# Final Report

## Design Verification and CEDRIG Analysis Study

Submitted to:

**Small Irrigation Programme,**
**Programme Management and Implementation Support Consultant,**
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# Acronyms

| | | |
|---|---|---|
| CA | : | Command Area |
| CO | : | Community Organizer |
| DAG | : | Disadvantaged Group |
| GCA | : | Gross Command Area |
| GPS | : | Global Positioning System |
| ha | : | Hectare |
| HDPE | : | High Density Polyethylene |
| HH | : | Households |
| IEE | : | Initial Environmental Examination |
| lps | : | Liter per second |
| NCA | : | Net Command Area |
| NPR | : | Nepalese Rupee(s) |
| O&M | : | Operation and Maintenance |
| PMISC | : | Programme Management and Implementation Support Consultants |
| PPR | : | Project Preparation Report |
| PVC | : | Poly Vinyl Chloride |
| RCC | : | Reinforced Cement Concrete |
| SDC | : | Swiss Agency for Development and Cooperation |
| SIP | : | Small Irrigation Programme |
| SqKm | : | Square Kilometer |
| WUA | : | Water Users' Association |
| WUG | : | Water Users' Group |

# Acknowledgement

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From the consultancy team, Mr. Purushottam Timilsina and Mr. Vijaya Chandra Khatiwoda carried out the study. It is by their effort, this report has come to this shape. We also like to thank Mr. Anil Yadav, who supported the data collection for the study from the consultancy team.

# Executive Summary

Small Irrigation Programme, Phase-II (SIP-II) is implemented by the Government of Nepal (GoN) in collaboration with the Government of Switzerland. It aims to provide year-round irrigation to 20,000 hectares in about 1,300 small-scale irrigation systems through community-driven process benefiting 65,000 farmer households. While SIP II is being implemented, achievement against the target set in terms of irrigation coverage, design of irrigation canal against the actual requirements and deviation in field implementation as well as available irrigation water against design discharge, shortcomings in either survey, analysis, planning, design or construction, or absence of concrete system operation plans, or the combination thereof, needed to be explored. This report enquires these issues and presents the findings. Total 15 rehabilitated sample irrigation schemes have been selected for the evaluation - three schemes form each of the five clusters. The schemes are scattered across different districts covering the geography of SIP-II implementation area.

Procedures of CEDRIG Strategic was followed for the verification on risk in this study. The study finds that there are some risks to the schemes from disaster, climate and environment. Similarly, the schemes are likely to affect the climate and environment to a very small extent. However, due to the careful implementation of the program and ample consideration of the risks in considering the risk aspects in the design and implementation, and due to the small scale of the individual schemes of the program, the overall risk is low.

The command areas in the schemes are more than reported in the project documents in general. For the selected command area there is enough discharge available for the system in winter and summer for the crops grown by users. The major improvement works in these schemes are lining and pipe works which has reduced the seepage water in the distribution system and has helped to cover more command area which was previously not possible. At present, none of these schemes was found to be lacking irrigation water. Discharge capacities of the canals were assessed in the lined canal sections to evaluate whether the capacities of the canals are sufficient to deliver the designed discharge. It was observed that in all the systems, the conveyance capacity is more than the maximum designed water requirement, which indicates that there is enough discharge available for irrigation in the systems.

The existing cropping intensity before the implementation of SIP and the expected cropping intensity after the implementation of the SIP have been derived from the design documents. The actual cropping intensity with crops grown in the schemes are compiled in this study. The present cropping intensity shows that there is considerable increase in the cropping intensity compared to the before program implementation situation with the exception of a few schemes in which the cropping intensity has slightly reduced though not drastically.

There are no major changes in the implementation compared to the plan finalized during the design of the schemes. In some cases, minor changes were done such as omitting the proposed structures from one location and placing other types of structures on other locations in the schemes as per the requirement during implementation. In some cases, the sizes of the outlets were increased by the users as they thought the size of the outlet which was designed as 75mm diameter pipe would not be enough to deliver water to the fields.

The design team uses SW Maps for recording information in the field. A web-based design application is used for design and estimate. This has helped produce design and report faster and with consistency in the contents and quality. Though SIP is doing rehabilitation of the existing schemes, sometimes it becomes critical to check the topographical levels and topographical survey methods to improve the performance of the existing systems with good hydraulic design. It is recommended that the use of survey data with more precise survey equipment be encouraged for producing the design of the schemes.

It is seen that in most of these schemes the designers have depended on type design. Type designs might help in producing general design in a short period of time. However, some of the structures and system components are quite specific in their nature; for example, intake structures and river crossings. It is recommended that the designer team consider the specific nature of the components and design them as per the field requirement depending less on the type designs.

The quality of works done is found to be good and satisfactory in general. The major works done in the schemes are mainly linings, and pipes in part of the conveyance in some of the schemes. The linings have contributed to reduce seepage water and thus increase the command area and irrigation water to the crops. Technically, lining of the most of the canal system is justified where seepage rate is high. However, the lining of the whole system will not be justified on economic criteria as they will prove to be too costly compared to the benefits to be derived from saving of water and increase of crop production. So, the SIP approach of providing lining in the most critical sections based on budget ceilings based on economic criteria is justified.

Some technical improvements are recommended such as proper design of the pipe works and type of pipe joints used during construction. It was noticed in some schemes that similar sizes of pipes were used in flat slopes and steep slopes. Farmers preferred to use socket joint with HDPE pipes while the proper way to join the HDPE pipes are to use heated butt welding type joint. Some of these schemes required proper diversion structures in form of weir or other proper hydraulic structures for headworks. But in most of the schemes, only side intakes have been selected even if proper diversion is required. Due to this, some of the schemes are facing difficulty in diverting water to the system while temporary diversions by the farmers are washed away by the flood. Gates in the side intakes are also required in some of these schemes. A properly designed outlet with proper release of the water is necessary which is less prone to erosion to sloping land.

Operation and maintenance combined with ICWM training has been planned by the SIP office. This training needs to be provided to the working committee of the users to enable them to operate and maintain the schemes by themselves contributing to the sustainability of the schemes. Though the structures have been well constructed, some damages are expected over time due to natural causes and human induced activities. A maintenance fund is needed for the repairs needed for such damages.

Skill development and awareness raising for good agricultural practices including use of machinery, use of best practices in agricultural activities to align with land and water conservation etc. are of vital importance, e.g., use of bio-fertilizer, bio-pesticides, use of agricultural methodology with reduced adverse impact on environment and climate change. At the same time agriculture extension services are needed once the infrastructures are completed and reliable irrigation is ensured.

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# 1. INTRODUCTION

## 1.1. BACKGROUND

Small Irrigation Programme, Phase-II (SIP-II) is implemented by the Government of Nepal (GoN) in collaboration with the Government of Switzerland and is built upon the experience of implementing SIP, Phase I (SIP-I). The programme will cover Local Governments (LGs) of mid-hills in Province 1. It aims to provide year-round irrigation to 20,000 hectares in about 1,300 small-scale irrigation systems through community-driven process benefiting 65,000 farmer households, of which at least 40% will be from disadvantaged groups (DAGs) and 70% from small landholder farmers having landholding of less than half hectare.

The expected impact of the programme is to increase the agricultural income of small farmers, especially from the disadvantaged groups (DAGs), thus reducing their poverty. This will be achieved through three outcomes:

1. LGs respond effectively to needs of small farmers for irrigated agriculture;
2. Small farmers, especially from the DAGs, increase agricultural productivity and
3. Market actors offer innovative supports and products to farmers in irrigated schemes.

The main approach of the programme is to consolidate the positive results in development of irrigation infrastructure, and further refine scheme design to condition these schemes for dry season irrigation of high value crops, and thus create enabling conditions for the introduction of commercialized agriculture. LGs shall actively support the introduction of improved agriculture practices with a focus on the production of high value cash crops as well as ensure a conducive environment for the development of the private sector and facilitate the linkage between the input and output markets with the farmers.

With the project in its third year, it is important to review the works implemented and lessons learned so far to apply to future implementations including project design, implementation arrangement and institutional linkages. For this purpose, an external study has been commissioned to review the design and implementation process. and the outcome of the programme so far.

## 1.2. RATIONALE OF THE ASSIGNMENT

A rapid risk and impact screening of SIP during the design of phase 2 using Climate, Environment and Disaster Risk Reduction Integration Guidelines (CEDRIG) tool revealed that there are no serious risks due to climate change or natural hazards to the project, and the Project has no serious impact on the environment. At this stage, the project wants to verify the claims on the risk to, and impact from the irrigation schemes developed by SIP.

In addition to these, achievement against the target set in terms of irrigation coverage, design of irrigation canal against the actual requirements and deviation in field implementation as well as available irrigation water against design discharge, have also been areas of enquiry. Shortcomings in either survey, analysis, planning, design or construction, or absence of concrete system operation plans, or the combination thereof, need to be explored.

With the Project entering into third year from July 2022, it is necessary to review the works of the first two years, which would enable the project to reflect and pave way for improved project delivery for the remaining duration and propose amendments (if any) required in design, implementation arrangements and/or institutional linkages.

## 1.3. OBJECTIVE OF THE ASSIGNMENT

The main objectives of the assignment as outlined by the ToR are:

- Conduct CEDRIG light analysis of SIP schemes;
- Review how SIP ensures environmental risk and impact;
- Review and assess the current survey and design methods of irrigation schemes adopted in SIP-II, including the online systems for both;
- Review actual irrigation coverage as well as water discharge vis-à-vis design values in constructed/rehabilitated schemes;
- Assess operation and maintenance of constructed/rehabilitated schemes;
- Compare design with actual implementation.

## 1.4. SAMPLE SIZE AND SELECTION

A total of 15 rehabilitated irrigation schemes have been selected as purposive sample for the evaluation: three schemes from each of the five clusters. The schemes were visited by the evaluation team to collect information related to environment, design, implementation and the outcomes which were then analyzed to derive at a conclusion. The various schemes selected for the evaluation is presented in Table 1-1 and the locations have been presented in Figure 1-1.

*Table 1-1: List of selected schemes with locations.*

| Cluster | District | Scheme Name | Municipality/ VDC | Total Household |
|---|---|---|---|---|
| Dhankuta | Dhankuta | Pakhale Khola Dhonde IS | Mahalaxmi Municipality | 47 |
| | Bhojpur | Siran kulo IS | Bhojpur Municipality | 38 |
| | Tehrathum | Taname IS | Myanglung Municipality | 79 |
| Khotang | Khotang | Jaljale Chuchhe Dhuna Dobela IS | Diktel Rupakot Majhuwagadhi Municipality | 23 |
| | | Kharuwa khola Nali pipal danda rajkulo IS | Diprung Chuichumma Rural Municipality | 130 |
| | | Khiku Khola Lamkulo IS | Khotehang Rural Municipality | 102 |
| Udaypur | Udaypur | Katari Sinchai Yojana IS | Belaka Municipality | 83 |
| | | Hadaiya Sana Sinchai Aayojana IS | Katari Municipality | 126 |
| | | Pahare Kulo Tin Dobhane Muni IS | Chaudandigadhi Municipality | 69 |

| Cluster | District | Scheme Name | Municipality/ VDC | Total Household |
|---|---|---|---|---|
| Okhaldhunga | Okhaldhunga | Adheri Rupse IS | Siddhicharan Municipality (Previously Betini VDC) | 22 |
| | | Argeli Taksar IS | Siddhicharan Municipality | 63 |
| | | Kabre Mahabir Sichai Yojana IS | Manebhanjyang Rural Municipality | 30 |
| Phikkal | Ilam | Saanimai Kharibote Sana IS | Sandakpur Rural Municipality | 79 |
| | | Lewak Tole IS | Suryodaya Munucipality | 27 |
| | Panchthar | Khung Khola Titriya Sejepa Phewadin IS | Phidim Municipality | 167 |

## 1.5. BASIC INFORMATION OF THE SAMPLE SCHEMES

The total household benefitted from 15 sample schemes are 1085 households. The total beneficiary households for the selected schemes range from 22 households to 167 households with total disadvantaged groups (DAG) households of 427 ranging from 1 DAG household to 77 DAG households in individual schemes with total DAG population of 4215. There are a total of 82 women headed households in all these selected schemes.

