

Research Article

Impact of Irrigation on the Welfare of Small Holder Farmers of Bichariasuwa Irrigation Sub Project Command Area, Hilly Area

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A B S T R A C T

The purpose of this study is to assess the impact of the BichariAsuwa Irrigation Sub-project (BAISP) Terhathum, on the well-being of farmers of this command area. The main aim of this irrigation project was to provide irrigation to 50 hectares of land with main canal of 2.225 km having discharge of 100 lps, which was not previously irrigated due to insufficient infrastructure. This study evaluates the impact of the project on the project area, focusing on its relevance, effectiveness, impact, efficiency, sustainability. The study finds that the project had a positive impact on poverty reduction, food sufficiency, reduction of women's drudgery in household works, gender issues, migration control within the project area. The project also created employment opportunities and changed the cropping pattern, resulting in increased cropping intensities of major crops like paddy, maize, potato, pulses. Field visits with a checklist, a questionnaire survey, key informant interviews and Focus Group discussion were used to collect data, which was then analyzed using the Relative Importance Index and descriptive statistics. The analysis gives that the cropping intensity from 171 % to 240 % similarly cropping yield of paddy increased from 2.8 to 3.0 t/ha, wheat increased from 1.8 to 2.0 t/ha, maize increased from 1.8 to 2.0 t/ha and potato increased to 13 from 11 t/ha after the intervention of the implementation of project. The Water User Association (WUA) of this system have responsibility of effective decision-making, conflict resolution, working with farmers. However, due to technical and administrative difficulties, the WUA has been unable to develop a canal maintenance plan, raising concerns about sand and silt buildup. The main intentions of such types of study is finding appropriateness and relevance of the project design, planning, activities, including regularity, resource mobilization, coordination, institutional development, strategies that were applied Which guide for similar irrigation projects in the future.

Keywords: Irrigation, resource mobilization, Water User Association, Relative Importance

Introduction

Nepal is an agrarian country, with agriculture serving as the primary source of income for more than 60.4 % of the population, as well as a source of foreign exchange and national economic growth. The agricultural sector's performance determines the country's economy and it's conducive 27% to the national GDP in 2017.¹ Smallholder farmer rainfall dependent farming practices agricultural production, where a range of crops are cultivated throughout the country, defining the success of production, yield, welfare outcomes.² A significant portion of the GDP is thought to come from agriculture, which accounts for an average growth rate of 32 percent. Almost 86 percent of rural residents depend on agriculture for their livelihood 3. Agriculture is Nepal's most important economic growth sector and a major source of food for the country, it is heavily reliant on rainfall.⁴ Changes in agro-ecological conditions caused by climate change have direct impact on food production systems.⁵ Rainfall pattern in Nepal is both temporal and spatially variable due to change in climates.⁶ It is difficult for a developing nation like Nepal to build new projects and ensure their sustainable functioning. A functional irrigation system is required in a country that is predominantly agricultural in order to ensure fruitful agriculture.⁷ Agriculture has long been seen as the foundation of Nepal's economy because it employs the most people of any sector.⁸ Some findings show that agriculture directly affect farmer income, also help to advance economic growth outside of agriculture by creating additional jobs. Growing agricultural productivity boosts farm earnings, expands the food supply, brings down food prices, generates additional employment opportunities.⁹ Irrigation is a important part of the Nepal government's plans for food and water security. The government has been actively investing in irrigation in an effort to boost agricultural output and extend irrigated areas.¹⁰ It is crucial to look at adaptive factors that support irrigation system resilience to climate variability and change in order to protect and sustain significant investments in irrigation development.¹¹ The degree to which small-scale irrigation affects the food security of household was appraised as high .¹² Farmers' perceptions were used to assess how irrigation resource development and water sharing methods have increased household food security while reducing pressure on natural resources.¹³ Similarly increment in water availability and reliability through irrigation development crop diversity, cropping intensity, food sufficiency, farmer economic return. Community characteristics will be improved.¹⁴ The 1992 Irrigation Policy required at least 20% women on the Executive Committees of all WUAs, which was increased to 33% in the 2003 Irrigation Policy.¹⁵ Traditional limited roles of women in irrigation have also changed as a result of

the introduction of new technologies such as separate drinking water systems in villages, cell phones that facilitate communication, women learning new skills such as bicycling to negotiate long distances for irrigation maintenance and exchanging agricultural products in the market, as well as broader social changes caused by a variety of factors.¹⁶ Wet seasons are likely to become wetter, dry seasons are likely to become drier, resulting in high variability in water availability for agriculture, low crop productivity, degradation of rangelands and pasture with nutrient loss.¹⁷ In recent years, climate change-related drought has emerged as a source of household vulnerability in Nepal's rainfed hill agriculture. Farmers are unable to grow crops if there is no rain during the cropping season.¹⁸ BichariAsuwa Irrigation sub-project may be a Hill area irrigation project of Nepal. The canal system was constructed century ago by farmers but wasn't capable to irrigate whole command area and wasn't functioning well. it had been rehabilitated by Kuwait Fund for Arab Economic Development Project (KFAED) under support from Nepal Government.¹⁹ This irrigation system increases the farmer income as well as also creates a barrier to the migration of locals.

