Government of Nepal

Ministry of Irrigation

Department of Irrigation

Irrigation and Water Resources Management Project

Jawalakhel, Lalitpur.

Benchmarking of Ramgunj Branch of Sunsari Morang Irrigation System.

Development Support Consult (P.) Ltd.

Sinamangal, Kathmandu

TABLE OF CONTENTS

SAILENT FEATURES

➢ Name of the Canal	:	Ramgunj Secondary Canal S10
➢ Source of the Canal	:	Chatara Main Canal
➢ Source of the Chatara Main Canal	:	Koshi River
➢ Total length of the Canal	:	11.46 km of S10
➢ Command Area	:	6845 ha
➢ Nos. of Sub secondary/Tertiary Canals	:	24 (SS-5, T-13 & DT-6)
➢ Nos. of Tertiary Canals	:	19
➢ Total length of Sub-secondary Canals	:	14.923 km
➢ Total length of Tertiary Canals	:	46.831 km
➢ Nos. of Watercourses	:	230
➢ Total length of Watercourses	:	312.61 km

➢ Existing Physical Facilities:

Secondary Canal S10

- Head Regulator : 7 Nos
- Cross Regulator cum Culvert/Drop : 7 Nos.
- Aqueduct : 3 Nos.

Sub-Secondary & Tertiary Canal

- Head Regulator : 6 Nos.
- Proportional Distributor : 12 Nos.
- Drop : 26 Nos.
- Culvert : 44 Nos.
- Unit outlet : 35 Nos.
- Cross Drainage Works : 21 Nos.
- Tail structure : 20 Nos.
- Distribution Box : 1652 Nos.

➢ VDCs of the Command Area : 10 VDCs of Sunsari District

- Khanar
- Majhel
- Sonapur
- Semaria
- Tanmuna
- Duhabi
- Bhaluwa

- PurwaKushaha
- Ramgunj
- AmahiBela

- Number of User Households : 8229
- Total land acquired by the System Network : 343.95 ha
- WUO/WUG : 3-Tiers of organization.

1. Introduction

1.1 Background

The project entitled as Irrigation and Water Resources Management Project (IWRMP) has been implemented as follow on project of NISP under Department of Irrigation (DOI). This IWRMP is co-funded by the Government of Nepal and a grant from the International Development Agency (IDA, World Bank). Additional Technical Assistance (TA) is being provided by a consortium of private consulting contracting companies under contract by the Department of Irrigation (DOI), and reporting to the Office of the Project Manager (OPD/IWRMP). This project has basically four working components on which Component B is designed to address problems exhibited in large public irrigation schemes (Agency Managed irrigation Systems or AMIS) of below capacity performance, poor O&M, low cost recovery, and inadequate maintenance funds. Component B of the IWRMP is focused on irrigation management transfer (IMT) of Agency Managed Irrigation Systems (AMISs) to the farmers/ WUAs as per irrigation policy. The objective of the IMT process is to successfully and sustainably transfer the management and operations of selected pilot areas of the four irrigation systems to their respective Water Users' Associations (WUAs). The expected outcome of the IMT process is to improve irrigation service performance and service delivery to the selected pilot irrigation systems by achieving the expected primary outputson efficient and equitable service delivery by financially and institutionally sustainable WUAs, Improved physical performance of the irrigation schemes and Reliable bulk water delivery by the DOI, according to the IMT Agreement with the respective WUAs. Such IMT process being supported by the IWRMP Component B consists of both "hardware" (the improvement of essential irrigation infrastructure, termed "ESI" works), and "software"support including training and institutional development support to local DOI staff and Water User Association (WUA) strengthening.

Hence before the handover of such AMISs to the farmers/WUAs, the overall status of the systems should be identified. The present functional status, major requirements and other different database /information related to the irrigation systems is very much necessary before the IMT process which is generally assessed as benchmarking job of irrigation systems. Under component B of IWRMP benchmarking of different irrigation systems (either main or sub system) is being carried away so as to support the IMT process. This job of Benching of Ramgunj Branch of Sunsari Morang Irrigation Project is one in this sequence.

1.2 The Irrigation System

1.2.1 General

The Sunsari Morang Irrigation Project, the largest irrigation system in Nepal has been established to irrigate the area of 68000 hectors of Morang and Sunsari districts of eastern development region of Nepal. The source river of this system is Koshi River. It is also called Chatara canal and it has the 60 cumecs capacity of water discharge. It is located in the southeast Terai, a continuation of the Gangetic Plain. Figure 1 shows the layout map of the SMIS project. The gross command area is larger than 100 000 ha with an irrigated area of about 68000 ha. The SMIS is served by the Chatra Main Canal (CMC), which extends 53 km from the left bank of the Koshi River in a general west to east direction, with a maximum capacity of 60 m3/second. A series of secondary, sub secondary and tertiary canals run in a southerly direction nearly 20 km to the Indian border.

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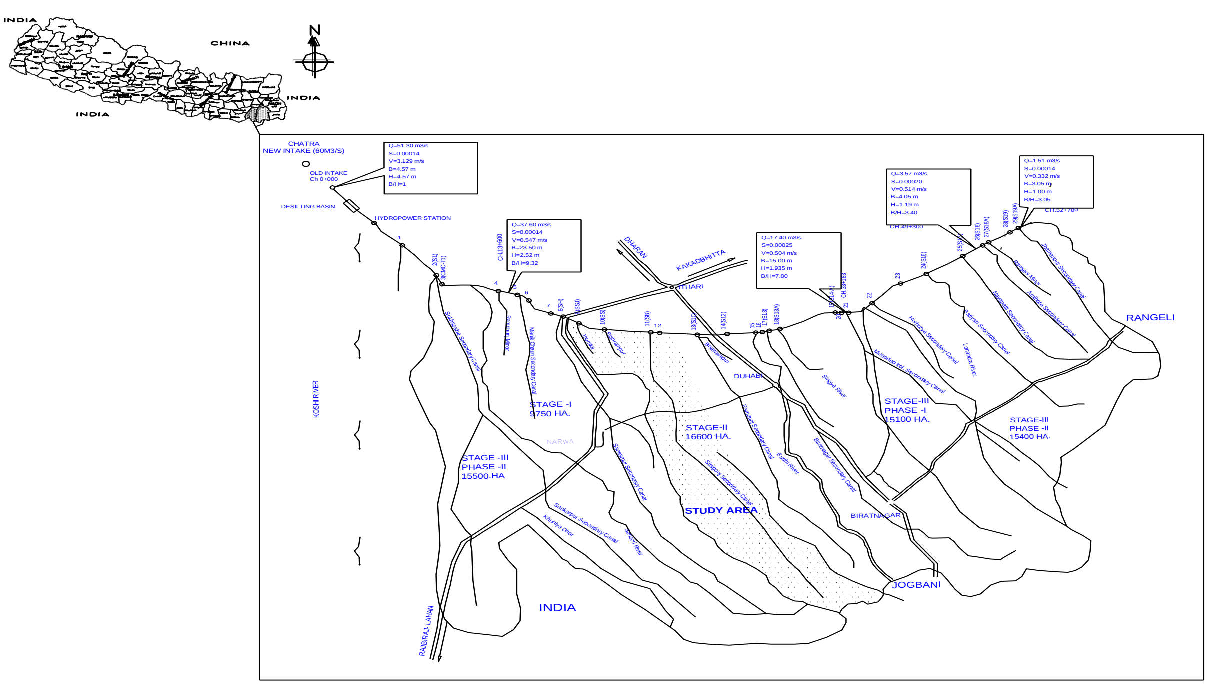
Figure 1 Layout map of Sunsari Morang Irrigation Project



This system was originally designed for supplementary irrigation of paddy rice during the monsoon (kharif) season based on 80-percent rainfall. Thus, the capacity of the system is not sufficient by itself to supply the full crop water requirement to the entire command area. Similar to large irrigation projects in India, the SMIS was intended to provide drought protection and deliver irrigation water to as many farmers as possible. However, demand for irrigation water on a year-round basis has increased steadily. After construction of the system in the mid-1970s, farmers began to utilize the system for a winter wheat crop in the rabi season (November–March). Later, spring season (April–July) crops were introduced in portions of the system.

The major crops grown in the command area include paddy rice in the summer; wheat, pulses (lentil, soybean, other local varieties), oilseed crops (mustard, linseed), and vegetables (cauliflower, cabbage, onion, tomato, etc.) in the winter; and jute, mung bean, maize, vegetables and spring paddy in the spring. The average landholding per household is 0.5–1 ha, (source: MASSCOT: a methodology to modernize irrigation services and operation in canal systems. Applications to two systems in Nepal Terai: Sunsari Morang Irrigation System and Narayani Irrigation System, Food and Agriculture Organization of the United Nations Rome, 2006) which is significantly less than when the project was initially designed and constructed. The mean annual rainfall is 1840 mm,(source: MASSCOT: a methodology to modernize irrigation services and operation in canal systems. Applications to two systems in Nepal Terai: Sunsari Morang Irrigation System and Narayani Irrigation System, Food and Agriculture Organization of the United Nations Rome, 2006) most of which occurs between May and September.