The small and marginal landholding in each individual schemes ranges from 8 household to 92 households at the same time the middle and large landholding in each individual schemes ranges from 2 households to 76 households. the detail of beneficiary information with landholdings has been presented in Table 1-1.

The gross command area of the selected sample schemes ranges from 5.3 ha to 63.4 ha.

The locations of the schemes selected for the study has been presented in Figure 1-1.

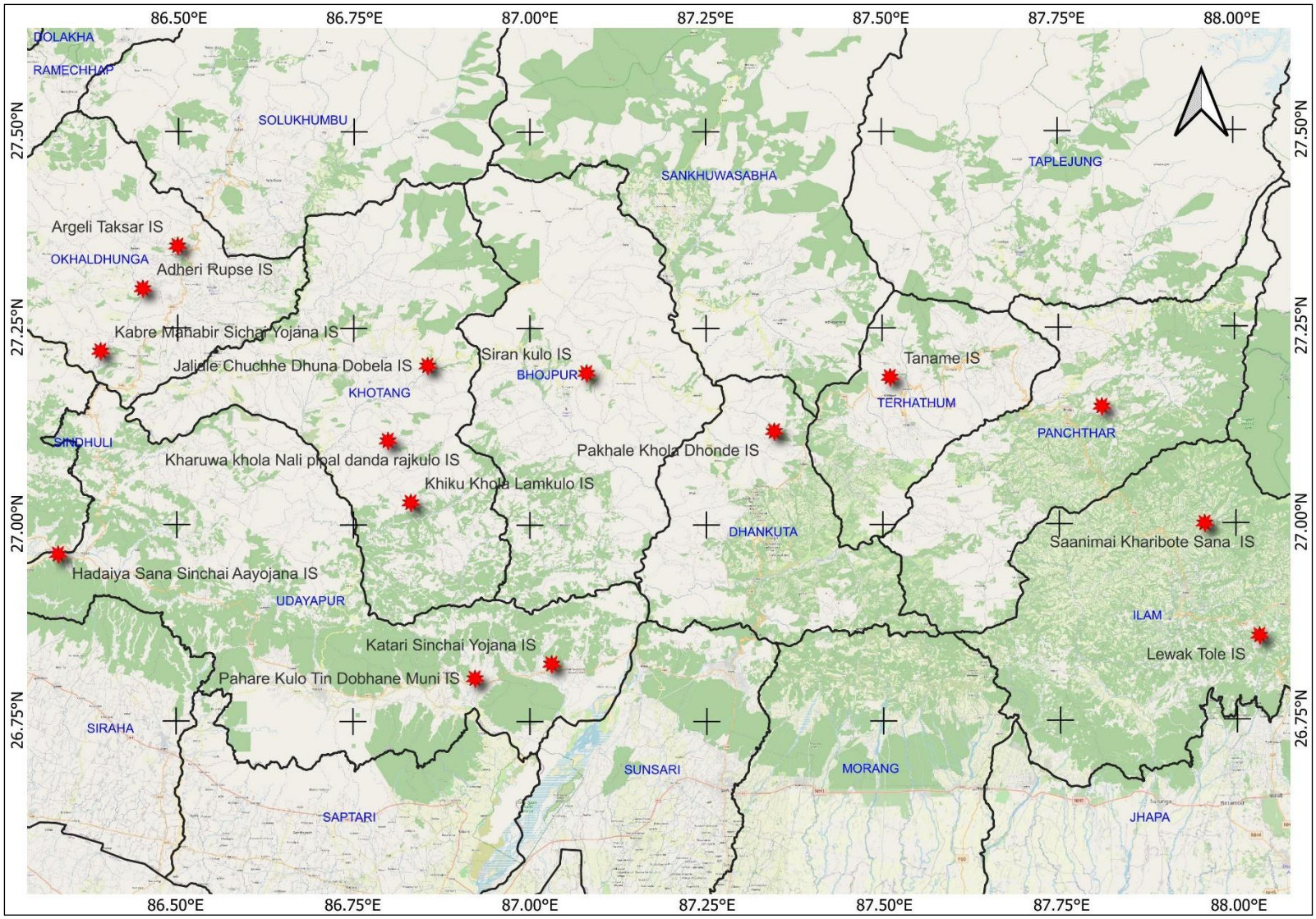



*Figure 1-1: Locations of selected schemes for evaluation.*

# 2. METHODOLOGY

## 2.1. OVERVIEW OF THE METHODOLOGY

The study adopted mixed methodology to conduct the verification of achievement against the target set in terms of irrigation coverage, design of irrigation canal against the actual requirements and deviation in field implementation as well as available irrigation water against design discharge. The study team carried out walkthrough survey from the headworks to the command area along the canal alignment and verified the extent of the command area in each individual schemes. The team consulted the staff of each SIP cluster offices to gather the relevant information regarding the implementation of the schemes. The team also carried out workshops and individual meetings with farmers and WUA in individual schemes to gather information on implementation process, design verification and impact on the environment. Additionally, the team also visited the office of respective wards and met the representatives including the chairperson to discuss the implementation process and the lessons learned by local governments from implementation of SIP.

To analyze the impact from project to the environment, climate and disaster and vice versa, the CEDRIG tool was used.

## 2.2. TOOLS USED FOR THE STUDY

### 2.2.1. Review of Documents

Review of existing materials from SIP and other sources was done and the information gathered from the project documents were validated and further analyzed during the data collection in the field. The following works have been completed:

- Conducted an online meeting with PMISC staff on the general evaluation process;
- Review of existing programme documents available from SIP and other sources including project documents, design documents, project evaluations and other relevant documents to assess the condition and system information of SIP-II irrigation schemes;
- Review of Climate, Environment and Disaster Risk Reduction Integration Guidance (CEDRIG) analysis of SIP-II;
- Review of available maps, Google image, photographs and other freely available satellite imagery/DEM for desk level remote sensing and GIS study. Review of available topographical maps for topographical information.

Available secondary information regarding the programme and the individual schemes have been compiled and discussed in the following chapters. Based on the information obtained from the desk study and literature review, a detailed plan of field works was developed. Development of questionnaires and checklist to collect relevant information of scheme performance on irrigation services, agriculture and system operation,

management, environment climate change and disaster scenario and water management of the study area were prepared.

### 2.2.2. Field Visits and Information Collection

#### *I. Verification of the Command Area and Discharge Measurement*

A verification of the command area was conducted in the field to check the designed command area versus the actual command area. Information was gathered from both field measurement and from the farmers to check the actual command area. SW Maps apps was used to record the geographical coordinates of the command area to draw the boundary wherever possible and relevant for verification. The command area was plotted in Google Satellite Imagery to get the actual command area measurements in GIS environment.

Discharge capacities were assessed in the lined canal sections to evaluate whether the capacity of the canals are sufficient to deliver the designed discharge if water is available in the source. Canal dimensions were measured in the field visits. Maximum depths of flow of water were noted with enquiry from the farmers as well as considering 5cm freeboard on the available canal sections. Then the discharge capacities were computed based on Manning's formula with the longitudinal slope as per the designed documents.

#### *II. Risks and Impacts Related to Environment, Climate Change and Other Hazards with CEDRIG Analysis*

The Climate, Environment and Disaster Risk Reduction Integration Guidance (CEDRIG) analysis is an instrument developed by the Swiss Agency for Development and Cooperation (SDC) to help development and humanitarian actors reflect whether existing and planned strategies, programs and projects are at risk from climate change, environmental degradation and natural hazards, as well as whether these interventions could further exacerbate GHG emissions, environment degradation or risks of natural hazards[1].

CEDRIG follows an integrated approach to assess the risks for, and the unintended potential negative impacts of, a new strategy, program or project. By its application, existing or planned interventions will become more climate, environmental and risk smart. CEDRIG is divided into 3 parts: CEDRIG Light to decide whether a detailed risk and impact assessment must be conducted or not. In case of a 'yes', CEDRIG Strategic is recommended to analyze strategies and programs, while CEDRIG Operational is applied for projects.

CEDRIG Light is proposed to be conducted individually or in a participatory manner by involving various relevant stakeholders. CEDRIG Strategic or Operational are proposed to be conducted in form of a workshop with all relevant stakeholders.

CEDRIG Strategic has been used in the field to gather information regarding the risks and the results of the analysis have been presented in this report. During the programme initiation of SIP, CEDRIG Light was used for the assessment of the risk on the programme, which acted as a rapid risk and impact screening tool for

[1] https://www.cedrig.org/

initial filter to assess whether a strategy, programme or project is potentially at risk due to climate change, environmental degradation or natural hazards. CEDRIG Operational is designed to systematically integrate climate change, environmental issues and natural hazards at the project level while CEDRIG Strategic is to systematically integrate climate change, disaster risk reduction and environment at the strategic or programme level. As the assessment of the projects already implemented has been done to present overall effect of the programme and the overall effect of climate change, disaster risk reduction and environment of the programme is required, CEDRIG Strategic has been used.

#### *III. Review of Design and Implementation Process*

Information was collected during the field observation and measurement, and review of the following was done regarding the design and implementation of the programme:

- Checked the designed parameters in the irrigation schemes against the actual delivery and present the comparison with recommendations for improvement in program design and implementation wherever necessary;
- Reviewed the choice of technology on design, e.g., selection of piped system vs open channel, selection of hydraulic structures, types of intakes etc.;
- Observed the implementation of irrigation schemes, works done or being done assessing each and every component of the schemes and their performance. Compared the performance of each component such as intakes, canals, distribution systems and command area against designed parameters and actual conditions;
- Assessed the performance of the system against the expectations of the farmers, and recommended if further modifications are required on future implementations.

#### *IV. Review of Targeted and Achieved Irrigation Services and Outcomes*

Information was collected during the field observation and measurement and review of the following were done regarding the irrigation services and perceived outcomes:

- Information of agricultural status including present cropping intensity and compare to the before programme scenario and targets in the design documents;
- Analysis of the service delivery of the selected irrigation schemes with comparison of envisaged scenario vs actual situations;
- Assess the situation of water availability vs crop water requirement and present the overall water management scenario in the irrigation schemes.

### 2.2.3. Consultation with Stakeholders

The study team met the following stakeholders:

- Staffs of PMISC;
- Irrigation scheme beneficiaries including WUA members and farmers;
- Representatives of Local Government;
- Other relevant stakeholders.

The list of people met during the evaluation and field observation is presented in Annex.

FGD were conducted during the field visit by the evaluation team in the field inviting key farmers, members of the WUA, representatives of Local Government and other relevant stakeholders. The following information were discussed in the discussions:

- Status of the scheme and level of rehabilitation done in the systems for improved irrigation;
- Results and outcomes achieved in the schemes after the implementation of rehabilitation works in terms of irrigation service delivery, water availability and cropping intensity;
- People's opinion on design, construction, delivery of services and achieved results and comparison of actual results versus required situations;
- Assess people's participation during all stages of the program implementation by interaction with the stakeholders;
- Issues and recommendation in the schemes from the stakeholders' perspective and room for improvement.

*Photo 2-1: Consultation with users in Taname IS, Tehrathum.*

# 3. FINDINGS OF THE ANALYSIS

## 3.1. IRRIGATION COVERAGE

The study found that the actual command area exceeds the value reported in the PPRs. In most of the cases, the actual command area is more than reported (as much as a maximum of 205% in Katari Sana Sinchai Aayojana IS to a minimum of 3.8% in Kabre Mahabir Sichai Yojana IS). However, there is a small reduction of command area than planned in Kharuwa khola Nali pipal danda rajkulo IS and Khiku Khola Lamkulo IS with reduction of 6.9% and 6.0% respectively. In most of the cases, the actual agricultural area available is more, which means if discharge were available from the source more command area could be irrigated from the same system. So, for the purpose of the project, users included only that part of the total available land as command area which can be irrigated with available water.

