Performance Assessment of Irrigation: A Case from Nepal-Asia

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Area/Section: Project Management.
Type of the Paper: Archival Research.
Type of Review: Peer Reviewed as per |C|O|P|E| guidance.
Indexed in: OpenAIRE.
DOI: https://doi.org/10.5281/zenodo.6657541
Google Scholar Citation: IJMTS

How to Cite this Paper:

Mishra, A. K., & Aithal, P. S., (2022). Performance Assessment of Irrigation: A Case from Nepal-Asia. *International Journal of Management, Technology, and Social Sciences (IJMTS), 7*(1), 444-464. DOI: https://doi.org/10.5281/zenodo.6657541

International Journal of Management, Technology, and Social Sciences (IJMTS)
A Refereed International Journal of Srinivas University, India.

CrossRef DOI: https://doi.org/10.47992/IJMTS.2581.6012.0201

Received on: 25/04/2022
Published on: 18/06/2022

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ABSTRACT

Purpose: *The overall objective of the research was to conduct the performance assessment of Lipe Khola Baseri Irrigation Sub Project of Okhaldhunga district with specific objective to analyze structural performance of physical structure and institutional performance of Water Users' Association through water use activities, structure control activities and organizational activities of the system to examine the effect of Irrigation Project on change in cropping intensity, cropping pattern, crop yield and productivity of project area..*
Design/Methodology/Approach: *To meet the above goals essential and optional information were gathered. Family review, key sources meets, and centered bunch conversation were completed to gather the essential information in the review and optional information were gathered through project-related archives, reports, sites, distributions, and diary articles.*
Findings/Result: *The system had no water right problem. Adequate water was available at the system. Rotational water distribution system was used for equitable water distribution from head to tail. The system was designed for conveying 60 1ps of water throughout the system to irrigate 30 hectare land. The operation and maintenance of the system was done collectively as per the rules and regulation. The decision-making and conflict resolution of WUA was established satisfactory but weak in resource mobilization. Training was fruitful for management of system and needs further training on agricultural advancement. The crop yield of monsoon season remained unchanged while the winter and spring crop yield of the project area has increased by around 10%. The cropping intensity before the project was 163%, which has increased to 173.33% after the project but still it does not meet the target 197%, set by the project.*
The project construction ensures the sufficient water for irrigation but this does not change the cropping pattern of the farmers. Farmers of the project area are practicing the old method of farming. They use local seeds and grow traditional crops. Involvement of the agricultural institution in project area is essential for achieving the project objectives.
Originality/Value: *This study helps policymakers and local level government to assure construction with compliance of standards. It makes it easier for policymakers to incorporate the development needs without compromising quality through regulatory provision.*
Paper Type: *Archival Research*
K**eywords:** Physical structure, Cropping intensity, Cropping pattern, Crop yield, Water users, Water use activities

1. INTRODUCTION :

A developing country like Nepal has a challenge to construct new project and assure its sustainable operation. Being agricultural country irrigation infrastructure is one of most focused and it needs a functional system of irrigation to assure productive agriculture. In irrigation projects, the operation and maintenance part after handover to the water user's committee are very weak. Sustainability of irrigation project is one of the major problems. So, it should be addressed while planning the irrigation project. The main causes of the failure of the irrigation projects are the lack of proper participation of farmers and other stakeholders during project implementation. Finding the need based project and involving the

farmers from planning of project to the construction of the project makes the project more sustainable. Involvement of farmers in the project development procedure and involving them in decision making during the project planning to project construction improve the farmer's capability to handle the project. This study has been conducted to assess the systematic objective achievement of the project with a case study of Lipe Khola Baseri Irrigation Subproject of Okhaldhunga district.

2. PROBLEM STATEMENT :

Based on a study of Lipe Khola Baseri Irrigation Subproject of Okhaldhunga district the major issue suggested for study were the structural performance of the physical structure and institutional performance of Water Users' Association through water use activities, structure control activities, and organizational activities of the system highlighting the effect of the Irrigation Project on change in cropping intensity, cropping pattern, crop yield, and productivity of project area (Mishra, 2022) [1]. So, this research is attempted to fulfil the gap of the same with same system.

3. OBJECTIVES :

The overall study of the study is to conduct the performance assessment of Lipe Khola Baseri Irrigation Sub Project of Okhaldhunga district with physical structure and institutional performance of Water Users' Association through water use activities, structure control activities and organizational activities of the system along with effect of Irrigation Project on change in cropping intensity, cropping pattern, crop yield and productivity of project area.

4. LITERATURE REVIEW :

4.1 Performance measures:

As expressed by Chaponnière et al. (2012) [2], there is regularly in Irrigation Systems "an exchange of the board liabilities" from legislative foundations "to Water Users Associations and different sorts of associations". It appears to be along these lines consistent that ranchers (water clients) are the chief designated entertainers to assess the exhibition of this sub-framework, since they are the two partners and leaders.

Abernethy (1984) proposed the exhibition measures as: value, consistency, dependability and sturdiness; Chambers (1988) [3] which incorporates usefulness, value and security; Uphoff (1988) which incorporates efficiency, value, amicability, natural supportability and monetary manageability or cost viability; and as indicated by Abernethy (1989) [4] execution measure incorporates efficiency, value, productivity, maintainability and personal satisfaction. Bos (1997) [5] summed up the exhibition markers utilized in the Research Program on Irrigation Performance (RPIP). RPIP evaluates and test around 40 multidisciplinary execution pointers connected with water conveyance, water use productivity, upkeep, supportability of water system, ecological viewpoints, financial and the board.

4.2 Participatory Irrigation Management:

Participation is necessary in any Irrigation project. Irrigation projects are developed to increase the food production. Farmers are the ultimate users of the irrigation system. Without proper participation of farmers, irrigation projects do not success. The unsatisfactory water distribution and inefficient management of the system leads the irrigation project to a failure project.

Participatory water system the executives has been advanced as the push of viable water system the board box including and partner ranchers in arranging, activity and upkeep of water system framework are starting around 1980. The superb target of PIM is commitment, association and strengthening of water client's relationship in water system improvement and the board. In this respects, Government of Nepal has been embraced different lawful arrangements like Water Resource act 2049, Water Resource Regulation 2050, and Irrigation Regulation 2056, Irrigation Policy 2060 which is more overhauled and created Irrigation Policy 2070 for additional bearing of water system advancement and the executives of in Nepal.

Association of IMP in two of the DOI oversaw water system plans, Sirsia Dudhaura and Handetar in 1986-87, was the start of deliberate execution of participatory water system the board program in DOI oversaw water system plans [6 & 7]. Support is characterized as an interaction through which partners impact and offer control of advancement drives and of choices and assets that influence them. Along these lines, investment requires something other than dispersing data and giving ranchers government-

determined jobs in projects. Investment in water system the executives includes a bigger job for ranchers, water gatherings, and different partners. It might go from expressing data and impressions during interviews, to completely empowering ranchers to go about as head leaders taking all things together or most task exercises (ADB, 2012) [8].

The major thrust of participatory irrigation management is to be self-sustain WUA. Without self sustain WUA, the achieving goal of participatory irrigation management is not possible. Self sustain is the process and method also to achieve the target and objective of the Participatory irrigation management. Self-regulating, self-controlling, self-governing, self-financing, self-supporting and self-mobilizing are the core principle self sustained WUA which are the important and essential ground of participatory irrigation management.