Material and Methodology

Study Area

The BichariAsuwa Irrigation sub-project is located in Phedap Rural Municipality Ward No.-2 in Terhathum district in Nepal's eastern northern region which is approximately 34 kilometers north of Terhathum district's Myanglung Bazaar. Taplejung and Sankhuwasabha border the district to the north, Taplejung and Panchthar to the east, Dhankuta and Panchthar to the south, Sankhuwasabha and Dhankuta to the west as shown in figure 1. The district is divided into 6 local body, four of them are rural municipality and 2 of them area municipality. The district has a total area of 679 square kilometers. The greatest elevation point is 3034 m above mean sea level, the lowest elevation point is 322 m. The district has three distinct climate types because of the variations in elevation that are upper tropical at elevation below 1000 meters, sub-tropical at elevation between 1000 to 2000 meters and temperate at elevation above 2000 meters with coverage area of 24 %, 56.4 % and 19.5 % respectively. Airport in Biratnagar, Morang, is the closest. Myanglung roads is the closest road access. The project is situated at 27° 9'54" North and 87° 32'40" East.²⁰ The BichariAsuwa Irrigation sub-project lies in sub-tropical climate range within elevation range of 1000 meters to 1354 meters as shown in figure 2. There was a gentle slope with terrace farming practices. There soil of this project area was sandy soils types and sandy loam types. Similarly, the land use pattern of this command area was found that 70 % of total command area were Agriculture land 20% were Forest 20% and only 10 % area were others land use likes roads, built-area, bare land and etc. as shown in Figure 2.

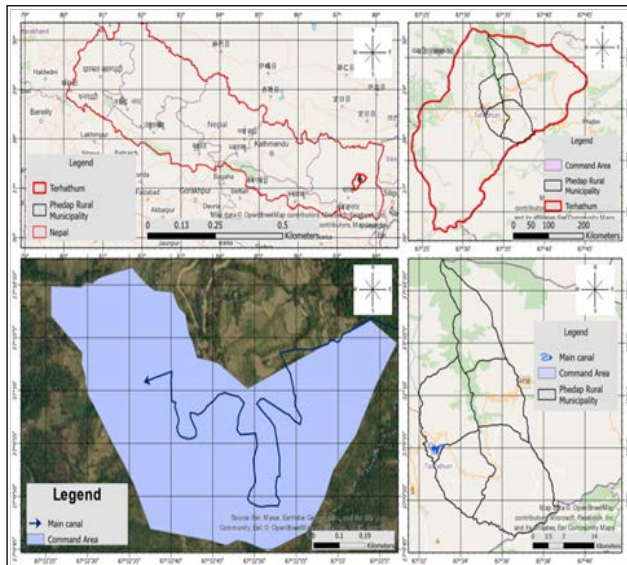


Figure 1. Study Area

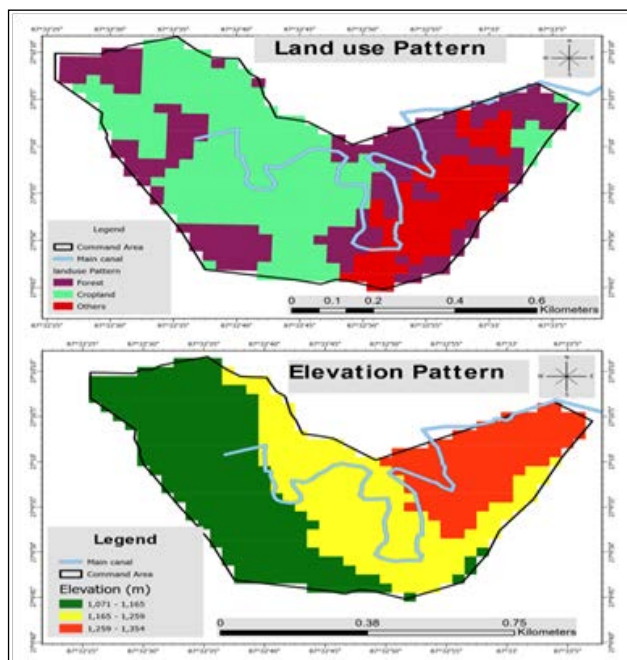


Figure 2. Elevation pattern and Land use Pattern

Study Design

The main theme of the impact study is to compare the project's pre-intervention and post-intervention socioeconomic, environmental, technical performance scenarios. The current study's data has been compared the baseline data. As a result, the baseline study report is a critical component of the study. The study relied on primary and secondary sources of data and information, as well as quantitative and qualitative data and survey results. The study's schematic design is shown in graphical form in figure 3. The methodology adopted to meet the scope and objectives of the study consist of collection of primary and secondary data using household survey, FGD,

Key informant interviews and analysis of collected data using qualitative and quantitative techniques as shown in above graphics.

