparison of the results framework of 12<sup>th</sup> FYP with that of NIMP, the RAA noted inconsistencies in the performance measures and indicators. There are no linkages in the performance measures and indicators formulated in the 12<sup>th</sup> FYP and NIMP. Further, there were inconsistencies in the baseline data considered for setting the performance targets. The differences in performance measures and indicators are as shown in the **Table-5**:

*Table-5: Comparison of Performance Indicators*

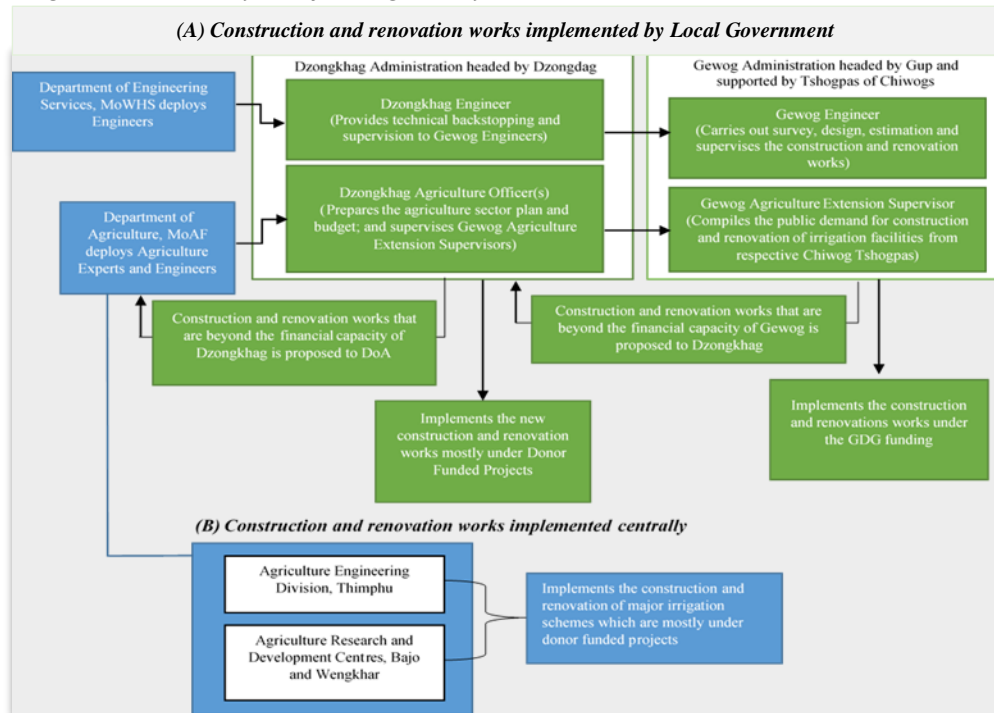
NIMP		12th FYP	
Goal: Food and nutrition security enhanced		Goal: Food self-sufficiency and nutrition security enhanced	
Indicators:	Baseline (2014)	Indicators:	Baseline (2017)
1. Food self-sufficiency in paddy (rice) increased	51%	1. Rice self sufficiency	46.7%
2. Food self-sufficiency in total cereals increased	64%	2. Maize self sufficiency	86%
3. Cropped areas under paddy crop increased	53,659 ac	3. Vegetable self sufficiency	86.1%
4. Cropped areas under total irrigated cereals increased	77,789 ac	4. Fruit production	53,961 MT
5. Cropped areas under cash crop increased:(Baseline: 12,630 ac)	12,630 ac	5. Area under assured irrigation	39,163 ac
6. Cropping intensity of irrigated agriculture increased: (Baseline: 110%)	110%	6. Agriculture land under cultivation	2.75%
		7. Fallow land brought under cultivation	120 acres

- c) For instance, the baseline indicator for rice self-sufficiency in the NIMP was 51% based on production in 2014 while the baseline indicator for the same was maintained at 46.7% based on 2017 data. Except for rice self-sufficiency, all other indicators in the NIMP have changed with different performance targets.
- d) Such changes in performance measures and indicators without due regard to the master plan have substantially distorted the performance framework developed to monitor the progress of the NIMP. There were no documentations of changes made and hence, progress of NIMP cannot be tracked nor course corrections and modifications made to ensure greater performance be identified. Thus, the goals and outcomes that were intended through various strategies developed in the master plan have become irrelevant and line of sight blurred in terms of achieving the overall sectoral goal of food self-sufficiency.
- e) Thus, incoherence of performance measures and indicators of 12<sup>th</sup> FYP with NIMP have resulted in distortion of the entire results framework with numerous changes and modifications of performance measures and indicators. The progress of the master plan cannot be tracked and monitored as clear linkages cannot be established between the two.

### 2.3. Inadequacies in coordination among agencies in irrigation development

- a) The NIP 2012 requires that, '*stakeholders at all levels participating in irrigation development will be responsible and accountable in delivery of services for irrigation development.*' This policy statement transpires a wisdom of necessitating an integrated approach throughout the process of planning and development of the irrigation infrastructure from need assessment and prioritisation to management of the irrigation schemes.
- b) The DoA (at central level) and the Dzongkhags and Gewogs Administration (at local government level) are the primary institutions responsible for developing and managing irrigation facilities. The irrigation schemes which are beyond the capacity of Gewogs and Dzongkhags are undertaken by the DoA. The two tier system for irrigation development is as illustrated in **Figure-7**.

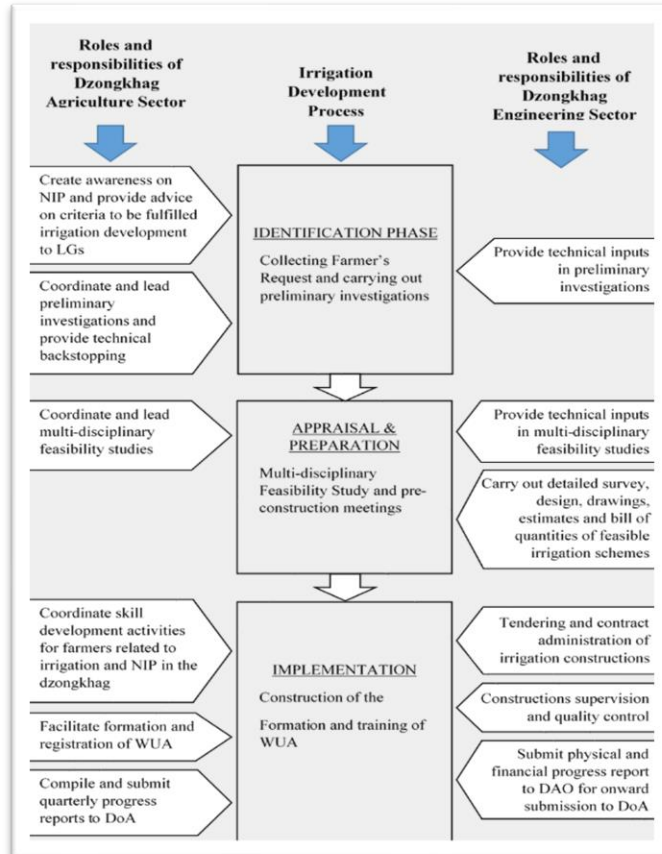


**Figure-7: Two tier system for irrigation system**

- c) Based on the current arrangement, the DoA had identified 108 irrigation schemes to be undertaken and 33 schemes were included in the 11<sup>th</sup> FYP. Only 9 schemes were completed at the end of the 11<sup>th</sup> FYP. The list of irrigation schemes included in the NIMP considered the remaining balance of 108 irrigation schemes identified earlier. Those that were undertaken by the LGs are prioritised in the GTs and DTs and implemented as per the budget availability.
- d) RAA noted that the development/rehabilitation of irrigation schemes undertaken by LGs are not based on the list as per NIMP but depended on availability of budget of the respective LGs. There was no synchronised way of planning and prioritising for development or rehabilitation as well during execution of the projects.
- e) Even for the irrigation systems which were centrally executed by the Agriculture Engineering Division, DoA, there are no administrative arrangements for collaboration with the Dzongkhags during implementation. The completed structures are handed over to the respective Dzongkhags/Gewogs only after the completion of the project.
- f) Due to such siloed practice of implementation of irrigation systems, the RAA noted instances where monitoring and supervision during execution could not be ensured by the central agency. As a result, there were instances of irrigation facilities that could not be put to use due to substandard works and technical defects of the structures.
- g) The RAA also noted lack of coordination between DoA and DoFPS in terms of complementing its roles in managing water source and watersheds through sharing of information. While DoA is responsible for the land-use and irrigation, the DoFPS is responsible for watershed management, water resources in forest, wetlands and protection of catchment areas.

- h) Further, there is also lack of coordination with other agencies, which has resulted in causing damages to irrigation schemes due to expansion of roads and other developmental activities. During the field visits, the RAA came across seven irrigation schemes damaged by construction of roads and developmental activities.

**Figure-8: Roles and responsibilities of DAO and DE in developing irrigation schemes**



- i) Within the Dzongkhag Administration, the NIP 2012 delineates roles and responsibilities to agriculture sector and engineering sector as shown in **Figure-8**. The Dzongkhag Agriculture Sector and Dzongkhag Engineering Sector are required to collaborate in all the stages of developing the irrigation scheme. However, RAA observed that the role played by the Dzongkhag Agriculture Sector is only to the extent of coordinating the annual plan and budget for the proposed irrigation works. None of the roles and responsibilities shown in **Figure-8**, especially for identification phase and appraisal & preparation phase, are being fulfilled by the Dzongkhag Agriculture Sector.
- j) In the current practice, the Dzongkhag Engineering Sector independently carries out the surveys, designs and estimations and gets the works executed through contracts or through voluntary labor contribution whichever option is decided by the local governments. Thus, Dzongkhag Agriculture Sectors have not taken full ownership of the irrigation development activities in the Dzongkhags and remained unaccountable for all the failed projects.
- k) RAA observed instances where some Gewog Agriculture Extension Staff hardly know what irrigation repair and maintenance works were executed by the Gewog Administration in previous years. This clearly shows the level of involvement of the agriculture sector officials in implementing the irrigation works.
- l) These are clear cases of non-adherence to the roles and responsibilities delineated in the NIP 2012 and are attributable to monitoring and control weaknesses within the agencies as well as inadequate oversight mechanisms in enforcing the responsibilities at various levels.