Participation in irrigation aims at shifting of primary management responsibility to the water users with contraction of government's role and corresponding increase in the role of the water users (Sharma and Shukla, 1997) [6 & 7].

4.3 Design Principle for Sustainable Management:

Elinor Ostrom [9, 10, 11 &12] has developed the eight design principles for common resource management sector. It can be related with the self-sustainability of WUAs as follow.

- Clearly defined boundaries (members, water right and responsibility of the WUA members and officers are to be clearly defined in the WUA by laws
- Each members benefit and contribution must be even
- Monitoring and accountability is another mechanism for making WUA self-sustain. Provision of monitoring of WUA activities in the regular basis shall be established in the WUA institution and every performed activity are to be regularly monitored by certain body of WUA.
- Violators of rules have to receive gradual penalties
- Conflict resolution mechanism
- Autonomy to devise their own organization and rules
- Rules can be modified by the collective decision of members
- Decentralization of functions and decisions within the organization

Structures for controlling water (design, construction, operation and maintenance). Second type is water use activities which is focused directly on water (acquisition, allocation, distribution, drainage) and last type is organizational activities which focuses on organization which manages the water and structures (decision making, resource mobilization, communication and conflict management), where each one has four components as shown in figure. However, not all activities are equally important in each environment and the irrigation management institutions will reflect the relative importance el activities in a particular location.

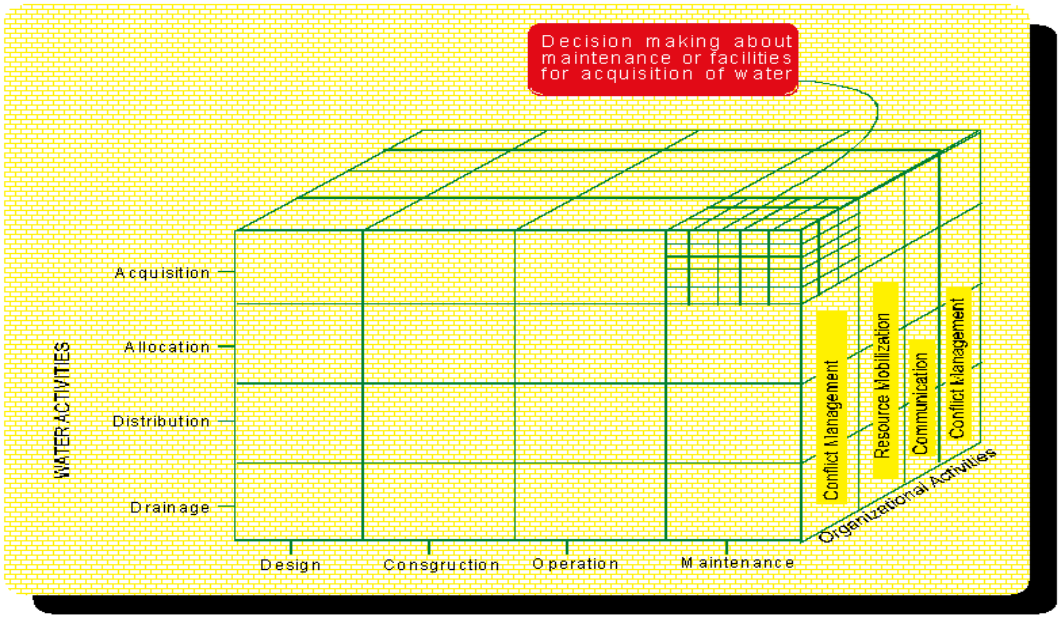

Fig. 1: Matrix of Irrigation Management Activities (Uphoff, 1986) [3 & 4]

For, the productivity augmenting effect of irrigation is determined by various factors, such as a change in land use, intensity of cropping, efficiency in the use of fertilizers and nutrients, quality of irrigation (quantum, assurance and timeliness in supply), agro-climatic conditions, the pattern of rainfall and its distribution, bio-chemical technology, seed varieties, chemicals and other inputs.
Changes in the crop pattern needed to be adopted in order to enhance the productivity of irrigation [13, 14 & 15]. The well-endowed green revolution areas (in terms of good soils and assured irrigation) have experienced tremendous decline in poverty levels owing to consistent agricultural growth. The elasticity of cropping intensity in respect of irrigation has been around 0.3 and of land productivity with regard to irrigation has been above 0.5 (FAO, 1993).
The first year of impact assessment of Sirsia Dudhaura Irrigation System done by East Consult in 1989 indicated yield increment of monsoon paddy from 2220 kg/ha and that of wheat from 1170kg/ha to 1650 kg/ha (Sharma and Shukla, 1997) [6]. Rice yield increased by 25% in Sinkalama and Mechi, by 44% in Irrigation Sector Project, and by 56`)/0 in Irrigation Line of Credit (ILC) Project [17, 18 & 19]. Sharma et. al (2004) [7] studied the different Irrigation Programs in Nepal and Agricultural impacts of the irrigation Programs are listed in the table 1.

Table 1: Agricultural Impacts of the Irrigation Programs

Program	No. of Scheme evaluated		Cropping intensity (%)	
		Before Project	After Project	Percentage increase
SINKAMALAMA	16	NA	230	
ILC	22	198	233	17
ISP	34	190	212	11
Mechi Hill	10	144	208	44

Source: [6, 7, 16, 17, 18, 19 & 20].

The result shows the remarkable positive impacts of irrigation in cropping intensity of the project area.

5. METHODOLOGY :

The research is an Extension research of Mishra, 2022 [1] where Lipe Khola Baseri Irrigation Project was need-based with Proper farmer participation and need to study the performance has been highlighted. so, the method is adopted mostly with slight modifications in focused areas for specific objective requirements.

5.1 Study Area:

The research is continued in Lipe Khola Baseri Irrigarion Sub Project located in Kuntadevi VDC of Okhaldhunga district. To investigate the major objectives, the study employed both quantitative and qualitative research techniques. For the analysis, data were collected well-structured schedules comprising of questions pertaining to important variables which are included in this study. These questions have been framed as the basic objective.

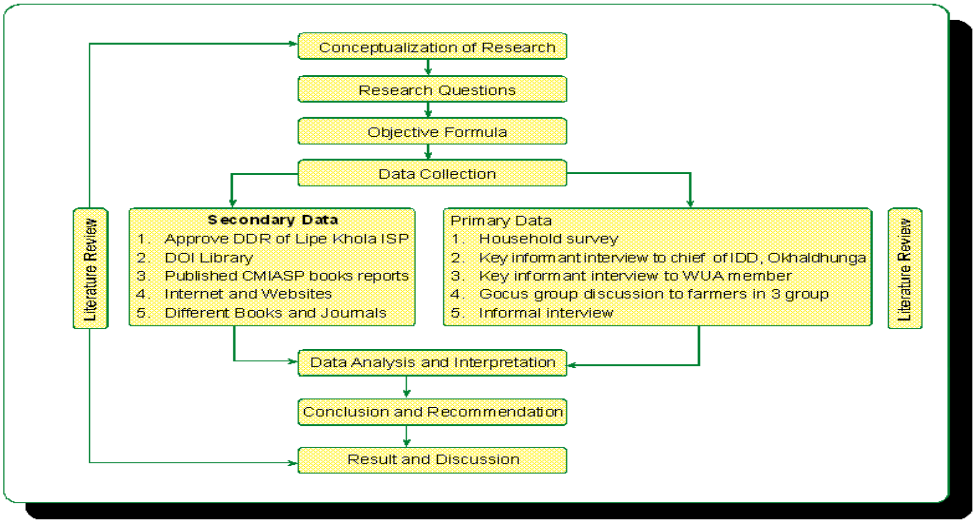

Fig. 2: Research Framework

The source of the project is Lipe Khola is a perennial source and salient features have been referred in Mishra, 2022 [1].