Photo 1: General Layout of Ramgunj Canal

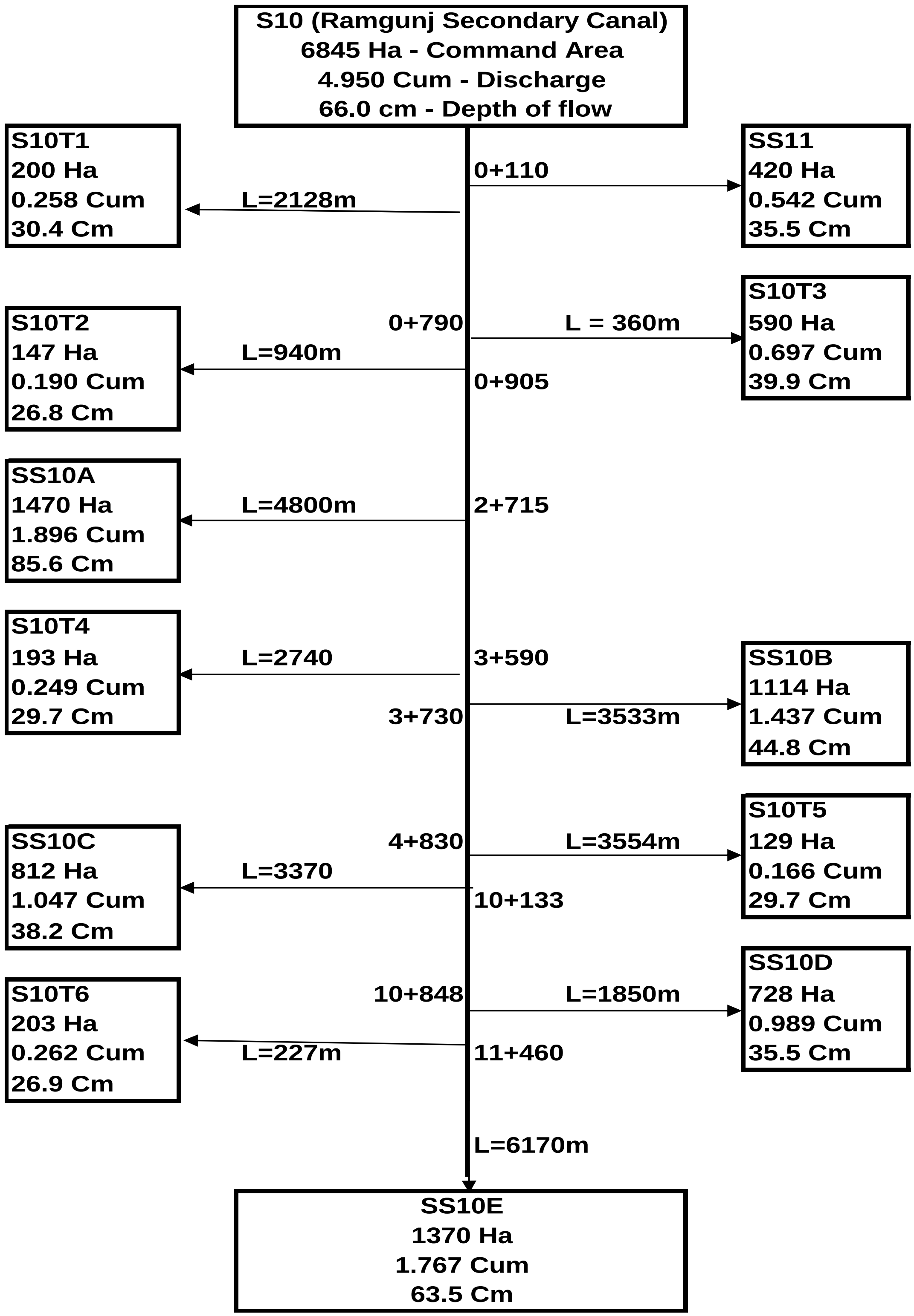
1.2.2 Ramgunj Secondary Canal

It is to be noted that the present study is focused on only the Ramganj secondary canal of the SMIP. As per documents received from the concerned authorities, a total length of the Ramganj Secondary canal named as S10 is 11.463 km and is serving 4845 ha land. The discharging capacity of the Ramgunj branch canal is 4.95 cumecs and it bifurcates from CMC at chainage 28.12 KM. Ramgunj S10 is situated in between Ramganj secondary canal and Biratnagar secondary canal.

The record of land acquired by the government of India for the construction of higher level canals during its initial stage of development is not available including the area occupied by the canals, their infrastructures and the site office compound. Presently, there are no any itspucca buildings and any kachhi hutment at Ramgunj site. The site has no tree and other properties like heavy machines. All the machines have already been handed over to Mechanical Division no.1 Office at Biratnagar, under the Department of Irrigation. It is mentioned by the SMIS Office that some vehicle like Jeep and motorcycles can be transferred to the WUA's. But the capacity of WUA / WUO to maintain and operate the vehicle should be considered.

Ramgunj branch canal S10 off takes from CMC at chainage 28.12 Km 94 RD west from Khanar. The S10 system has the command area around 4,950 ha and carries 4.95 Cumecs discharge. The S10 comprises of intake, secondary canal itself, 5 numbers of sub secondary canals SS10A, SS10B, SS10C, SS10D and SS10E and 6 direct tertiary canals S10 T1, S10T2, S10T3, S10T4, S10T5 and S10T6. In addition the system has 13 other tertiary canals off-taken from the sub secondary and 225 watercourses. The system is fed by Chatra Main Canal (CMC) at RD 94 and the source of the CMC is the Koshi River which is a perennial type. The canal network diagram describes about the number of sub secondary canals and direct tertiary canals with their respective lengths, discharges, command areas, and flow depths. This information is presented in Figure 2.

Figure 2: Canal Networks within the Ramgunj Secondary Canal



S10 (Ramgunj Secondary Canal)
6845 Ha - Command Area
4.950 Cum - Discharge
66.0 cm - Depth of flow
S10T1
200 Ha
0.258 Cum
30.4 Cm
L=2128m
0+110
SS11
420 Ha
0.542 Cum
35.5 Cm
S10T2
147 Ha
0.190 Cum
26.8 Cm
0+790
L=940m
0+905
L = 360m
S10T3
590 Ha
0.697 Cum
39.9 Cm
SS10A
1470 Ha
1.896 Cum
85.6 Cm
L=4800m
2+715
S10T4
193 Ha
0.249 Cum
29.7 Cm
L=2740
3+590
3+730
L=3533m
SS10B
1114 Ha
1.437 Cum
44.8 Cm
SS10C
812 Ha
1.047 Cum
38.2 Cm
4+830
L=3370
10+133
L=3554m
S10T5
129 Ha
0.166 Cum
29.7 Cm
S10T6
203 Ha
0.262 Cum
26.9 Cm
10+848
L=227m
11+460
L=1850m
SS10D
728 Ha
0.989 Cum
35.5 Cm
L=6170m
SS10E
1370 Ha
1.767 Cum
63.5 Cm

1.2.3 Water Resources

The Koshi River drains the southern slopes of the Himalayas in Nepal and is formed by three main streams: the TamurKoshi originating from Mt. Kanchenjunga in the east, ArunKoshi from Mt. Everest in Tibet, and Sun Koshi from Mt. Gosainthan farther west. From their confluence north of the Chatra Gorge onwards, the Kosi River is also known as Saptakoshi. The trans-boundary river crosses northern Bihar branching off into several channels and joins the Ganges near Kursela in the Katihar district.

The Saptakoshi is 720 km (450 mi) long and drains an area of about 61,000 km2 (24,000 sq mi) in Nepal and Bihar. In the past, several authors proposed that the river has shifted its course for more than 133 km (83 mi) from east to west during the last 200 years. But a review of 28 historical maps dating 1760 to 1960 revealed a slight eastward shift for a long duration, and that the shifting was random and oscillating in nature.

The river basin is surrounded by ridges which separate it from the Yarlung Tsangpo River in the north, the Gandaki in the west and the Mahananda in the east. The river is joined by major tributaries in the Mahabharat Range approximately 48 km (30 mi) north of the Indo-Nepal border. Below the Siwaliks, the river has built up a mega fan some 15,000 km2 (5,800 sq mi) in extent, breaking into more than twelve distinct channels, all with shifting courses due to flooding. Kamlā, Bāghmati (Kareh) and Budhi Gandak are major tributaries of Koshi in India, besides minor tributaries such as Bhutahi Balān. (Source: http://en.wikipedia.org)

1.3 Need of the Study

The unpredictable rainfall incidence that has affected Nepalese agriculture for the recent past years has forced the policy makers to consider irrigation development as a means of securing self-sufficiency in food production. In addition, rapidly increasing population demand high agricultural production. In line with the immediate need for an increased food production, the development of irrigation schemes has been regarded as a promising option. As a result, considerable investments have been made to develop irrigation facilities. Because of this extensive irrigation development about 1,279,000 hectares, including the traditional schemes implemented by farmers, has been brought under irrigated agriculture. Despite the considerable investments for the development and management of irrigation systems, most of these schemes are being run far below the planned capacity and many do not live up to the expected economic life. Most of the command area is under irrigation and there are some schemes even that do not give any irrigation service at all.

In general, regardless of the huge investments in the development of the infrastructure, the productive efficiency of the irrigation schemes is very low. This low performance may depend on various conditions that prevail in each scheme. However, weak management and poor operation and maintenance activities are common to most of schemes in the country.

With the vision of escalating resource demands for development of irrigation sector to produce more food for people together with poor performance of the irrigation schemes and at the same time the competition over the water resource from the other sectors, will oblige the users to improve the performance of the irrigation schemes.

SMIP has the low water use performance, low water delivery performance, could not meet the Operation and Maintenance cost within itself, poorly management by WUA. Therefore it is needed for IMT. So, Ramgunj Canal has to be selected.

The performance assessment and benchmarking is therefore, used as a tool to analyze the performance of irrigation schemes and to identify the performance gap by comparison, in order to develop proposals and recommendation for improving the performance. Specifically, the research has been aimed at addressing the following issues:

- How productively are land and water being used?
- Is there enough water available to meet crop demand?
- Are crops getting enough water or too much?
- Is the system financially sustainable?

1.4 Objective of the Study

The objective of this task is to prepare Benchmarking Report of Ramgunj branch of SMIP to assess the functionality of that branch in physical, organizational and production level. The general objective of this study is to develop and introduce simple benchmarking approach in order to improve the performance of Ramgunj Irrigation System. The specific objectives of this study are as below.

- To produce the baseline information on water delivery status, system performance, O & M activities, institutional aspects and identify the performance gap for IMT process.
- To introduce the performance assessment and benchmarking approach in Ramgunj Irrigation System (RIS) and provide system managers, policy makers and farmers with information on existing performance of irrigation schemes, enable them to identify gaps.
- To identify the performance gap of the schemes that will be helpful to improve the scheme.
- To help the farmers to develop farmers oriented scheme monitoring and evaluation system.

1.5 Limitation of the Study

Unavailability of time series data regarding operation and maintenance, cost for various activities, actually irrigated area, agriculture practice, and socio-economic conditions of the study area to find the actual baseline information are major constraints of this study. Several approximations were made as required by the benchmarking toolkit. Some of the quantitative data used in this study were gathered based on memory of the WUA and their perception.

2. Conceptual Framework and Literature Review

2.1 Conceptual Framework

Various organizations and researchers working in the field of irrigation have developed their own definition of benchmarking. However, the basic intent is to find and implement best available and possible alternative for adequate, reliable, and equitable irrigation service delivery.

2.2 Benchmarking

Benchmarking is a systematic process for securing continual improvement through comparison with relevant and achievable internal or external norms and standards. It implies comparison – either internally with previous performance and desired future targets, or externally against similar schemes performing under similar conditions (Malano and Burton, 2001). The main objective of benchmarking is to compare the system inside and outside and improve the performance. Being a continuous process, it involves the following steps.

Performance assessment is a process to achieve optimum output against input based on relevant feedback to the scheme management at all levels. It is internal evaluation of the scheme, which suggests corrective actions, if necessary. Performance assessment can be defined as the systematic observation; documentation and interpretation of the management of scheme with the objective of ensuring that the input of resources, water delivery schedules, intended outputs etc. and required actions proceed as planned (Bos, 2000). A sound performance assessment thus requires a systematic scheme planning that is done in sufficient detail.

Benchmarking and performance assessment are related but different in several ways. Benchmarking is essentially an externally focused activity. In benchmarking, the specific aim is to identify key competitors/comparable schemes, and find best management practices. These then become standards and/or norms against which to assess scheme's own performance. The indicators are specifically identified to enable the comparison, and to monitor progress towards closing the identified performance gap. Performance assessment on other hand assesses the performance against internally set standards; it is focused internally with no reference to the performance of external schemes. It covers a wider range of internal performance indicators, like equity, flexibility, that are required for day-to-day management work. Benchmarking may thus be considered a part of performance assessment or a comparative performance assessment.

2.3 Benefit of Benchmarking

Benchmarking is an important management tool for organizations that aim to implement a service oriented management to their operation. The benefits of benchmarking to an organization, if the process is followed correctly, are an improvement in its level of performance. The performance improvement is visible in the outputs of the organization (such as the level of service provided to water users), and in the organization's internal processes.