## 2.4. Non-enforcement of multi-disciplinary feasibility studies

- a) NIP 2012 stipulates that *'feasibility studies including technical feasibility, social and economic benefits should be done one year before implementation to ensure the sustainability of the irrigation schemes.'* To effect this policy statement, the NIP 2012 delineates roles and responsibilities to:
  - i) The Dzongkhag Agriculture Sector *'to take lead coordination role in preliminary investigations and multi-disciplinary feasibility studies,'*
  - ii) The Gewog Agriculture Extension Office *'to take a lead role in preliminary investigations and multi-disciplinary feasibility studies,'* and
  - iii) The Dzongkhag Engineering Sector *'to provide technical inputs in preliminary investigations and multi-disciplinary feasibility.'*
- b) During the field visits to Dzongkhags, the RAA noted that there is no practice of carrying out multi-disciplinary feasibility studies while proposing the irrigation projects. The proposals for irrigation projects are endorsed from GTs and DTs along with other plan activities and there were no documentations of such studies being conducted across all LGs. There is no record of assessing the requirement and its compliance by the authorities in the process of proposing the irrigation projects.
- c) Further, there is no prescribed process or guidelines for conducting multi-disciplinary feasibility studies except for policy intent. Such guidelines would suggest critical elements, processes and modalities of feasibility studies to facilitate implementation and enforcement of requirements across LGs.
- d) Multi-disciplinary feasibility study is a critical exercise to assess the viability of the proposed irrigation systems in terms of water sources, economic and social benefits, technical prospects, etc. to ensure overall sustainability of proposed irrigation systems. If enforced and complied, the government could have avoided investments in those irrigation projects that could not be put to intended use due to problems attributable to non-compliance to this requirement.
- e) RAA noted several such cases where sustainability of irrigation systems could not be ensured as discussed below:

### **Illustration I (Picture-4):**

Thangna-Pangna Irrigation Scheme under Drujeygang Gewog, Dagana was undertaken by Dzongkhag at the cost of Nu. 13.63 million from 2016-17 to 2018-19. A mix of pipelines and concrete canals, planned in two packages. RAA noted that the Package-1 could not be completed as it had to cut across the cliff for which the contractor did not have the capacity. Package-2 was completed but abandoned as it cannot be used unless Package-1 is completed.



*Picture-4: Thangna-Pangna Irrigation Scheme, Drujeygang Gewog, Dagana*

### **Illustration II (Picture-5):**

Jalikhhar Irrigation Scheme in Chamkhar Throm, Bumthang was awarded on contract at Nu. 2.29 million from 2016-17 to 2018-19. The pipeline and reservoir tanks were installed to supply water for the paddy fields of Jalikhhar community. However, the community refused to take over the facilities as it did not meet the deliverables proposed by the community. The structures delivered were found to be of poor quality, which are currently lying unutilised.



*Picture-5: Jalakhar Irrigation Scheme in Chamkhar Throm, Bumthang*

### **Illustration III (Picture-6):**

- i. During the FYs 2015-16 to 2017-18, Trongsa Dzongkhag had spent Nu. 4.30 million to construct several water storage tanks for irrigation purposes in Korphu Gewog. However, these storage tanks and pipelines were currently not in operation due to drying up of water sources. Beneficiaries had to abandon despite contribution of their private lands for the project. The RAA also noted missing and damage of several pipes due to road constructions.
- ii. A massive water storage tank namely ‘Mang Gi Zing’ was constructed in Talo Gewog, Punakha along with several distribution iron pipelines to supplement the agricultural water shortages (cost and year of construction not known). However, the storage tank was found abandoned due to an unreliable water source. During the site visit, the RAA found that the majority of pipes were also stolen.



**Picture-6: Monmogang Reservoirs and Irrigation facilities, Korphu Gewog, Trongsa (Top two Rows); Mang Gi Zing, Talo Gewog, Punakha (Bottom Row)**

#### **Illustration IV (Picture-7):**

- i. Tserina water storage tank in Sharpa Gewog, Paro and Rubesa storage tank in Rubesa Gewog, Wangdue Phodrang have also faced the similar consequences. Tserina storage tank was abandoned after the water source dried up and the Rubesa storage tank has not been used by farmers for the same reason.
- ii. A typical instance was observed in Kangpar Gewog, Trashigang where a storage tank was constructed but washed away by erosion as the tank was constructed in the marshy area without studying the stability of the soil.



**Picture-7: Tserina Reservoir, Sharpa Gewog, Paro (Bottom row left); erstwhile reservoir in Threlphu, Kangpara Gewog, Trashigang (Bottom Row Right).**

**Illustration V (Picture-8):**

- i. Tseza Gewog, Dagana has installed pipelines to upgrade traditional earthen Tajulum Irrigation Scheme. The fields are currently left fallow and pipelines are lying unutilised. Nonetheless, most of the villagers have migrated to town looking for better economic opportunities and a few households who were willing to cultivate the land could not succeed due to severe wildlife conflicts. A typical instance was observed in Kangpar Gewog, Trashigang where a storage tank was also constructed but washed away by erosion as the tank was constructed in the marshy area without studying the stability of the soil.
- ii. Similarly, Pema Gatshel Dzongkhag has installed pipelines to cultivate the Bronkola area of Khar Gewog under the CARLEP Project. However, farmers had stopped cultivating the field due to severe wild-life threats and labour shortage as the fields are located far from the settlements. The land is currently left fallow and the pipeline lying unutilised.



**Picture-8: Tajulum Irrigation Scheme, Tseza Gewog, Dagana (Top Row) and Bronkola Irrigation Scheme, Khar Gewog, Pemagatshel (Bottom Row)**

- f) Had there been a system of carrying out multi-disciplinary feasibility studies within the process, the investment could have been avoided if it was assessed to be not viable technically or otherwise. Thus, the above cases of abandonment and inability to make use of the infrastructure could be attributed to non-conduct of necessary feasibility studies.
- g) The current system lacks enforcement and monitoring mechanisms in that the pre-studies related to irrigation development are not based on holistic assessments to ensure long term sustainability of the infrastructure. Neither such practices would facilitate prudent allocation of resources.

## 2.5. Non-implementation of National Irrigation Master Plan (NIMP)

- a) The infrastructure development in the NIMP consists of two types of irrigation developments; (a) improvement of existing irrigation systems and (b) development of new irrigation systems as shown detailed in **Table-6**.

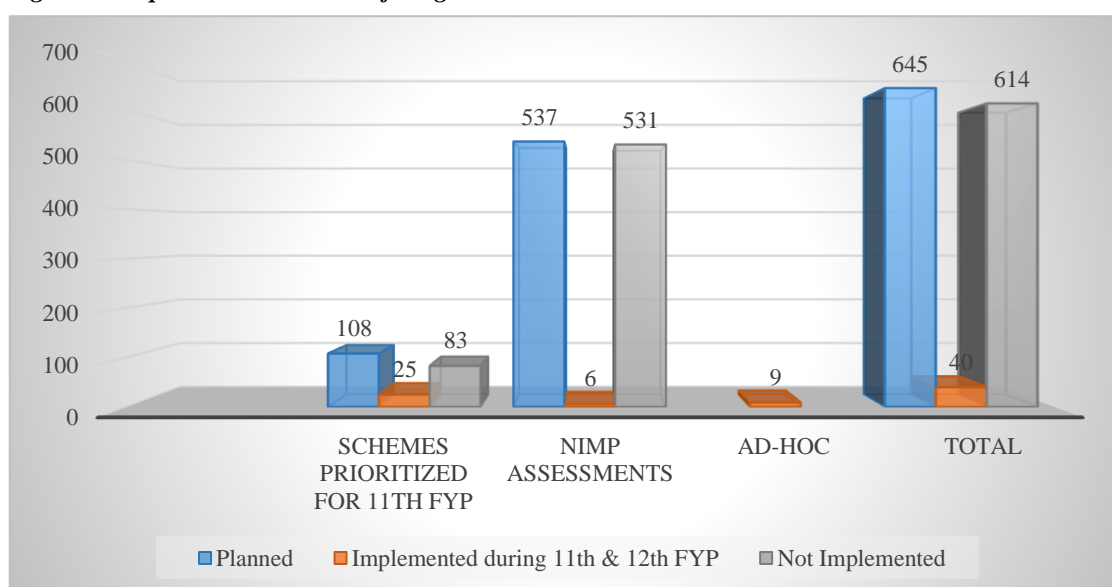
**Table-6: Summary of a proposed Irrigation development project till 2030 period**

Type	Proposed irrigation sub – projects (Number)	Targeted Areas command (acres)
<i>Existing irrigation improvement project (EIIP)</i>		
1.1 Modernisation of Existing Irrigation Systems	243	18,000
1.2 Renovation of existing irrigation systems	49	7,930
1.3 Bottleneck repair of Existing Irrigation Systems		22,000
<i>Development of new irrigation systems</i>		
2.1 New Hill Irrigation Development Project (NHIDP)	144	13,763
2.2 Dry Land Irrigation Development Project (DLIDP)	57	4,000
2.3 Wet Subtropical Irrigation Development Project (WSIDP)	44	11,000
	<b>537</b>	<b>76,693</b>

As depicted in **Table-6**, 537 irrigation sub-projects with target command areas of 76,693 acres over a 15-year period. These irrigation schemes were selected based on the intensive research in collaboration and consultation with relevant stakeholder and beneficiaries. The prioritisation selection of schemes was done using Multi-criteria analysis (MCA) for each of the projects. Besides the schemes identified in NIMP, DoA had also prioritised 108 schemes to be implemented during the 11<sup>th</sup> FYP. Thus, in total 645 irrigation schemes were planned to be implemented till 2030

- b) On review of implementation of NIMP, it was noted that out of 645 schemes identified for implementation, only 40 schemes were implemented during the 11<sup>th</sup> and 12<sup>th</sup> FYs, which includes 25 from the 108 prioritised schemes, six from NIMP and nine ad-hoc (as depicted in **Figure-9**). As evident from the Figure, it can be noted that the NIMP is not integrated with the FYs for the implementation of the master plan.