5.2 Collection of Data:

Primary and secondary data were collected for this study.

5.2.1 Primary Data Collection:

Key witness interview:

Key witnesses' interview to the Division Chief of Irrigation Development Division Okhaldhunga was led for the task the executives system and cycle of ranchers partaking in the various periods of an undertaking. Key witness interview was taken to the director and financier of WUA to know the WUA status, peace promotion, system of activity and upkeep of the venture, and serious issue connected with water system water the executives. Key witness interview was done to the District Agriculture Development Office (DADO), Office.

Focus Group Discussion:

Focus Group Discussion was directed in three distinct gatherings. Each gathering included six members. The center gathering conversation was arranged toward the rancher's cooperation during the various periods of the task improvement, activity, and support of the framework and change in rural editing design, trimming force, and yield of the venture region.

Poll Survey:

Out of 59 families, 50 quantities of the family were arbitrarily chosen in this poll review. The poll study incorporated the insight and inclusion of the rancher's interest in various periods of undertaking advancement and water system water the executives. After the poll review, every one of the members were partitioned into three gatherings head client ranchers, center client ranchers, and tail client fanners.

5.2.2 Secondary Data Collection:

Project-related auxiliary information were gathered from IDD, Okhaldhunga. The task report, information about the execution methodology of the undertaking were gathered from the IDD, Okhaldhunga. Information connected with WUA development, review reports, and WUA gatherings were gathered from the WUA workplaces. Different information were gathered from:

- Library Nepal Engineering College and library of Department of Irrigation
- Sub Project Proposal Report (SPPR) of the task, Detail Designed Report (DDR) of the venture from IDD, Okhaldhunga
- DOI/CMIASP paper show, distributions.
- Web/Websites.
- Books and diaries

5.3 Analysis of Data:

The data acquired from the meetings was arranged and dissected to set up this report. Every one of the arbitrarily chosen respondents were separated into three classifications as head clients, center clients, and tail clients. WUA partitioned the waterway into four portions for successful activity and support. For this concentrate on those ranchers whose land exist in portion one that is separated by the WUA for activity and upkeep is considered as the head client, ranchers having land in section two and fragment three is considered as a center client, and ranchers having land in fragment four is considered as a tail client.

In view of their subjective investigation of all important essential and optional information proposals have been made. The issues connected with the board, issue in investment were dissected by the data acquired from the meetings of IDD, Okhaldhunga Chief, and WUA individuals from the undertaking.

The gathered information was ordered, investigated, deciphered, and introduced in light of the quality and nature of the information. The subjective information was introduced to foster the legitimate grouping while the quantitative information were introduced in tables and figures and rates.

6. RESULTS AND DISCUSSION :

Management of the irrigation system, Institutional Performance and Physical structure Performance. For the management of the irrigation system, fanners were formed a Lipe Khola Baseri Irrigation Water Users Association. The IDD, Okhaldhunga handover the irrigation system to WUA after completion of the project construction.

6.1 Performance of Physical Structure:

The schematic diagram of the the Lipe Khola Baseri Irrigation system is shown in figure 3. This shows that the system has one temporary diversion structure at intake. Superpassage was used as the drainage crossing structure at two drain and two number of footbridge was constructed. Total eight number of outlet were constructed for the water control. RCC lining and pipe lining was used at different chainage that is not shown in this schematic. Lining was given priority to reduce the seepage loss in canal. Environmental work was done properly. Gabion retaining wall was constructed for preventing the landslide above and below the canal. Earth cutting was reduced by constructing canal lining above the Random Rubble Masonry wall where the geology was prone to landslide. Pipe was proposed where earth mass was constantly moving.

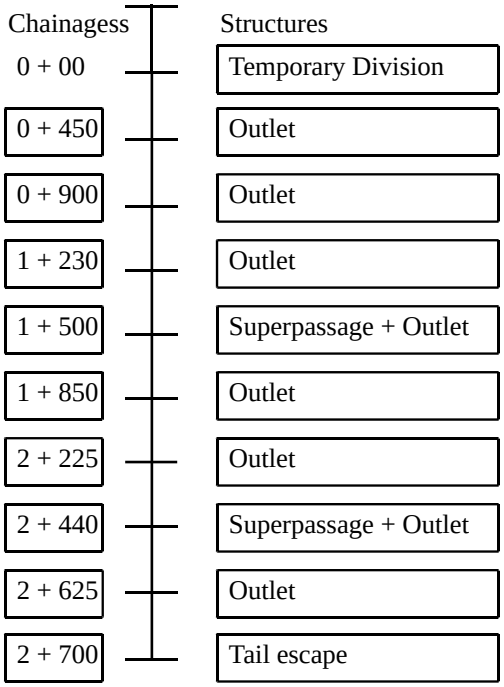

Fig. 3: Schematic Diagram of the Lipe Khola Baseri ISP

(A) Status of Physical Infrastructure:

According to key informant interview, the headwork was washed out by the flood of 2015. There was no gravel trap and the canal at the intake site was filled by the silt and sand. This reduces the water carrying capacity of the canal. The quality construction of the canal system had been prioritized so the canal lining, was working properly. But no regular maintenance observed during the site visit. Canal lining was covered with silt and mud.

During the construction of the project, there was no provision of construction of branch canal. Some outlet were constructed at the local kholsi so that the water from outlet flowed through that kholsi and farmers trap the water from kholsi and diverted the water to the farm land by making earthen canal. This leads to the water loss due to seepage. Unauthorized canal outlet was strictly prohibited. All the outlets were functioning well. The earthen canal section was covered by the mud.

6.1.1 Institutional Performances:

A. WUA Structures:

WUA of this sub project was organized and registered Irrigational Development Division (IDD) Okhaldhunga district on March 14 2009 A.D. WUA was organized for the application of farmers request form in Irrigation Development Division, Okhaldhunga. There was 11 members in the WUA committee including four numbers (36.36%) of women participation and one member from Dalit. It is above the 33% of women participation in WUA executive committee. The organizational structure of the Water Users' Association is shown in Figure 4.