Benchmarking the activities and processes of irrigation and drainage organizations can provide valuable insight on how well the organization is performing in all areas of service delivery and resource utilization; and also become an important element of the organization's accountability to its shareholders. In the wider context of irrigation and drainage the benefits are in more productive and efficient use of resources – land, water, labor, finance and agricultural inputs – leading to more productive and sustainable irrigated agriculture and improved livelihoods and well-being of the rural population. In many instances such improvements will have a direct impact on poverty alleviation. There are a range of beneficiaries to the benchmarking process:

- Water users
- Service providers
- Government regulatory bodies
- Donors and funding agencies

Water users who are paying for irrigation water (and associated management, operation and maintenance costs) will be interested in ensuring that best management practices are adopted in order to minimize costs and optimize level of service provision. Service providers, who are investing for water, extension advice, inputs, or marketing, will be interested to benchmark their performance in order to improve level of service, minimize costs and maximize benefits.

Government regulatory bodies can benchmark different irrigation service providers against best practices, either regionally, nationally or internationally, to drive improvements in performance.

Donors and funding agencies see benchmarking as a means to improve standards of performance in the irrigation and drainage sector, thus making better use of investment and contributing to the fight to eradicate poverty and enhance livelihoods. Donors could use benchmarking as a rational basis for funding interventions in particular schemes.

2.4 Benchmarking Process & Procedure

The process of benchmarking is illustrated in Figure 3, with six stages: identification and planning; data collection; result analysis; integration; action; and monitoring and evaluation (Malano& Burton, 2001). The six stages can be divided into two parts: Part one –Finding out and Part two – Taking action.

Part one – Knowing about the system

Stage 1: Identification and planning

Identification and planning is an important starting point for benchmarking. In this stage the following are decided:

- The purpose, desired outputs of the benchmarking process;

- The stakeholder;
- What areas of activities are to be benchmarked;
- Against whom or what performance is to be benchmarked;
- Indicators of performance; and
- What data is required and how it will be collected.

The planning phase, like that of many other processes, is one that will to a large extent determine the success of the benchmarking activity. The extent and specifications of data needed for benchmarking is defined at this stage. Consistency in the definition of the performance indicators used for benchmarking is of critical importance to ensure that all the data collected are comparable.

Stage 2: Data collection

The core of any benchmarking exercise is data collection. In order to enable comparison between irrigation schemes, data used for benchmarking needs to be consistent and comparable. This is a crucial aspect that requires adequate provisions during the identification and planning phase of the program. There are three types of data collection:

- Data collected for day-to-day management, operation and maintenance of the irrigation systems;
- Data collected for benchmarking and comparison with other systems; and
- Data collected as part of the diagnostic process within the benchmarking exercise to identify causes of performance.

The data collection for the day-to-day operation of the system play a critical role in achieving high performance of service delivery and in helping to interpret the outcomes of the benchmarking comparison.

There are many variables that influence the performance of irrigation schemes, making comparative performance difficult. This is one of the major challenges to any benchmarking activity in this sector. To be able to group similar types of schemes for benchmarking purposes it is necessary to collect background descriptive data on each scheme, including information such as the location, climate, water source, type of crops grown, irrigated area of scheme, average farm size, irrigation method, type of management, and type of irrigation system.

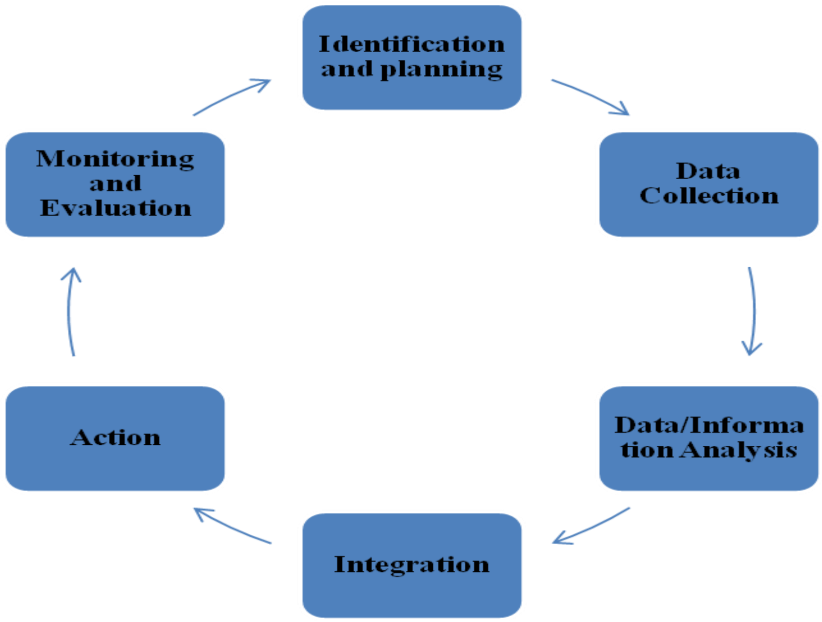


Figure 3 Stages of the Benchmarking Process

Most of the irrigation organizations around the world are collecting data on various aspects their operations. Each organizations, however, is collecting information for its own internal management processes and though there may be some overlap between different organizations, it is unlikely that there is sufficient data being collected to undertake a benchmarking comparison between organizations. The extent, maturity and accuracy of the data collected vary widely between organizations.

To enable organizations with different levels of data available to participate in the benchmarking initiative, a range of benchmarking indicators is proposed. Using the level of data collection efforts and complexity as criteria the indicators have been classified into two sets: a) basic data and b) enhanced data.

The number of performance indicators and their scope need not to be rigid. There is always room for innovation and new indicators may be introduced, depending on the scheme characteristics, management mode and other special features. However, definitions of indicators have to be consistent in order to make comparison reliable.

Stage 3: Analyses

The analysis stage identifies the performance gap between the schemes based on predefined performance indicators with which the scheme is compared. From the analysis comes the understanding of:

- The performance gap;
- The causes of the performance gap; and
- The actions required for closing the gap.

Thus benchmarking is not just a comparative performance assessment exercise, it also incorporates diagnostic analysis, which is finding out about the causes of identified levels of performance. Once the causes are understood then solutions can be identified targets are formulated. The final target values are established during the integration stage when the feasibility of achieving these values are discussed and agreed with key stakeholders.

Part two– Taking action

Stage 4: Integration

The action plan developed from the analysis phase must be integrated into the operational processes and procedures of the organization in order to bring about the desired change. It is crucial that those responsible for benchmarking have the power within the organization to bring about change. Benchmarking program often fail at this stage, leaving those involved disillusioned with the process, and with the performance of the organization. The following are important aspects of integration:

- Reviewing the findings and producing tables, charts and graphs to support the analysis.
- Identifying gaps in performance between the organization and better performers.
- Seeking explanations for the gaps in performance.
- Ensuring that comparisons are meaningful and credible. Where necessary, normalize the measures used - that is apply correction factors to take account of reasons for differences in performance other than inefficiencies.
- Communicating the findings as outlined in the communications strategy at the beginning of the project.
- Identifying realistic opportunities for improvements.

Stage 5: Action

Once acceptance of the new processes and procedures has been gained they can be put into place to bring about the desired change. Monitoring and evaluation of the process is required at this stage to ensure that the desired targets are being achieved, and that corrective action, where necessary, is taken in time. Training is also a key element here. This is essentially implementing recommendations. It involves the following:

- Implementing the action plan(s).
- Monitoring performance.
- Rewarding and communicating successes.
- Keep key stakeholders informed of progress.

Stage 6: Monitoring and evaluation

The success of benchmarking is marked by the continuing measurement of the scheme's performance against the target norms and standards established during the analysis and integration stages. These targets are, however, changing over time, and continual updating and revision of the targets is necessary to maintain best practices and relative performance. The following are important steps in monitoring and evaluation:

- Evaluating the benchmarking process undertaken and the results of the improvements against objectives and success criteria plus overall efficiency and effectiveness.
- Documenting the lessons learnt and making them available to others.
- Periodically re-considering the benchmarks in the light of changes in those conditions that impact on performance relative to good practice.

3. Approach and Methodology

3.1 General Approach

The description provided in the Terms of Reference (ToR) particularly objectives and scopes of the study are clear and provide the guidelines to carry out the study. The approach and methodology adopted by the consultant team in undertaking irrigation benchmarking of Ramgunj Irrigation System are provided below.

3.2 Selection of Canal System at Head, Middle, Tail and up to Tertiary Level

Data collection is the main activity of benchmarking exercise to know the operational reality of canal systems. However, it is not possible to cover the entire canal network for benchmarking and sample canals need to be selected to resemble the performance of the whole system. Hence, three sub-secondary canal systems from Ramgunj Secondary Canal were selected for benchmarking of main canal. S10T1, SS10B & SS10E sub-secondary canals were selected for benchmarking exercise. These sub-secondary canal systems also represent head, middle and tail parts of the Ramgunj Secondary Canal as a whole.

To best represent the Ramgunj canal, it was decided to divide it into head, middle and tail parts and take one of sub-secondary and or tertiary canal from each part. One tertiary or sub-secondary canal system was selected from these head, middle and tail parts of the Ramgunj canal. This exercise was carried out on layout maps of the secondary canal system. Each sub-system was treated as separate unit for data collection and analysis. In each unit more or less same methodology was applied for collecting data and information, which is illustrated below.

3.3 Desk Study

Before the mobilization for the field survey, the Consultant had performed the following activities:

A. **Collection of documents, reports, data and information from secondary sources;**
   The necessary documents, reports, data and information were collected from the Department of Irrigation, Department of Agriculture and the concerned offices and websites.

B. **Review and analyze the existing documents, reports and data.**
   The relevant existing documents, reports and data were reviewed, analysed and segregated.

C. **Selection of Indicators**
   The indicators necessary for the benchmarking of the irrigation system were selected and were given a final touch. The indicators selected are given below in the matrix form with their approaches and methodology.