**Figure-9: Implementation status of irrigation schemes**



- c) DoA, however, has implemented nine schemes neither from proposed list in the master plan nor from the prioritised list as presented in **Table-7** below. The ad-hoc selection of schemes is an indication of inadequate planning and lack of coherence with the master plan.

**Table-7: Development of irrigation schemes outside NIMP**

SN	Dzongkhag	Gewog	Village	Name of Scheme	L(km)	Funding Source	Remarks	Type
<b>FY 2013-2014</b>								
1	Lhuntse	Minje	Gorgan	Gorgan	10.00	ABSD	Completed	R
2	Lhuntse	Minje	Khamdhar	Khamdhar	10.00	ABSD	Completed	R
<b>FY 2017-18</b>								
3	Lhuntse	Maedtsho	Yamalung	Zhamangchhu_Yamalung	7.00	GCCA	Completed	R
4	Sarpang	Chhudzom	Dovan	Maogoan irrigation channel	7.60	GoI	Completed	N
<b>FY 2018-19</b>								
5	Trongsa	Korphu	Nabji	Lingbay Irrigation Scheme	2.30	GEF LDCF	Completed	N
6	Haa	Samar	Langpa	Langpa_Nobgang	10.00	GEF LDCF	Completed	R
<b>FY 2019-20</b>								
7	Sarpang	Gakiling	Gakiling	Laringkhola Irrigation Scheme	7.50	GAFSP/FS APP	Completed	N
8	Samtse	Dophuchen	Somlachen	Bir Kulo Irrigation Scheme	2.00	GAFSP/FS APP	Completed	N
9	Samtse	Sibsoo	Sibsoo	Beru-sibsoo Irrigation Scheme		RGoB	Completed	R

- d) Although development of new irrigation schemes and rehabilitation or modernisation of existing schemes are clearly identified in the NIMP, the DoA still continued to implement the spillover projects from the 11<sup>th</sup> FYP during the 12<sup>th</sup> FYP without integrating FYPs with the master plan. The current trend shows that a maximum of three years is taken to complete the construction and renovation of irrigation schemes. DoA is found to be implementing previous years / spill over irrigation schemes (presented in **Table-8**) from the past years (2014-2018) which hindered the implementation of the master plan.

**Table-8: Summary of spillover activities**

SN	Dzongkhag	Gewog	Village	Name of Scheme	L(km)	Type	Planned Yr.	Status
<b>Irrigation Schemes completed during FY 2018-19 as indicated in APA document</b>								
1	Tsirang	Sergithang	Sergithang Mae	Jhatey Irrigation Scheme	7.20	GEF LDCF	FY 2015-16	Completed
2	Trongsa	Korphu	Nabji	Lingbay Irrigation Scheme	2.30	GEF LDCF	FY 2015-16	Completed
3	Punakha	Talo	Lunakha/Bejana	Phendey Irrigation Scheme	25.00	GEF LDCF	FY 2014-15	Completed
4	Haa	Samar	Langpa	Langpa_Nobgang	10.00	GEF LDCF	FY 2017-18	Completed
<b>Irrigation Schemes completed during FY 2019-20 as indicated in APA document</b>								
1	Sarpang	Dekiling	Dekiling	Rateykhola Irrigation Scheme	3.50	GAFSP/FSAPP	FY 2014-15	Completed
2	Sarpang	Gakiling	Gakiling	Laringkhola Irrigation Scheme	7.50	GAFSP/FSAPP	FY 2015-16	Completed
3	Samtse	Norbugang	Bhimtar	Taraykhola Irrigation Scheme	11.00	GAFSP/FSAPP	FY 2015-16	Completed
4	Samtse	Dophuchen	Somlachen	Bir Kulo Irrigation Scheme	2.00	GAFSP/FSAPP	FY 2015-16	Completed
5	Tashigang	Phongmey	Yabrang/Saling	Yabrang/Saling Irrigation Scheme	7.80	RDCCRP/WB	FY 2014-15	Completed
6	Lhuntse	Maenbi	Zhungkhar	Zhungkhar_Maenbi	3.00	RDCCRP/WB	FY 2015-16	Completed
7	Samtse	Sibsoo	Sibsoo	Beru-sibsoo Irrigation Scheme	8.00	RGoB	FY 2015-16	Completed

Source: AED, DoA

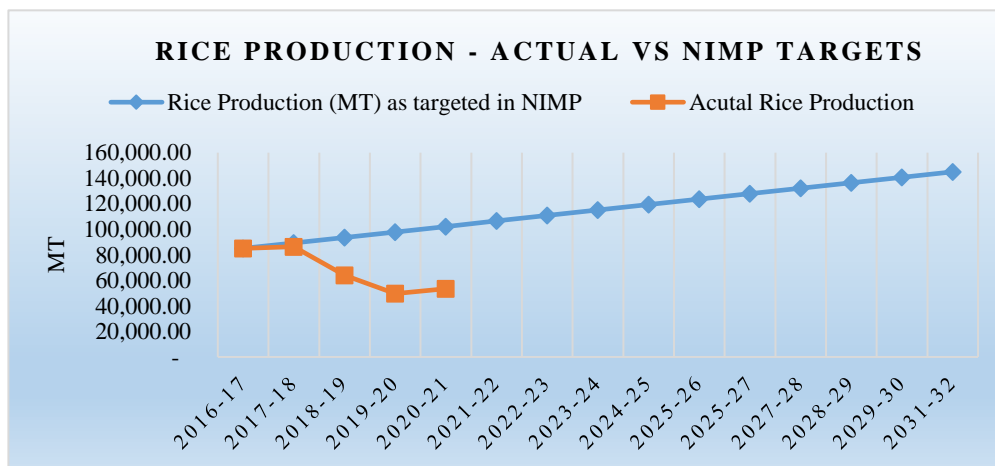


- e) While the financial layout for the master plan was estimated, the same could not be realized/secured for implementation of NIMP. Despite the huge investment made in developing the NIMP as a road map for irrigation development in the country, the DoA has not been able to operationalise the intent of the master plan through integration into Five Year Plans.
- f) Therefore, the department’s core mandate to ensure sustainability of the irrigation system to realise the food security would be derailed and attaining the desirable outcomes would be far-fetched without any strategic focus for the sector.

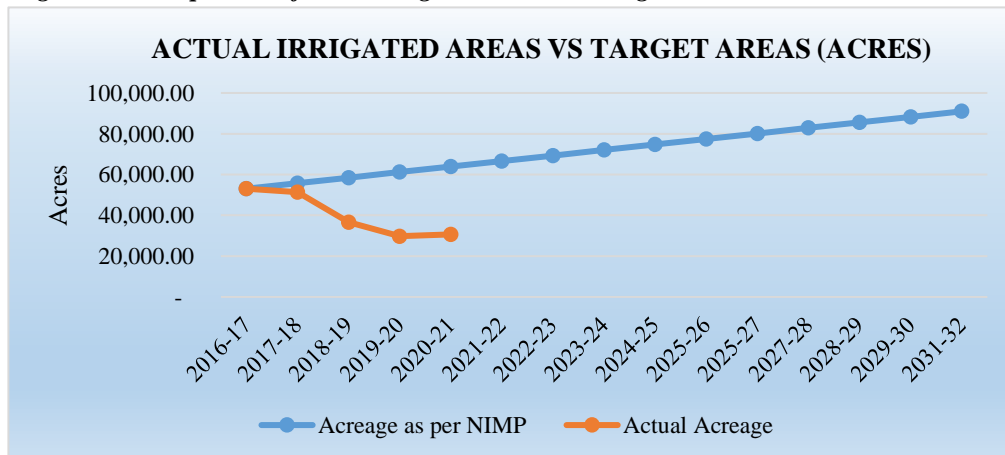
**2.6 Irrigation sector is not geared to achieve the targets of NIMP**

- a) DoA was expected to prioritise the activities in the National Plan aligning with the Master Plan to pursue national goals of reaching food and nutrition security and enhancing rural income in the country.
- b) The RAA compared two targets of paddy production and areas under irrigation of the NIMP with the actual targets achieved as of 2020-21 and noted that it is unlikely to achieve the plan targets by 2030 given the pace at which the progress is made as evident from **Figure-10 and 11** below:

*Figure-10: Comparison of rice production with NIMP targets*

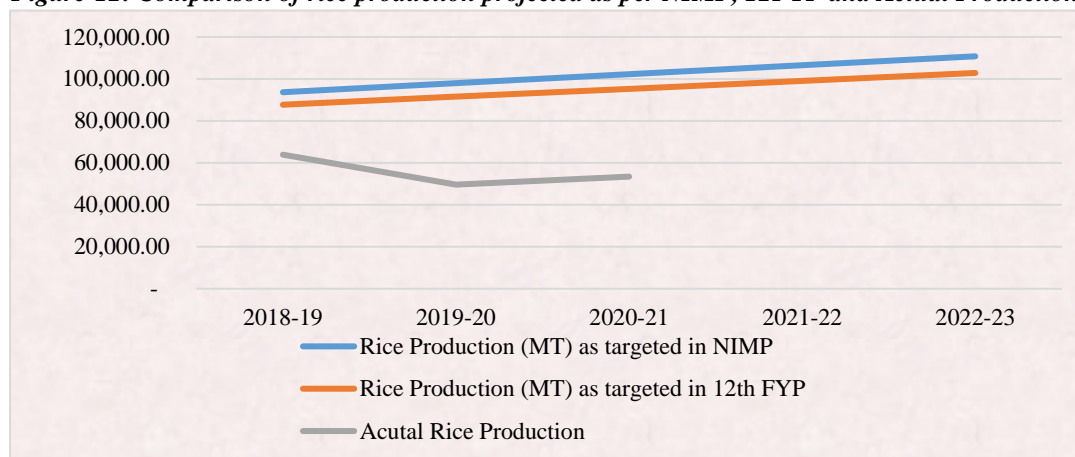


*Figure-11: Comparison of actual irrigated areas with target areas*



- c) The 12<sup>th</sup> FYP set a target of 102,827.00 MT of rice production by end of 2022-23 and its annual production targets throughout the five-year plan period showed an almost consistent target of NIMP (extrapolated). However, the actual productions in the first three years of 12<sup>th</sup> FYP fell short by around 50% from its annual targets. The trends of targets of NIMP, FYP and actual production are as depicted in **Figure-12**.