The designed command area versus the actual command area have been presented in the Table 3-1. We compared only the GCA as CCA has been taken as a certain percentage of the GCA in PPR documents which is the usual practice in irrigation as well. The actual verification of the command area was done in the field with enquiry from farmers; the boundaries of the irrigated areas were marked in the mobile based apps - SW Maps - which were plotted during the analysis phase in GIS based module to compute the actual command area. The boundaries of the command areas overlaid in Google Satellite Imagery have been presented in Appendix 3.

*Table 3-1: Designed command area versus actual command area in the field.*

| Scheme Name | Designed Total Gross Command Area (ha) | Designed Total Net Command Area (ha) | Actual Gross Command Area from verification (ha) | Deviation in GCA (%) | Reason for change |
|---|---|---|---|---|---|
| Pakhale Khola Dhonde IS | 14.94 | 12.5 | 22 | 47.3% | More land could be irrigated with improved irrigation |
| Siran kulo IS | 17.17 | 15 | 22.9 | 33.4% | More land could be irrigated with improved irrigation |
| Taname Kulo IS | 49.89 | 42 | 67.4 | 35.1% | More land could be irrigated with improved irrigation |
| Jaljale Chuchhe Dhuna Dobela IS | 19.67 | 17 | 28.7 | 45.9% | More land could be irrigated with improved irrigation |
| Kharuwa khola Nali pipal danda rajkulo IS | 55.99 | 46 | 52.1 | -6.9% | Minor over counting during the design period |
| Khiku Khola Lamkulo IS | 36.72 | 28 | 34.5 | -6.0% | Minor over counting during the design period |
| Katari Sana Sinchai Aayojana IS | 21.61 | 20 | 65.9 | 205.0% | Water flow greatly improved, they could supply irrigation to d/s agriculture lands which was not counted before |
| Hadaiya Sana Sinchai Aayojana IS | 50.15 | 44 | 84.4 | 68.3% | The agricultural land available for irrigation is more than this, |

| Scheme Name | Designed Total Gross Command Area (ha) | Designed Total Net Command Area (ha) | Actual Gross Command Area from verification (ha) | Deviation in GCA (%) | Reason for change |
|---|---|---|---|---|---|
| | | | | | the actual command area depends on the availability of water. More land could be irrigated with improved irrigation. |
| Pahare Kulo Tin Dobhane Muni IS | 38.95 | 31 | 56.1 | 44.0% | Some people did not get involved in the project during design phase. More request came up once they could see improved irrigation. |
| Adheri Rupse IS | 5.33 | 5 | 8.9 | 67.0% | More land could be irrigated with improved irrigation |
| Argeli Taksar IS | 17.61 | 15 | 18.9 | 7.3% | More land could be irrigated with improved irrigation |
| Kabre Mahabir Sichai Yojana IS | 8.77 | 7.5 | 9.1 | 3.8% | More land could be irrigated with improved irrigation |
| Saanimai Kharibote Sana IS | 53.11 | 40 | 64.2 | 20.9% | More land could be irrigated with improved irrigation |
| Lewak Tole IS | 25.63 | 21 | 28 | 9.2% | More land could be irrigated with improved irrigation |
| Khung Khola Titriya Sejepa Phewadin IS | 63.4 | 48.7 | 75.8 | 19.6% | More land could be irrigated with improved irrigation |

## 3.2. WATER DISCHARGE

For the selected command area, there is enough discharge available for the system in winter and summer for the crops grown by farmers. Due to the improvement of the systems with lining and pipe works, water seepage in the distribution system has decreased and has helped to cover more command areas which was previously not possible. Water used to get lost during the conveyance and only fraction of the command area used to be irrigated - mainly on the head reach - due to loss of water. At present, none of the schemes had inadequate irrigation water.

Discharge capacities were assessed in the lined canal sections to evaluate whether the capacity of the canals are sufficient to deliver the designed discharge if water is available in the source. Canal dimensions were measured in the field visits. Maximum depths of flow of water were noted with enquiry from the farmers as well as considering 5cm freeboard on the available canal sections. Then the discharge capacities were computed based on Manning's formula with the longitudinal slope as per the designed documents. The capacity of the canals together with the maximum designed irrigation requirements have been presented in Table 3-2. It can be observed that in all the systems, the conveyance capacity is more than the maximum designed water requirement, which indicates that there is enough discharge available for irrigation in the systems. The constructed sections can't be reduced less than 0.3 m in width due to facilitating cleaning and

operation by farmers. Actually, for design flow smaller sections might be enough for actual discharge but to maintainining the minimum section, capacity has been increased.

Siran Kulo Irrigation Scheme in Bhojpur was already preparing for nursery for rice planting and required irrigation water. They mentioned that they have practice of transplanting rice when the rice plants are high as the farmland becomes swampy was they become wet and the shorter rice plants are likely to be submerged in mud. In some systems, irrigation was required for cardamom and vegetables, and they were using irrigation water from the schemes. Other schemes were not using water as crops did not require water at the time of field observation. The discharge measured during the field observation in the schemes have been presented in Table 3-2.

*Table 3-2: Discharge capacity of the canals in the schemes, maximum designed water requirements and canal discharge measured during the field visit.*

| S. No. | Name of the Schemes | Discharge Capacity of Canal, lit/s | Max Designed Water Requirement, lit/s | Canal discharge measured during observation, lit/s | Discharge planned in PPR during the same time, lit/s | Deviation in % |
|---|---|---|---|---|---|---|
| 1 | Hadaiya Sana Sinchai Aayojana IS | 68.4 | 31.7 | 104.49 | 20.7 | 80.2% |
| 2 | Pahare Kulo Tin Dobhane Muni IS | 269.6 | 101.4 | 0 | 20 | No flow in canal |
| 3 | Katari Sana Sinchai Aayojana IS | 111.8 | 47.7 | 0 | 5.9 | No flow in canal |
| 4 | Taname Kulo IS | 96.9 | 70.6 | 0 | 7.6 | No flow in canal |
| 5 | Pakhale Khola Dhonde IS | 96.9 | 32.7 | 23.7 | 10.7 | 54.9% |
| 6 | Siran Kulo IS | 96.9 | 28 | 22.44 | 10.1 | 55.0% |
| 7 | Jaljale Chuchhe Dhuna Dobela IS | 68.6 | 44.1 | 4.14 | 3 | 27.5% |
| 8 | Kharuwa khola Nali pipal danda rajkulo IS | 144.4 | 75.4 | 11.84 | 15.7 | -32.6% |
| 9 | Khiku Khola Lamkulo IS | 144.4 | 103 | 29.24 | 20.1 | 31.3% |
| 10 | Argeli Taksar IS | 144.4 | 28.6 | 4.32 | 6.6 | -52.8% |
| 11 | Adheri Rupse IS | 96.9 | 8.9 | 35.1 | 1.3 | 96.3% |
| 12 | Kabre Mahabir Sichai Yojana IS | 96.9 | 24.4 | 8.58 | 4.4 | 48.7% |
| 13 | Lewak Tole IS | 96.9 | 28.9 | 8.33 | 17.9 | -114.9% |
| 14 | Saanimai Kharibote Sana IS | 96.9 | 58.9 | 10.8 | 20.6 | -90.7% |
| 15 | Khung Khola Titriya Sejepa Phewadin IS | 221.1 | 62 | 14.24 | 4.9 | 65.6% |

Note: In Hadaiya Sana Sinchai Aayojana, the discharge measurement was done in head of the canal, the water was released to the river and no irrigation was done to the field. So, actual irrigation water used is zero.

The discharge requirement is different than the actual discharge used in the same period because a) the crops were slightly different than actually designed, b) the timing of irrigation from farmers is not as per designed, and c) the discharge measured is from one particular day and time, while the discharge required in the document shows a figure over a period of a fortnight.

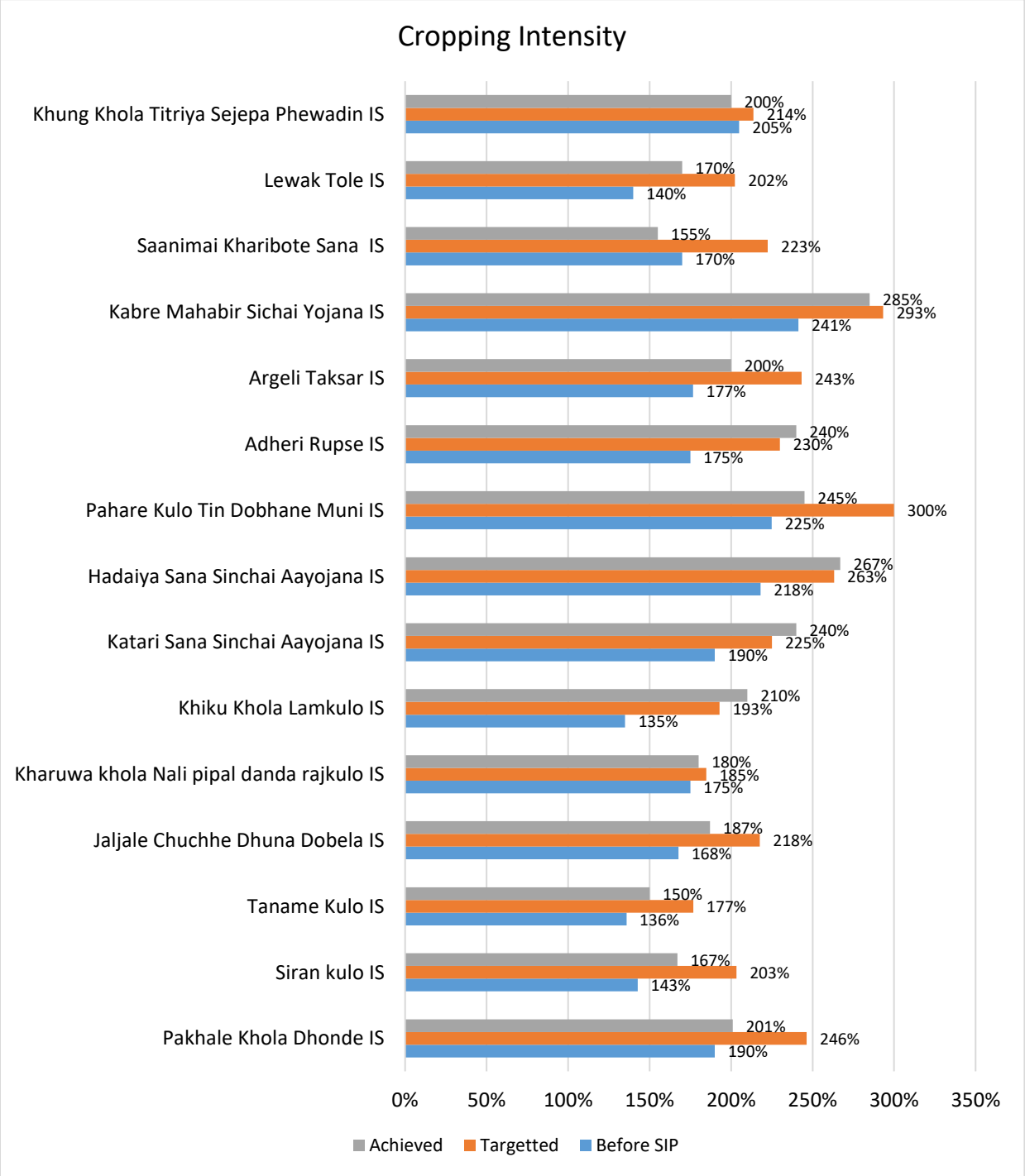



*Figure 3-1: Comparison of before programme cropping intensity, designed cropping intensity and the actual cropping intensity in the selected schemes.*

## 3.3. CROPPING INTENSITY

The cropping intensity before and after the implementation of SIP have been derived from the design documents and the actual cropping intensity with crops grown in the schemes are compiled in this study. The information was received from the farmers during the field interactions. The information of the before programme cropping intensity, designed cropping intensity and the actual present cropping intensity have been plotted in Figure 3-1.