   Table 1: Selected Indicators for Benchmarking

Indicator	Approach & Methodology	Respondents
Systematic Performance		
1. Annual irrigation water supply per unit area (m3/ha)	By estimation using discharge-depth relationship or,	Agency (GoN) WUA
	By using questions/answers (Key informant interview)	
2. Water supplied ratio	By using questions/answers (Key informant interview)	Agency (GoN) / WUA
	Potential created=Design discharge/Area served	
	Utilized=Delivered discharge/Actual area served	
	Water supplied ratio=Potential created/Area served	
3. Satisfaction of farmers	Farmers from each head, middle and tail ends will be selected	Farmers
Agricultural performance		
i. Agricultural production per unit irrigated area(ton/ha)	Subjective question/answer from sample households	Farmers
ii. Agricultural production per unit irrigation water supply (m3/ton)	This cannot be calculated using the ratio of seasonal irrigation water supply per unit area to the seasonal agricultural production per unit irrigated area.	Agency/WUA/Farmers
iii. Cropping intensity	Area covered for agricultural production on each season will be accessed from sample household.	Farmers
iv. Cropping pattern	Crop calender will be prepared by household survey.	Farmers
v. Local & improved seed varities	Subjective question/answer from sample households	Farmers
vi. Use of compost and chemical fertilizers	Subjective question/answer from sample households	Farmers
vii. Machinery used	Subjective question/answer from sample households	Farmers
Financial Performance		
i. Total O & M cost per unit area	Total O & M cost invested from agency per unit area will be accessed (as much as possible 3 years' data will be	Agency

	collected.)	
ii. Man days for O & M per unit area	Total man days/ha from user side will be accessed and converted it into NPS/ha.	WUA
iii. Cost recovery ratio	Actual ISF collected annually per ha will be accessed(Rs/ha)	WUA/Agency
	Cost recovery ratio=ISF collected (NPS/ha)/O & M cost per unit area (NPS/ha)	
iv.Total O & M cost per unit volume supplied	Total O &M cost per unit area/ Annual irrigation water supply per unit area	WUA/Agency
Environmental Aspect		
Land & canal damage index	Command area damaged due to river, flood, drainage and water logged condition will be accessed.	WUA/Agency
	Length of canal damaged will be accessed.	
	Land damage index=Command area damaged/Actual irrigated area	
	Canal damaged index=Length of canal damage/Total length of canal	
Social & WUA aspect		
i. Equity performance ratio	Labour provided for O & M from each farmer per unit irrigated area will be accessed. (No. of labor/ha)	WUA
	Time of water supplied for farmer's per unit irrigated area will be accessed (Hr/ha)	WUA
	Equity performance ratio=(Hr/ha)/(No. of labour/Ha)	WUA
ii. Population	Descriptive question answer from the sample Household or WUA or DDC and VDC profile	DDC profile, VDC profile, Farmers
iii. Migration of labour	Economically active labor or agricultural labor migration from the command area will be accessed from secondary information as KII	DDC profile, VDC profile, Farmers, WUA
iv. Avilability of labor	Avalability of active labor within the command area will be accessed from secondary information as KII	DDC profile, VDC profile, Farmers, WUA
v. WUA structure	Structure as participation of women, dalit, janajati will be collected from KII	WUA
vi. Water user membership	No. of potential land holding farmers for	WUA

ratio	the irrigation will be accessed.	
	No. of actual farmers, they are taking membership of WUA paying membership will be accessed.	
	Water user membership ratio=Actual member/Potential member	
vii. Actual irrigated area WUA effort	WUA that are working for the water allocation, O & M work will be accessed.	WUA
	WUA effort=Actual area WUA effort/Total potential irrigated area	
viii. Actual use of irrigation water (m3/ha/yr)	Irrrigation water use annually per ha will be calculated using prior information.	WUA
ix. Management cost (NPS/ha/yr)	O & M cost investmetn in terms of salaries from agency will be accessed.	
	O & M cost investmetn in terms of salariesby WUA will be accessed.	
x. Output per ha irrigated area (Rs/ha/Yr)	Sales of agricultural product will be accessed using KII	WUA
xi. Water distribution	It is the process of water distribution.	WUA/Famers
	Where, how & who are actively participated for the water distribution.	
	Who makes the decision for the water distribution.	
O & M		
i. Current practices	What are the current practices for the O & M operation from secondary to water cause using KII	WUA
	How, when and makes the decision for O & M using KII	
ii. WUA's participation	How effictively WUA participated for the O & M operation using KII	WUA
	What are the process for WUA's participation for the O & M operation using KII	
iii. Roles & Responsibility	What are the different activities for the O & M operation.	WUA/Agency
	Who are responsible and what are the responsibilities of each agency for O & M operation.	
iv. Regular/Emergeny maintenance	Who are responsible for what types of maintenance.	WUA/Agency

Water Delivery		
i. Effectiveness	Water delivered timeliness at head, middle and tail reach using KII	WUA/Famers
	Is water sufficient/scare/abundant in terms of volume using KII	
ii. Weakness	What are the issues and problems related to water delivery at head, middle and tail end using KII.	WUA/Famers

D. Preparation of Checklists / Questionnaires;
The checklists/questionnaires were prepared consulting with the staffs of Department of Irrigation. The questionnaires are attached herewith the report in the annex-I.

E. Preparation and Submission of Inception Report.
After the contract was made, Inception report on benchmarking of Ramgunj Irrigation System was prepared and submitted to the Department of Irrigation before moving to the field.

3.4 Desk Study

A study team comprising Irrigation Engineer and the other team members mobilized for field survey to complete the field work. According to the **Work Plan, General Approach and Methodology** presented in the Inception Report, the team performed the following field works:

Transect walk: Transact walk was carried out in the selected tertiary units to observe the physical conditions of the system, maintenance standards, and canal encroachments. The team has also acknowledged the functionality and applicability of water distribution structures along the canal. Chairman of water users committee was also accompanied the team during the field visit.

Photo 2: Transect walk during field visit

Focus group discussions: Focus group discussions were made at the field to verify the data. At the beginning, the team had explained the users about the objectives and scope of the benchmarking study. The major groups discussed were women group, WUA officials, and farmers available at the site. Information related to sub-system operation and maintenance, reliability of water supply, water distribution practices, norms and culture of the society to allocate and distribute water were collected from the discussions. In addition, the role of WUA for maintenance, resource mobilization for maintenance, rate of irrigation service collection and extent of farmers approach to project office were covered in focus group discussions.

Photo 3: Focus Group Discussion with the farmers and stakeholders

Key informant interview: Local chaukidars, gate operators and dhalpas were also consulted as key informants for obtaining flow data and operational reality of the system. Flow data were not available for most sub-secondary canals, and only raw gauge readings were available at most sites. The team had converted the gauge data into flow with the help of approximation of stage discharge relationship. Key informants were asked the percent of flow running in the canal during each season of the year, which was later replicated into flow data.

Secondary data collection

Secondary data and information is equally important for benchmarking exercise. As illustrated in toolkit manual, systematic record of time series flow data is one of the basic requirements for benchmarking, which figures out the water service delivery at the point of interest. In addition to flow data, agriculture production data is also equally important. The main source of secondary data is the SMIS office, District Agricultural Development Office and so on.

3.5 Data Processing and analyzing

After the collection and preparation of primary and secondary data through desk and field work, experts prepared report for their respective subject of study. All sorts of filled questionnaire were analyzed through MS-excel and other statistical tools. All the primary data related with socio-economic information were produced in digital data base.

3.6 Preparation of Draft Report

After all the data were collected, processed and analysed, the draft report was prepared and it was submitted to IWRMP, Department of Irrigation.

3.7 Constraints in Data Collecting

Due to lack of systematic records of flow, it was difficult to collect real time series data. Several approximations were carried out to estimate the flow. The main difficulties encountered were at the lower order canals where flow division structures are not equipped with flow measuring devices. To estimate the flow at these locations farmers information of percent flow at indicated markings were noted along with cross section of the canal reach.

4. Result and Discussion

The indicators for irrigation benchmarking are the essential parameters set by the consulting team for study, recording, measurement and analysis suitable to the existing Ramgunj Irrigation System. The established indicators are the key elements of the whole benchmarking procedure that reflect the true picture and scenario of the irrigation systems which provides the key and relevant information on suitability, reliability, dependability and adequacy of the whole irrigation network and its management. The results obtained with reference to these indicators are discussed below. [Note: The indicators are given in the chapter **Approach and Methodology**]

4.1 System Performance

Delivery of water, to meet user requirement for irrigation and other purposes, is the primary focus of the project authorities. The water delivery process is strongly influenced by physical, climatic, economic and other factors and the project authority has limited control over some of these factors. In particular, the prevailing climatic conditions largely determine both, the available water resources and the crop water requirements in any season. The main task of the project in-charge is to manage the system so as to optimize the use of available resources in order to meet agreed user needs in an effective and efficient manner.

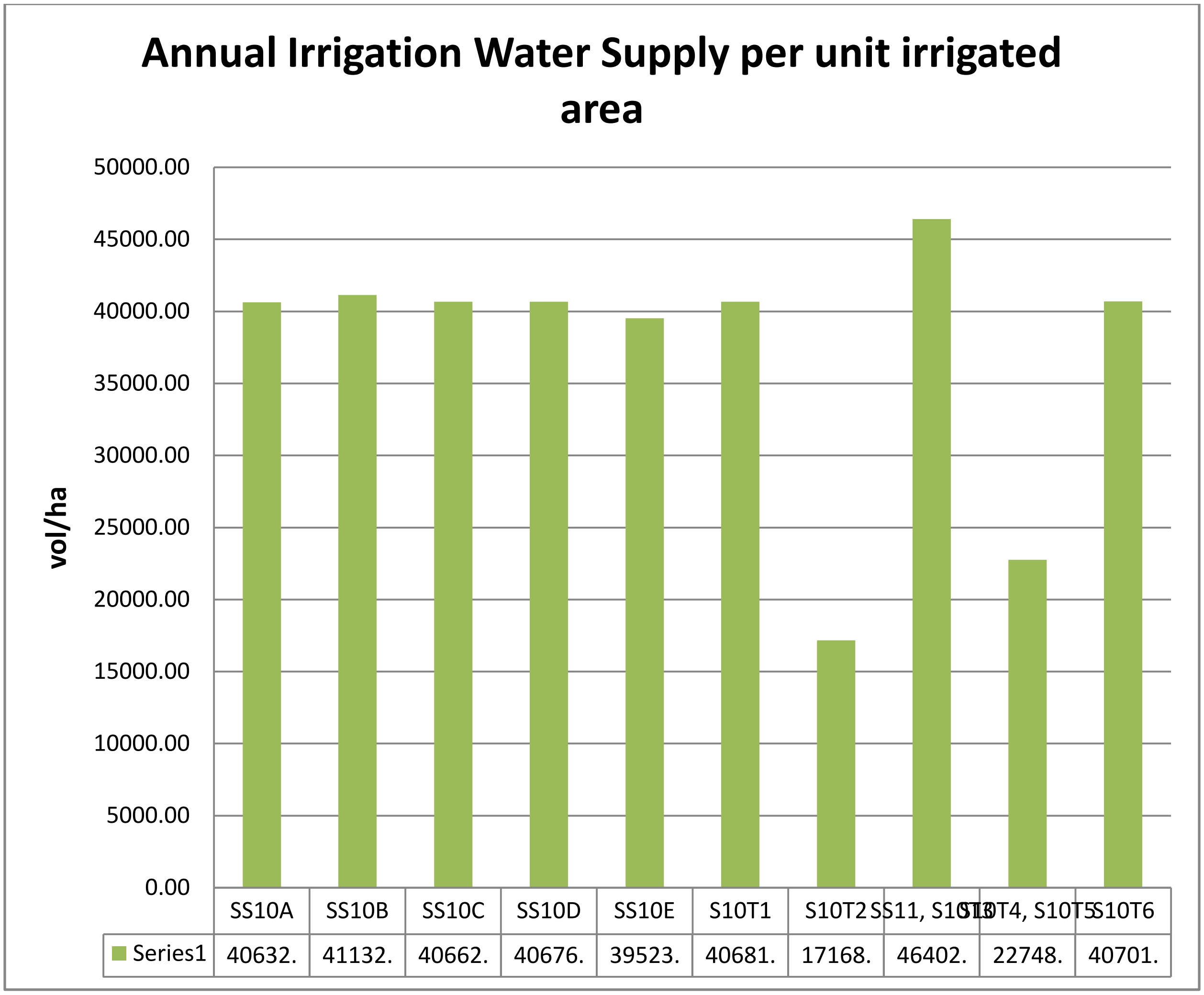
4.1.1 Annual irrigation Water Supply per Unit Irrigated Area

Annual irrigation water supply per unit irrigated area is total quantity of water supplied for irrigation in all the seasons of a year divided by the irrigated area in that year.