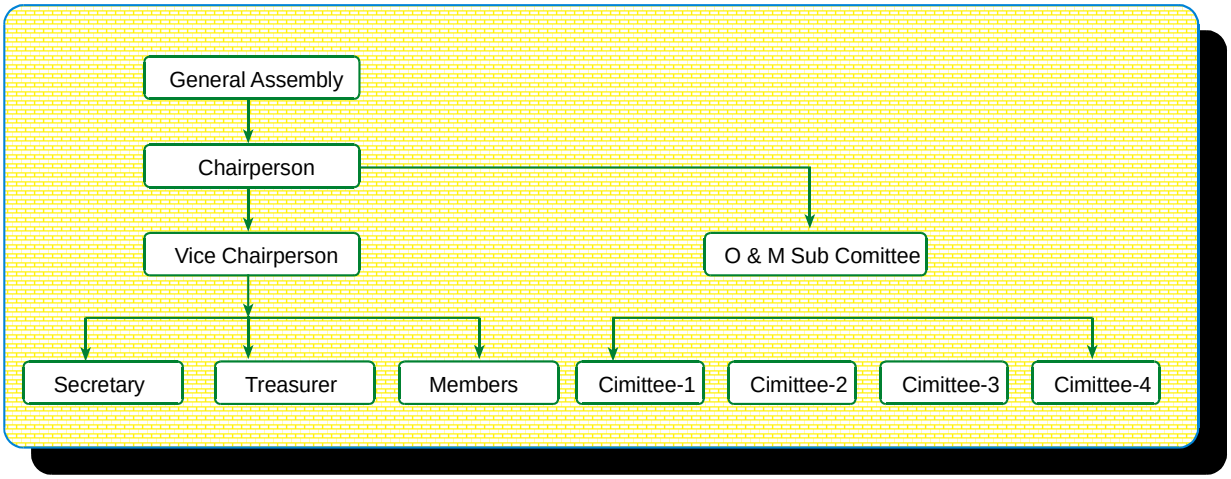

Fig. 4: WUA Organizational Structure

WUA committee formed another Operation and Maintenance subcommittee for the mobilization of the resource during the canal Operation and Maintenance. The Structure of operation and maintenance subcommittee is as shown in figure 5.

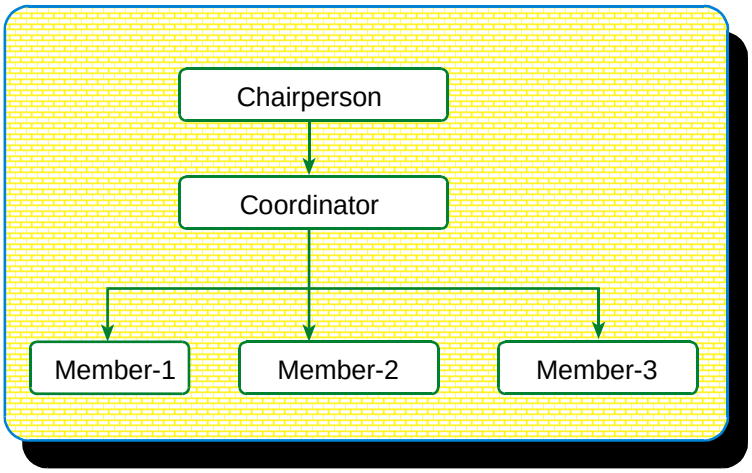

Fig. 5: Operation and Maintenance Sub Committee Structure

B. Objective and Functions of the Organization:

The main function of the WUA committee is canal operation and maintenance to ensure reliable irrigation water in agricultural field to increase the agricultural productivity.

The objectives and functions of the organization are:

- Construction, operation, repair maintenance and management of irrigation and drainage system.
- Resource collection and mobilization from different sources for operation and maintenance of the canal.
- Making water distribution schedule on reliable and equitable basis.
- Making rules and regulation for water distributions.
- Coordinating with other supporting agencies.
- Resolution of local disputes amongst members and between members and non-members.
- Maintaining the administrative and accounting records.
- Coordinate among the fainters and Water Users' Association regarding to irrigation issues.
- Disseminate the decision and other information to the farmers.

From the focus group discussion and key informant interview, it was found that the WUA was working satisfactorily in fulfilling the objectives of the organization. It was found out that the WUA had formed four group of operation and maintenance group to manage the operation and maintenance properly. WUA was able to repair the temporary structure and unable to repair and construct the permanent

structure of the system due to the financial weakness. Decision-making. Information-dissemination, coordination, and resolution of dispute of WUA was found satisfactory. Financial resource collection was found weak. Administrative management was found weak. WUA had taken a house for the office use but the documents were kept in individual WUA member's house not in office.

6.1.2 Performance on Water Use Activities:

A. Water Acquisition and Allocation:

Lipe Khola is the source of water of the Lipe Khola Baseri Kulo Irrigation Sub project. Lipe Khola is the perennial spring source. According to households survey, key informant interview with the WUA members and focus group discussion with the farmers, it was revealed that the system has no major problem of water acquisition and water right to use the source of water. Allocation of water for this system is primarily for irrigation use. In households survey 100 % said that there was no water right problems.

B. Water Distribution:

Water distribution among farmers is being carried out on rotation basis. According to focused group discussion, it was found that the irrigation is rotated after 36 hours. WUA divided the whole command area within four segment and at a time one segment was irrigated. According to WUA member, Wa' Segment had included around 6.5 ha. Land, 'Kha' segment had included 8-hector land, `ga' segement had included 7.5 ha and `gha' segment had covered around 8 ha land. Each segment irrigate the agriculture land for 9 hour and after 9 hour, next segment of the land is irrigated. The water was used by this system during the peak season of water need. Tail reach of the canal gets sufficient water. WUA committee meetings decide how to distribute the water and the decision communicate through the subcommittee. WUA strictly prohibited the unauthorized outlet in the canal. Unauthorized outlet will fine NRs. 500.00 at first time and for repetition of same, committee meetings finalized the type of penalty. The losses problem of canal reduced after project completion so there was no scarcity of water. 90% water available in monsoon season, 85% in winter and 80 % available in spring season.

From the focus group discussion, it was found that the problem of seepage and standby of farmers at the canal for emergency repair and maintenance had been solved after the project construction.

i. Basis for Water Distribution:

Table 2 shows the respondent's results about the basis for water distribution. From household survey on basis of water distribution, 86% (43 Nos.) used irrigation water in land on need basis, 10% (5 Nos.) based on farm size and 4% (2 Nos.) on the basis of time limit (scheduling). Household survey was done on whether all the farmers get water on equitable basis or not, 82% (41 Nos.) said that they get water on equitable basis and 18 % (9 Nos.) said that they did not get water on equitable basis. Farmers were using the water on need basis during the monsoon season when excess water is available and they used rotational system on other season.

Table 2: Basis of water distribution

How do you distribute irrigation water to the irrigation land?		Head Users N=16	Middle Users N = 20	Tail Users N = 14	Total Respondents	Percent
Respondents	On Need Basis	13	17.00	13.00	43	86.00
	On the basis of farm size	3	2.00	0.00	5	10
	Time limit (Scheduling)	0	1.00	1.00	2	4
	Others, Specify	0	0.00	0.00	0	0
	Total	16	20.00	14.00	50	100.00
Do the farmers of head reach, middle reach and the tail reach of the canal get water equitable basis?		Head Users N=16	Middle Users N = 20	Tail Users N = 14	Total Respondents	Percent
Respondents	Yes	16	16	9	41	82.00
	No	0	4	5	9	18.00
	Total	16	20	14	50	100.00

As per the Operational Procedure Manual (OPM) of CMIASP, for improving the water distribution, WUA has to establish the rules and regulations on water distribution and to implement as per the rules. Breaching of the rules should be punished.

ii. Water adequacy:

In this heading, for the irrigation adequate water available or not in the irrigation system at different locations of the canal and different seasons is studied. Respondents were asked the questions for their views on water adequacy. For the enough water available or not. 78% (39 Nos.) said they had enough water for irrigation while 22 % (11 Nos.) said no. The reasons for the insufficient water out of 11, 45.55% (5 Nos.) said due to water theft, 27.27% (3 Nos.) said seepage loss and 27.27 % (3 Nos.) said poor coordination of water distribution. The result of the response on the water adequacy is shown in table 3.