Review of the designed cropping intensities shows that some of the expected data are not on the realistic side. For example, the designed cropping intensity of Pahare Kulo Tin Dhobhane Muni IS of Udayapur is expected to be 300% after the programme implementation and that of Kabre Mahabir Sichai Yojana IS of Okhaldhuna is expected to be 293%. This means that to achieve this level of cropping intensity, virtually three crops need to be grown in 100% of the command area which is not a realistic assumption. The expectations are found to be a bit on higher side and further program design needs to consider the issue.

The present cropping intensity shows that there is considerable increase in the cropping intensity compared to before SIP implementation with the exception of few schemes in which the cropping intensity has slightly reduced though not drastically.

## 3.4. CONSTRUCTION OF SYSTEMS AS PER DESIGN VS IMPLEMENTATION

There are no major changes in the implementation compared to the approved design of the schemes. In some cases, minor changes were noted such as omitting the proposed structures from one location and placing other types of structures on other locations as per the requirement during implementation. The overall design of the schemes was not changed during the implementation phase as continuous monitoring and SIP staff provided support during the implementation period. In some cases, size of the outlets was increased by the users as they thought the proposed size of 75mm diameter would not be enough to deliver water to the fields. Farmers could not present any documentations of such changes.

The change of structures carried out during the implementation phase in comparison to the original design has been presented in Table 3-3.

*Table 3-3: Changes in the designed structures during implementation.*

| Name of the Scheme | Original Design which was changed | Changes in the Implementation | Reasons for changes |
|---|---|---|---|
| Hadaiya Sana Sinchai Aayojana IS | Simple hume pipe crossing for local river. 45cm diameter hume pipe crossing was designed | Additional gabion protection was added from other financial sources on the river bed to protect hume pipe. Hume pipe crossing diameter changed to 60cms. | There was not enough protection works designed in the PPR document. |

| Name of the Scheme | Original Design which was changed | Changes in the Implementation | Reasons for changes |
|---|---|---|---|
| Taname Kulo IS | The size of the pipe outlet was designed as 75mm | The diameter of the outlet pipe was changed to 160mm | Farmers changed it by themselves as they felt that the discharge from the designed diameter will not be enough for them |
| Jaljale Chuchhe Dhuna Dobela IS | Size of the outlets were designed as 90mm diameter | The diameter of the outlet pipes was changed to 110mm | Same reason as above |
| Kharuwa khola Nali pipal danda rajkulo IS | Size of the outlets were designed as 75mm diameter | The diameter of the outlet pipes was changed to 125mm | Same reason as above |
| Lewak Tole IS | Superpassage was designed for river crossing | Superpassage was changed to aqueduct | As per the site condition superpassage was appropriate instead of aquaduct |
| Saanimai Kharibote Sana IS | Road crossing designed | Road crossing was cancelled and one super passage was built instead | Original design did not consider superpassage in the required drain crossing. Farmers changed the road crossing to superpassage |
| Khung Khola Titriya Sejepa Phewadin IS | Three superpassages were designed for river crossing | Five superpassages were constructed | Two more superpassages were required for local drain crossing which were not included in the original design |

## 3.5. SURVEY AND DESIGN PROCESS

The design team uses SW Maps for recording information in the field. A web-based design application is used for design and estimate which has helped produce design and report faster and with consistency in the contents and quality. Though SIP is rehabilitating existing schemes, sometimes it becomes critical to check the topographical levels using suitable topographical survey methods to improve the performance of the existing systems with good hydraulic design. It is recommended that the use of survey with precision equipment be encouraged for producing the design of schemes.

Almost in all of the systems, canal linings have been designed at a longitudinal slope of 1:100 and site specific existing longitudinal slopes have been ignored. These are existing canal systems constructed by the farmers and are on different longitudinal slopes. It is seen that in most of these schemes the designers have depended on type design. Type designs might help in producing general design in a short period of time. However, some of the structures and system components are quite specific in their nature for example intake structures and river crossings. The specific natures of these structures need to be considered in designing the structures. It is recommended that the designer team consider the specific natures of the components and design them as per the field requirement depending less on the type designs.

## 3.6. PHYSICAL INFRASTRUCTURES

The quality of works done is found to be good and satisfactory. The ward chairs compared SIP's works with other works done through contractors and agencies and said that the quality of works done by SIP is better.

The major works done in the schemes is linings and pipes in part of the conveyance. The lining works are done in RCC and is found in good condition. The lining has contributed to reduced seepage water and increased command area and irrigation water to the crops. Technically linings are needed for all the canal networks to reduce the seepage water and to deliver more water to the crops. While lining of the whole system is technically justified, it might not be justified on economic grounds as they prove to be costly compared to the derived benefits from saving water and increased crop production. In SIP-II, linings have not been done in full canal lengths due to limitations of the budget ceilings used for a particular scheme against the command area to fit the economic criteria. The linings have greatly contributed to reduction of seepage and increase in command area for irrigation. Linings have also reduced landslide in some cases as the seepage water in the slopes have reduced. Farmers have requested lining in all the schemes for the entire canal networks. So, the SIP approach of providing lining in the most critical sections based on budget ceilings based on economic criteria is justified.

HDPE pipes have been used in schemes where pipes have been used in part of the conveyance. For HDPE pipes, the connections between pipes need to be done with butt welding with fusion of the pipe ends by heating plate and pressing against end to end once the ends are heated and melted to required degree. However, farmers chose to heat one end of the pipe to expand it and insert other pipe to make a kind of socket joint which is not standard procedure for HDPE joint. Such a joint is likely to come apart as the water flows though the pipes and pressure is developed. For proper butt welding, heating plates are needed. Generators are needed for electrical heating in remote locations where electricity is not accessible. Farmers were not provided with this equipment for connection of the pipes neither were they trained properly. It is recommended that for future implementation, full set of electrical heating plates with generators be procured and kept either in the cluster office or provided to the local governments so that farmers can borrow them for construction and return once the job is done.

*Photo 3-1: Examples of weak pipe joint a) Jaljale Chuchhe Dhuna Dobela IS, Khotang and b) Kharuwa khola Nali pipal danda rajkulo IS, Khotang.*

*Photo 3-2: Release of water from outlet to slopes without proper protection in Khiku Khola Lamkulo IS, Khotang.*

Proper anchoring of the pipes is necessary where pipe conveyance has been used. Due to lack of anchoring of the pipes especially at joints, pipe joints have failed in some cases.

In some of the cases, the size of the pipes used is similar in both cases - mild slopes and steep slopes - for the same discharge, which is technically not justified. A proper design of pipe is recommended for the discharge, L-slope and head available.

Less emphasis has been given for the construction of headworks in the source river. Some of these schemes required proper diversion structures with less complicated nature in form of weir or other proper hydraulic structures for headworks. But in most of the schemes, only side intakes have been erected even if proper diversion is required. Due to this, some of the schemes are facing difficulty in diverting water to the system while temporary diversions by the farmers are washed away every now and then by flood.

Proper distribution structures are also required in the system. Canal networks do not have efficient division structures. There are lack of gates where installation of gates would have been useful for controlling flow in the system. Gates in the side intakes are also required in some of these schemes.

The outlets are designed as pipe outlets embedded in the concrete lining which discharge out water in the open field. In hill schemes, discharge from the outlets have been released in the slopes without any structures. This has made the slopes more vulnerable as the open release of water may trigger landslide or erosion of the slopes. A properly designed outlet with proper release of the water is necessary. It is clarified by PMISC that they have improved the design of the outlets in recent years.

*Photo 3-3: Pipe exposed to landslide and in vulnerable condition in Siran Kulo IS, Bhojpur.*

## 3.7. IRRIGATION SERVICES

The following points are noted for irrigation services in the schemes:

- As the water seepage has reduced due to lining and pipe works in the conveyance systems, the area coverage for irrigation has increased and reliability of irrigation with adequate water flow has increased;

- For the selected command area, discharge available in the source, through the conveyance system, is sufficient. However, some water management system is necessary to proportionately distribute the irrigation water among users. For example, if all the farmers use water at the same time there will not be enough water irrespective of the increased water supplied to the system. A distribution system as per the crop requirement is necessary. Farmers are already using rotation system for distribution of water among various part of the command area including distribution at the head end and tail end of the command area dividing the flow in hours for each farmer. There is a plan from SIP to provide operation and maintenance together with ICWM training to users but nowhere has it been done so far. The cluster office mentioned that they have been planning and will provide the operation and maintenance training together with ICWM training. In addition to this, the users require water management training to provide them knowledge on how to manage available water for required irrigation. The ICWM training manual was available from PMISC. The manual covers topics such as preparation of annual crop and water management plan, preparation of ICWM plan, ICWM implementation activities, suitable ICWM interventions and monitoring of ICWM activities and recommends that the training need to be one full day training with a half day follow up training on crop management at the critical stages. Though this will provide an overview of ICWM in one day to the farmers, detailed practical training, a separate one on each topics is recommended so that farmers can actually learn the skills to implement in the real field;
- Proper infrastructures, lining and pipe conveyance and other required structures have improved the water availability to the command area for irrigation. As this has increased the level of irrigation services, farmers have increased level of satisfaction on the rehabilitation done for the schemes;
- Nonetheless, there is a feeling among farmers that SIP has not done all that is needed as farmers expect the system to be more improved with full lining of the canal networks, proper diversion structures etc. They feel that there is more works needed to fully get the advantage of irrigation service from their systems.
- Users requested piped distribution system in command area to be able to use sprinkler systems in some of the cases.

*Photo 3-4: Individual farmers using small pipes for sprinkler irrigation, needs appropriate design for distribution pipes for sprinklers.*

## 3.8. SUSTAINABILITY OF IRRIGATION SCHEMES

Climate change may lead to temperature rise, heat or cold waves, erratic precipitation and flow in the river, reduced water flow and extreme events of precipitation and flood. This may seriously affect the reliability of irrigation in the schemes. While climate change is a global phenomenon, farmers can use measures of adaptation to climate change for agriculture.

SIP has planned the various structural components in the schemes with proper design. Before actual design work, site visit was carried by SIP design team and verification of the required lining, pipes and structures were done. This helped the staff prepare the list of structures required in the schemes which has contributed to the long-term sustainability of schemes by improving water management.

As the work has been done completely by users', there is a feeling of ownership which has contributed to maintaining good quality of works thus contributing to the sustainability of the systems.

## 3.9. OPERATION AND MAINTENANCE

Operation and maintenance is the responsibility of farmers. Operation and maintenance combined with ICWM training has been planned by the SIP office shortly. This training needs to be provided to the working committee of the users and is expected to increase the knowledge of users on how to operate and maintain the schemes contributing to the sustainability.

Though the structures have been well constructed, some damages are expected over time due to natural causes and human induced activities. A maintenance fund is needed for the repairs needed for such damages. Farmers only have the fund they have contributed in the beginning of the implementation. In the case of large damages beyond the capacity of the farmers, some external support such as from the ward offices or other external agencies is needed when large fund is required for maintenance.

*Photo 3-5: Use of sprinkler irrigation for Cardamom in Taname IS in Tehrathum.*

## 3.10. PEOPLE'S PARTICIPATION

The financial contribution required from the users in the implementation of SIP is 10%. All the works are done by users though users' committee. Most of the works are labor intensive and users from the command area are mobilized to complete the works. The amount of labor

contributed to the schemes is related to the area of land irrigated of individual users. Additionally, users were consulted in all stages of implementation by the SIP staff and the design of the schemes were prepared based on the feedbacks provided by the farmers in each individual schemes.