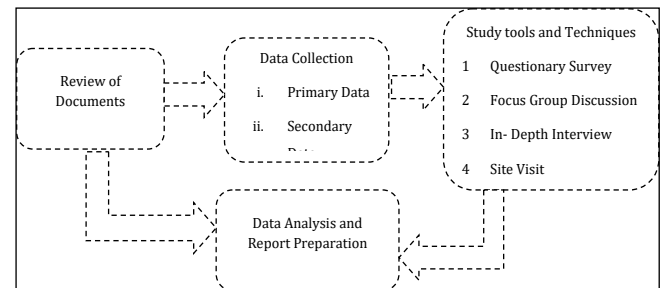


Figure 3. Study design

Review of Documents

The primary goal of the review of literature, previous reports, studies was to be aware of the government's existing plans and policies to address the issues of new irrigation development and feasibility study, past experience in hill irrigation planning and implementation, to collect data and information to best interpret the study. Some important reports reviewed.

- Legal and Policy documents
- Water Resources Strategy 2002
- National Water Plan 2005
- Water Resources Act 1992
- Interim Plan 2011-13
- Irrigation Policy 2070

Data Collocation

Primary Data Collection

This study is based on information gathered through Participatory Rural Appraisal (PRA) and a household survey of 57 farmers from this study area. The data was gathered in two stages: PRA and household survey (Individual Interviews). In the PRA, farmer respondents were stratified based on their overall assessment of their families' livelihood status. Village opinion leaders, farmer leaders, local administrative heads helped stratify households to ensure proportional representation of different types of farmers. Following stratification for sampling, data were collected in the succeeding round via household survey using a semi-structured questionnaire with simple questions to provide answers to reported feeling.

Enumeration of the Target Group

The structured questionnaire was used to collect primary quantitative data and information for interviews with project intervention area beneficiaries. The questionnaire inquired about the demographic status of the target groups, such as community structure, ethnicity diversion, social inclusion, the impact on socioeconomic status. The target group also collected perspectives on natural resources,

agriculture, assets and infrastructure for supporting livelihoods from local community structures. The effect study of the project before and after the project's intervention at the household level was precisely observed during the household survey using a questionnaire survey. There were 57 households, 334 people total, distributed equally between the head, middle, tail with a reference based in previous research.^{21,22,23,24,&25.}

Focus Group Discussion (FGD)

A group discussion was carried out with members of Water User Association, Teachers, representatives of CBOs and local community people.

Key informant Interview (KII)

A semi-structured questionnaire was used for interviewing the president of WUA, representative of District agricultural development office, Irrigation Division office and the stakeholders of Projects and others.

Secondary Data Collection

The feasibility study and baseline survey reports, the design report, the environment study report, the monitoring report, other related records and documents, the estimated budget and actual expenditure by details of expenditure headings, the target and achievement by activities, the annual plans and programs, the estimated time schedule of each activity and the actual time spent, the training modality, the level of participation received by the project, the efforts toward sustaining.

Study Tools and Techniques

Household Sample Survey

This survey included most crucial variables checklist about existing data on age, sex, family structure, caste, ethnicity, religion, personal information about beneficiaries, landholding status, education status, food security, livelihood, agricultural inputs, credits, infrastructure, employments, family income, water accessibility, state of agricultural production and market, Operation and maintenance of the system.

Focus Group Discussion (FGD)

FGD was carried out by organizing a gathering of water user associations to evaluate the program's effects, its future direction, its current issues and gaps, institutional readiness, level of participation, sustainability, efficiency, level of satisfaction from stakeholders and project staff.

In-depth Interview

In-depth interviews with a few key informants were conducted to cross-check FGD results in order to deduce program and program area information, including institutional capability and sustainability. The official

body's recommendation had assisted us in identifying the additional considerations that should be implemented during the rehabilitation process. Key informants included Irrigation Development Division officials, Agricultural Development Office officials, WUA members.

Direct Observation

Seepage loss, silt collection problems, flowing over the canal were found from direct observation and field measurement.

Analysis of Collected Data

The household survey data were compiled into separate respondent-sex, racial, educational, key informant groups. By employing required procedure and statistical tabulation techniques, data were compared and contrasted. Based on the aims and goals of the project research, both qualitative and quantitative methods of data analysis were used in the data processing approaches. The report placed a lot of emphasis on the extraordinary changes that the rehabilitation effort brought about. Each heading was examined based on the many survey data evaluation techniques, including changes in production before and after the project, sustainability indicators, improving socioeconomic position, social inclusion, employment, a decrease in drudgery. The surveys data were loaded into the computer, tools like MS Excel were used to examine all calculations and data.

Results and Discussion

Performance of WUA

The following major concepts, along with their indicators and intrinsic connected features, were researched in order to acquire thorough perceptions and facts about the performance state and level of the WUA Irrigation System.

- WUA establishment
- Admirations and financial management
- Resource mobilization
- Irrigation service delivery to users
- Program management
- Conflict management

Established WUA

Office Establishment

WUCC office of BAISP is running in a rent room located at Phedap Municipality -2 Terhathum district. The office kept level records.