**Figure-12: Comparison of rice production projected as per NIMP, 12FYP and Actual Production (MT)**



- d) The mid-term review of 12<sup>th</sup> FYP conducted in May 2021 identified achievement of rice production target as risk and proposed for revision of target to 43% self-sufficiency from 60% which is a drastic reduction of target even falling below the baseline target of 46.70% in 2017.
- e) While reviewing the NIMP documents, the RAA noted that the master plan was prepared based on thorough studies and the targets and strategies proposed were grounded on well researched facts and information. If FYPs were guided by such plans, development of agriculture could be driven in the manner that would ensure achievement of the targets set. However, due to the fact that there had been a disconnect between the FYPs and NIMP in terms of integration of activities, the goals set by the NIMP would continue to remain unaccomplished. Further, the revision of annual targets merely on the basis of anticipated risk instead of identifying mitigation measures would further derail the sector from achieving its long term goals.
- f) Thus, in view of the fact that NIMP has not guided the development of FYP related to the irrigation sector, the realisation of strategic outcomes is not facilitated. The question also arises as to the need to have such plans in the first place. Thus, considering the achievement of targets so far, the financial resources of Nu. 101.28 million (\$1,624,677 @ Nu. 62.334) spent on developing NIMP (*including National Integrated Water Resource Management Plan, Wangchhu River Basin Management Plan and Engineering Manual*) have not been able to achieve value for money.

## 2.7. Inadequacies in research and development for irrigation technologies

- a) In order to address the scarcity of water at the individual watershed levels and also to supplement irrigation water, the NIP intends exploration of new technologies for ensuring sustainable irrigation through research and development and delineates the responsibility to RNR Research & Development Centers under DoA.

- b) Inadequacies of technological solutions for tapping the water usually result in scarcity being experienced even along the banks of rivers. The water needs are not addressed despite perennial rivers providing abundant water as shown in **Picture-2**.
- c) The NIMP also suggests that prior to designing an irrigation system, it is essential to decide on the irrigation technology to be adopted to render the capability of delivering irrigation water to meet the desired objective. The most appropriate irrigation technology for a particular setting needs to be studied under various circumstances as the suitability of a particular irrigation technology depends on factors like natural conditions, type of crops, irrigation methods, irrigation experience, required labor inputs, and costs and benefits.
- d) In line with this intent, a few researches on lift irrigation systems (using pumps) were carried out and piloted four projects in some Dzongkhags during the 11<sup>th</sup> FYP. However, the RAA noted several instances where such pilot projects were unsuccessful and failed to serve the purpose. It was learned that the high turbidity of water especially during monsoon was one of the reasons causing damage to the pumps. In addition, the steep terrain, huge electricity consumption, inadequate knowledge to operate such pumps etc., were some problems cited as reasons for the failure of lift irrigation systems.
- e) Instances of defunct and non-utilisation of lift irrigation system noted are discussed below:

#### Illustration VI:

- i. Two lift irrigation systems installed in Ugyentse and Tashichhloing Gewogs, Samtse were not utilised due to high operating cost, unfamiliarity of the system for usage, and need for change in electrical panel boards.
- ii. The Lift Irrigation System in Chhimipang, Lobeysa has become defunct since its establishment due to some technical issues with pump accessories and electrical connections.

#### Illustration VII (Picture-9):



**Picture-9: Water Pump system and Reservoir Tank Wangchang Gewog, Paro.**

Similarly, the lift irrigation system, installed at Wangchang Gewog, Paro at a cost of Nu. 5.14 million during 2015-2016 & 2016-2017 to irrigate the paddy fields around the Bondey area, was not used. The pump was lying idle as the pipeline system attached to the pump failed to work due to outbursts at several locations.

### Illustration VIII:

- i. The lift irrigation system in Wangringmo, Trashy Yangtse became defunct due to blockage of the pump system caused by fine silts in filter assembly. The system was not repaired until now due to lack of maintenance budget.
- ii. Wangdue Phodrang Dzongkhag has piloted a pump system along Dangchhu River to irrigate the paddy fields in Rubessa Gewog. Although the pump system did not require electricity to operate as it is done automatically by the current of the river, the pump system became defunct due to the fluctuating water level and blockages caused by fine silt. The water tanks, pipes and other items procured for the lift irrigation were missing from its location and moreover, there are no records available with the Dzongkhag Agriculture Sector.



*Picture-10: Jalakhar Water Pump Systems, Chamkhar Throm, Bumthang which is a success story*

- f) The RAA also noted a success story of use of centrifugal water pumps installed at Jalakhar under Chamkhar Throm, Bumthang as shown in **Picture-10**.
- g) A low-cost plastic lined water harvesting pond was piloted in Barshong Gewog, Tsirang in 2014. While the project was successful during the pilot period, use of such ponds could not be promoted across the country because DoA is of the view that their responsibility is to research and test technologies and the responsibility to promote such technologies lies with local governments.

- h) One of the successful water management initiatives implemented by the DoA is the use of plastics for mulching and tunneling. Plastic mulching and tunneling are the best methods to retain soil moisture during the dry seasons. However, the excessive use of plastics is a concern in terms of generating a huge amount of waste in the future, which the DoA currently does not have any plans and strategies for safe disposal of the unserviceable plastics. The examples of plastic mulching and tunneling are provided in **Picture-11**.



*Picture-11: Example of Plastic Mulching (Left) and Example of Plastic Tunneling (Right)*

- i) During the field visits, the RAA came across many good practices left behind by international agencies in constructing concrete irrigation canals. For instance, there are several well-designed canals built by Dai Nippon Construction in early 1980s, which are still functioning without any damage to the concrete structures as shown in **Picture-12**. The working files of some old projects implemented by the Japanese companies also contain preliminary study and feasibility study documents which can be taken as an example to institute a system of carrying out preliminary studies before constructing the irrigation schemes.
- j) The culture of using sprinkler and drip irrigation technologies in the country is at the rudimentary stage. Although such technologies are best in terms of sustainable use of water, the RAA did not find significant progress in the use of such irrigation methods except in a few areas. **Picture-13** is an example of a sprinkler irrigation system initiated by the Dzongkhag where the beneficiary farmers expressed great satisfaction of having such projects particularly for cultivating vegetables. Thus, the RAA is of the view that the agriculture sector has a scope to promote such technologies in the country for vegetables and horticulture productions.



*Picture-12: Irrigation schemes constructed by Dai Nippon Construction*

- k) Given geographical limitations, various challenges are faced in sustaining a particular type of technology. Most often failures are attributed to high turbidity of water in the use of lift irrigation systems. There is a need to explore appropriate technological solutions based on thorough research to ensure sustainability of water for irrigation and also replicating successful ones throughout.



*Picture-13: Kheri Pam Micro Irrigation, Samkhar Gewog, Trashigang*

## 2.8. Issues of quality related to irrigation infrastructure

The RAA through the document reviews and physical verification of various irrigation infrastructures in some of the Dzongkhags and Gewogs noted a range of issues related to the conditions of the irrigation infrastructure. These are related to quality, and improper development and management of infrastructure undermining the overall functionality, usefulness and sustainability of the irrigation systems as depicted below:

### Illustration IX (Picture-14):

In this example, the canal for Janagakha-Phongdho irrigation scheme, Tsento, Paro is found deeper and wider at the beginning with a capacity to draw a huge volume of water. However, several stretches in the middle became proportionately shallow and narrow leaving the possibility of overflows.



*Picture-14: Janagakha-Phongdho Irrigation Scheme, Tsento Gewog, Paro*

**Illustration X (Picture-15):**

In this example, a massive intake tank developed for the Melongkhar irrigation scheme, Yallong, Trashi Yangtse, was completely filled with sand because of design shortcomings. There are no washout mechanisms installed to drain out the sand.



*Picture-15: Melongkhar Irrigation Scheme, Yallang Gewog, Trashi Yangtse*

**Illustration XI (Picture-16):**

Pipes installed for the Aum Tshokimo-Wolathang irrigation scheme were damaged due to inappropriate installation of air valves in the pipelines. If the valves are not installed at the right positions, the pipes will be sucked in and flattened whenever there is a burst or wash-out activities carried out.



*Picture-16: Aum Tshokimo-Wolathang Irrigation Scheme, Toedwang Gewog, Punakha*

**Illustration XII (Picture-17):**

Some of the irrigation schemes that RAA has visited had inadequate or poor support systems which resulted in breakage of irrigation pipes.



*Picture-17: Layo Kulo, Kilkhorthang Gewog, Tsirang; Karshong Irrigation Scheme, Nubi Gewog, Trongsa; and Yangbari Irrigation Scheme, Gongdu Gewog, Mongar*

**Illustration XIII (Picture-18):**

As illustrated in **Picture-18**, there was a design problem with inflow and outflow pipes for Lungdarichhu irrigation scheme, Tongmijangsa, Trashi Yangtse. The inflow pipe [A] of the silt basin was bigger than outflow pipe [B] which may result in loss of water through overflow.



*Picture-18: Lungdarichhu Irrigation Scheme, Tongmijangsa Gewog, Trashi Yangtse*

**Illustration XIV (Picture-19):**

In some cases, water pipes were improperly laid affecting the durability of the pipes due to frequent disconnections, bursts, and breakages resulting in waste of water on transit.



*Picture-19: Daba Irrigation Scheme, Nubi Gewog, Trongsa*



**Illustration XV (Picture-20):**

Open canals were poorly designed to suit the gradient of the land. In some cases, irrigation canals were too steep leading to uncontrolled flow of water resulting in a loss of water on transit as seen in **Picture-20**.