## 3.11. AGRICULTURAL PRACTICES

Farmers tend to grow regular traditional crops such as rice, wheat, maize, potato in most of the cases. Normally, farmers sell rice, potato and maize. In general farmers grow vegetables but for their own consumption and not for trading. In some cases where market is available vegetables are produced and are sold in the market. The agricultural products are also collected in the field by traders. Farmers in Bhojpur cluster and Fikkal Cluster are growing cardamom as commercial crops which are sold in the market. Vegetables are grown in some of the schemes as commercial farming.

In general, once the irrigation in the command area has been established, the crop production has improved. However, there are no improvement in diversification in crops, improvement in mechanization or fertilizers etc. as the farmers are still relying on the crops they have grown in the past.

## 3.12. MAJOR ENVIRONMENT ISSUES

The following environmental effects and issues have been noted:

- Floods are likely to damage the intake and infrastructures in the schemes. With the effect of climate change the floods have become more extreme and the severity of damage has increased due to natural causes. Farmers have mentioned extreme cases of flood in the past. But there is no specific quantitative data;
- Most of the selected schemes are built on hill slopes and there is some risk of landslide due to steep slopes in some schemes;
- Reduced seepage from the canal systems has also helped in decreasing the risk of landslide;
- Open and unprotected outlets have contributed to erosion of soil and landslide;
- There is a possible of reduction in water flow due to effect of climate change;
- There is a possibility of increased use of fertilizer and pesticides in irrigated agriculture compared to unirrigated situation to boost production;
- In one particular scheme, users reported that the greenery has increased due to availability of soil moisture from irrigation water;

Overall, despite the possible environmental consequences, no major effect has been noted and the environmental impact from the irrigation schemes or to the irrigation schemes is considered low.

## 3.13. OTHER ISSUES

Reliable irrigation service being within their reach, farmers have requested for agricultural extension services so as to be able to shift to commercial agriculture, as well as to get improved production with diversity of crops.

In some of the schemes situated far from major road networks and far from markets, people have tendency to migrate out. Due to this, agriculture workforce is in shortage in the area.

## 3.14. CEDRIG ANALYSIS

Procedures of CEDRIG Strategic was followed and information was gathered in the field to prepare detailed analysis of CEDRIG Strategy for the schemes. CEDRIG Strategic systematically integrates climate change, disaster risk reduction and environment at the strategic or programme level. CEDRIG Strategic helps to determine whether or not the strategic goals, aims or priorities are set at risk of effects of climate change, at risk of disasters or at risk of the environmental degradation. It also aims at determining whether a strategy or programme has a negative impact on climate or the environment, or whether it creates new or exacerbates existing risks. The analysis is presented in Appendix 1. The following adaptation measures for the strategy/programme were identified:

- Training to users on operation and maintenance of the systems including repairs of damages of infrastructures.
- Maintenance fund is needed for repair in case of damage.
- Additional protection structures are required in some of the schemes including river bank protection structures, landslide protection structures etc.
- Awareness raising and skill development for water management practices (e.g., the idea of crop water management, irrigation scheduling, canal operation plan, hydraulic operation of structures, rotational use of water etc.), drainage management (e.g. what is the role of drainage, how drainage affects crops, how to manage drains etc.) and integrated crop water management (e.g. interaction of crop and water, varieties of crop and water needs, crop yield vs use of irrigation etc.) activities to reduce the effects on climate change, and reduce the disaster risks in the context of local agriculture practices and irrigation management.
- Formation and implementation of watershed management plan with skill development of the users.
- Skill development and awareness raising for good agricultural practices including use of machinery, use of best practices in agricultural activities to align with land and water conservation, e.g., use of bio-fertilizer, bio-pesticides, use of agricultural methodology with reduced adverse impact on environment and climate change;
- Integrating environment aspects in the design and implementation of irrigation systems.

There are some risks to the schemes from disaster, climate and environment. Similarly, the schemes are likely to affect the climate and environment to a very small extent. However, due to the careful implementation of the program and ample consideration of the risks in aspects in design and implementation, and due to the small scale of the individual schemes of the program, the overall risk is low.

CEDRIG Light was carried out for Small Irrigation Programme, Phase II and was part of the project document of the Programme. The summary of the CEDRIG Light has been presented in Appendix 1. The document analyzed the risk to environment, effect of climate change and possible hazards, presenting the summary. The document carried out CEDRIG Light analysis on risk perspective and impact perspective. This document mentioned that there is low to medium risk from flash floods, mudslides, landslides, deforestation and degradation, but the CEDRIG Light analysis has recommended that no detailed impact assessment is needed. The CEDRIG Strategic exercise carried out in the field reconfirms this claim.

# 4. CONCLUSIONS AND RECOMMENDATIONS

## 4.1. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations were drawn from the study:

- In general, the existing command area in each of the selected irrigation schemes surpassed the reported command area in the SIP design document. In many cases the available command area is more than the designed value, taken for SIP implementation. So, the SIP II implementation more than meets the target for achieving the reported command area with the exception of a few cases where the command area is slightly less than planned;
- In all of the schemes, capacity of the irrigation canals in the lined sections supported by SIP was found to be exceeding the actual water requirements. However, there was little need of irrigation water at the time of field observation by the team and the canals were running with very little water to irrigate some crops being cultivated at the time;
- The major improvement in the schemes are linings and piped canals. The linings and pipe canals have helped to reduce seepage water along the alignment and has improved the water availability to the crops. However, due to considerations of economic aspects and limitations of the budget, lining of partial system has been done against the farmers' wish to have a completely lined canals up to the field levels. Technically, lined canals are required to reduce the seepage loss and to increase the irrigation water to the fields. However, due to economic considerations lining of the whole canal network may not become viable as the output gained from the reduction of seepage water will be much more than the investment. So, SIP strategy of installing the linings in partial reach of the canals or installing pipes in partial reach of the alignment is justified;
- The cropping intensities have increased in general but the actual increase in the cropping intensities is not as expected in the design documents. A few of the targeted cropping intensities in the design documents look over-ambitious as 293% to 300% cropping intensities have been targeted which is very hard to meet. The information of cropping intensities shows that two of the selected schemes reported lower cropping intensities than before the project but by a narrow margin as farmers did not put much attention on increasing the coverage of cultivation in these schemes.
- There are no major changes in the implementation compared to the designed components. However, due to site situation, farmers changed some structures in form or type to suite the need of the schemes in few of these schemes. e.g., changing superpassage to aqueduct or changing road crossing to a superpassage. The change was done without any additional financial requirements. In general, the farmers assessed the designed 75mm diameter pipe outlets to be insufficient for delivering water and changed the outlets to a larger diameter during construction. This shows that the structures proposed by SIP design team are appropriate as only minimum changes have been noticed during the implementation phase;

- The design team has been using mobile based apps called SW Maps to gather the social, environmental, market, agricultural and technical information from the irrigation systems, and has been using web-based design application especially developed for SIP for detailed design and estimate. This approach is functional and is able to deliver consistent and quality design documents;
- Procedures of CEDRIG Strategic was followed and information was gathered in the field to prepare detailed analysis of CEDRIG Strategy for the schemes. It was found that there are some risks to the schemes from disaster, climate and environment. Similarly, the schemes are likely to affect the climate and environment to a very small extent. However, due to the careful implementation of the program and ample consideration of the risks in considering the risk aspects in the design and implementation, and due to the small scale of the individual schemes of the program the overall risk is low;
- Other environmental issues included a) reduced seepage from the canal systems has decreased the risk of landslide, b) erosion of soil and contribution of landslide due to outlets open to the slopes, c) possible reduction of water available in the source due to effect of climate change, d) increased use of fertilizer and pesticides in irrigated agriculture compared to unirrigated situation to boost production, e) vulnerability of landslide due to use of pipes in place of open canals which used to collect drainage water and carry it away from the slopes.

## 4.2. RECOMMENDATIONS

The following points are recommended from the study:

- The targeted cropping intensities with a target of 293% and 300% in some of the selected irrigation schemes seem to be over ambitious as after the SIP program implementation the real figure were not meeting these expectations. It is recommended that further design documents consider the targets to a more achievable number;
- Water management training is required for changing the perception and incorrect practices of the farmers as they have perceived that the 75mm outlet size is not enough for meeting the irrigation need. Water management training is also needed for the farmers to familiarize to the operation of the hydraulic structures such as operation of division boxes, sedimentation tanks, intakes and outlet structures;
- It has been noticed that the design team has depended heavily on the type designs. The site-specific characteristics of the hydraulic structures are quite influential which governs the type and functions of the irrigation structures. Though the design team has designed the structures based on site verification, it is recommended that the team incorporate these site- Same reason as above specific information to design the structures individually and depend less on the type designs where the functions of the structures are critical; Hence, a meeting point should be decided between labor and time involved in the design, and the outcome.
- It is recommended to place the heating plates and generators either in the cluster offices or in the Municipality/ Rural Municipality Office which need to be handed over to the farmers for joining HDPE pipes. The farmers need to return the equipment once the job is done, which can then be used in other

schemes from the same office. Additionally, the farmers also need to be trained by experts for joining the HDPE pipes;

- The following additional design improvements are recommended:
  - Proper distribution structures are also required in the system. Canal networks do not have efficient division structures. There is lack of gates where installation of gates would have been useful for controlling flow in the system. Gates in the side intakes are also required in some of the schemes.
  - The outlets are designed as pipe outlets embedded in the concrete lining which discharge water in the open field. In hill schemes, the discharge from the outlets have been released in the slopes without any structures. This has made the slopes more vulnerable as the open release of water may trigger landslide or erosion of the slopes. A properly designed outlet with proper release of the water is necessary.
  - In some of the cases, size of the pipes used for conveyance is similar for mild and steep slopes for the same discharge which is technically not justified. A proper design of pipe is recommended for the discharge, L-slope and head available;
  - The farmers have tendency to use sprinkler irrigation systems in some of the schemes. However, there is no proper design of outlet systems for connection of pipes to use the sprinklers and farmers have just put the pipes in open canals or in chambers for these sprinklers. It is recommended that proper outlets be designed to connect the sprinkler system to the outlets where farmers wish to use the sprinklers;
  - Permanent diversion headworks are needed in the schemes where water diversion is difficult in the source without diversion structures. Though these systems are complicated, improvement in the system without a proper diversion may not be of use in some cases. It is recommended to construct proper diversion structures where they are actually required;
- It has been noticed that once the farmers are able to get water delivered in the fields more reliably, they need more knowledge on agriculture. It is recommended that the post implementation phase need be supported by agriculture extension services. It is expected that the ward offices and Agriculture Knowledge Centers manage the extension services. However, due to lack of resources and higher priorities in other diversified issues, less attention is being paid by these entities to the completed schemes for improvement of agriculture;
- Skill development trainings need to be provided to the farmers especially on operation and maintenance and water management practices. It is known that the cluster offices have a plan to provide the operation and maintenance training and ICWM training. These trainings should be imparted to the farmers in the completed schemes.