Annual irrigation water supply per unit irrigated area varies with water availability, cropping pattern, climate, soil type, system conditions, system management etc.

The result of annual irrigation water supply per unit irrigated area is given below in the chart-1.

Chart 1: Annual irrigation water supply per unit irrigated area



The above result shows that the highest annual irrigation water supply per unit irrigated area is in SS10T4,T5, i.e., 46402.9 m3/ha and lowest is in S10T2, i.e., 17178.6 m3/ha. The data above presented is only theoretical, but according to farmers, the volume of water supply per unit irrigated area has been decreased by more than 20% than that of design volume.

4.1.2 Potential Created and Utilized

4.1.3 Satisfaction of head, middle and tail farmers on water availability

Focus Group Discussions were done with the selected farmers from the head; middle and tail reach of the system. Amongst them, the farmers in the head reach say that water is available to them in sufficient amount throughout the year. Farmers from middle reach say that they are getting water partially. Water is available for about 70% of the command area in the middle reach. But the farmers in the tail reach say that they are ‘discriminated’ regarding the water use. They say that they even do not get sufficient water in the monsoon. About 35-40% of the command area is irrigated throughout the year in the tail reach of the system.

It is noted that about 70% of the command area is getting fully irrigation facility while remaining 30% of the area is getting partial irrigation facility as a whole**.**

4.2 Agricultural Productivity

Nepal is predominantly an agricultural country that provides employment of 2/3rd of the people and contributes 34.9 percent of GDP (Source: Economic Survey, 2010/11). Until 1980, Nepal used to export surplus food grains. However, in recent years, due to ever increasing population growth and static in productivity of major agricultural crops many of the districts are under acute food deficit. Static or meager increase in production and productivities major crops in Nepal were mainly due to decline soil fertility, poor access of irrigation, poor or no adoption of improved agricultural technologies (varieties, breads and management) along with inappropriate government policies.

Of the all factors of productivity, irrigation plays the vital role and at present of the total cultivated area of 2642000 ha. 2/3rd of is potentially irrigable, however, only 17 % area has year round irrigation. About 4/5th of the agriculture land is under rain fed conditions. An estimate shows that < 8% of the country's water potential is used for irrigation (WECS, 2011).

In Ramgunj Irrigation System, a large population depend upon the agriculture, so it is needed to know the condition of agricultural productivity with respect to the irrigated area and the water supply. The production per unit area as well as per unit water is vital for the country’s economy. Therefore, this indicator has been chosen.

The indicators chosen for benchmarking are:

1) Output per unit irrigated area.

2) Output per unit irrigation water supply.

4.2.1 Output (Agriculture Production) per unit Irrigated Area

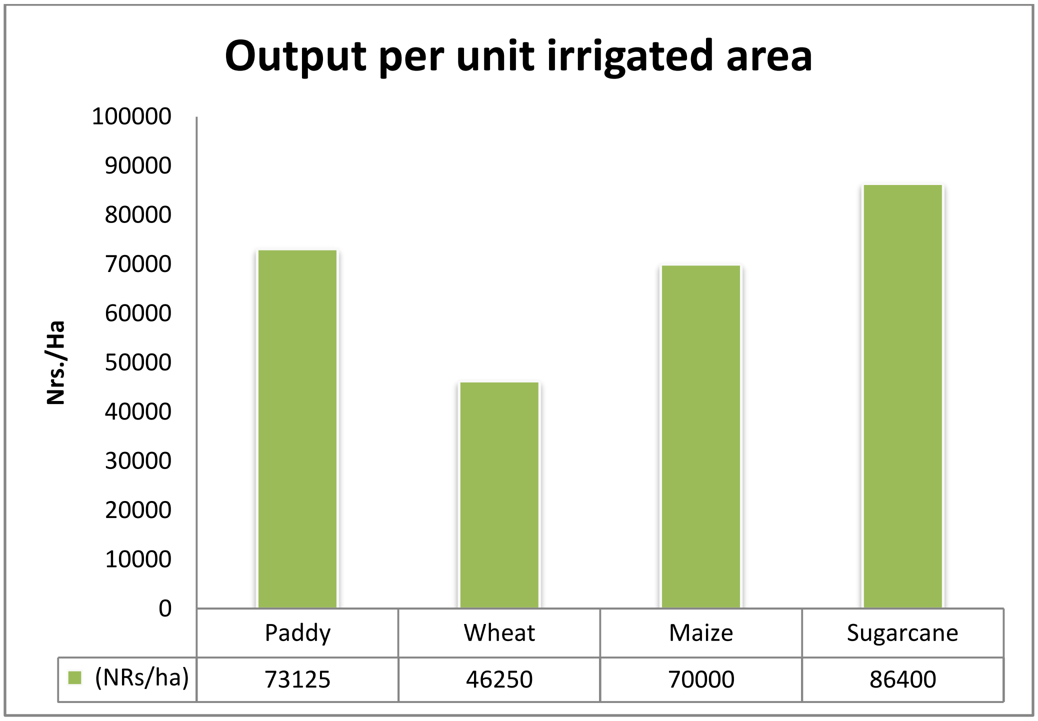
Output per unit irrigated area is the output in rupees of agricultural production from irrigated area divided by total irrigated area. It has a unit of NRs/ha.

As the population grows, the land holding per capita is going to be reduced. Secondly there is limitation on land to be brought under irrigation. Thus it is important that the output per unit area has to be increased with efficient water and land management, improved seeds and adoption of latest technology.

The efforts have to be made to increase output by diversification of cropping pattern, better farm practices and judging the market needs. However, water is the only output in agriculture on which service provider has control. Therefore to have an idea about trend of production in the command, this indicator has been adopted. The yield data of various crops is collected through local farmers in the field. The market prices are obtained from the local farmers through the interview with them.

The output per unit area in Ramgunj System is given below in the chart 2.

Chart 2 Output per unit irrigated area in Ramgunj Irrigation System



4.2.2 Cropping Intensity

Cropping intensity is calculated as annual cropped area (sum of area under all crops in a year)/net land area * 100.

Annual Cropping Intensity of Sunsari Morang Irrigation System is found to be 240% (*Source: Benchmark Report of Sunsari Morang Irrigation System*). Since Ramgunj is a branch of the same system and this branch is fed from the SMIS, therefore annual cropping intensity is taken the same as that of SMIS, i.e., 240%.

4.2.3 Cropping Pattern

Summer paddy is planted in majority of land (about 90% land of the command area) followed by spring paddy in 50% land, wheat in 25% land, sugarcane, jute, pulses, oilseeds & others in 25% land. Paddy and wheat are the main crops. An average yield of the summer paddy and spring paddy are 4.1 and 4.5 ton per ha respectively whereas this value for wheat is 1.6 ton per ha and maize 4 ton per ha. The traditional labor intensive system is gradually changing into mechanization system.

The traditional method for land preparation is practiced by 80% farmers whereas modern method by 20%. Use of both fertilizer and manure are practiced. In an average cropping intensity of the system is found more than 200%. Cropping pattern in the command area is as given in table below:

Table 2 : Cropping Pattern in SMIP

Crop Period	Crops
Ashar to Mangsir	Summer paddy, Sugarcane, Jute and Others
Kartik to Chaitra	Wheat, Pulses, Oilseeds, Maize and Others
Chaitra to Ashar	Spring paddy, Pulses and Others

In addition, seasonal vegetables are practiced in each season for their own use and selling purpose to some extent. It was reported that some of the crops (Kurthi, Bhade Paddy, Maruwa, Kodo&Rahar) were grown in the past, but presently these crops are not grown. It is learnt that spring paddy is slowly getting space as a new crop in the command area.

4.2.4 Local and Improved Seed varieties

During the discussion with the farmers, it was reported that the farmers are using both local and improved seed varieties for all crops and vegetables, but some of the hybrid seeds of paddy and vegetables are also being used. The varieties of these seeds are presented in a table below.

Table 3: Varieties of seeds used in the command area

Type/Seeds	Paddy		Wheat	Maize	Potato
	Monsoon	Spring			
Local	Local Basmati, Kanchhi	-	-	-	Rato&SetoAal u
Hybrid	Mansuli, Subarna, Radha 12	Chaite 2, Chaite 4, Sabitri, Malika	NL, UP, Annapurna, Bhrikuti	Pioneer, Shankar	Laalgulab, Sankupri, Sathiya

4.2.5 Use of compost and chemical fertilizers

Use of both compost and chemical fertilizers was noticed. But the use of chemical fertilizers in comparison of compost is unexpectedly high. Farmers are worried about the excessive use of chemicals fertilizers, because they are feeling that the fertility of the soil is decreasing day by day. Tentative use of chemical fertilizers is presented below in the table. These data were taken from the sample groups of farmers in the different systems of the Ramgunj Canal.

Table 4: Use of fertilizers for different crops

Crops	Fertilizers	Use(Kg/ha)	Remarks

Rice	DAP	60 kg/ha	80 % farmers use DAP
	Urea	60 kg/ha	
Wheat	Urea	75 kg/ha	Almost farmers do not use DAP, urea, potash in wheat.
	DAP	75 kg/ha	
	Potash	30 kg/ha	
Maize	Potash	30 kg/ha	-
	DAP	80-90 kg/ha	
Potato	N.P.K	-	
	Organic fertilizers	-	
	Gandyaula Mal	-	
Sugarcane	DAP, Potash, Urea	70-75 kg/ha	-

4.2.6 Status of use of mechanization

The use of agricultural machines is increasing day by day. The cost for land preparation and harvesting from machineries is considerably low than that of traditional methods (using bullocks, male buffaloes and labors). The other aspect is that more than 80% of male population work in the factories or are abroad, so the use of machineries is getting popularity. It is reported that about 70% of farmers are now using the agricultural machines for land preparation and harvesting the crops. Harvesters and tractors are commonly used for agricultural purposes. It costs about NRs. 5000/- per bigha for the land preparation for wheat & paddy.

4.3 Financial Aspects

It is vital for any system to be self-sustainable that at least O & M expenditure is met from its own revenue.

In SMIP, it is proposed to levy the water charges to all users, including irrigation & non-irrigation use on volumetric basis to encourage efficient use.

The indicators chosen for financial performance are given below.

1) Cost Recovery Ratio.

2) Total O & M Cost per unit area

3) Revenue per unit water supplied.

4) Total O & M Cost per unit Volume of Water Supplied.

5) Mandays for O & M per unit area.

4.3.1 Cost Recovery Ratio

It is the ratio of recovery of water charges to the cost of providing the service. It is imperative to devise water rates and mechanism for recovery of water charges for irrigation use in such a manner to meet, at least, annual cost of management, O & M of system and recovery of some portion of capital investment on the projects in order to make the system self-sustainable. Theoretically the cost recovery ratio should be at least equal to one.