*Picture-20: Photo from left to right: Tangsibji Irrigation Scheme, Tangsibji Gewog, Trongsa; one of the distribution canals in Melongkhar village, Yallang Gewog, Trashigang; and Dungjuri-Lem Irrigation Scheme (Phongmey Gewog, Trashigang)*

**Illustration XVI (Picture-21):**

Irrigation schemes deteriorated from the original state despite renovation because of poor quality of works as shown in **Picture-21**.



*Picture-21: Photos from left to Right- Yuseb Irrigation Scheme (Phangyul Gewog, Wangdue Phodrang); Samtegang Irrigation Scheme (Nisho Gewog, Wangdue Phodrang); Tangsibji Irrigation Scheme (Tangsibji Gewog, Trongsa)*

**2.9 Deficiencies in maintenance of irrigation schemes**

- a) One of the policy objectives of NIP 2012 is to sustain irrigation infrastructure through renovation and routine maintenance. The renovation of irrigation schemes is to be implemented by the project implementing agency of the RGoB or the local government and the responsibility of routine maintenance to be entrusted to WUAs after the completed irrigation channels are handed over.
- b) Renovation of existing irrigation systems, as per the NIMP 2016 involves essential structural improvements (ESI). It focuses on replacing temporary structures by more durable ones, reshaping of canals, and building water control structures where needed with an objective of enhancing the system's efficiency. This does not involve reengineering of irrigation systems. The NIP 2012 defines Routine Maintenance as *'activities such as clearing canals/pipes of vegetation, sediments, repairing minor damages to canal embankment, gates, intake structures that can be performed by the beneficiaries without external assistance.'*

- c) During the site visits, the audit team noted that the formation of WUAs were normally absent, rather Water User Groups (WUGs), which have been formed since the first development of irrigation canals and operation of such groups were based on traditional and customary water sharing practices. WUGs, although not formally registered, are taking over the irrigation schemes after completion and involve the beneficiaries in the management and routine maintenance of the irrigation schemes through labour or financial contributions.
- d) The routine maintenance activities that required a certain level of technical knowledge and training were found implemented by the WUA/WUGs within their capacity. Additionally, as per the NIP Procedural Manual 1993, the WUA should be involved during the construction phase not only to ensure meaningful participation but also in order to prepare for later operation and maintenance tasks. Throughout the construction period farmers should receive training in technical skills, particularly the masonry skills. It was noted that the some WUAs have exhibited good workmanship and quality of works as seen in **Picture-22**:



*Picture-22: Example of a concrete work executed by the beneficiaries who have skills (Renovation of Jichulum Irrigation Scheme, Kabjisa Gewog, Punakha).*



*Picture-23: Daba Irrigation Scheme, Nubi Gewog, Trongsa (Top Left); Aum Tshokimo to Wolathang Irrigation scheme, Toedwang Gewog, Punakha (Top Right); Bayul Irrigation Scheme, Dzomi Gewog, Punakha (Bottom Left); Karshong Irrigation Scheme, Nubi Gewog, Trongsa (Bottom Right).*

- e) While the NIP 2012 intends to delineate responsibility of major renovations to LGs and government agencies, and limit the responsibility of WUAs to routine maintenance, it is apparent that beneficiaries are compelled to extend their role. LGs and government agencies are not able to undertake renovation works. In most cases, due to lack of adequate skills of the WUAs, the quality of work could not be maintained and hence, undermined its functionality. Some of such cases of poor quality of works executed by WUAs are as shown in **Picture-23**.
- f) The RAA noted that the renovation works are initiated as a temporary measure due to lack of strategic maintenance plan and secured funding. Though the NIMP identified irrigation systems for renovations, due to clear link of integration into Five Year Plans, the implementation status cannot be ascertained.
- g) Without a clear plan for renovations, and also due to the lack of skills of beneficiaries, the sustainability of existing irrigation channels would be at risk. The current practice of undertaking renovations by the beneficiaries may not support the policy objective if, strategic renovation and maintenance plan is not put in place and the LGs and relevant government agencies do not take a lead role in undertaking renovations.

## 2.10. Incomplete inventory of irrigation Schemes

- a) Section 11 of Water Regulations of Bhutan 2014 recognises the importance of maintaining comprehensive inventory of irrigation systems in the country and designates MoAF as the Competent Authority on irrigation system, watershed and wetland management and one of its functions include *developing a comprehensive inventory on irrigation systems in the country and review periodically*.
- b) NIP 2012 specifies one of the objectives as maintaining ‘*a comprehensive inventory of irrigation in the country.*’ The responsibilities were delineated to Gewogs and Dzongkhags respectively.
- c) MoAF had published Irrigation Schemes Atlas of Bhutan 2015 containing a list of irrigation schemes with details of Scheme ID, Scheme Name, Village, Gewog, Length and Functionality along with Dzongkhag wise maps. The Irrigation Atlas identified 851 schemes as functional, 47 as non-functional and 5 schemes as ongoing projects as of 2015.
- d) RAA noted that there is no comprehensive irrigation inventory maintained either with DoA or Dzongkhags and Gewogs to provide necessary information of existing schemes including the record of renovations carried out so far.
- e) Even with the existing records, there were several cases of mismatch of basic information such as names, numbers, length etc. of the schemes. The list of the irrigation schemes submitted by the DoA and Dzongkhags are provided in the **Appendix I**. Moreover, the irrigation schemes which existed before 2015 were found not included in the Irrigation Atlas 2015.

- f) RAA obtained a list of irrigation schemes from 20 Dzongkhags and noted that there were inconsistencies and incomplete information relating to functional status, year of construction, command areas, source of funding, etc. The summary of the incomplete information is presented in **Table-9**.

**Table- 9: Missing or incomplete information in list of irrigation maintained in local governments**

Sl. No.	Information requested by RAA	No. of Schemes with missing information
1	Name of Village	32
2	Length of Canal (Km)	41
3	Functional Status (Functional, Semi-Functional, Non-Functional)	1
4	Source of Irrigation Water (Eg. Stream, River Basin, etc.)	206
5	Year of Construction	485
6	No. of Beneficiary Households	60
7	Gross command area (Ac)	429
8	Net command area (Ac)	426
9	Constructed by (1. Government, 2. Farmer's Initiative)	309

Source: Compiled by the RAA based on the information provided by DoA

- g) RAA noted during the field visits that the list of irrigation schemes submitted were basically a compilation of information provided by the engineers and verbal descriptions given by the Chiwogs' Tshogpas rather than through proper documentation processes initiated by the agriculture officials.
- h) The inconsistencies and mismatch of information is largely due to the lack of a standardised process or system of information management with regard to new developments, maintenance and renovations of the irrigation systems. The information maintained at LG are based on the individual experiences and understanding of officials at LG levels leading to inconsistent practices.
- i) Further, there are no mechanisms or controls to ensure integrity of information maintained at LGs through a regular monitoring and reporting system as intended by the NIP through M&E.
- j) Further, the RAA noted that the limited understanding of the local governments in creating data has impeded maintenance of proper records of irrigation schemes through physical verifications and technical studies.
- k) The latest published document on irrigation systems at the national level is the Irrigation System Atlas 2015 besides some centralised information maintained in Excel documents at DoA. The document has not been updated and published thereafter.
- l) Not having a comprehensive inventory on irrigation systems would pose a challenge to planning for development of new as well as rehabilitation and maintenance of existing irrigation to ensure sustainability of the infrastructure. This had led to issues of deteriorated conditions of numerous existing schemes affecting the users and beneficiaries which ultimately would impact the achievement of the national goal of food sufficiency.

## 2.11. Existing allocation systems do not ensure equal access to water

- a) **Section 39** of the Water Act of Bhutan 2011 stipulates that, '*allocation of water shall be done based on the principle that water is a resource owned by the State and that every citizen has an equal right to these resources.*'
- b) **Section 40** of the Water Act upholds the customary practices of water allocation that existed in the community for more than twenty years. However, such customary practices shall sustain only '*...if they are fair and equitable and do not result in denial of water to any individual or community, including downstream and upstream needs, and are acknowledged by a Water Users' Association or other local beneficiaries' groups in the areas.*'
- c) Some of the customary practices for allocation of irrigation water noted during the field visit are as follows:

### Illustration XVII (Picutre-24): Water share determined in proportion to labour contribution

Most irrigation schemes in the country were built by the communities themselves through collective labour contribution. As per the existing customary practice, for some of those irrigation schemes, only those households who have contributed the labour are deemed entitled to use the water, while those households who did not contribute labour are not given rights to use even if their paddy fields are located within the command area forcing the landowners to leave the land fallow.

Usually those denied rights, use water either through payment of cash or compensate through labour contribution for access time allotted. The average rate charged for purchasing the irrigation water ranges from Nu. 1,000.00 to Nu. 1,500.00 per day as learned from discussions with some beneficiaries.



**Picture-24:** (Photos from right to left) First two photos are the Barto Irrigation Scheme which was supposed to benefit 26 households but in reality, three households do not have the right to use the water from this scheme due to non-contribution of labour while constructing this scheme. The third photo is from the Chhubu Gewog which has 11 irrigation schemes benefiting 627 households. However, RAA took cognisance of one household who do not have right to use water from any of the schemes.

**Illustration XVIII (Picture-25): Limited or no access to water for downstream users**

RAA has also noted instances where downstream users have limited or no access to water. A typical example of such an instance is the case of **Jawangkha Irrigation Scheme in Bomteykha Chiwog, Chhubu Gewog, Punakha**. During the paddy cultivation season, the downstream users do not get water as the entire stream of water is being used for the fields located upstream. The overflows from the upstream fields are diverted to the other side of the hill. Hence, downstream users have no option but to depend on rains. Example of a structure built by the downstream users to collect the rain-fed water is provided under **Picture-25**.