# Appendices

# Appendix 1: CEDRIG Analysis

**Risk Perspective**

| Step A1 | Step A2 | Step A3 | Step A4 | Step A5 | Step A6 | Step A7 |
|---|---|---|---|---|---|---|
| **Hazards** | **Consequences[2]** | **Vulnerabilities** | **Likelihood** | **Risk Significance[3]** | **Adequately addressed or to be treated** | **Measures** |
| Floods | Damage to Intakes and headworks (harmful) | Loss of agricultural production | Very Likely | High Risk | Design of intake/ headworks takes into account flood risk. Some headworks need permanent structures as temporary diversions have been washed away in the flood every time. | Training of Operation and Maintenance and management to users<br>Maintenance fund for repair in case of damage is needed |
| | Erosion of agriculture land (slightly harmful) | Loss of agricultural land | Very Likely | Medium Risk | River bank protection structures installed; needed in some cases | River bank protection structures needed in some cases<br>Training of Operation and Maintenance and management to users<br>Maintenance fund for repair in case of damage |
| Landslide/ mudslide (from natural causes) | Damage to canals, pipes or other structures (harmful) | Disruption of water delivery services | Likely | Medium Risk | Landslide protection structures are required in some cases | Retaining walls, slope land drainage and vegetative measures |
| | Destroy agricultural land (slightly harmful) | Loss of agricultural land | Likely | Low Risk | Watershed protection and management plan is necessary. | Watershed management plan (e.g. slopeland agriculture, afforestation, |

[2] Unlikely: occurs once in a life time (i.e. in 80-100 years), Likely: Once in a generation i.e. in 20 – 30 years, Very Likely: every few years i.e. in less than 10 years.

[3] Risk category as per CEDRIG Strategic document.

| | Slightly Harmful | Harmful | Extremely Harmful |
|---|---|---|---|
| Very Likely | Medium Risk | High Risk | High Risk |
| Likely | Low Risk | Medium Risk | High Risk |
| Unlikely | Low Risk | Low Risk | Medium Risk |

| Step A1 | Step A2 | Step A3 | Step A4 | Step A5 | Step A6 | Step A7 |
|---|---|---|---|---|---|---|
| **Hazards** | **Consequences[2]** | **Vulnerabilities** | **Likelihood** | **Risk Significance[3]** | **Adequately addressed or to be treated** | **Measures** |
| | | | | | | drainage management, agro-forestry etc.) |
| Source drying from effects of climate change | Reduced or no irrigation service available (harmful) | Loss of agricultural production | Unlikely | Low Risk | Adaptation to climate change | Awareness raising of climate change, adaptation measures in place |
| Degradation of Watershed | Reduced or no irrigation service available (harmful) | Loss of agricultural production | Unlikely | Low Risk | Watershed management plan is necessary | Control measures for deforestation, conservation agriculture, watershed management plan |
| | More landslide/mudslide (harmful) | Damage to infrastructures | Unlikely | Low Risk | Watershed management plan is necessary | Watershed management plan |

***Adaptation strategy/ programme:***

- Training to users on Operation and maintenance of the systems including repairs of damages of infrastructures;
- Maintenance fund for repair in case of damage;
- Additional protection structures required in some of the schemes including river bank protection structures, landslide protection structures etc.
- Awareness raising and skill development activities in climate change and disaster risk reduction in the context of agriculture practices, in how the functions of irrigation will be at risk from climate change and disasters, and how to adopt and mitigate the effects;
- Formation and implementation of watershed management plan with skill development of the users.

**Impact Perspective**

| Component of the Strategy/programme | Potential negative impact on climate (Task 1) | Significance of the impact (Task 2) | Mitigation measures (Task 3) |
|---|---|---|---|
| **Step B1 - Assess Impact on Climate** | | | |
| Reliable irrigation induces better agriculture production requiring more agriculture equipment and machinery for cultivation to harvesting to processing. Use of more machinery induce adverse impact on climate change | Release of harmful gases to environment | Low, as the use of machinery will be on small scale and not be on industrial scale | Promote electrical machinery to use electricity generated from hydropower having low impact on climate change |
| **Step B2 - Assess Impact on the environment** | | | |
| Too much exploitation of water resources for irrigation from the river source affect wildlife and bio-diversity with reduced water flow downstream | Loss of life due to reduced water flow or no water flow downstream in the water source | Low, when scheme is designed only part of the flow available in the source is tapped. Downstream area gets additional flow due to seepage in the river and additional watershed | Consider downstream effect in design of headworks/ intakes of the schemes<br>Integrate environment measures in the design of irrigation schemes |
| Degradation of land due to agriculture practices | Loss of quality of soil due to existing agricultural practices, more erosion of sloping land on agricultural fields | Low, as the systems are already on use | Promote good agricultural practices, promote conservation agriculture and promote watershed management activities side by side with agricultural activities |

| Component of the Strategy/programme | Potential negative impact on climate (Task 1) | Significance of the impact (Task 2) | Mitigation measures (Task 3) |
|---|---|---|---|
| Use of chemicals in agriculture degrading the environment | Contamination of air, water and soil by chemical fertilizers, pesticides and herbicides | Low, as the schemes are implemented only on cultivated areas where agriculture is already happening | Promote use of bio-fertilizers, bio-pesticides and bio-herbicides and use of integrated crop and water management practices |
| In some cases, irrigation induced more soil moisture producing growth of more vegetation in the area | Due to the increase of soil moisture, natural vegetation has flourished | Positive impact on environment | Promote growth of vegetation in available land with improved irrigation facilities |
| **Step B3 - Assess Impact on disaster Risk** | | | |
| Pipes, canals and canal structures | Induce landslide due to use of pipes to disrupt natural drainage from existing earthen channels. Induce landslide due to seepage in canals and release of uncontrolled flow from outlets and escapes along the slopes | Moderate but in most cases; Landslide will be reduced due to reduction of seepage and controlled water flow | Construction of drainage along sloping lands, protection of existing canals to use as drainage channels when pipes are used, use of buried pipes instead of exposed pipes |
| | Reduce landslide due to control of seepage water | Positive impact on disaster risk | Promote the activity |

***Adaptation strategy/ programme:***

- Skill development and awareness raising for good agricultural practices including use of machinery, use of suitable practices in agricultural activities to align with land and water conservation;
- Awareness raising and skill development for water management practices, drainage management practices and integrated crop water management practices;
- Integrate environment aspects in the design and implementation of irrigation systems.

## SUMMARY OF CEDRIG LIGHT ANALYSIS OF SIP II PROJECT REPORT

CEDRIG Light was carried out for Small Irrigation Programme II and was part of the project document of Small Irrigation Program II. The document analyzed the risk to environment, effect of climate change and possible hazards presenting the summary. The document carried out CEDRIG Light analysis on risk perspective and impact perspective. The summary of these analysis has been outlined in Annex Table 1 and Annex Table 2. This document mentioned that there is low to medium risk from flash floods, mudslides, landslides, deforestation and degradation but the CEDRIG Light analysis has recommended that no detailed impact assessment is needed.

*Annex Table 1: Summary of the risk perspective of CEDRIG Light analysis of SIP-II.*

| **Hazard** | **Comments** | **Consequence** | **Likelihood, Extent, Risk Level** |
|---|---|---|---|
| Flash Floods, floods | Possibility of flash floods which can damage to intake structures and head reaches of the irrigation canals. | Damage of irrigation intake structures and head reaches of irrigation canals. | Likelihood: Likely<br>Extent: Slightly Harmful<br>Risk Level: Low Risk |
| Mudslides, Landslides | Four types of landslides can affect the irrigation canals: a) Soil creep, b) Slumping, c) Debris flow and d) Rock fall. | Damage of the irrigation canal by landslides. | Likelihood: Likely<br>Extent: Slightly Harmful<br>Risk Level: Low Risk |
| Deforestation | Vegetation cover in most of the small catchment areas is still being degraded by deforestation and overgrazing. | Deforestation in catchments of water sources for the small irrigation systems. Reduces the retention capacity of the catchments leading to irregular flow pattern, more frequent flash floods and reduced base flows. | Likelihood: Likely<br>Extent: Harmful<br>Risk Level: Medium Risk |
| Degradation (Land, soil, ecosystem, biodiversity) | Land degradation above and below the canal alignment as a result of deforestation, terracing of steep slopes, over grazing, | Land degradation along the canal alignment increasing the risk of slope destabilization and landslides. | Likelihood: Likely<br>Extent: Harmful<br>Risk Level: Medium Risk |

| Hazard | Comments | Consequence | Likelihood, Extent, Risk Level |
|---|---|---|---|
| | abandonment of agricultural land and road construction | | |

The CEDRIG Light analysis of SIP-II document also presented the impact perspective and assessed the impact on climate change, impact on environment and the impact on disaster risk. The summary of the impact analysis is presented here in Annex Table 2.

*Annex Table 2: Summary of the impact perspective of CEDRIG Light analysis of SIP-II.*

| Impact perspective | Component of the Activity | Impacts |
|---|---|---|
| Estimate impact on climate change | Improved diversion structures, water distribution systems and water storage facilities | It will mitigate to certain extent the impact of climate change on the reduced reliability of water supply as a result of the increase in irregular flow patterns in the irrigation water sources. |
| Estimate impact on the environment – Water | Construction of permanent diversion of intake structures | Might reduce downstream discharge especially during low stream/river flows, which might affect downstream water users. |
| Estimate impact on the environment – Soil | Commercialized agriculture | Cultivation of high value crops and the use of improved varieties of cereal crop will require higher levels of pest control and fertilizer use. Excessive use of pesticides, herbicides and fungicides and improper dosage of fertilizer might cause soil pollution. |
| Estimate impact on disaster risks | Operation of the canal system | Uncontrolled inflow of water, degraded canal section or blockage of canals due to small slips might cause over-topping of the canals and cause landslides and damage to |

| Impact perspective | Component of the Activity | Impacts |
|---|---|---|
| | | agriculture land or properties below the canal alignment. |

# Appendix 2: General Observations of the Selected Irrigation Schemes

## 1. UDAYAPUR CLUSTER

### 1.1. Hadaiya Sana Sinchai Aayojana IS

The water in the scheme is diverted form Tawa Khola which is a perennial with large fluctuation in the flow during dry and monsoon period. The scheme has side intake at Tawa Khola with a link canal at the head reach to convey water from intake to the main canal. Farmers have to work on the river after every flood to divert the water to the link canal as no permanent structure has been constructed. One of the major structures built in the scheme is river crossing in a tributary of the source river in the head reach, in addition to linings and division boxes. A hume pipe crossing structure has been built at this crossing. According to the farmers, SIP supported only for the hume pipe crossing and the farmers had to manage gabion for the protection of the structure from their own resources. The river crossing structures need to be more robust considering the flood situation with enough protection measures to avoid the risk of getting washed out in the extreme flood events.

The command area considered in the design report is 50.15 ha GCA and 44 ha CCA. It is found that there is more command area available for irrigation but for the management of the scheme only limited command has been included. There is enough water available for the scheme for irrigation during dry season as well as in rainy season. There was enough water available in the link canal at the head (105 lit/s as per measurement) but the farmers did not require much water at the time of observation.

The users complained the design of the new canal under SIP scheme is not sufficient to provide enough irrigation water to the command area. It is found that the sections of the rehabilitated canal constructed by SIP has been reduced as compared to the existing sections in the head reach. Farmers wish to increase the height of the lined canal to increase the conveyance capacity of the canal.

It is found that the users' need to properly maintain and operate the distribution structures. The earth cover on the sides of some of the distribution structures were damaged and the users had not maintained the distribution structures as required for proper water distribution.

Farmers have been growing traditional crops such as rice, wheat, mustard, pulses and maize in the command area. Potato and other vegetables have been largely grown for home consumption. The nearest market available is Katari where the farmers have to compete with the cost of agricultural products from India to sell their agricultural products.

The farmers request extension of the lining of the canal system in the scheme to avoid more seepage loss.

There is a risk of flooding and bank erosion of agricultural land. There is also a risk of washing away of side intake, link canal and river crossing structures. There was a big flood in the river in 2077 BS due to damming up of the river in the watershed following the landslide triggered by the heavy rainfall, and bursting of the

earthen dam thus created afterwards. River bank embankment has been constructed along the side of the command area on the banks of the river to protect from flooding and erosion from other sources.