In Ramgunj System, before 2058 B.S., for two years, Irrigation Service Fee (ISF) was collected at a rate of NRs. 150/- per bigha. But due to various constraints, there is no record of ISF collection since 2058 B.S. to till date. The standard norms for ISF collection for SMIP is set to be NRs. 300/- per ha. When ISF was used to collected, the water delivery from head to tail was good. From 2051 to 2058 B.S., the SMIP has made provision of the collector to collect the ISF, but after 2058 B.S., ISF collection was totally stopped. There is no up-to-date record of ISF collection. In the past, from 2044 to 2046 B.S., ISF was used to be collected with the '*Maalpot*'. But, this system also became ineffective as there is no exact record of the land with the farmers. While questioning about ISF, some farmers in the tail reach re-question that we do not get water in their field during their needs, then why to pay the fee? Therefore, the analysis shows that the cost recovery ratio is zero.

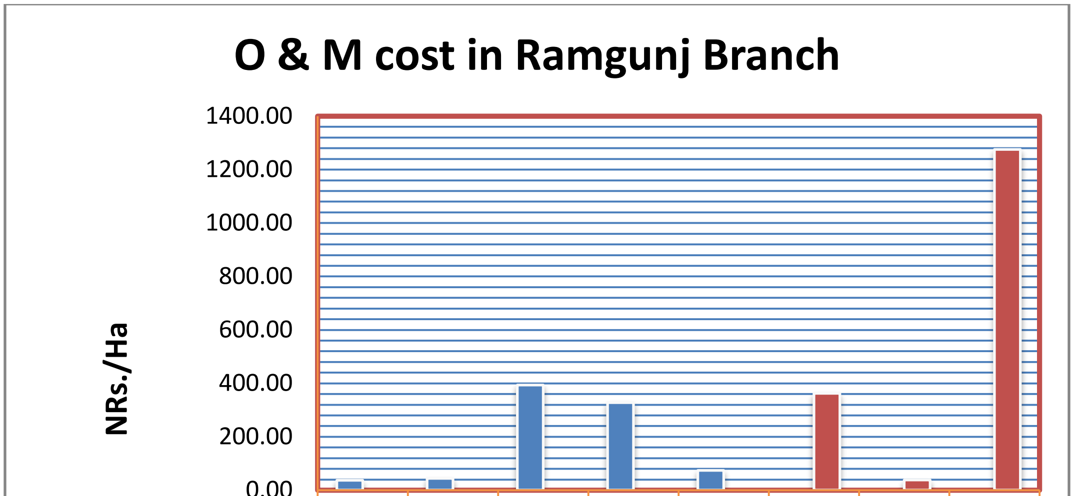
4.3.2 Total O & M Cost per unit Area

Total O & M cost per unit area is the ratio of total O & M cost incurred for management of the system and area irrigated during the year.

Generally, the O & M cost per unit area should be as minimum as possible. More the O & M cost, lesser will be the cost recovery ratio.

The result of O & M cost as obtained from the SMIP is given below in the chart-3.

Chart 3: O & M cost in Ramgunj Irrigation System



	SS10E -T1	S10, S S10A, SS10 A-T2	SS10E T1	SS10 A-T3	Ramgunj Secondary Canal	SS10E -T1	S10	SS10 B T1,T2 ,T3
Cost/Area FY 067/68	36.35	43.73	392.88	327.15	73.53	0.00	0.00	0.00
Cost/Area FY 068/69	0.00	0.00	0.00	0.00	0.00	361.90	37.20	1275.5

The analysis shows that the maximum O & M cost per unit area in Ramgunj is in SS10B(T1,T2,T3) in the FY 068/69, i.e., 1275.59 (NRs/Ha) and the least is in SS10E-T1 in FY 067/68 ,i.e., 36.35 (NRs/Ha).

4.3.3 Man days for O & M per unit Area

Man days for O & M per unit area means number of CRT, Work-charged and daily rated staff engaged in management of the system divided by area irrigated. It is always advisable to have optimum number of man days for O & M. But with fixed establishment of CRT, there is less scope for improvement. The reduction in irrigation area due to less availability of water for irrigation and more reservation for non-irrigation uses results in abnormal increase in the ratio. Considering the sanctioned staffing pattern for management section, the target of three mandays/ha is considered to be ideal one.

4.4 Environment Aspects

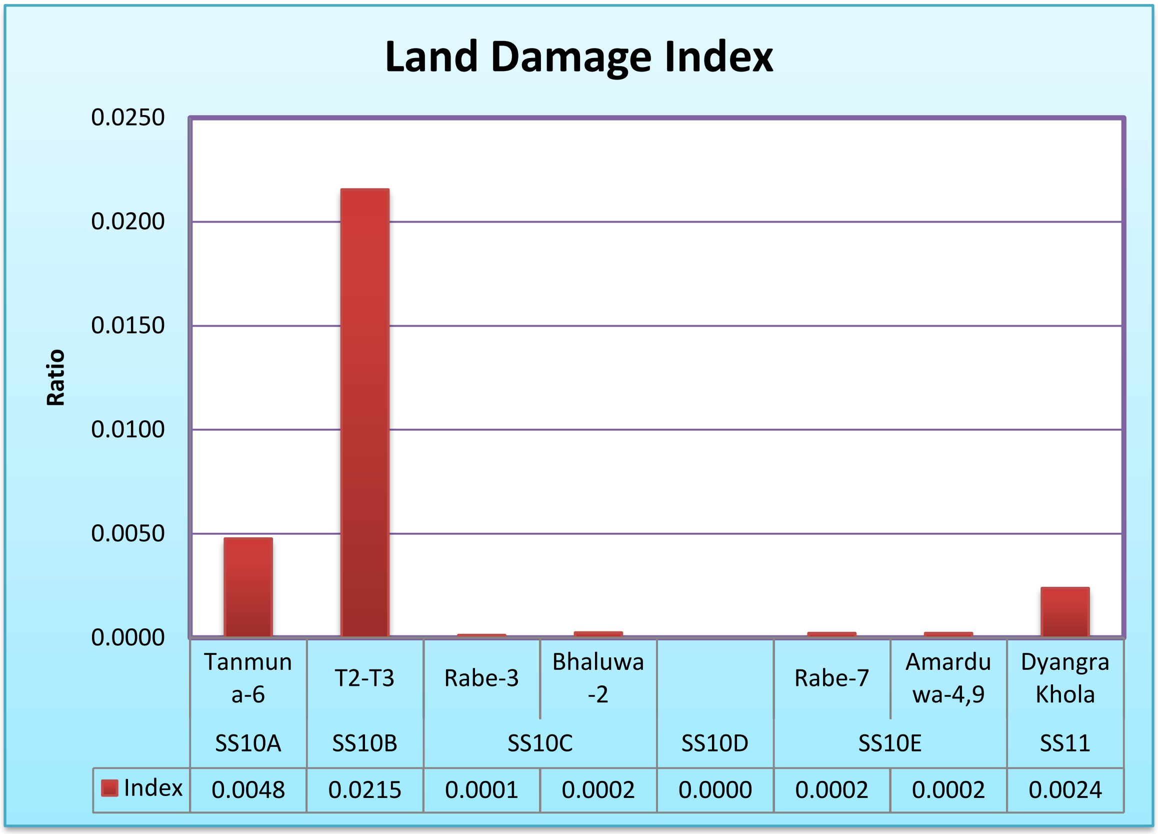
4.4.1 Land Damage Index

Land damage index is expressed as percentage of land damaged to irrigation potential created.

The lands under irrigation become saline or waterlogged due to excessive use of water resulting in low productivity. This problem is faced in areas where high water intensive crops are grown year after year with unscientific methods of irrigation like flooding. Water logging and salinity occur in soils with poor drainability.

The result of land damage index is given below in the chart-4.

Chart 4: Land Damage Index in Ramgunj System



The result of land damage index in the Ramgunj shows that the highest damage is in SS10B-T2,T3, equal to 0.0215 and the minimum is in SS10D, equal to zero.

4.5 Social & WUA Aspects

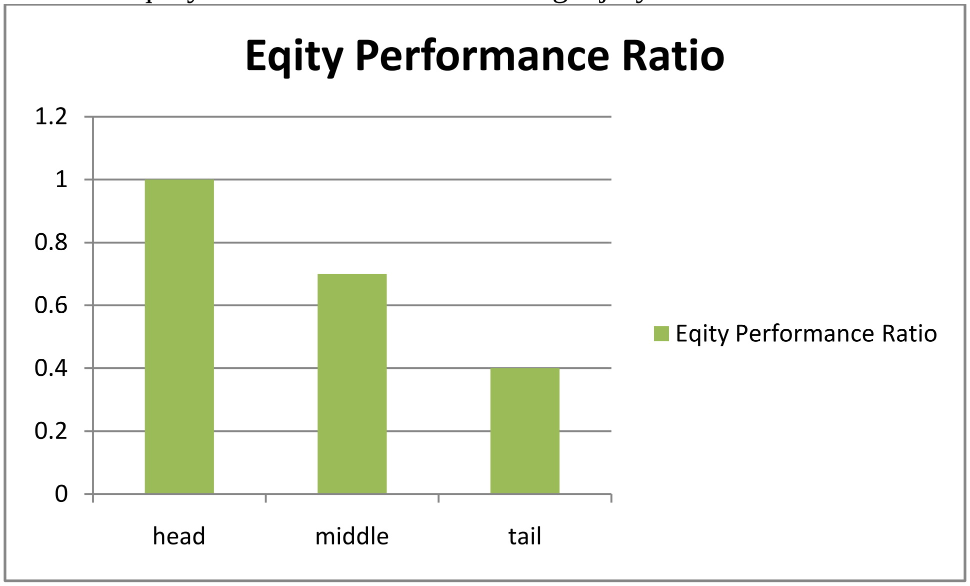
4.5.1 Equity Performance Ratio

Most of the schemes are gravity systems with canals and distribution system. The canal system is divided in to head, middle & tail reach equally with reference to length of canal. Equity performance means ratio of area irrigated to projected irrigable area in head, middle and tail reach expressed as percentage. This indicator gives clear picture as to whether the irrigation facility is provided equitably to head, middle & tail reach farmers or otherwise.

The benefit of irrigation should be given to the beneficiaries in head, middle & tail reach equitably. Ideally for equity, this ratio should be equal to one for head, middle as well as tail reach.

But the tentative performance ratio is seen as given in chart-5 in the Ramgunj System.

Chart 5: Equity Performance Ratio in Ramgunj System



4.5.2 Population with Cast & Ethnic Group

The total population in the VDC's of Ramgunj System is found to be 93957. Among them, 47834 are male and remaining 45123 are female. The total number of household is 22898 whereas the average household size is 4.97. (*Source: CBS-2011*). The data is presented below in tabular form.

Table 5: Distribution of population within VDC's of Ramgunj System

S.N.	Name of VDC	Population			Household Nos.	Avg. HHs Population
		Male	Female	Total		
1	Amduwa	4510	4157	8667	1670	5.2
2	Bhaluwa	2034	1924	3958	820	4.8
3	Madheli	3614	3566	7180	1433	5
4	PurbaKusahawa	3492	3428	6920	1327	5.2
5	RamgunjBelgachhi	3988	3543	7531	1383	5.4
6	Simariyia	2312	2228	4540	933	4.9
7	Sonapur	5026	4770	9796	2038	4.8
8	Tanmuna	2505	2375	4880	4880	4.9
9	Khanar	7663	7120	14783	3449	4.3
10	AmahiBelaha	3378	3216	6594	1256	5.3
11	Duhabi	9312	8796	18108	3709	4.9
Total/Average		**47834**	**45123**	**92957**	**22898**	**4.97**

4.5.3 Situation of Ingoing and Outgoing Migration from Command Area

The ingoing and outgoing migration from command area is negligibly small. The past trends show that 5 to 6 households per VDC are ingoing in the command area. But outgoing migration is not reported. Farmers say the probable cause for outgoing migration to be negligible is that there are a lot of factories nearby the command area, so the farmers have not to remain idle after they finish their agricultural works. Almost 90% of the farmers are working in the factories, so there is no need to migrate in the search of job or similar other purposes.