**Picture-25:** Example of upstream users denying water to downstream users (Jawangkha Irrigation Scheme, Chhubu Gewog, Punakha)

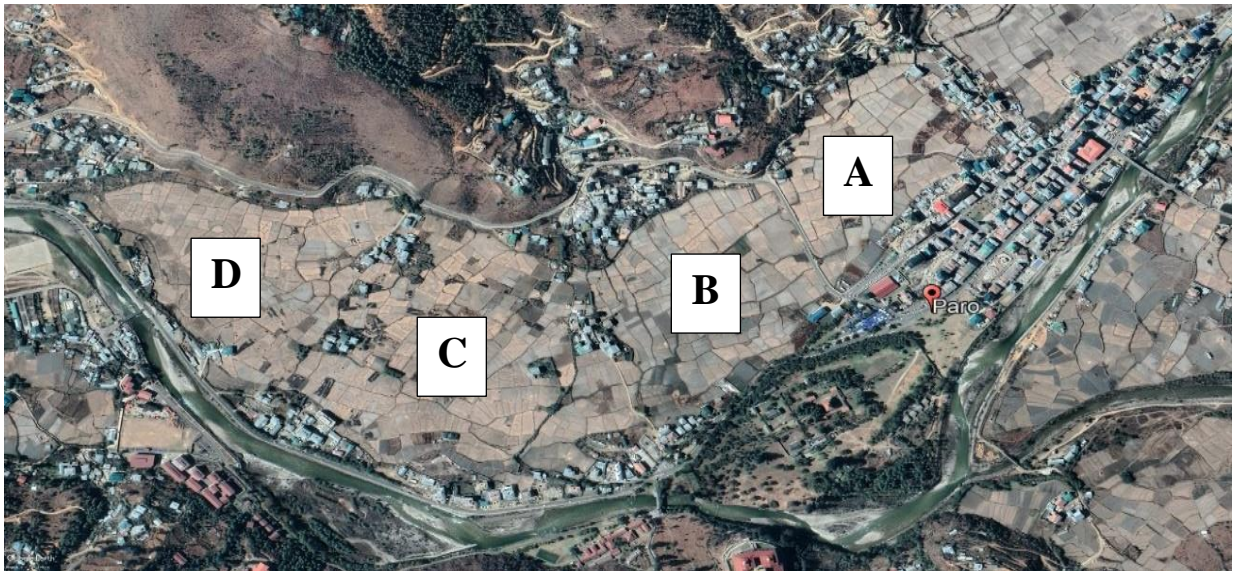
Similarly, the Neyphu village under Dochhoeten-Neyphu (Paro Dzongkhag) does not get sufficient water for irrigation because based on past agreement and traditional practice, the village is allotted only 63mm sized pipe to source water for the Bayel irrigation scheme, Tsadhu Sima. The water is sourced from the same stream used by Bara-Zhunggar village. The major share of water is channeled to Bara-Zhunggar village.

**Illustration XIX (Picture-26 & 27): Water allocation practices based on Court verdicts**

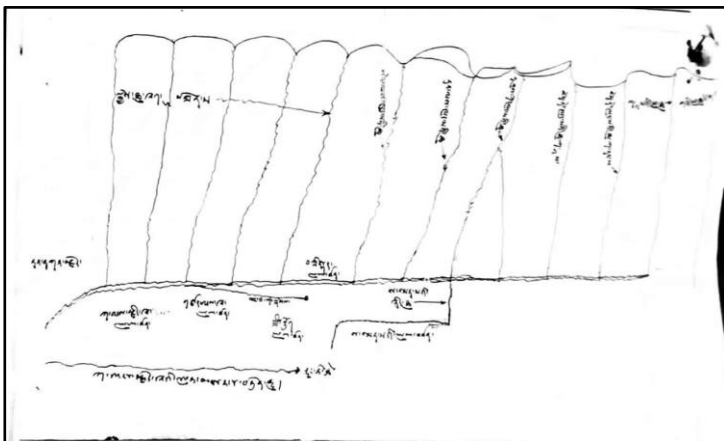
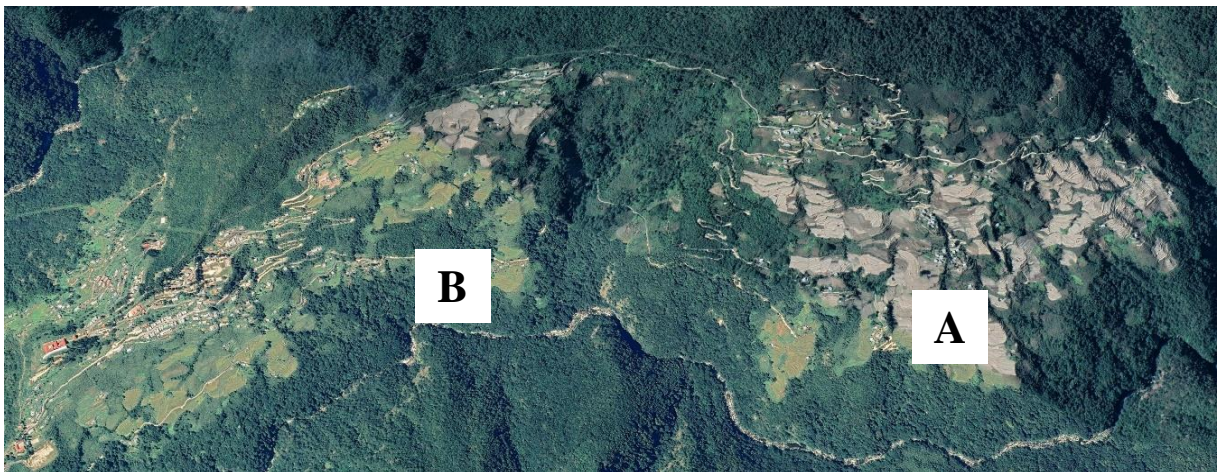
In the past, the communities often landed up in the Courts for disputes over the act of obstruction, diversion and stealing of the water when there was no adequate legal framework for water. While resolving the disputes, the Courts had passed judgments determining a water allocation practice between communities.

Two typical examples where water allocation practices were determined by the Courts and still practiced.

As shown in **Picture-26**, there are four distinct groups of paddy fields connected by one irrigation scheme (Nemjo-Khangkhu Irrigation Scheme) in the A-B-C-D sequence. However, the right to use the water, as ruled by judgement, starts from D and ends at A. The practice is such that until D completes the transplantation, households in other areas are not allowed to use water. Thus, the transplantation in area A often gets delayed if any of the areas delay their transplantation.



**Picture-26:** A typical water sharing practice in Wangchang Gewog, Paro determined by the Court during medieval period.



**Picture-27:** Top -A typical water sharing practice in Tseza Gewog, Dagana ruled by the High Court bottom row (from left to right)- (i) pictorial evidence of how community explained to RAA about the diversion of streams to Community B; and the picture of Ekulum Irrigation Scheme.

Another case is from Tseza Gewog, Dagana (*Picture-27*) where the Community A is entitled to use only one (Ekulum Stream) among many streams as ruled by the High Court. All other streams are channeled to Community B. Thus, Community A is constantly challenged with insufficiency of water despite having abundant water resources and a huge arable land is left fallow.

### **Illustration XX: Water allocation practices following the age-old tradition**

The RAA also noted practices where some households are given the privilege of using irrigation water before other households. Until these households complete their transplantation, the rest of the households do not get to use the water. The problem with such practices is that if first user households delay their transplantation, other households miss transplantation season.

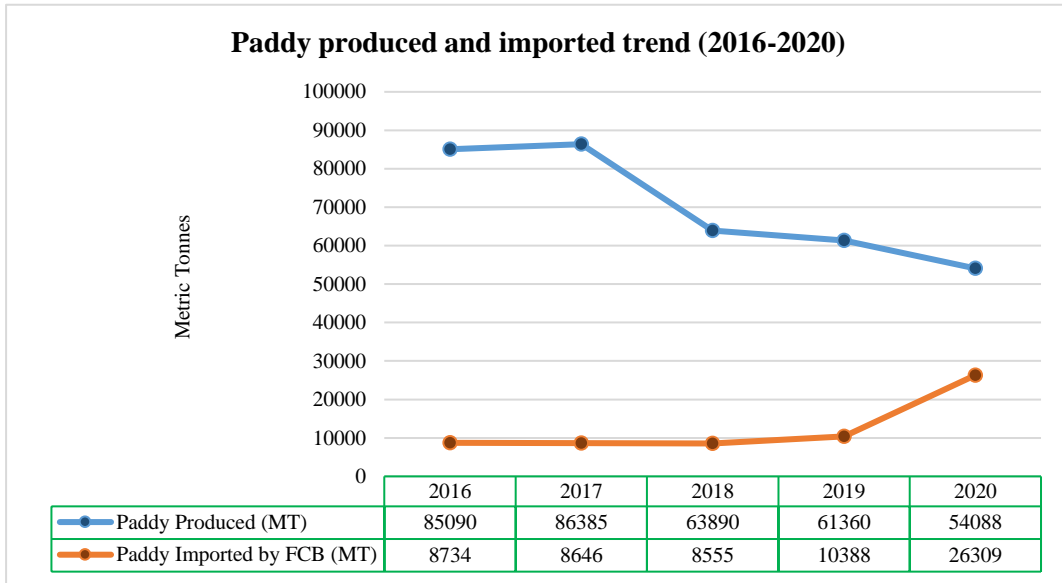
- d) An assessment of National Irrigation Policy conducted by the Policy and Planning Division of the MoAF in 2017 also reported existence of such practices of water sharing mechanisms based on age-old traditional system or norms and recommended **‘to empirically ascertain whether the traditional norms used for water sharing and management are better than those institutionalised through WUAs.’** The RAA noted that there was no record of such empirical study carried out by the Ministry.
- e) As evident from the above four illustrations, such customary water allocation practices result in inequitable distribution of water and deprive certain sections of water users of having equal access to irrigation water although the Water Act provides an equal right to water resources to every citizen.

## **2.12 Decreasing food production (paddy)**

- a) RAA reviewed the trend of some of the main drivers to the agriculture sector particularly with respect to paddy production, irrigated area, and fallow land and noted that the performance trends have become a cause of concern which possibly signify risk to achieving sectoral outcome of food self-sufficiency and security.
- b) Paddy production is synonymous to food self-sufficiency as rice is the staple food for the population. NIMP as well as the successive FYPs have targeted interventions to enhance rice production and irrigations in the country are usually intended to cater to needs of paddy cultivation.
- c) The trend of paddy production over the period from 2016 to 2020 shows that there has been a decreasing trend since 2017 as shown in **Figure-13**.