*Annex Photo 1:River crossing structure in Hadaiya Sana Sinchai Aayojana IS.*

## 1.2. Pahare Kulo Tin Dobhane Muni IS

The source river is Pahare Khola. Discharge depends on the rainfall in the watershed but is enough for diverting for irrigation requirement. As per the observation of the locals, the discharge in the river has not reduced to great extent in over the last ten years.

The total command area for the scheme is 38.95 ha GCA and 31 ha NCA in the design document. The actual field observation verifies the command area. However, there was a plan to excavate additional new canal to the part of the planned command area. The users' have not yet completed the canal network in this part and they have mentioned that this year they plan to complete the work and then only 100 percent of the command area can be covered with irrigation. If we do not count this area the present NCA is only 20 ha. This part was not being irrigated in the past due to lack of water as water seepage rate was too high and the water could not reach this part. Once lining has been completed from the programme, seepage in the canal has reduced and the enough water is available for whole of the command area planned.

Some households did not believe that the project will become successful and did not get involved in the users' committee. Now, the works have been completed and people have seen water coming to the fields more than it used to in the past; hence, these farmers also wish to get involved in the scheme.

Farmers believe that SIP planning was good to support the lining and construction of much needed structures in the irrigation scheme but they feel that more support is still required as SIP planned lining only till the beginning of the command area and similar lining is required till the outlet level field units.

There is no diversion headworks in the system and only side intake has been constructed. Farmers require to block the water with local materials such as boulder and brushwood for temporary diversion. A permanent diversion structure is required for the system.

The farmers grow usual crops such as rice, maize, mustard but wheat is not grown in the area. Potato and vegetables are grown only for personal use and commercial agricultural has not been realized yet. Nearest market is at Beltar Sanibare. Plan of vegetable farming has been prepared with the support from a cooperative.

There is a likelihood of soil being unstable and landslide in the head reach of the canal. However, this is not disrupting the canal at the moment.

*Annex Photo 2: Intake of Pahare Kulo Tin Dobhane Muni IS.*

## 1.3. Katari Sinchai Yojana IS

The total command area planned is 21.61 ha GCA and 20 ha NCA. The command area is verified in the field and is found to be adequate. The users reported that more command area can be irrigated from the irrigation system beyond the area it is planned. The scheme has been providing water during dry season *beyond* the boundaries of planned command area once the irrigation requirement of the area *within* the boundary is met. During the rainy season, downstream area beyond the boundary of the scheme don't need water from the scheme as they can tap water from the river as there is enough water in the river in rainy season. However,

in dry season the case is different. There is enough water in the rainy season and continuous flow irrigation is done while hourly rotational distribution system based on area is observed during dry periods.

There is no permanent diversion structure in the source and only side intake has been constructed. Farmers have requested permanent headworks to facilitate diversion of required water in the scheme.

The farmers have been producing rice, maize, wheat and mustard as the main crops. The command area is pocket area of mustard as mustard is grown in about 25% of the total command area. They have observed better production of rice due to availability of reliable irrigation water and no pest this year. Vegetables are grown only for personal use and commercial vegetable production has not been started. Nearest agricultural market is Rampur Bazaar at 3 km East of the area.

There was extreme flood about 12 years before which submerged the adjacent agricultural land and eroded the agricultural land along the banks of the river.

Farmers reported that the greenery of the command area has been increased due to availability of additional soil moisture in the area. This can be considered as a positive environmental impact due to the irrigation scheme.

*Annex Photo 3: Intake of Katari Sinchai Yojana IS.*

## 2. DHANKUTA CLUSTER

### 2.1. Pakhale Khola Dhonde IS

Pakhale Khola Dhonde IS is in Mahalaxmi Municipality, Ward No 8 of Bhojpur District and has GCA of 14.94 ha and NCA of 12.5 ha. Pipes and linings have been constructed intermittently along the main canal. Some

pipe crossing structures have been constructed in addition to the RCC ones. However, pipes are hanging with no proper support structures which need to be taken care of for withstanding the force of running water along the pipes. There is open side intake for water diversion. Gated structures are needed to regulate the flow. For the canal crossing with natural streams hydraulic design need to be improved.

Due to seepage problem, water did not use to reach the command area before the implementation of the program. There is a good production of mustard this year due to adequate and reliable availability of irrigation water during winter this year, thanks to reduction of seepage water made possible by lining. However, more pipes and linings are required to increase the flow of water. Rotational system is being practiced during the period of water shortages and irrigation is provided from head to tail as per the planned schedule.

RCC lining was planned for canal in some parts of the alignment and not for the whole of the alignment. The total quantity of RCC lining has remained the same as designed but the users changed the locations of lining as per the requirement during the construction period.

Farmers are growing traditional crops like rice, maize, mustard in addition to growing cardamom in sloping land. Farmers have been growing vegetables only for personal use. Users feel that there is a need for commercial farming. Additionally, farmers have grown turmeric and ginger for household use only but these products have commercial value and need to be promoted. There is a possibility of vegetable farming such as potato, peas, tomato in addition to the possibility of coffee farming which was tried in the area in small scale as a pilot. Nearest accessible market is Jitpur Bazaar.

There is problem of landslide along the canal alignment. The source has not completely dried and the users have noticed only 10 to 20% variation in the lowest water flow.

*Annex Photo 4: Canal RCC lining in Pakhale Khola Dhonde IS.*

## 2.2. Siran kulo IS

Sirankulo IS lies in Ward No 10 of Bhojpur Municipality in Bhojpur District. It has GCA of 17.17 ha and NCA of 15 ha. There is more command area available beyond the present boundaries designed for the scheme but due to shortage of water the area cannot be included in the scheme. During the lean flow, rotation system is practiced among farmers with interval of 7 days, 3 to 8 farmers irrigating at the same time. The lining in the canal and pipe conveyance has helped increase the irrigation flow in the command area due to reduction of seepage water from the canal.

RCC lining has been done in different segment of the canal alignment and pipe laying is done in the initial reach of the alignment for water conveyance under the program. Side intake has been constructed for catching irrigation water from the source with no permanent structure in the river. It is seen that the unlined canal section is not sufficient to accommodate the incoming water in many reaches. The capacity of unlined section that are constructed are not enough in some sections even to accommodate the designed discharge. The canal is likely to get damaged in such reaches due to overflow as the water is flown with full capacity in the canal.

There is a practice of cultivating seeds in the nursery for rice during the month of Chaitra for the rice to be planted in Jestha or Asar which is quite early compared to practice for rice in other areas in Nepal. Farmers mentioned that there will be swampy conditions in the field with water and the shorter rice will be fully submerged in the mud. So, they have practice of transplanting long plants with early seedlings. Canal operation was ongoing for the development of rice nursery at the time of observation. The rice seedling is done quite early as there is a practice of transplanting long rice plant as the rate of soil being swampy is high

once the field is irrigated and shorter rice plants get buried in the mud. There is a practice of cultivating traditional crops such as rice, maize, wheat and mustard in the area with potatoes and other vegetables. The nearest market is Bhojpur Bazaar at 12 km from the area.

There is problem of landslide in the initial reach of the alignment. Pipe has already been damaged by the landslide and repair has been done. The construction of road near the pipe alignment has also triggered the landslide.

*Annex Photo 5: Intake of Siran Kulo IS, Bhojpur.*

## 2.3. Taname IS

The reported command area in Taname IS is 49.89 ha GCA and 42 ha NCA. Field verification has confirmed the actual command area which has availed the irrigation facilities. The work consists of 750m of 250mm HDPE pipe and 440m of RCC canal lining including other structures. The users have reported that due to the implementation of rehabilitation program in the scheme, the seepage of water during the conveyance has greatly reduced which has made it possible to cover the command area with irrigation. The users reported that the water is enough at the time of winter also.

The original design of intake has been changed during construction as there was big boulder available in the intake site which was not considered in the original design. RCC outlet chambers have been constructed in the scheme. The outlet pipe was designed as 75mm diameter HDPE pipes. The farmers did not consider the size of the outlet enough and increased it to 160 mm.

The main crops in the area are rice, maize, millet, potato, wheat and cardamom. Cardamom is a major crop in the slopes and is cultivated for commercial purpose. Cardamom requires irrigation during winter season.

Some users have used shifting type of sprinkler irrigation for cardamom. However, they have simply inserted the pipe in the BPT or at the open junction chambers. Design of proper distribution for using sprinkler system when users are willing is necessary which has not been considered in the system. Vegetables have been grown only for household use. The nearest market is at Sansari Market/Shitalpati Market which is at 20 km distance from the area.

It is found that the joints in the pipes are not done in standard manner. For HDPE pipes butt welding is required with heating the end of the pipes and pressing against each other for fusion. It is noticed that the farmers were not provided with and lack the necessary equipment which are electrical heating plates, jacks and generator to carry out the joint in the pipes properly. So, they carried out joining heating one pipe and inserting the other into the heated pipe. This joint is not standard and is likely to fail with water pressure. The pipes need to be buried into the soil to avoid external impact to the pipes. However, the pipes have been installed open on the ground exposing it to the outside disturbances which is likely to cause damage ot the pipes.

Before the implementation of the program, there was open channel for conveyance of irrigation water. This irrigation channel also acted as a drainage channel in the time of rainfall collecting excess water and transporting it away, to the command area. Now as pipes are installed, they cannot collect the rainwater during heavy rainfall. This is likely to trigger landslide as rain water is not disposed away from the slope as it was done previously. Additional catch drains need to be constructed to avoid the landslide during heavy rain period. Some minor landslides have already been observed along the alignment of the pipe and canal.

*Annex Photo 6: Pipe conveyance in Taname IS, Tehrathum.*

# 3. KHOTANG CLUSTER

## 3.1. Jaljale Chuchhe Dhuna Dobela IS

Jaljale Chuchhe Duna Dobela IS lies in Diktel Rupakot Majhuwagadhi Municipality, Ward No. 8 of Khotang District. It consists of 19.76 ha of GCA and 17 ha of NCA. The command area is verified in the field and is as per reported. There are 5 irrigation schemes completed in this ward so far; one scheme is ongoing and two schemes have just been initiated this year under SIP. WUA registration process of these schemes is ongoing in the municipality.

There is enough discharge available for the system in winter and summer for the crops grown by the users. However, there is a need to improve the water distribution in the command area by efficient water management practices. Users are requesting for piped distribution to field so that they can use sprinkler irrigation. Where there is shortage of water, rotation system has been adopted.

Joint of the pipe is not done in standard manner. No butt welding has been done with end fusion but one pipe has been inserted into the other one with heating which is not standard method due to which the pipe joint is likely to become vulnerable during water flow. Proper anchoring of HDPE pipe has not been done due to which the joint is vulnerable due to water flow in pipe drop. The pipe joint has opened up due to the water pressure in drops due to lack of anchoring and improper joint. Similar pipe sizes have been used both for milder as well as steeper slopes with similar discharge as it looks like that the design is not adjusted as per the flow requirement and head available.

Farmers sell rice, potato and maize. Farmers grow vegetables but for their own consumption and not for trading. The agricultural products are collected in the field by buyers. Nearest market is Diktel.

Size of outlets have been changed from 90mm pipe to 110mm pipe as farmers' perception is that no sufficient water can be taken from 90mm pipe as per their requirements.

There is problem of land subsidence in the middle part of the canal alignment which has created minor crack in the canal lining and it might affect the canal lining in the long run if the land subsidence does not stop. There is problem of landslide along the canal alignment.

*Annex Photo 7: Canal lining and command area of Jaljale Chuchhe Dhuna Dobela IS in Khotang District.*

## 3.2. Kharuwa khola Nali pipal danda rajkulo IS

Kharuwa Khola Nali pipal Danda Rajkulo IS lies on Ward No 8 of Diprung Chuichumma Rural Municipality in Khotang District. The scheme has 55.99 ha GCA and 46 ha NCA. The command area was verified in the field and was found to be adequate. Some masonry lining and structure construction was done in the scheme previously which is not working properly as water seepage exist in the old remaining masonry lining works not replaced by RCC lining. Similarly, there is water leaking from the old structures. There is water shortage in general. Enough water is available in rainy season during plantation of paddy but not enough in winter. Farmers practice rotation system when there is water shortage in the system. There is more water scarcity during dry season towards the tail end of the scheme.