Election

WUCC conducts democratic elections from the bottom up. There are two rules: election and unanimous selection. Farmers banded together once more and expressed interest in the BichariAsuwa Irrigation System Management Division for a new election. The National Irrigation Department

(NIMD) helped them with the new election process. The present executive committee of the WUA is as follows:

Table 1. Present Executive Committee

S.No.	Name	Post
1	Ganga Bahadur Shrestha	President
2	Raj Kumar Shrestha	Secretary
3	Chandra Kumari Kandwa	Treasurer
4	Durga Maya Limbu	Member
5	Parshuram Byalkoti	Member
6	Rambahadur Shrestha	Member
7	Menuka Shrestha	Member

Rules and Norms

WUCC of BAISP consists of their own constitution, norms for election, rules for finance, administration and canal operation for MSC. The rules and norms are put to General Assembly for approved. According to their norm's following process is followed:

- First a hydraulic boundary is fixed
- Then inventory of the farmers is collected
- An election day is announced for election or selection of Committee

Administration and Financial Management

Meeting

At least one meeting on 15th of every month is held at WUCC and within 1st to 15th of every month. This schedule for Meeting is already fixed for no communication is needed. The urgent meeting if any required is called by secretary or by president.

Decision Making

Democratic decision-making process is followed in WUCC. Agenda is prepared in WUCC in the presence of members; it is discussed and decision is made collectively. The decision is recorded in the minute and decision is circulated to all.

Financial planning and Record

A systematic budget planning process was reported in BAISP WUCC. Annual budget plan is prepared taking suggestions of the representative members of WUCC. After budget plan is prepared, it is submitted to general assembly for approval after which, it is executed

General Assembly

WUCC of BAISP holds General Assembly meeting once a year during Kartik and Mangsir. Generally, plans such as annual work plan, report of review of past year income and expenditure report, work division of different members, progress on ISF collection and canal repair and maintenance cost are submitted in General Assembly meeting of 7 members for discussion and approval.

Irrigation Service delivery to Users

COPs Development

The WUCC of BAISP provides irrigation services to users on an as-needed basis. According to project personnel, COPs are being prepared, after which WUCC members will be trained.

AMPs Development

At MSC canal area the AMPs are used in the practice of maintaining and cleaning the canals.

Program Management

There are practices for preparing annual plans, but their effectiveness is questionable because there is no adequate practice for program preparation and no M&E trained personnel at WUCC.

Conflict Management

There is no trained committee or person assigned to conflict resolution tasks. In the past, evidences of conflict occurrences such as obstruction in field channel construction and claim of old WUA office for private use were observed. These conflicts, according to WUCC members, were resolved by WUCC and project personnel.

Summary of WUCC Performance

The performance status and performance levels of WUCC of BAISP on the basis of collected data are summarized in the Table 2. As show in table the administration, Financial and Resources mobilization is very poor condition which limited them for their development and also limits their performance in very adequate.

Table 2. Summary of WUCC Performance

Indicators	Status	Performance level
Office Establishment	completed	Satisfactory
Administration Management	poor	satisfactory
Financial Management	poor	satisfactory
Resource Mobilization	very poor	Unsatisfactory
Program Management	Not completed	satisfactory
Conflict Management	moderately adequate	Satisfactory
Overall Performance	Inadequate	Unsatisfactory to desired level

Socio Economic Background

Distribution by Sex

The initial data of household survey gave that 55 percent of total respondent's farmers of number 337 were female and 45 percent of them were male. this show that the agriculture in this study area was led by women. The distribution is shown in Figure 4.

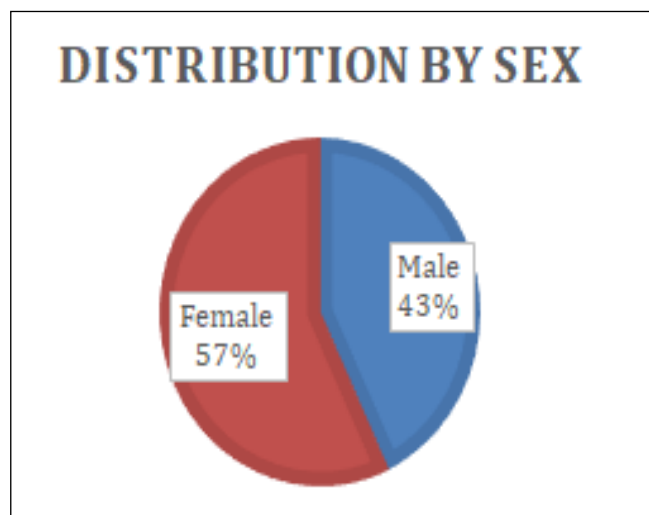


Figure 4. Distribution by sex

Age Composition

It was found that respondent's involvement in agricultural activity by age group between 15-59 was highest with 55.6 percent followed by 0-15 age group was 22.5 percent and 17.5 percent of above age of 60 years. This composition is shown in below figure 5.

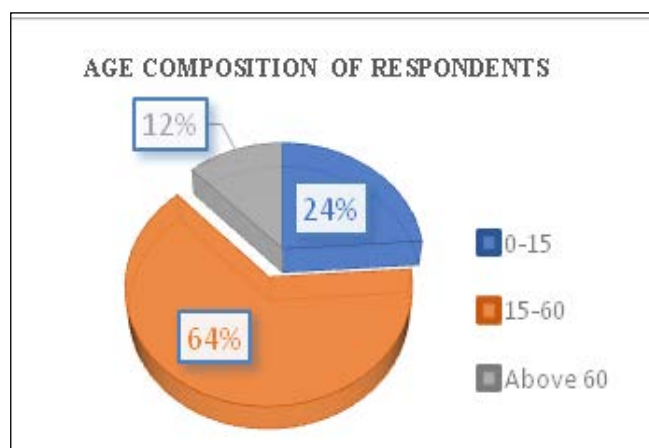


Figure 5. Age composition

Caste/ Ethnic Composition

Major caste of respondent of study area was Brahmin, Kshetri, Newar, Limbu Janajati and others. The data Shows that the largest number of respondents is Newar and the least number is Sarki and Damai.