Figure 13: Showing the trends of paddy production and import of rice



- d) On the other hand, the import of rice as per the records of Food Corporation of Bhutan Limited had remained constant from 2016 to 2019 except in 2020 during which there was a sharp rise. The rise in 2020 could be due to stocking of rice through import necessitated by the pandemic.
- e) While the decreasing trend could be attributed to many factors, it can be directly linked to the area of paddy field brought under cultivation over the years as shown in **Figure-14**.

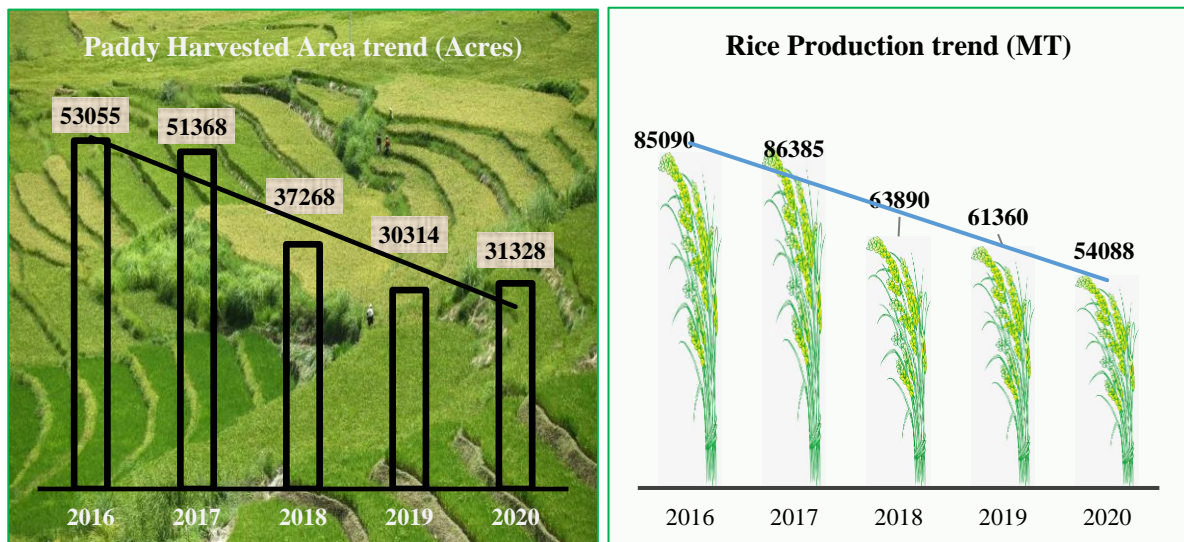
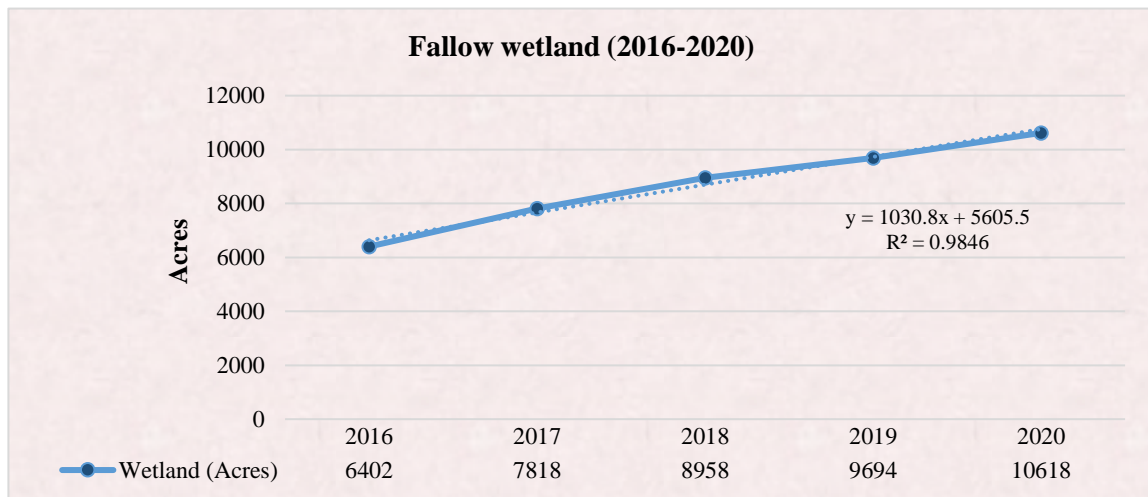


Figure-14: Showing the trends of paddy harvested area and rice production

- f) As apparent from the graph, there is a proportionate decrease in the area brought under cultivation over the period. While reasons for decreasing area need a separate review, one of the reasons could be due to abandonment or leaving the land fallow due to unpredictable water for irrigation. The trend of fallow land shows an increasing trend over the same period as shown in **Figure-15**.

**Figure-15: Showing the trend of increasing fallow wetland**

- g) Thus, notwithstanding the interventions and programmes directed towards enhancing the production in the country, it is apparent that it is not yielding desirable results. If the trend continues, realising the ultimate goal of self-sufficiency would not only be far-fetched but it is likely that deficit would increase and make the country highly dependent on imports.
- h) Thus, there is a need to review the relevance and appropriateness of current strategies and interventions to reinforce the nation's potential to attain the desired goal of food self-sufficiency.

## CHAPTER 4 AUDIT RECOMMENDATIONS

Based on the issues and deficiencies discussed in Chapter 3 of this report, the RAA has developed recommendations aimed at suggesting actions to improve the development and management of irrigation systems in the country. These are discussed below:

### 4.1 NEC should expedite the operationalisation of National Integrated Water Resource Management (IWRM) Plan

The National Integrated Water Resources Management Plan (NIWRMP) was developed by NEC in 2016 to provide an overall framework for integrated water resources in the country. It establishes principles and mechanisms for coordination amongst agencies in planning and implementing related activities to achieve the common goal of ensuring water security.

Based on the NIWRMP, the NEC had established a River Basin Committee only for the Wangchhu River Basin in 2016. The RBCs for the remaining four major river basins (Amochhu, Punatsangchhu, Mangdechhu and Drangmechhu) are yet to be established.

Thus, in order to provide structures and systems through a whole-of-government approach to integrate the programs, plans and policies of sectors, there is a need to expedite the operationalisation of NIWRMP. This would provide institutional systems and coordinated approach to planning and development of irrigation systems across the country as well as facilitating integration of functions and priorities of various stakeholders.

### 4.2 DoA should review NIP 2012 and NIMP

The National Irrigation Policy (NIP) 2012 mandates the DoA to monitor and evaluate irrigation programme and NIP at the national level and also stipulates the DoA to develop an irrigation development master plan.

NIMP was developed as a road map for the irrigation sector to guide development and management of irrigation systems in the country for the period of 15 years from 2017 to 2032. A comprehensive document, which was thoroughly researched, containing well-articulated outcomes and interventions to steer the sector to achieve the national development goal of food self-sufficiency and security, apparently had not received due consideration in formulating the Five-Year Plans.

Thus, to ensure the sectoral growth and development of irrigation, the DoA should review the NIP & NIMP and further develop a way forward strategies for implementation in order to realise the national goals of achieving food self-sufficiency and security. Further, there is a need to have performance measures to render a basis for assessing performance of the sector as to the outcome of the long term plans such as NIMP.

### **4.3 DoA should continue to explore and adopt appropriate technologies for sustainable irrigation infrastructure**

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The NIP 2012 intends exploration of new technologies for ensuring sustainable irrigation through research and development and the NIMP also suggests adopting appropriate technology prior to developing an irrigation system. The most appropriate irrigation technology for a particular setting needs to be studied under various circumstances as the suitability of a particular irrigation technology depends on factors like natural conditions, type of crops, irrigation methods, irrigation experience, required labor inputs, and costs and benefits.

On the technology front, the irrigation sector is still in the stage of exploration with few pilot implementations initiated. Most irrigation systems are surface irrigation using open channels and pipelines to source the water. Lift, sprinklers, and drip systems are used on a very negligible scale. Besides using appropriate types, the sustainability of the irrigation systems also depends on the technical designs and quality or workmanship of the construction. For instance, a few irrigation systems built in the 1980s by Dai Nippon Construction are still found to be intact in structures as well as their functions. Similar experiences can be built and sustained to enhance the sustainability of the irrigation schemes.

The DoA should continue to explore and adopt suitable technologies and build capacity to address the challenges of steep terrains, and soil conditions resulting in disruptions in the sourcing, channelising, damages, leakages, and insufficiency of water.

### **4.4 DoA should update inventory of irrigation systems in the country**

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Recognising the importance of having a comprehensive inventory of irrigation systems for the overall strategic development of irrigation infrastructure in the country, the Water Regulation 2014 mandates MoAF to develop a comprehensive inventory on irrigation systems in the country. Additionally, the NIP 2012 also aims to maintain a comprehensive inventory of irrigation.

DoA had published the Irrigation Schemes Atlas 2015 which is supposedly the overall inventory of the irrigation systems in the country. However, there were numerous inconsistencies in the information pertaining to numbers, names, length etc. besides the incompleteness of the list. The document has not been updated even once. Thus, there is no single source of truth for information of inventory of irrigation systems in the country for various decision-making needs. The incomplete and inaccurate inventory of irrigation schemes in the country as intended by the NIP poses challenges to proper planning for development and maintenance of irrigation infrastructure in the country.

This challenge is fueled by lack of standardised system for maintaining the inventory and also due to lack of monitoring and reporting systems to ensure management of these information. A robust inventory of irrigation systems would provide information while planning for development, operations and maintenance, and also can be useful for other socio-economic development activities.

Thus, there is a need for DoA to play a lead role in maintaining the information on irrigation systems through a standardised format and oversee the compliances at various levels.