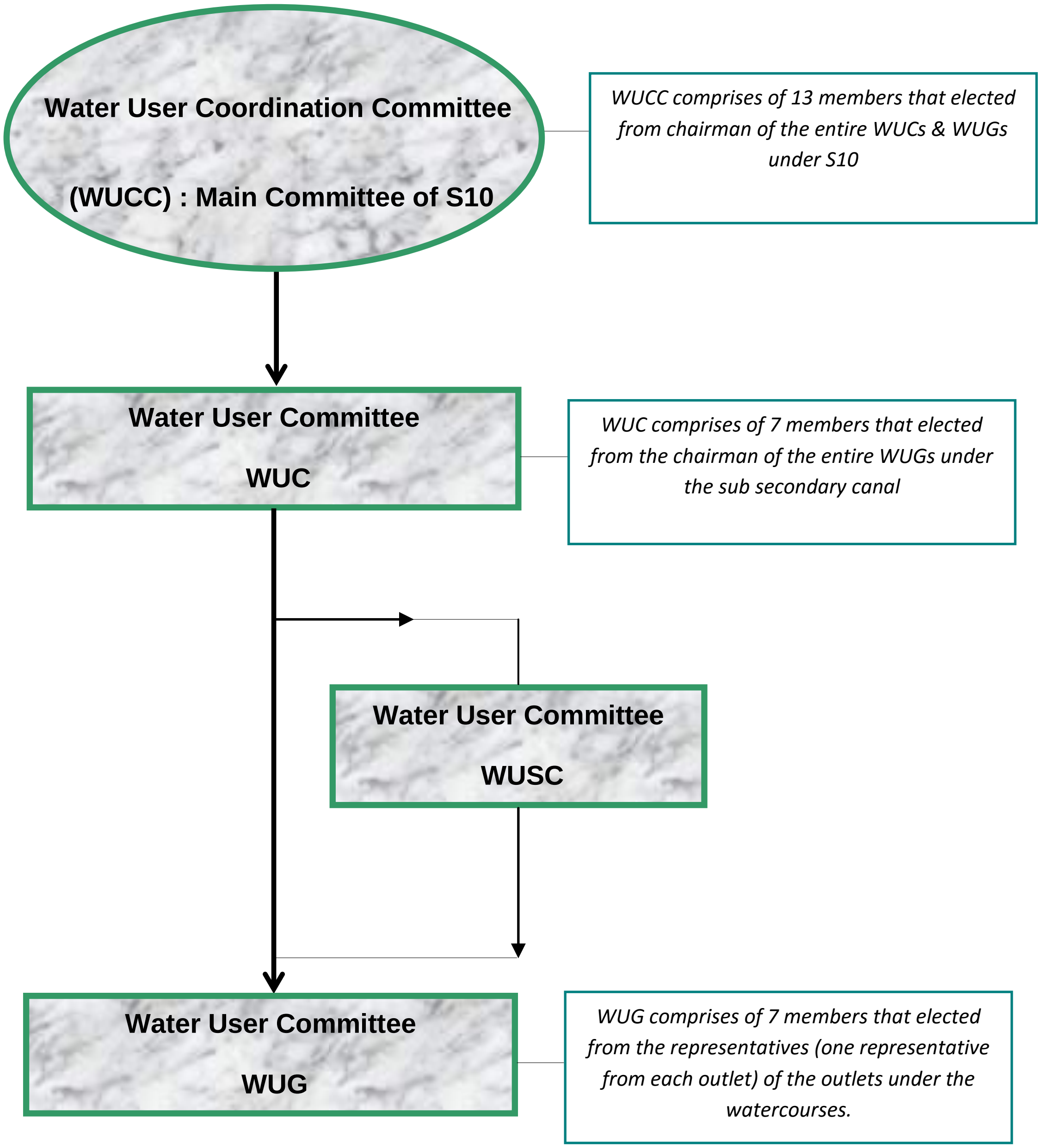
4.5.4 Availability of Labor

Farmers report that about 90% of farmers are working in the factory, so the availability of labor is going to be scarce day by day. In an average, a person earns NRs. 300/- to NRs. 600/- per day, according to the nature of work, which is more than what he earns from the agricultural works. So the attraction of farmers (labors) is towards the factories rather than the agriculture. But, they also report that those labors who work in factories get engaged in the agricultural activities during the plantation and harvesting periods. In an average, a woman gets NRs. 200/- per day without food and a man gets NRs. 350/- per day with food, when they are engaged in agricultural works. The migration rate is negligibly small and the labors leaving the country are relatively small compared to the other parts of the country, there is not acute problem of labors. On the other hand, agricultural system is modernized day by day and use of machineries is increasing, so till date, labor problem is not greatly noticed.

4.5.5 WUA structure

Presently, Ramgunj Secondary Canal – S10 is comprised of 3-tiers of organizations such as Water User Coordination Committee (WUCC) for S10, Water User Committee (WUC) for sub secondary canal and Water User Group (WUG) for watercourses, even though there is provision of 4-tiers of organization including Water User Sub Committee (WUSC) for tertiary level canal, in the constitution of WUO. The land owners who are themselves the tillers are no doubt the member of the water user group / committee. But sharecroppers also are eligible to become the member and the person who tills the land has to become the member of WUG/WUO. The detail of the committees is also presented in Figure 4.

Figure 4: Organization Chart of WUCC



It is to be noted that Sunsari Morang Irrigation Project (SMIP) is comprised of 5 – tiers of organization that includes Water User Central Coordination Committee (WUCCC) as Main Committee, Water User Coordination Committee (WUCC) for secondary canal, and Water User Committee (WUC) for sub secondary canal, Water User Sub-Committee (WUSC) for tertiary canal and Water User Group (WUG) for watercourse levels.

WUCC

The WUCC is comprised of total 13 members including Chairperson -1, Secretary-1 and Executive Members (EMs) - 11 numbers. All the executive members are elected from the chairpersons of the all WUCs and WUGs under the Ramgunj Secondary Canal, for four years. WUCC is divided into four Sub-Coordination Committees in order to make more active and are the followings:

a) Maintenance Coordination Sub-Committee;
b) Resource Mobilization Coordination Sub-Committee;
c) Canal Operation Coordination Sub-Committee; and
d) Election Coordination Sub-Committee.

WUC

The WUC is comprised of 7 members including Chairperson -1, Secretary-1 and Executive Members (EMs) - 5 numbers. All the members are elected from the chairpersons of the all WUGs under the sub secondary canals, to work for four years. To make active the WUC technically, the committee is divided into three sub committees;

a) Maintenance Sub-Committee;
b) Resource Mobilization Sub-Committee; and
c) Canal Operation Sub-Committee.

WUG

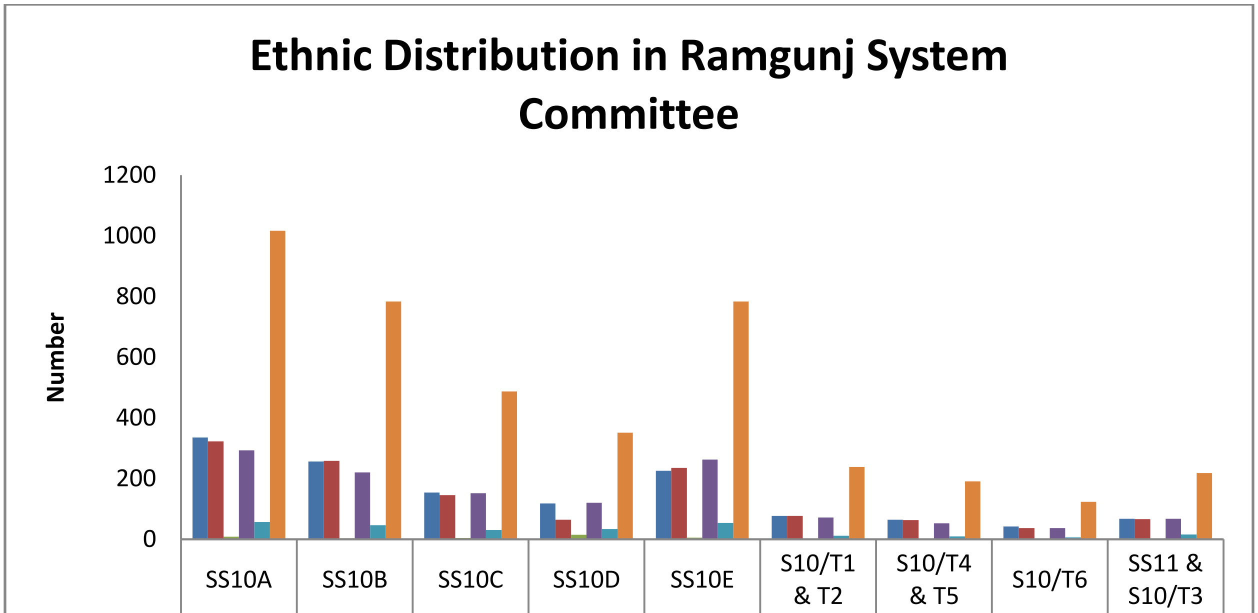
The WUG is comprised of 7 members including Chairperson -1, Secretary-1 and Executive Members (EMs) -5 numbers. All the members are elected from the representatives (one representative from each outlet) of the outlets under the watercourses, for four years. To make active the WUG, the committee is divided into three sub committees;

a) Maintenance Sub-Committee;
b) Resource Mobilization Sub-Committee; and
c) Canal Operation Sub-Committee.

4.5.6 Ethnic Distribution in WUAs in Ramgunj

The ethnic distribution in WUA committees in Ramgunj System is presented below in the chart-6.

Chart 6: Ethnic Distribution in WUAs in Ramgunj:



	SS10A	SS10B	SS10C	SS10D	SS10E	S10/T1 & T2	S10/T4 & T5	S10/T6	SS11 & S10/T3
Madhesi	335	256	154	118	226	77	64	42	68
Janajati	323	258	146	64	235	77	63	37	66
Dalit	8	3	4	15	5		1	1	
Male	293	220	152	120	263	72	53	37	68
Female	57	46	31	34	54	12	10	6	16
Total	1016	783	487	351	783	238	191	123	218

4.5.7 Output per ha Irrigated Area (Rs/ha/year)

In Ramgunj System, there is no output according to the input. Farmers demand of agricultural trainings and the new technology in the farming system. In Ramgunj area the value of land is NRs. 15,00,000/- per hectares. So the transaction of the land is increasing. Farmers are showing less interest to their land as the productivity of the land is decreasing. In an average, the input for the rice is NRs. 27000/- per year per hectare, while the output is NRs. 48000/- per year per hectare. The net benefit to the farmers comes to be NRS. 21000/- per year per heactre.

It has been late to take the steps for increasing the crop productivity in the Ramgunj area. DAO, NARC and other agricultural institutions should take initiatives for agricultural diversification to increase the crop productivity.