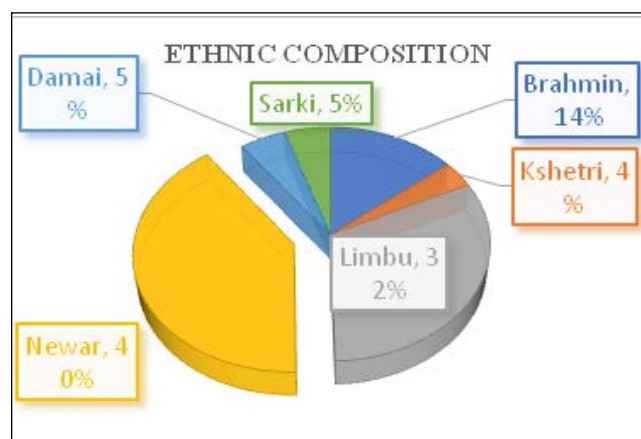


Figure 6. Ethical Composition

Education

In terms of education, 28 percent of farmers were literate, 14 percent had completed S.L.C. and only 7 percent were illiterate and 51 percent had completed their higher secondary school and above.

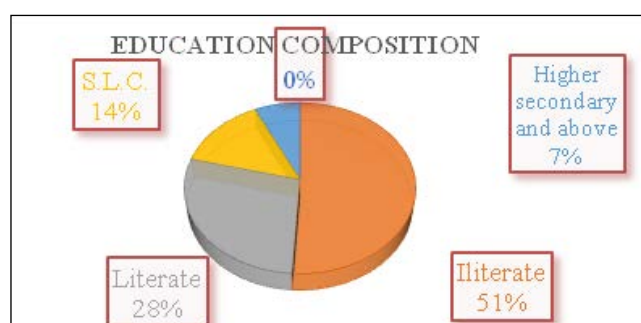


Figure 7. Education Composition

Landholding Size

In project command area almost, all farmers were land owners. Some of them have also had taken land in lease and were dwarfing farming. land distribution in the command area was not uniform.

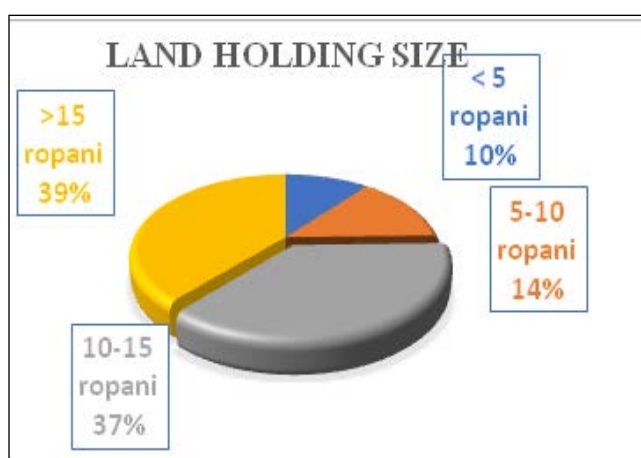


Figure 8. Land Holding Size

Occupation, Income and Expenditure

Agriculture was found to be the main source of income in this project area. Most of the family has land for agriculture so their source of annual expenditure is agriculture. Some of the member of their family has gone to foreign employment, some of them to Kathmandu for study and work and some of them are engaged in their own business. 65 % respondents had agriculture as main source of income whereas, 15 % respondents had major source of income as service and 20 % respondents had business and foreign Employment as shown in figure 9.

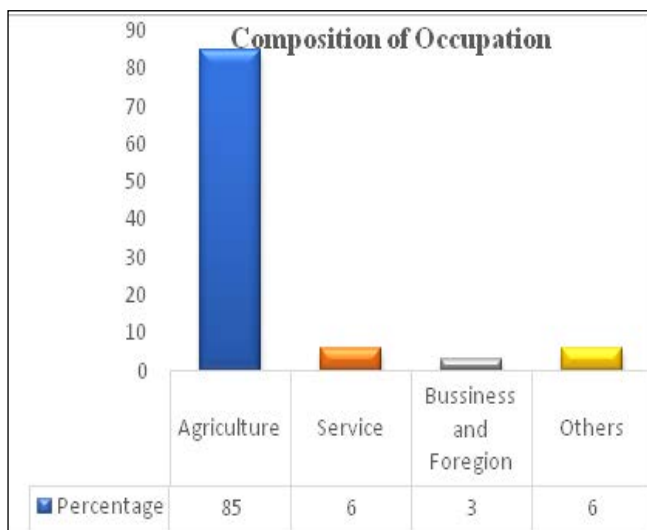


Figure 9. Composition of Occupation

The average annual household income of the respondent household was found three lakhs fifty thousand only while, average annual expenditure per household was three lakhs only.