Table 3: Adequacy of water and causes of inadequacy

Do you get enough water for irrigation?		**Head Users N=16**	**Middle Users N = 20**	**Tail Users N = 14**	**Total Respondents**	**Percent**
Respondents	Yes	16	16	9	41	82.00
	No	0	4	5	9	18.00
	Total	16	20	14	50	100.00
Do you don't get enough water what are the reason?		N=0	N=6	N=5	Total = 11	Percent
Respondents	Yes	0	0.00	0.00	0.	
	Seepage loss	0	1.00	2.00	3	27.27
	Poor coordination of water distribution	0	2.00	1.00	3	27.27
	Water theft	0	2.00	3.00	5	45.46
	Total	0	5.00	6.00	11	100.00

For the water adequacy at different location_ 100% (50 Nos.) respondents responded that at the head reach the water is excess. At middle reach, 24% (12 Nos.) said excess, 64% (32 Nos.) said adequate and 12 % (6 Nos.) said inadequate. At tail reach, 14% (7 Nos.) said excess, 54% (27 Nos.) said adequate and 32% (16 Nos.) said inadequate (table 4).

Table 4: Water adequacy at different reach of the canal

Water adequacy at head reach		**Head N =16**	**Middle N=20**	**Tail N=14**	**Total**	**Percent**
Respondents	Excess	16	20	14	50	100.00
	Adequate	0				0.00
	Inadequate	0				0.00
	Total	16	20	14	50	100.00
Water Adequacy at middle reach?		**Head N =16**	**Middle N=20**	**Tail N=14**	**Total**	**Percent**
Respondents	Excess	3	4	5	12	24.00
	Adequate	13	10	9	32	64.00
	Inadequate	0	6	0	6	12.00
	Total	16	20	14	50	100.00
Water adequacy at tail reach		**Head N =16**	**Middle N=20**	**Tail N=14**	**Total**	**Percent**
Respondents	Excess	3	4	3	10	20.00
	Adequate	13	10	7	30	60.00
	Inadequate	0	6	4	10	20.00
	Total	16	20	14	50	100.00

For the water adequacy in different season, at monsoon, 100% said excess water is available, at winter, 82 % (41 Nos.) said adequate water available and 18% (9 Nos.) said inadequate water available. At spring, 74% (37 Nos.) said that adequate water available and 26% (13 Nos.) said that inadequate water is available.

Table 5: Overall response level on water adequacy at different reach

Water adequacy at different reach	**Head users N=16**	**Middle Users N=20**	**Tail Users N=14**	**Overall response Level**
Water adequacy at head	3.00	3.00	3.00	3.00

reach				
Water adequacy at middle reach	2.19	1.9	2.36	2.15
Water adequacy at tail reach	2.19	1.90	1.93	2.01

For evaluation of water adequacy at different reach of the canal response were given weightage as 3 for excess, 2 for adequate and 1 for inadequate and overall average was calculated. The result was found as 3.00 for head reach, 2.15 for middle reach and 2.00 for tail reach (table 5). The result shows that the water adequacy of the system was good.

From the household survey, it was found that the head users farmers were getting enough water for irrigation but some farmers from middle user and tail users are not satisfied with the water distribution. From the focus group discussion, it was found that design water flows from head to tail section of main canal but sufficient water is not available at the land far from the outlet. The tail land from outlet are facing, the problem of irrigation water. The tail end farmers from outlet are getting water after irrigating water whose farm is near the water outlet. Farmers are using local kholsi as branch canal and they divert the water by constructing feed channel this leads to the seepage water loss. Field water use mechanism of the system is shown in figure 6.

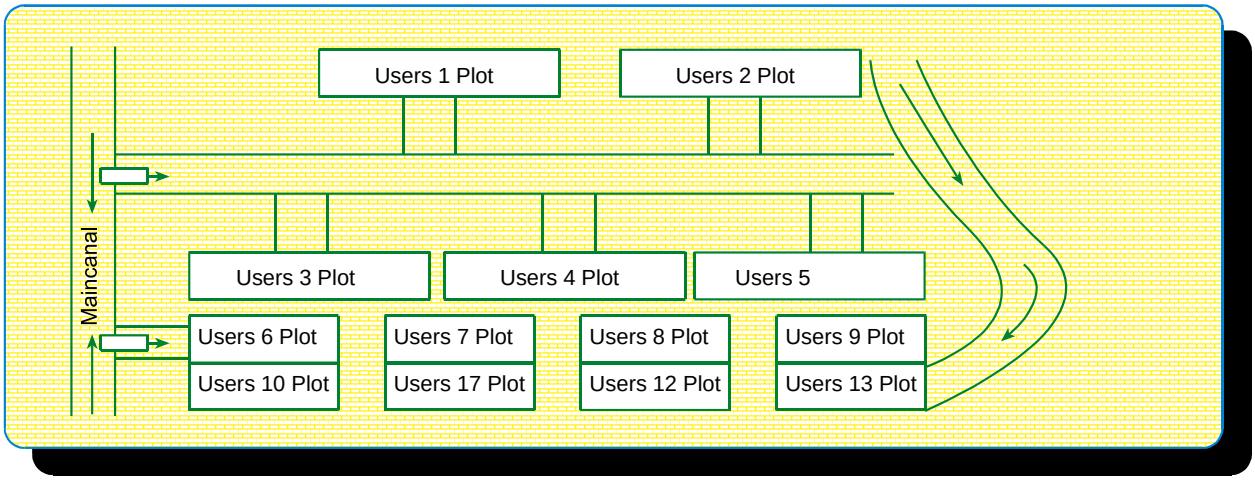

Fig. 6: Field water use mechanism of the system

6.1.3 Performance on Control Structure:

A. Design:

The system was designed for irrigating 30 ha. Land of Kuntadevi VDC-4 of Okhaldhunga district. The canal structure was designed for design discharge for 60 1ps with duty of 2 1ps per hectare. The whole canal system from head to tail was designed for the 60 1ps discharge. The typical drawing structures are used for the systems. Headwork was constructed with temporary diversion which was destructed by the flood of 2015. There was no water controlling structure at the intake site. The water was controlled by the canal lining section at the intake and excess water was spilled out from the spillway. Design water flow was controlled by the canal section and no other provision was provided in the system.

B. Operation and Maintenance:

From focus discussion and key informant interview, it was found that operator has not appointed and the canal operated by the farmers collectively. WUA had formed four subcommittee dividing the canal in four branch from head to tail. Subcommittee is responsible for the coordinating to the farmers for the operation of canal in the respective branch.

The maintenance of physical structures to acquire and control water is an important aspect of irrigation system management. Before the intervention by CMIASP, the regular maintenance works were carried out two times per year. One family member from each households must participated for maintenance work otherwise penalized by NRs. 300.

While running the canal, two groups of fanners stayed in intake location and other landslide location for the emergency maintenance.

After the project, regular maintenance works are carried out on two times per year by the end of Jesth and by the end of Kartik. Main canals are cleaned of debris and mud and temporary headwork is repaired collectively during the regular maintenance. Problem of canal washout by landslide was solved by environmental protection work during project implementation. The flood washed out the temporary intake constructed by the CMIASP. Those farmers whose turn for the irrigation water use is responsible for the emergency type of maintenance at that time.

The Coordinator of the each group is responsible for organizing the operation and maintenance of the canal in respective branch. WUA committee determined the scope of the work and coordinate with farmers through coordinator of subcommittee. It is necessary to participate each household member during the regular maintenance. WUA decided to fine by NRs. 500 on absenteeism of household member during the regular maintenance.