#### **4.5 DoA should institute mechanism to enforce the requirement to carry out multi-disciplinary feasibility studies**

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As intended in the NIP, the feasibility studies (technical, social and economic) are to be completed before implementation to ensure sustainability of proposed irrigation schemes. As discussed in the earlier chapter, some of the irrigation systems are plagued with issues of dried-up water sources, underutilisation and abandonment, washed away structures, incomplete projects, non-functional schemes, damages to structures, inadequate supply of water etc. One of the common causes of these problems is either due to lack of preliminary studies or inadequate preliminary studies being conducted prior to the implementation.

The Irrigation Engineering Manual 2016 prescribes requirements to conduct project study and survey encompassing the aspects of planning, identification study, feasibility study, environmental impact study, selection and prioritisation and report preparation. Despite this requirement, most irrigation schemes were implemented without complying to the requirements. Further it was noted that, there is no enforcement mechanism to ensure compliance by the central authority through appropriate monitoring and reporting systems.

Therefore, DoA should institute appropriate mechanisms to enforce the requirement of conducting pre-investment feasibility studies before implementing irrigation schemes to ensure its sustainability.

#### **4.6 NEC should review the existing water allocation practices to ensure equitable distribution of water.**

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Water is a state property as defined in the Water Act, and every citizen is guaranteed equal rights of access. The Act also encourages to maintain customary practices of allocating water rights as long as it does not result in denial of water to any individual or community.

Based on the review of customary practices pertaining to few irrigation schemes, the RAA observed cases of exclusion of some individuals resulting from undue preference exercised by few based on traditional rights. Some of such exclusive or preferential rights were reinforced through court verdicts. In some cases, the access to few were restricted or limited due to their non-involvement or refusal to make monetary contributions during construction or maintenance. The restrictions placed in these manners are found to deny access of irrigation water to these groups of water users that compel them to either leave their fields uncultivated or make best of insufficient amounts of water made accessible to them.

Thus, to enforce the spirit of the Act which grants equal rights to all citizens, there is a need to review the existing system of allocation of irrigation water to users. If it shows to be discriminatory, appropriate strategies must be developed and enforced.

#### **4.7 DoA should facilitate institutionalisation of WUAs**

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NIP intends to empower beneficiaries through a farmer-centred approach for effective participation at all levels of planning, implementation, operation and management. This approach was to be carried forward through formation of Water User Groups among the beneficiaries who are to be supported by the DoA.

However, as intended by the NIP, the WUAs are yet to be formally institutionalised through registration with the competent authority as per the Cooperatives Act of Bhutan 2009. The existing WUAs are informal groups that function based on customary norms or unwritten rules. Without formal establishment of WUAs, neither the institutionalisation of functions nor any specific interventions related to capacity development could be initiated to enhance management of existing irrigation infrastructures. This current state of affairs in engaging the citizens would have serious implications on development, operation and maintenance of the irrigation infrastructure in the country.

Thus, there is a need to prioritise the establishment of WUAs formally and institutionalise the system of operations and management involving the users and formalise mechanism of coordination, backstopping and monitoring to support the policy objective of promoting farmer-centered approach.

#### **4.8 MoAF should have administrative arrangements in planning, execution and monitoring of irrigation infrastructure development**

The development of irrigation schemes is currently undertaken at two levels, at Department and LG. Major projects which are beyond the capacity of the LG are planned and implemented by the Department. Similarly, those bigger projects which are beyond the capacity of the Gewogs are undertaken by the Dzongkhags. Gewogs are basically involved in maintenance and repair of existing irrigation schemes.

The projects for development, rehabilitation and maintenance are supposedly screened through the criteria established for prioritisation and are routed through respective GTs and DTs. However, there are no administrative protocols as to how the Department collaborates with LGs during implementation. The central projects are wholly managed by the department without the involvement of Dzongkhags except during handing over of infrastructures after the completion. Similarly, in view of the various issues associated with the projects implemented by the LGs, there is also a need to establish protocols between the department and LGs for overseeing the project implemented by LGs. A mechanism of monitoring and reporting should be established to ensure the quality and sustainability of the irrigation schemes. In addition, LGs should take responsibility for complying with the requirements or policies defined by the Department in relation to irrigation schemes.

The siloed culture of implementation does not seem to support the policy objective of promoting the effectiveness of beneficiaries at all levels of planning, implementation, operation, and management through a farmer-centered approach.

Thus, there is a need to have administrative protocols between the Department and LGs in the implementation of irrigation schemes across the country to ensure that the planning and development of irrigation facilities are in harmony with the strategic focus of the sector, besides ensuring a minimum quality of infrastructure.

## CHAPTER 5 CONCLUSION

Bhutan is known for its rich biodiversity where around 70% of its surface is covered under forest. Given such rich biodiversity, the per capita water resource availability in the country is reported as 94,500 m<sup>3</sup>/capita/ annum. However, ensuring a sustainable water supply for irrigation and drinking has always been a challenge although the need of addressing the issue has constantly been reflected in the five-year plans.

The RAA carried out the review of irrigation systems with an overall objective to ‘ascertain the economy, efficiency, and effectiveness in development and management of reliable, adequate and sustainable irrigation systems’ including the institutional arrangement supporting the planning and development of irrigation systems.

There were inadequacies related to institutional structures in implementing an integrated approach as envisaged by the Water Act and its Regulations, which impeded the implementation of integrated water resource management at the river basin level. The NIMP, which was developed in line with the NIP for the development of irrigation systems in the country, has not been integrated with the FYPs in terms of key performance indicators, targets, and activities resulting in the derailment of the goals set in the plan and non-achievement of policy and strategic objectives of the sector. There were also several cases of poor-quality works, dried-up water sources, defunct irrigation schemes, abandonment, and underutilisation of schemes mainly because of the non-enforcement of multidisciplinary feasibility studies to be undertaken prior to the development of irrigation schemes. There were inconsistencies in the information on irrigation schemes maintained by the Department of Agriculture and LGs.

In order to address the issues pointed out in the report and also to improve the planning and development of irrigation systems, the RAA has provided eight recommendations.





# ANNEXURES



## MANAGEMENT ACTION PLAN

Recommendation No.	Audit Recommendation in brief	Action Plans: Action taken or to be taken	Estimated implementation date	Estimated completion date	Responsibility Entrusted to:	
					Name & Designation	EID & CID No.
4.1	NEC should expedite the operationalisation of National Integrated Water Resource Management (IWRM) Plan					
4.2	DoA should review National Irrigation Policy (NIP) 2012 and National Irrigation Master Plan (NIMP)					
4.3	DoA should continue to explore and adopt appropriate technologies for sustainable irrigation infrastructure					
4.4	DoA should update inventory of irrigation systems in the country with comprehensive and accurate information					
4.5	DoA should institute mechanism to enforce the requirement to carry out multi-disciplinary studies					
4.6	NEC should review existing water allocation practices to ensure equitable distribution of water					
4.7	DoA should facilitate institutionalisation of WUAs					
4.8	MoAF should have administrative arrangements between central and local government in planning, execution and monitoring of irrigation infrastructure development					

## ACCOUNTABILITY STATEMENT

Recommendation No.	Recommendations	Accountability for implementation of action plans					
		Personal Accountability			Supervisory Accountability		
		Name & Designation	EID & CID No.	Signature of Consent	Name & Designatioin	EID & CID No.	Signature of Consent
4.1	NEC should expedite the operationalisation of National Integrated Water Resource Management (IWRM) Plan						
4.2	DoA should review National Irrigation Policy (NIP) 2012 and National Irrigation Master Plan (NIMP)						
4.3	DoA should continue to explore and adopt appropriate technologies for sustainable irrigation infrastructure						
4.4	DoA should update inventory of irrigation systems in the country with comprehensive and accurate information						
4.5	DoA should institute mechanism to enforce the requirement to carry out multi-disciplinary studies						
4.6	NEC should review existing water allocation practices to ensure equitable distribution of water						
4.7	DoA should facilitate institutionalisation of WUAs						
4.8	MoAF should have administrative arrangements between central and local government in planning, execution and monitoring of irrigation infrastructure development						

# APPENDICES



**APPENDIX I: Information variations in the list of irrigation schemes submitted by DoA and Dzongkhags**

Row Labels	Functional Schemes			Semi Functional Schemes			Non Functional Scheme			No Information			Total Schemes		
	Dz o.	Do A	Varia nce	Dz o.	Do A	Varian ce	Dz o.	Do A	Varia nce	Dz o.	Do A	Varia nce	Dz o.	Do A	Varia nce
Bumthang	40	25	15										40	25	15
Chhukha	53	32	21				10	3	7	26	1	25	89	36	53
Dagana	92	80	12		3	-3	15	11	4				107	94	13
Gasa	18	3	15										18	3	15
Haa	19	8	11				2	3	-1	1		1	22	11	11
Lhuentse	93	42	51				4	4	0				97	46	51
Mongar	40	30	10				4	3	1				44	33	11
Paro	154	53	101		1	-1	3	2	1	2		2	159	56	103
Pema Gatshel	7	2	5				2	7	-5				9	9	0
Punakha	143	87	56				1	4	-3	5	1	4	149	92	57
Samdrup Jongkhar	76	40	36	1		1	7	2	5	10		10	94	42	52
Samtse	82	24	58	1		1	15	6	9				98	30	68
Sarpang	157	81	76		2	-2	25	17	8	7	1	6	189	101	88
Thimphu	53	27	26		1	-1							53	28	25
Trashi Yangtse	3	37	-34					8	-8	42		42	45	45	0
Trashigang	119	33	86		1	-1	9	9					128	43	85
Trongsa	76	37	39		1	-1	8	7	1	2		2	86	45	41
Tsirang	313	71	242	1	3	-2	14	8	6	1		1	329	82	247
Wangdue Phodrang	85	89	-4	2	5	-3	2	5	-3	12		12	101	99	2
Zhemgang	29	32	-3					10	-10				29	42	-13
	<b>1652</b>	<b>833</b>	<b>819</b>	<b>5</b>	<b>17</b>	<b>-12</b>	<b>121</b>	<b>109</b>	<b>12</b>	<b>108</b>	<b>3</b>	<b>105</b>	<b>1886</b>	<b>962</b>	<b>924</b>







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