Effectiveness of Irrigation on Agriculture

The principal objective of irrigation is to enhance agricultural output and intensify crop cultivation within designated project area. Consequently, the tangible impact of the project intervention can only be observed through improvements in productivity, yield, alterations in cropping patterns and intensity within the designated study area. The household survey and examined information obtained from the survey, which is detailed below.

Cropping Pattern and Intensity Before and After the Project

Before the Project

Prior to the implementation of the projects, crops were cultivated in three seasons namely monsoon, winter, Spring. The primary crops grown within the command area included maize, paddy, wheat with potato and vegetables being secondary crops. Cropping pattern prior to the project is depicted in Table 3.

Table 3. Cropping pattern and intensity before project

Season	Crop	Net command Area		Irrigation Status
		ha	%	
Monsoon	Paddy	43.5	87	Sub-optimal
	Vegetables	3	6	
Monsoon Cropping Intensity		46.5	93	
Winter	Wheat	17.5	35	Sub-optimal
	Potato	6.5	13	
	Pulse/oilseed	3.5	7	
Winter Cropping Intensity		27.5	55	
Spring	Maize	11.5	23	Residual Moisture
Spring Cropping Intensity		11.5	23	
Total Cropping Intensity		85.5	171	

The data presented in Table 1 indicates that main crop grown during monsoon season was monsoon paddy, which covered 93% (46.5 ha) of the irrigated land. In contrast, only 6% (3 ha) of the land was utilized for cultivating vegetables during this season. While during winter season, farmers showed a preference for cultivating wheat and potato, with 35% (17.5 ha) of the total land being allocated for wheat cultivation and approximately 13% (6.5 ha) for potato cultivation. In addition, coarsely 7% (3.5 ha) of the total area was utilized for pulse/oilseed cultivation during this season. In the Spring season, only 23% (11.5 ha) of the land was utilized for maize cultivation, while the remaining land remained unused.

After the Project

Based on the data collected from focused group discussions with farmers and WUA members, the cropping pattern and intensity of the project were examined, the findings are presented in Table 2. The table indicates that there was no change in the cropping pattern for monsoon season, with monsoon paddy continuing to be the primary crop grown. Therefore, the cropping pattern remained the same as before the project. But in winter season, the cropping pattern is changed with addition of vegetables, with wheat continuing to be the primary crop cultivated. Similarly, potato is also added into the cropping in Spring season as in Table 4. The collected data indicates that some

Table 4. Cropping pattern and intensity after project

Season	Crop	Net command Area		Irrigation Status
		ha	%	
Monsoon	Paddy	46	92	Optimal
	Vegetables	3	6	
Monsoon Cropping Intensity		49	98	
Winter	Wheat	26.5	53	Optimal
	Potato	12	24	
	Pulse/oilseed	4.5	9	
	Vegetables	3.5	7	
Winter Cropping Intensity		46.5	93	Optimal
Spring	Maize	20	40	
	Potato	4.5	9	
Spring Cropping Intensity		20	49	
Total Cropping Intensity		115.5	240	

additional interest in cultivating wheat potato, pulse/oilseed as well as some area in this season is also occupied in vegetables farming. this Table 2. shows that 53 % of land is being utilized for wheat, 24% land for Potato, 9% of area for Pulse/Oilseed and 7% of area utilized in vegetables farming. During the spring season, maize was grown on 40% of the land, followed by potato which were cultivated on 9% of the land.

farmers were cultivating vegetables during the winter season and Potato in Spring season after the implementation of project, which represents a significant change in the cropping pattern of this project area. Similarly, the total cropping intensity of project area raised in different season as shown in Figure 10. Where overall cropping intensity raised from 171% to 240% after implementation of this irrigation project.

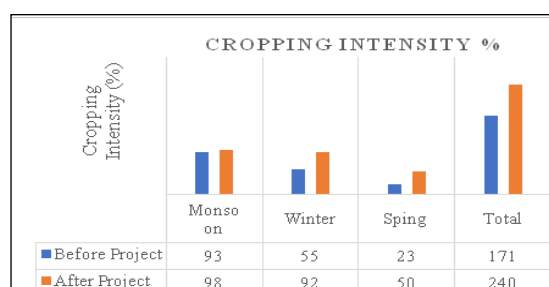


Figure 10. Overall Cropping intensity

This study shows that cropping pattern of project area before the project intervention is paddy– Vegetables, Paddy–Maize, Paddy–Vegetables–Maize, Paddy–Wheat–Maize and due to insufficient amount of water most of the land were left barren. But after the project intervention cropping pattern has changed to Paddy–wheat/Potato/ Vegetables–Maize, Paddy–vegetables–Maize and also farmers started to grow off-season vegetables and seasonal vegetables enough to sale in market.