To find out the farmers view in terms of operation and maintenance of the system individuals are asked about the maintenance of the irrigation system (table 6). For the frequency of maintenance per year, all the respondent said twice in year. All the respondents said that they contribute labor to the maintenance of the irrigation system. 16% (8 Nos.) of the respondent evaluated the maintenance as very good_ 68% (34 Nos.) evaluated as good and 16 % (8 Nos.) evaluated as poor. For the causes of poor maintenance, out of eight, 25% (2 nos.) said due to the poor coordination of maintenance activities, 37.5% (3 nos.) said due to unwillingness of some members to make labor contribution and 37.5% (3 nos.) said as siltation problem in canal.

Table 6: Maintenance evaluation of the project

How do you evaluate the maintenance of scheme?		**Head Users N = 16**	**Middle Users N = 20**	**Tail Users N = 14**	**Total Respondents**	**Percent**
Respondents	Very Good	6	2	0	8	16.00
	Good	10	14	10	34	68/00
	Poor	0	4	4	8	16.00
	Total	16	20	14	50	100.00
What do you think are the causes for poor maintenance?		**N=0**	**N=4**	**N=4**	**Total Respondent**	**Percent**
Respondents	Poor coordination of maintenance activities by WUA	0	2	0	2	25.00
	Unwillingness of some members to make labour contribution	0	2	1	3	37.50
	Siltation	0		3	3	37.50
	Total	9	4	4	8	100

For the operation and maintenance quality of the project, 54% (27 Nos.) said that the operation and maintenance capacity is constant after the project while 32% (16 Nos.) said improved, 10% (5 Nos.) said no idea and 4%, (2 Nos.) said decrease than before the project. Operation and maintenance capacity was increased but still did not meet the farmer's expectation. Farmers needed an operator for operation of the canal. This seems that more trainings required to increase the operation and maintenance capacity. For the satisfaction of mobilization of WUA in maintaining and improving the irrigation facility, 56 % (28 Nos.) said satisfied, 26% (13 -Nos.) highly satisfied and 18% (9 Nos.) dissatisfied (table 7).

Table 7: Satisfaction of operation and maintenance quality

Capacity of Operation or Maintenance quality improved after project		**Head Users N = 16**	**Middle Users N = 20**	**Tail Users N = 14**	**Total Respondents**	**Percent**
Respondents	Improved	5	6	5	16	32.00
	Good Constant	9	10	8	27	54.00
	Poor Decrease	0	2	0	2	4.00
	No Idea	2	2	1	5	10.00
	Total	16	20	14	50	100
Are you satisfied with the		N=0	N=4	N=4	Total	Percent

mobilization of WUA in maintaining and improving irrigation facility?					Respondent	
Respondents	Highly satisfied	7	3	3	13	26.00
	Satisfied	9	12	7	28	56.00
	Dissatisfied	0	5	4	9	18.00
	Total	16	20	14	50	100.00

Source: Field survey 2016

For finding out overall response level of the system, the response was given weightage as: 3.00 for Improve, and highly satisfied, 2.00 for good, constant and satisfied, 1.00 for poor, decrease and dissatisfied and 0.00 for no idea and overall average response.

Table 8: Performance on Organizational Management Activities A. Resource Mobilization

Description	Head Users N = 16	Middle Users N = 20	Tail Users N = 14	Percent
How do you evaluate the maintenance of the scheme?	2.37	1.9	1.71	1.99
Capacity of operation or maintenance quality improved after project	2.06	2	2.21	2.09
Are you satisfied with the mobilization of WUA in maintaining and improving of irrigation facility?	2.44	1.9	1.93	2.09

Resource mobilization is one of the major activities of the WUA. Resource mobilization based on equality is important Cash, kind or labors are to be recorded properly. It should be transparent and account is open to all members of the system for inspection (table 8). The possible source of income of WUA are membership fee, irrigation service fee, penalties and other charges received from members, donations received from different organization and persons and loans received by WUA from various financial resources.

From the key informant interview, it was revealed that the WUA did not have any provisions for collections of irrigation service fee. There was the provisions of penalties and other charges for breaching of canal operation rules and regulation. But no one was penalized for breaching the rules and regulation. WUA annually present the income and expenditure in formal mass meeting and auditing of WUA account.

From the focused group discussion and the key informant interview of IDD, Okhaldhunga it was revealed that the WUA still do not claim the upfront cash deposited during the submission of project request form and retention money. The respondents were asked how did they contribute in this project and 100% said that they contribute labor and the contribution is equally for all users. WUA meetings fix the equal number of days for every households and every households contribute one labor per household.

Table 9: Resource mobilization and farmers attitudes towards ISF and penalties

How did you contribute in this project					Freq. N= 50	Percent
Respondents	Cash				0	0.00
	Labor				50	100.00
	Land				0	0.00
	Others				0	0.00
	Total				50	100.00
What is the farmers attitudes toward the ISF and penalties?		**Head users N=16**	**Middle Users N=20**	**Tail Users N=14**	**Total Respondents**	**Percent**
	Positive	5	10	7	22	44.00
	Negative	5	3	1	9	18.00
	No Idea	6	7	6	19	38.00
	Total	16	20	14	50	100.00

About the farmers attitudes toward the ISF and penalties, only 18% said that they have the negative

attitude about the ISF and penalties and 44% respondents said that the penalties and ISF collection is positive and 38% were neutral and said that they have no idea. From focus group discussion, it was found that fanners have lack of awareness about the resource generation for financial sustainability. Farmers said that if the ISF and penalties improve the operation and maintenance of the system. They are ready to pay ISF and penalties. Result shows that majority of the negative attitude toward ISF are coming from head user farmers. Head reach farmers said that they got adequate water before project so they don't want to pay ISF (table 9).

B. Conflict Management:

From focus group discussion and key informant, it was found that conflicts arising from water allocation and distribution are a common phenomenon among irrigators within and between groups.

Table 10: Conflict over Irrigation Water After the projects

After the project, the conflicts are increased or decreased?		Head users N=16	Middle Users N=20	Tail Users N=14	Total Respondents	Percent
Respondents	Increase	1	1	3	5	10.00
	No change	2	6	5	13	26.00
	Decrease	13	12	6	32	64.00
	Total	16	20	14	50	100.00

The overall response level on farmers response to the trend of conflict over irrigation water was calculated by giving weightage on response to 1.00 for increase, 2.00 No change and 3.00 for decrease. The result is shown in table 4-20. The overall response level was found as 2.52 which shows that overall response level was slightly increased. From key informant interview and the focus group discussion, it was found that the reason of conflict management improve was due to the training conducted by the IDD, Okhaldhunga and the ISPM consultant on the issue of conflict management (Table 10).

For the presence of conflict arising from distribution and allocation of irrigation water. They mentioned water scarcity, water theft and improper water distribution by WUA as the prominent factors for water conflict 45% (9 Nos.) of the beneficiaries reported that the conflicts were arise due to the improper water distribution by WUA whereas 30% (6 Nos.) said water theft was also another factors for water dispute within groups and only 15% (3 Nos.) said that water scarcity was the cause of the conflicts. Key informants also expressed that lack of enforcement of bylaws for water allocation has also been one of the most important constraints that led to unnecessary water disputes.