4.5.8 Water Distribution within Command Area

Water distribution within the command area is seen to be on adhoc basis. Water delivery to sub-secondary canals is based on the experience of gate operator on quality basis. No measurement practice is seen yet. It was noticed that secondary canal was gauged previously but since 2-3 years no gauging is done. Flow into water course canals is made into proportion to board crested weir of proportional division structure placed in SSC/TC level. Farmers at head reach get more water in comparison to tail reach farmers. But no schedule practice is seen.

4.6 Assessment of the Operation and Maintenance of the Systems

4.6.1 Current Practices, (secondary to water course)

The current practice of Operation and Maintenance of the system is outlined below:

Ramgunj Secondary Canal - S10

It is noted that no cleaning and regular O & M of Ramgunj Secondary Canal (S10) is done. The maintenance work is carried out during the emergency period for preventive measures. WUCC and SMIS office determine the emergency work and organize accordingly in this context; SMIS leads and performs the entire works in coordination with the WUCC. It is noted that no cleaning and regular O & M of the structures of S10 is done. The maintenance work is carried out during the emergency period for preventive measures. WUCC and SMIS jointly determine the emergency work and organize accordingly; SMIS leads and performs the entire works in close coordination with the WUCC.

Sub Secondary Canals under S10

It is noted that no cleaning and regular O & M of Ramgunj Sub Secondary Canals is done. The maintenance work is carried out during the emergency period for preventive measures. WUC/WUCC and SMIS office determine the emergency work and organize accordingly and in this relation, SMIS leads and performs the entire works in coordination with the WUC/WUCC. It is noted that no cleaning and regular O & M of the structures of Ramgunj Sub Secondary Canals is done. The maintenance work is carried out during the emergency period for preventive measures. WUC/WUCC and SMIS office jointly determine the emergency work and organize accordingly; SMIS leads and performs the entire works in close coordination with the WUC/WUCC.

Tertiary Canals

It is noted that no cleaning and regular O & M of Tertiary Canals under Ramgunj Secondary Canal is done. The maintenance work is carried out during the emergency period for preventive measures. WUG/WUC/WUCC and SMIS office determine the emergency work and organize accordingly and in this relation, SMIS leads and performs the entire works in close coordination with the WUG/WUC/WUCC. It is noted that no cleaning and regular O & M of the structures of the Tertiary Canals under Ramgunj Secondary Canal is done. The maintenance work is carried out during the emergency period for preventive measures. WUG/WUC/WUCC and SMIS determine the emergency work and organize accordingly and in this relation, SMIP leads and performs the entire works in close coordination with the WUG/WUC/WUCC.

Watercourses

It is noted that no cleaning and regular O & M of Watercourses under Ramgunj Secondary Canal is done. The maintenance work is carried out during the emergency period for preventive measures. WUG/WUC/WUCC determine the emergency work and organize accordingly, WUG leads and performs the entire works in coordination with the WUC/WUCC and SMIS office has almost no role in the O & M of watercourses. It is noted that no cleaning and regular O & M of the structures of the Watercourses under Ramgunj Secondary Canal is done. The maintenance work is carried out during the emergency period for preventive measures. WUG/WUC/WUCC determine the emergency work and organize accordingly and in this relation, WUG leads and performs the entire works in coordination with the WUC/WUCC and SMIS office has almost no role in the O & M of watercourses.

4.6.2 WUA's Participation

The participation towards Operation & Maintenance is not seen active in Ramgunj. The watercourses are cleaned and maintained by the farmers themselves, but the maintenance of tertiary canals is done by WUAs, but they are paid for their work by SMIP office, Biratnagar.

4.6.3 Agency's Roles and Responsibility

The roles and responsibility of the agency in the Ramgunj Irrigation System is listed below:

I. To carry out the Operation and Maintenance of the system.
II. To strengthen the WUAs for the efficient operation of the system.
III. To make the routine for the distribution of the water with the co-ordination of WUAs to the canals in the system.
IV. To provide the financial and technical assistance to the system.

4.6.4 Regular and Emergency Maintenance Practices

The regular maintenance of water courses is done by the farmers themselves and emergency maintenance practice is done by the agency, i.e., SMIP. It provides the financial and technical assistance for the maintenance of the system. If the maintenance is done by the farmers, the cost of the maintenance is beared by the agency.

4.6.5 Availability of human resources to WUAs

Human resources are available to the WUAs for the day to day maintenance of the system. Sunsari-Morang Irrigation System has been bearing the wages of the staffs involved in the operation and maintenance of the system. They are paid on the daily wage basis (at the rate of district rate) according to their presence in the Muster Roll. In altogether, fifteen staffs have been engaged in the Ramgunj System. Their post and the work entitled for them is given below in the table 5 below.

Table 6: Working area of the staffs involved in the Ramgunj System.

S.N.	Post	No. of Staffs	Working Area
1	A.O.	1	To carry out the daily adminstration of the sub-division office.
2	Chaukidar and Mali	4	To look after the main gate and keep the quarter and roads within quarter clean.
3	Supervisior	1	To operate the Ramgunj Canal from head to tail according to the routine and to give direction to dhalpa and gate operater to do their work according to necessity.
4	Gate operator	5	To operate and maintain the gates of the branch canals
5	Dhalpa	4	To operate and maintain the gates of the branch canals

4.7 Practices and status of the water delivery at all level of WUA committee

Water delivery to all the sub-secondary and water-courses is on the adhoc basis. Water is delivered to sub-secondary canals on the experience of gate operator on quality basis. No measurement practice yet. Flow in water-course canals is made in to proportion to board crested weir of proportional division structure placed in SSC/TC level.

Farmers on head reach get more water in comparison to tail reach. The practice of water-theft by cutting the canals and by inserting the siphons is seen in the secondary and tertiary canals. Even the office warns the farmers against the illegal water use to the farmers but the practice of water-theft is not stopped. On the other hand, some of the tertiary canals and water courses are completely damaged; therefore it has been great problem to deliver the water to the farmers' field.

Farmers in the tail reach are not satisfied by the system of water delivery. They report that, in their routine even they are deprived to use the water. The water is diverted elsewhere or is lost due to seepage or farmers in head reach draw water with pipes and cutting the canals.

The adjoining figure shows that the tertiary canal has completely damaged and the farmers in tail reach do not get water.

Figure 5: Tertiary canal completely damaged.

4.7.1 Effectiveness in Terms of Adequacy and Timeliness

Adequate water supply is not ensured in the Ramgunj System in the normal period. Even in the head reach of the system, the efficiency of the system is seen to be maximum 90%, while in the tail reach of the same system, more clearly, tail of the head, the efficiency of the system is seen to be maximum of 40%. In the tail reach of the whole system, the efficiency of the system is very miserable. Even in the head of the tail section, the efficiency of the adequacy of the water is seen to be only 30%. On the other hand, the tail of the tail section of the system, water availability is almost zero. Farmers at that section use the water from the boring as an alternative. The adequacy of the system can be better understood from the following table.

Table 7: Effectiveness of water adequacy in the Ramgunj System.

Canal Section	Water Availability Efficiency		
	Head	**Middle**	**Tail**
Head of Ramgunj System (S10T1)	80-90%*	60-70%	30-40%
Middle of Ramgunj System (SS10A)	60-70%	40-50%	20-30%
Middle of Ramgunj System (SS10B)	50-60%	30-40%	10-20%
Tail of Ramgunj System (SS10E)	20-30%**	0-10%	Almost zero

(Source: Field Survey)

Note: *The efficiency decreases due to heavy siltation and lack of proper operation and maintenance.

** The efficiency decreases due to illegal piping in the head and middle reach and lack of maintenance of the canal.

4.7.2 Weaknesses and User's Views about Water Delivery at all level.

The weaknesses of the system are outlined below:

Weakness

- Lack of proper maintenance of the drainage system, erosion take places at the various spots situated along the both banks of the drain during the rainy season;
- Lack of regular cleaning and O & M caused major defects in some structures as well as in the functioning of the canal;
- Some spots of the canals' banks are defective due to barrier made across the canal by the farmers, animal encroachment, and cutting of banks causing outflanking of water from the canal bank and damaging;
- The system is unable to deliver irrigation water in 25% length from the tail end of the most of the watercourses;
- The system is providing fully irrigation facility only in 70% command area and partially in the rest area;
- Irregular and partially collection of water charge and it is less than 10% of tota

5. Summary of Findings

Following findings were found from the benchmarking study of Ramgunj Irrigation System.

5.1 System Performance

- ✓ It was found that water distribution was not proper in Ramgunj canal as per schedule.
- ✓ The discharge in the canals is less than that of design discharge.
- ✓ The water availability in the head, middle and tail is not satisfactory. Farmers on head reach are more benefitted with water availability than that of middle and tail.
- ✓ Some of the structures like drops, outlets, canals etc are not proper functioning. Some canals are completely damaged.

5.2 Agricultural Productivity

- ✓ There is no satisfactory increase in the agricultural productivity though the farmers are using the improved varieties of seeds and fertilizers.
- ✓ The output per unit area is not satisfactory as the cost per unit area is increasing highly.
- ✓ The use of agricultural machines has helped the farmers in both physical and economical way.
- ✓ For increasing output per unit irrigated area and irrigation supply, farmers need to be encouraged for growing cash crops.
- ✓ For encouraging farmers for increasing the agricultural productivity, supporting incentive in the form of training and other resources are required to be provided to them.

5.3 Financial and Environmental Aspects

- ✓ The cost recovery ratio is found to be almost zero. The system is not self-sustainable. Farmers are not paying the ISF though it is clearly stated in their constitution.
- ✓ Financially, the WUAs are poor as they cannot repair and maintain the system by themselves.
- ✓ Land damage index is not seen high in the system. The problem of water-logging and drainage is not highly noticed, but the problem of siltation is high.

5.4 Social and WUA Aspects

- ✓ The water is not available equitably. But, quarrels and disputes are not much noticed.
- ✓ Labours are available for the agricultural works.
- ✓ WUA structure is newly formed and the WUA committees are sincere about the operation of the system.
- ✓ The migration in command area is negligibly small.
- ✓ The co-ordination of WUA with SMIP is seen well.
- ✓ One of the most important things that need to be seriously considered is that database with regard to operation and maintenance of canals must be kept for present situation analysis and future planning.

6. Recommendations

Analysis of benchmarking results identified several shortcomings which are listed below.

- ✓ Lack of information and data
- ✓ Flood problems due to drainage congestion
- ✓ Low cost recovery
- ✓ Inequitable distribution of water.

Lack of systematic data on several aspects of irrigation system results misleading in performance and planning. So, proper database should be maintained regarding the operation and maintenance by SMIS.

There is the problem of drainage congestion within command area. It is because the drainage area calculated and recommended at the time of design of SMIS is not now sufficient to drain all runoff during monsoon. Loss of land and erosion are some problems which have to be addressed with short term and long term river training works.

Inequitable distribution of water in the canal has been reported during field visit, especially tail reach. Inequitable distribution of water implies to low productivity, lower level of farmers' satisfaction and low cost recovery.

Low cost recovery recommends for increasing awareness of importance of maintenance of irrigation system and its relation to cost recovery. More emphasis with legal, institutional and policy frameworks should be given to water charging systems.