Table 5. Crop Yields of the Project Area

Season	Crop	Crop Yields (Mt/ha)		Increase Change %
		Before project	After project	
Monsoon	Paddy	2.8	4.1	46.4
	Vegetables	7.3	11.5	57.5
	Wheat	1.8	3.2	77.8
Winter	Potato	11	15.3	39.1
	Pulse/Oilseed	0.87	1.3	49.4
	Vegetables	7.8	11.7	50.0
Spring	Maize	2.3	3.5	52.2
	Potato	11.2	16.7	49.1

Crop Yields

Agriculture productivity of major agriculture crops in command area before and after project intervention was analyzed and shown in graph. Major crops during Spring season in Table 3. As shown in table the average production of paddy was 2.8 Mt/ha which raised to 4.1 and vegetables from 7.3 Mt/ha to 11.5 Mt/ha which was a great increment by 46.4 % and 57.5 % respectively only in Monsoon. Similarly, in winter season good increment percentage as 77.8, 39.1, 49.4, 50 percentage in the yield of Wheat, Potato, Pulse/oilseed and vegetables respectively. The increment in crop yields of Maize and vegetables in spring season is also prominent by the increase percentage of 52.2 percentage in maize and by 49.5 percentage in vegetables as shown in Table 5.

Impact of Irrigation Project

This irrigation project has significant impact on the livelihood of each farmer and their family within command area. These impacts were assessed through poverty reduction, food sufficiency, income generation, expenditure increment, reduction of women's drudgery in household works, gender issue and migration in the command area.

Poverty Reduction

The major impact of this project is poverty reduction by linking different factors such as agricultural income generation, employment opportunities, agricultural productivity, food security, sanitation, health services, as well as the ability to purchase durable goods and construct and maintain homes.

Income from Agriculture Production

The project intervention has resulted in an increase in agricultural production, which has allowed farmers to sell their products in the market and generate income for their livelihoods. The production of paddy and maize seeds and off seasonal vegetables has become the primary source of income for farmers in the command area.

Employment Opportunity

The irrigation project has had both short-term and long-term employment benefits. During the construction phase, the project created short-term employment opportunities for the local community. Additionally, the Water User Association (WUA) and local people took on the contract work for the project, rather than outsourcing it to contractors. This has helped to generate ongoing employment opportunities in the area.

Water scarcity in a village often results in women bearing the brunt of water management issues. However, the implementation of the irrigation project has had a significant positive impact on women's lives. Women are primarily engaged in field work, this project has helped to reduce their workload and drudgery. The timely plantation of crops made possible by irrigation has reduced weed infestations, particularly in paddy fields, which in turn reduces the labor required to maintain crops. Overall, the irrigation project has had a positive impact on women's lives in the village, as it has helped to reduce the burden of water management and field work. This has enabled women to focus on other areas of their lives, such as education and community development projects.

Food Sufficiency

The impact of the irrigation project on food sufficiency has been significant. Prior to the intervention, water availability was limited, farmers were unable to grow crops such as paddy, wheat, vegetables, which resulted in a lack of food sufficiency. However, the project has had a positive impact on food sufficiency in the area. The majority of respondents now report having sufficient food for their families year-round, while some may not sell their crops due to limited land, they are able to meet their family's food needs.

Expenditure Level of Farmer

The implementation of the irrigation project in Sherma

has led to an increase in farmers' income, resulting in an increase in their level of expenditure. As a result, farmers are now investing more in areas such as education, health, sanitation for their children, as well as personal and community development projects which was previously out of reach due to financial constraints.

Women's Drudgery

Water scarcity in a village often results in women bearing the brunt of water management issues. However, the implementation of the irrigation project has had a significant positive impact on women's lives. Women are primarily engaged in field work, this project has helped to reduce their workload and drudgery. The timely plantation of crops made possible by irrigation has reduced weed infestations, particularly in paddy fields, which in turn reduces the labor required to maintain crops. It has helped to reduce the burden of water management and field work. This has enabled women to focus on other areas of their lives, such as education and community development projects.

Gender Issue

Three women were included in the executive committee of the irrigation project, with one holding a major post, women's involvement in important decision-making during the planning and implementation phases may have been insufficient. However, during the construction phase of the canal, women played an active role in WUA payable and WUA contribution work and contributed with labor. Women also played an equal part in physical work during construction, alongside men. Additionally, women remain actively involved in repair and maintenance work, as well as cleaning. Participation of women in meetings, trainings, exposure visits has been satisfactory, but they still require support from related stakeholders to improve their capacity building, income generation, agriculture training.

Migration

The irrigation project has had a positive impact on the migration patterns of people in the region, as it has provided increased opportunities for employment and income generation, which has helped to keep people in the area rather than seeking work elsewhere.

Efficiency

The irrigation project intervention has had a significant impact on the total production, cropping pattern, cropping intensity of the project area. However, despite this impact, the majority of farmers in the area still practice traditional farming systems. There is high potential for vegetable production in the project area, but many farmers are not taking advantage of it due to a lack of knowledge about production and a lack of good marketing systems. Even those who are producing cash crops are facing difficulties

in marketing their products, as they are compelled to travel long distances of more than 34 km to reach the market by themselves. This highlights the need for more support and resources for farmers in the area, including training on modern farming practices, access to markets and transportation facilities, other forms of assistance to help them increase their productivity and income.

Sustainability

The concept of 'sustainability' refers to the idea of using resources in a way that meets the needs of future generations. In the context of irrigation schemes like BAISP, the project can be considered sustainable only if its WUA can manage and maintain the system without external support, ensure that water is delivered to the tail end of the system. To evaluate the sustainability of BAISP, its financial, technical, organizational, environmental aspects were analyzed.