The survey shows that the maximum number of beneficiary farmers 64% (32 Nos.) said that the conflicts are solved by the WUA, 24% (12 Nos.) responded as the conflicts are solved by the elderly mediation and rest 12% (6 Nos.) said that mass meetings solve the conflicts. For the WUA_ performance over conflicts, a significant number of beneficiary farmers 74% (37 Nos.) responded that the water committee takes immediate actions on cases to resolve conflicts when they arose,14% (7 Nos.) said that the water committee suspended cases and rest 12% (6 Nos.) said that the WUA committee members do not give right decision on time.

From the key informant interview and focused group discussion, it was found that the emergency types of disputes were solved in time and simple types of disputes kept in suspension and took no action. The view of WUA members about the simple types of disputes was such simple type of dispute settles on time itself.

From the survey, it is revealed that the conflict management of the project has been improved after the project construction. Majority of respondents 70% (35 Nos.) said that conflict management has been improved in the irrigation system, 16% (8 Nos.) said that the conflict management has not been improved and rest 14% (7 Nos.) said that they have no idea.

From the household survey it was found that middle user fanners and the tail user farmers were facing more conflicts than head user farmers. And from focused group discussion it was found that the disputes arises about the use of water and some disputes arises about the water theft. The fatwers of having. land far from outlet had blamed that the farmers having land nearer the outlet theft the water. In conflict resolution process, simple conflicts were resolved by the elderly mediation in the field and in the case of critical conflict, farmers complained in the WI_JA, WUA called a meeting and WUA resolve conflict. If the decision was not satisfied by the any party then a mass meeting was conducted for the conflict resolution. Result shows that the conflict management of the system had been increased and

this was due to the training provided by the IDD, Okhaldhunga.

C. Communication and Decision Making:

From the Key informant interview with WUA member and focus group discussion with farmers, it was found that the WUA committee decided the distribution system, Operation and maintenance date and norms and the decision was communicated through the subcommittee members.

Table 11: Communication Procedure

Does the WUA communicate the water delivery schedule properly?		**Head users N=16**	**Middle Users N=20**	**Tail Users N=14**	**Total Respondents**	**Percent**
Respondents	Yes	11	14	8	33	66.00
	No	5	6	6	17	34.00
	Total	16	20	14	50	100.00
Do you feel that communication process of WUA becomes more effective after project?		**N=16**	**N=20**	**N=14**	**Total**	**Percent**
Respondents	Excellent	5	2	2	9	18.00
	Satisfactory	7	11	6	24	48.00
	Poor	4	7	6	17	34.00
	Total	16	20	14	50	100.00

For the effective communication, it was asked does the WUA communicate the water delivery schedule properly. 66% (33 Nos.) said yes and 34% (17 Nos.) said WUA does not communicate effectively (table 11-12).

Table 12: Response on effectiveness in decision making procedure

Do you feel that decision making process of WUA becomes more effective after project?		**Head users N=16**	**Middle Users N=20**	**Tail Users N=14**	**Total Respondents**	**Percent**
Respondents	Excellent	5	10	7	22	44.00
	Satisfactory	7	3	1	9	18.00
	Poor	4	7	6	19	38.00
	Total	16	20	14	50	100.00

Table 13: Overall response on effectiveness in decision-making and communication

Description	**Head users N=16**	**Middle Users N=20**	**Tail Users N=14**	**Overall Response**
Do you feel that decision making process of WUA becomes more effective after project?	1.94	2.15	2.07	2.05
Do you feel that communication process of WUA becomes more effective after project?	2.06	1.75	1.71	1.94

From the above table 13, it was shown that the overall response on decision making process was 2.07 which shows that decision making process is satisfactory level and communication process is slightly below satisfactory level.

6.1.4 Training:

From key informant interview to IDD, Okhaldhunga, WUA member and focused group discussion, farmers had received the training provided by IDD, Okhaldhunga. The IDD, Okhaldhunga had provided the training about the quality of construction, information about the irrigation structure, repair and maintenance of the system, account keeping and irrigation water management. The IDD, Okhaldhunga provided the training for four times and WUA had selected the persons from different households for each training so that at least one members of each households must participate the training.

The users were asked whether they had got any training or not and the majority of respondents 74% (37 nos.) said that they received the training that was provided by the IDD, Okhaldhunga. For the evaluation of effectiveness of the training, the out of 37, 16 nos. (43.24%) said that the training was effective and 56.76% (21 nos.) said ineffective. Training was effective in terms of managing the resource during construction of the project, it was effective in quality construction and giving the knowledge about the irrigation structure in the system and their function. And the 100% respondents said that they need further training about the improved agricultural practices, use of inputs for increased production, commercial farming.

6.2 Effect of Irrigation Project:

6.2.1 Cropping pattern and intensity before and after the project:

(i) Before the project:

Before the projects, crops were grown in three seasons — monsoon, winter and spring. The major crops grown in the command area are Paddy. Wheat & maize. The other crops include Potato & Vegetable. The cropping pattern of the project before project is shown in table 14.

The table shows that the main crops in monsoon season was monsoon paddy. 97% (29.1 ha) of the land was covered by monsoon paddy and only 3% (0.9 ha) of irrigated land was covered by the vegetables. During winter season, farmers were willing to grow wheat and potato. 35% (10.5 ha) of the total land covered by wheat during winter season. Some part of land about 5% (1.5 ha) was covered by potato and very few 3% of land was used for growing vegetables in the project area. In winter season 17.1 ha remained as a bare land. In spring season, only 20% (6 ha) land was used and only maize was grown in the land.

Table 14: Cropping pattern and intensity before the project

Season	Crop	Net Command Area (30ha)		Irrigates
Monsoons		**%**	**Ha**	
1	Monsoon Paddy	97	29.1	Sub optimum
2	Vegetable	3	0.9	Sub optimum
Monsoons Total		100	30	
Winter				
1	Wheat	35	10.5	Sub optimum
2	Potato	5	1.5	Sub optimum
3	Vegetable	3	0.9	Sub optimum
Winter Total		43	12.9	
Spring				
1.	Maize	20	6.0	Residual Moisture
Spring Total		20	6.0	
Total Cropping Intensity		163%	48.9 Ha	

Source: IDD, Okhaldhunga SPPR report 2010

(ii) Cropping pattern and cropping intensity after the project:

From the focused group discussion with the farmers and WUA members, the data about cropping pattern and the cropping intensity of the project was collected. The table 15 shows the cropping pattern and cropping intensity of the project after the project.

The table shows that there was no change in the monsoon-cropping pattern. The project did not change the trend of growing monsoon paddy during the monsoon season. Paddy was considered as the major crops so cropping pattern is same as before the project.

In winter season, the cropping pattern was not changed. Wheat remain as the major crops in winter.

After the project, some more farmers are interested in growing wheat. Data shows that 40% of land covered by wheat in winter season and followed by 5% land by vegetables and 5% land by potato. This shows that only some more area of land were using after project in the project area.
In spring season, maize grown in 20% of land and followed by 5% of land by vegetables. In spring season, vegetables are started to grown in the command area after the project. This shows that the cropping pattern was changed only in spring season.