Financial Aspect

The BAISP was constructed century ago by farmers with their local skills and technologies. ISIP supported for the rehabilitation as its command area came under the priority of ISIP. The structures made by ISIP were capable of providing adequate water for Bichari command area. The canal lining still has about 1.6 km in Main to be extended for to increase irrigated command areas. This maintenance work cost is beyond the capacity of WUA, so WUA is expecting help from MOEWI and KFAED.

Technical Aspect

Based on the technical assessment, it seems that the irrigation canal system of BAISP is performing well in terms of meeting the water demand of the users. The users reported high adequacy of water and high confidence in the reliability of the water supply. The system also offers a great degree of flexibility to users in terms of choosing the frequency, rate, duration of water supply. However, the assessment did not mention any measures being taken to ensure equitable water distribution among users. It is important to ensure equitable distribution of water to avoid any conflicts among the users, especially those who are located at the tail-end of the canal. Additionally, the assessment only rated the durability of the structures of the canal system as satisfactory, but it is not clear whether the maintenance and repair of the canal system are being carried out regularly by the WUA. The sustainability of the project depends on the ability of the WUA to operate and maintain the system regularly without any external support. It is important to ensure that the WUA has the necessary resources, skills, knowledge to carry out the maintenance and repair of the canal system in a timely and efficient manner.

Organizational Arrangement Aspect

It is great to hear that BAISP has active and organized WUAs to manage irrigation activities. The fact that the WUA committee was formed and legalized by the Water Resources Committee and that meetings are held regularly to discuss various matters related to canal maintenance, water distribution, financial management is a positive sign of sustainable management. It is also encouraging to know that the WUA members are aware of their roles and responsibilities, that trainings and exposure visits have been conducted to enhance their knowledge and skills. It is worth noting that providing training and support to new members and the president of WUA after each mass meeting would be beneficial for the sustainability of the project. Also, the fact that no conflict has arisen due to water rights and distribution is a good indication of equitable water management. The high level of satisfaction among farmers with the performance of WUA is a testament to the strength of the organizational sustainability of the project. However, it is important to continue monitoring the performance of the WUA and address any issues that may arise to ensure the long-term sustainability of the project.

Environmental Aspect

It is great to hear that the BichariAsuwaKhola project has a positive environmental impact. The fact that the project did not pass through any protected forests, national parks, buffer zones, or environmentally sensitive areas is a good start for reducing potential negative impacts on the environment. The use of a labour-based, participatory approach also shows a commitment to sustainable and environmentally friendly practices. The preparation of Environmental Management Plan (EMP) is a good step in ensuring that the project's impact on the environment is monitored and mitigated. It is also encouraging to hear that bio-engineering measures have been adopted to further minimize the project's impact on the environment. The observation of mitigation measures during the walk-through survey of the canal and the WUA's program to clean weeds-infested canals when required are also positive signs of the project's environmental management. The low rate of application of fertilizers and pesticides in the command area is another good indicator that the project is environmentally friendly. Finally, it is reassuring to hear that the intake area is safe from landslides and that the project is located in a safe and relatively flat area. All of these factors combined suggest that the BichariAsuwaKhola project has a good environmental aspect. The overall conclusion of the impact study comprises with the relevancy, effectiveness, impact, efficiency and sustainability of the irrigation project. The overall evaluation conclusions are given below.

Table 6. Overall Evaluation of Project

Evaluation Criteria	Evaluation Result
Relevance	Highly Relevant (A)
Effectiveness	Highly Effective (A)
Impact	Highly Impacted (A)
Efficiency	Moderately Efficient (C)
Sustainability	Sustainable (B)
Overall Conclusion	Satisfactory (B)
Note: Rating criteria	

This project was evaluated using the rating method as highly relevant, highly effective, highly impacted, with moderate project efficiency and a satisfactory overall evaluation.

Conclusion

The overall conclusions showed that using small-scale irrigation in hilly area considerably increases the food security of households. Such types of projects increase yearly income of households using irrigation farming with multi cropping pattern as well as this also motivates farmer for off-seasonal farming. Similarly, Water User Association (WUA) have responsibility of the canal that has been effective in many areas, including decision-making, conflict resolution, working with farmers. However, due to technical and administrative difficulties, the WUA has been unable to develop a canal maintenance plan, raising concerns about sand and silt buildup. Water is primarily allocated for agricultural use in the system, there are no significant issues with water acquisition or rights. In order to reduce water theft, the WUA also fines illegal canal outlets. While the canal's operation and maintenance are satisfactory, no record of labor mobilization during maintenance exists, farmers are unaware of resource generation and mobilization for financial sustainability. Despite this, WUA's capacity for conflict resolution and information dissemination is adequate.

This cropping pattern of project area was significantly changed from paddy–Vegetables, Paddy–Maize, Paddy–Vegetables–Maize, Paddy–Wheat–Maize to Paddy–wheat/Potato/Vegetables–Maize, Paddy–vegetables–Maize. Similarly, most of the area are used for vegetables, wheat and potato farming after the intervention of the project which are barren due to insufficient amount of water. The over-all cropping intensity in study was raised from 171% to 240 % and crop yield was also improved due to project development. This significant change in cropping intensity and crop yield motivates the farmer of this area was also motivated to some cash crops and off-seasonal vegetable farming.

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