Table 15: Cropping pattern and intensity after the project

Season	Crop	Irrigation status Ha		Irrigation Status
		%	HA	
1	Paddy Monsoon	97	29.1	Optimal
2	Vegetable	3	0.1	Optimal
Monsoon Total		100	30	
1	Wheat	40	12	Optimal
2	Vegetables	5	1.5	Optimal
3	Potato	5	1.5	Optimal
Winter Total		50	5	
1	Maize	20	6	Optimal
2	Vegetable	3.33	1	Optimal
Spring Total		23.33	7	
Total Cropping Intensity		173.33	52	

Before the project, the cropping intensity of the command area was 163% and after the project, it is slightly increases to 173.33% although the water was adequate. From the focus group discussion, it was revealed that the wild animal (like monkey) disturbed their farming. The wild animal destroyed most of the crops grown by the farmers. The labor problem of the command area is another problem for farming. Most of the young members of the households were moved to the city area of the country for their study. Therefore, the farmers were demotivated to practice the new crops in the command area. For the solution of wild animal farmers has to grow crops which does not destroy by the wild animals.

Table 16: Crop yield

Season	Crop	Crop yield of subproject area (kg/ha)	District Av. Crop Yield (kg/ha)
Monson			
1	Paddy	2500	2550
2	Vegetable	13000	11719
Winter			
1	Wheat	1350	1254
2	Potato	13000	11879
3	Vegetables	12000	11719
Spring			
1	Maize	1650	1950

Source: IDD, Okhaldhunga DDR report 2011

Table (16) shows the crop yield of the command area before the project. The crop yield of the project area was same as average crop yield of the district. Yield of monsoon paddy of project area was slightly less than the average crop yield of the district whereas yield of vegetable was more than average crop yield of district. Yield of maize in project area was less than the average yield of the district.

Table 17: Crop yield after project

Season	Crop	Crop yield of subproject area (kg/ha)	District Av. Crop Yield (kg/ha)
Monson			
1	Paddy	2500	3000

2	Vegetable	13000	15000
Winter			
1	Wheat	1400	1500
2	Potato	15000	15000
3	Vegetables	13000	15000
Spring			
1	Maize	2000	3000
2	Vegetables	13000	15000

Table 17 shows the crop yield of the project area after the project handover to the WUA. From the focus group discussion with the farmers and WUA member, it was found that the crop yield of the project area after the project does not change in the monsoon season due to there was no change in water availability and cropping method. The crop yield of winter and spring seasons were changed because water availability in the farm. Result shows that around 10% of the crop yield was increased as compared to crop yield of project area before the project.

Credit facilities

From focus group discussion, it was found that there was not any co-operative for the credit facilities. Farmers received the credit from neighbours. Farmers were not able to get services from microfinance for agricultural activities.

Farming Practice

From focus group discussion. it was found that farmers are involving in farming only for day to day survival. Farmers were not engaged in commercial farming. Excess product of vegetable and potatoes only goes in market for sell. Most farmers were used Compost and Chemical fertilizers as urea_ DAP and Potash. The main problem of the farmers were unavailability of labor, youths have less interest in farming, lack of knowledge of commercial farming. and destruction of crop by wild animal like monkey.

Livelihood Enhancement

The livelihood approach is important in knowing how the benefits are distributed among farmers and its differential impact at the household level. In the project area, agriculture is the one of the major income generating source.

Respondents were asked to know their view about the livelihood enhancement and health condition of the farmers. About the general health condition of the people, 22 % (11 Nos.) said that the health condition is improved and majority of farmers 78% (39 Nos.) said that the health condition remains same. For the livelihood enhancement, 22% (11 Nos.) said that livelihood is enhanced after project and majority of the farmers 78% (39 Nos.) said that livelihood remains same.

Table 18 shows that tail users and middle users farmers said as improve health condition and livelihood. From focus group discussion, it was found that due to the increase in production of vegetables and potatoes in winter and spring season and from selling excess product, income of farmers has slightly increased but not satisfactory.

Table 18: General health condition and livelihood enhancement

Does general health condition of people improved after project		**Head users N=16**	**Middle Users N=20**	**Tail Users N=14**	**Total Respondents**	**Percent**
Respondents	Improved	0	4	7	11	22.00
	No Change	16	16	7	39	78.00
	Lower				0	0.00
	Total	16	20	14	50	100.00
Livelihood enhancement of local people after project		**Head users N=16**	**Middle Users N=20**	**Tail Users N=14**	**Total Respondents**	**Percent**
Respondents	Increase	0	4	7	11	22.00

	Constant	16	16	7	39	78.00
	Decrease	0	0	0	0	0.00
	Total	16	20	14	50	100.00

From focus group discussion, it was found that due to the increase in production of vegetables and potatoes and from selling excess product sources of income of farmers has slightly increased but not satisfactory. Increase in remittance was another source of livelihood enhancement. Performance is all about managing constraints effectively during construction and operation to assure success [21 & 22].

7. CONCLUSION :

There is the problem of water diversion during monsoon season due to the washout of the temporary diversion. There is no any water control orifice and gravel trap at the intake. Problem of silt and sand deposit at the canal section is seen in the canal. Other structures were functioning well. WUA is registered and has legal status. WUA has formed the operation and maintenance sub-committee which is responsible for managing the labor for maintenance and operation of the canal as per rules in their respective reach of the canal. WUA is unable to prepare the operation and maintenance plan due to inadequate technical capacity, weak to manage financial resource, unable to keep the administrative record properly. WUA is effective in labor mobilization for operation and maintenance of the canal, decision making and conflict resolution, Making rules and regulation for water distribution and coordinating with farmers. The system has no major problem of water acquisition and water right to use the source of water. Allocation of the water for this system is primarily for irrigation use. Adequate water is available in the irrigation canal. Rotational irrigation distribution system ensures the equitable water in head to tail of the project area. Farmers of middle reach and tail reach having land far from outlets are facing the water distribution problems. Unauthorized canal outlets are penalized which reduces the water theft from canal. Operation and maintenance of the canal system is satisfactory. Collective operation and maintenance system is the beauty of this system. Periodic maintenance is done two times in a year by involvement of all farmer and and regular maintenance is done by the farmers who is facing the water problem. There is no operator for the operation of canal. Farmers of the irrigation system have lack of awareness about resource generation and mobilization for financial sustainability. WUA does not maintained any record of labor mobilization during operation and maintenance of the system. Conflicts in the system are decreasing and the conflict resolution capacity of WUA is increased. WUA decision making and information dissemination system is satisfactory.

Cropping pattern is not drastically changed after the canal in operation. During monsoon total command area is covered by monsoon paddy and very small percentage of land covered by vegetables. While in winter, the same crop is practiced as before the project implementation and no new crops are introduced. In spring, farmers are now interested in growing vegetables. The major crops are paddy, wheat, potato and vegetables. Cropping intensity is not changed significantly. Before the project, the cropping intensity was 163% and after the project, it is increased to 173.33% which does not meet the target as 197% set during the project development. This shows that farmers are not motivated fully by the irrigation system. Problem of wild animal like monkey is the main cause of farmers demotivation. Crop yield of the monsoon crop is remained same. This is due to sufficient irrigation facility existed in the project area in monsoon season before the project. While in winter and spring season, the yield of the project area is increased by around 10%. The increase in yield is only due to the availability of sufficient irrigation water in the project area during winter and spring season. This shows that farmers method of farming before and after the project remain same. The increase in yield is only due to the irrigation water.

8. RECOMMENDATION :

- WUA should change the need based type of water distribution system to rotational equitable irrigation schedule.
- There should be a system of water estimation at intake for crop planning.

- More trainings and more agricultural demonstrations for winter season crops and spring season crops are required.

9. ACKNOWLEDGMENTS :

The author feels thankful to graduate students of Madan Bhandari Memorial Academy Nepal, Urlabari 3, Morang, Nepal.

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