Pipe has been used for mild slope in the main canal, which is not a proper design; due to this, enough water is not drawn in the system. Joints in the pipes are faulty and were not done correctly as no butt welding of HDPE pipes were done. The linings have been done in different segments intermittently along the canal alignment. Users request complete lining.

75mm diameter pipe outlets were designed but users constructed 125mm diameter pipe outlets with HDPE pipes as they thought the 75mm diameter outlets were not enough to draw required water to the command area.

Traditional crops are grown by the farmers including rice, wheat, maize, mustard and potato. Vegetable is grown for household consumption only. The nearest market is Diktel Bazar which is 40 km away from the area.

There are no major environmental concerns. Bamboo, *uttis* and *khayar* woods have been sold from the command area by farmers to generate cash due to which the environment is degrading. Due to migration of people from the area to cities, enough people are not available for agriculture.

*Annex Photo 8: Intake of Kharuwa khola Nali pipal danda rajkulo IS, Khotang.*

## 3.3. Khiku Khola Lamkulo IS

Khiku Khola Lamkulo IS is situated in Ward No 8 of Khotehang Rural Municipality in Khotang District. The total GCA of the schemes is 36.72 ha and the NCA is 28 ha which is verified in the field and is found to be correct.

Before construction there was water scarcity due to leakage problem in the canal. Now, after lining works sufficient discharge is available at all times. Rotation system was needed before the implementation of SIP. However, after the lining works, seepage has greatly reduced and there is enough water up to the tail end of the canal.

Due to the remoteness of the location, being far from the main road, there is migration of people out of the area to major cities due to which the cost of land is decreasing day by day and agriculture is not attractive to farmers in the area. Due to lack of workers in the locality, some agriculture lands have been left uncultivated and have been converted to barren land due to large migration of people to the cities.

Paddy and wheat are sold to Simpani Market at 10km road distance.

ICWM training is planned soon. Road connection to the area is only available for good weather condition. Due to lack of access to market and health facilities in poor weather conditions, people are reluctant to live in the area and tend to migrate to cities.

*Annex Photo 9: Intake of Khiku Khola Lamkulo IS in Khotand District.*

# 4. OKHALDHUNGA CLUSTER

## 4.1. Argeli Taksar IS

Argeli Taksar IS is situated in Ward No 7 of Siddhicharan Municipality in Okhaldhunga District. It has GCA of 17.61 ha and NCA of 15 ha. There is sufficient discharge available in rainy season but there is scarcity of water during winter season. So, in winter only head reach of the command area gets irrigation water from the scheme. There is leakage of water from old masonry lining in the head reach near intake. Seepage problem also exists in intake structure.

Farmers are using sprinkler systems. But the distribution system is not well designed to connect the sprinklers. So, farmers are inserting the pipe into open channel and outlet chamber to derive water to these sprinklers to irrigate the crops including vegetables.

The area is a pocket area for vegetables due to access of market situation at Okhaldhunga market at 16km from the command area. Farmers sell paddy, wheat, potato and vegetables.

*Annex Photo 10: Canal lining in Argeli Taksar IS in Okhaldhunga.*

## 4.2. Andheri Rupse IS

Andheri Rupse IS is situated in Siddhicharan Municipality, Ward No 10, Rupse village (previously, Betini VDC, Ward No 7). The total GCA in the scheme is 5.33 ha and total NCA is 5 ha which is available in the area. Water is drawn from Andheri Khola. A 9KW micro hydro was in operation from the canal in the past. Now it has become defunct since more than 15 years (FY 2061-62).

Users request for the construction of new permanent intake with proper water diversion as there is only side intake available in the system with no permanent structures for diversion. There is enough water available for irrigation.

This is a pocket area for vegetable production. The nearest market is at Okhaldhunga market at 18 km from the command area. Paddy, wheat, potato and vegetables are sold.

There is Bank erosion problem along the banks of Andheri Khola.

*Annex Photo 11: Main canal in Andheri Rupse IS in Okhaldhunga.*

## 4.3. Kabre Mahabir Sichai Yojana IS

The irrigation scheme lies in Ward No 8 of Manebhanjyang Rural Municipality of Okhaldhunga District. Among the users in the scheme, 15 households are from Sunkoshi Rural Municipality and 22 households are from Manebhanjyang Rural Municipality of Okhaldhunga District as the users live in two different pockets. There is temporary diversion in the river with boulder and brushwood installed from users and every time after the flood water, a new diversion is required to be constructed to divert the river flow into the canal.

Most people are living far from the command area and only a few households live near the command area. There is coordination issue due to this problem as people are scattered over different locations. Water is drawn to the scheme from a big river (Molung Khola) having more than 1 cumec discharge in April. Land owners are living in different locations. If any decision need to be done, the coordination becomes a problem due to landowners being scattered

Due to the availability of water in the river in all seasons, enough water is available for irrigation. However, tapping of water during flood season is a problem as the diversion structure is washed away by the flood during that time. A permanent diversion mechanism is required in the system to resolve the problem.

Farmers sell paddy, maize and vegetables in local village market.

There is problem of flooding agricultural land along the banks of the river in addition to the river bank erosion problem which eats away the agricultural land during the flood time from the banks of the river.

There is an issue of tenant system in agriculture in the scheme. The real land owners live far from the command area and the agriculture is being done by tenants who are mainly living in the vicinity.

*Annex Photo 12: Temporary diversion from the river to intake in Kabre Mahabir Sichai Yojana IS in Okhaldhunga.*

# 5. PHIKKAL CLUSTER

## 5.1. Sanimai Kharibote Sana IS

Sanimai Kharibote Sana IS is situated in Ward No 3 of Sandakpur Rural Municipality in Ilam District. The scheme has 53.11 GCA and 40 ha NCA. Weir in the river source for irrigation was constructed in the past from different sources. SIP has mainly constructed lining and canal structures. There was shortage of water due to high rate of seepage but after the canal lining, enough water is available in the system. The scheme has sharp drops along the main canal at several locations. One-side lining has been done in a few places. Farmers don't want to construct one-side lining as they have the experience that one-side lining is not effective in stopping the seepage water.

The main crops grown by the farmers are rice, wheat, potato, millet, mustard and vegetables. Cardamom and *amriso* are the cash crops in the area. *Amriso* doesn't need irrigation. Farmers are also growing kiwi fruit and ginger.

There is less risk of landslide along the canal alignment and in the command area.

*Annex Photo 13: Intake of Saanimai Kharibote Sana Sinchai IS in Ilam.*

## 5.2. Lewak Tole IS

Lewak Tole IS is situated in Ward No 12 of Suryodaya Municipality in Ilam District. The scheme has 25.63 ha GCA and 21 ha NCA. The irrigation water flow in the command area used to be less but after the implementation of the SIP program activities, due to reduction in loss of seepage flow effected by lining, the quantity of irrigation water has increased. The program assisted in construction of lining, intake, river crossing structures and division boxes which has facilitated improved water management in the scheme.

Farmers have used sprinkler irrigation for irrigating vegetables and cardamom. They are using individual pipes from open division boxes. There is no proper design for distribution system for sprinkler pipes. Pipe design for sprinkler connection need to be done for proper use of sprinkler systems for irrigation. Rotation distribution system need to be implemented from the month of Magh to the month of Baisakh due to shortage of water.

Vegetables including bitter gourd, cauliflower, tomato, leafy vegetables are grown in the command area and are sold in the market. Rice, cardamom, *amriso* and maize are also grown and are sources of income to the farmers. Farmers don't get appropriate rates for agricultural products. Buyers pick up the agricultural products from households.

During the construction period, one superpassage was changed to an aqueduct as per the field requirement. Other structures remained same as designed with no change.

Quantity of water flow has been decreasing in the source over the years due to effect of climate change. Farmers feel that there will be less landslide due to reduced seepage flow in the slopes effected by lining of canals.

*Annex Photo 14: Intake of Lewak Tole IS in Ilam District.*

## 5.3. Khung Khola Tritriya Sejepa Phewadin IS

Khung Khola Tritriya Sejepa Phewadin IS is situated in Ward No 11 of Phidim Municipality in Panchthar District. The scheme has 63.4 ha GCA and 48.7 ha NCA. The system connects three villages Tritiya, Sejepa and Phewadin. Total 2 km of RCC lining has been done. There is less water during dry season, mainly after the month of Chaitra. Farmers suggest there is a need of in-system tanks or reservoir to store water to be used in dry season. There was problem of water seepage along the canal due to which it was difficult to get irrigation water to the command area. After lining the problem has been reduced and the flow has been increased to the command area. The lining had been done only in the main canal but the farmers feel that lining need to be done up to the farm units to increase the irrigation flow. Lining was done in different

segments along the main canal while leaving earthen canal in some reaches. The earthen section looks like vulnerable to failure and seepage.

The source is being used by many other irrigation systems upstream and downstream of the intake point. There are in total about 50 irrigation systems which are using irrigation water from the same river in the vicinity. However, there is no water-use conflict as there is a good coordination among users of different irrigation systems and local water management rules have been followed.

The main crops grown by the farmers are rice, wheat, potato, mustard and ginger. The nearest market is Phidim Bazaar at 11 km

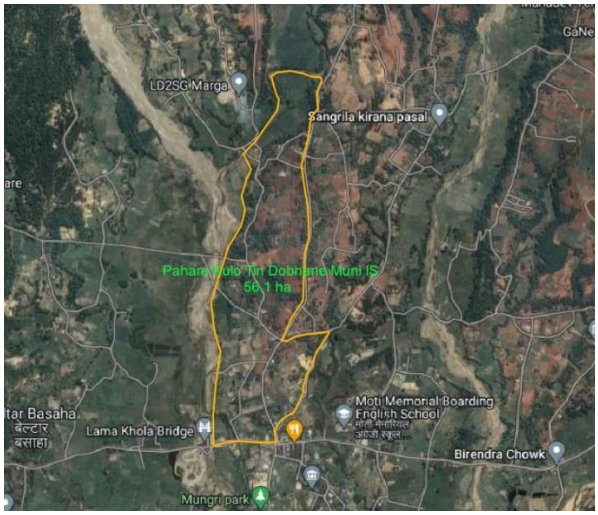
The farmers constructed 5 more foot-slabs than planned as per their own decision during the implementation stage. The size of these slabs are very small and the farmers constructed these slabs from the quantity of materials saved from the works. Similarly, there was estimate for construction of 3 superpassages for river crossing but the farmers constructed 5 of them.

There is landslide problem along the canal alignment. Farmers feel that source is gradually getting dry in a period of last 10 years.

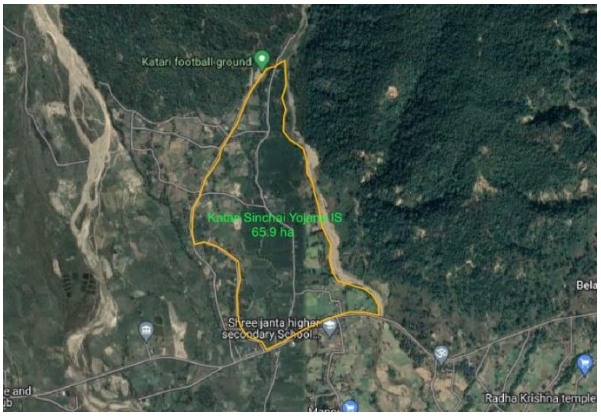
*Annex Photo 15: Intake of Khung Khola Titriya Sejepa Phewadin IS in Panchthar.*

# Appendix 3: Verification of the Gross Command Area.


Hadaiya Sana Sichai Aayojana IS, Udayapur

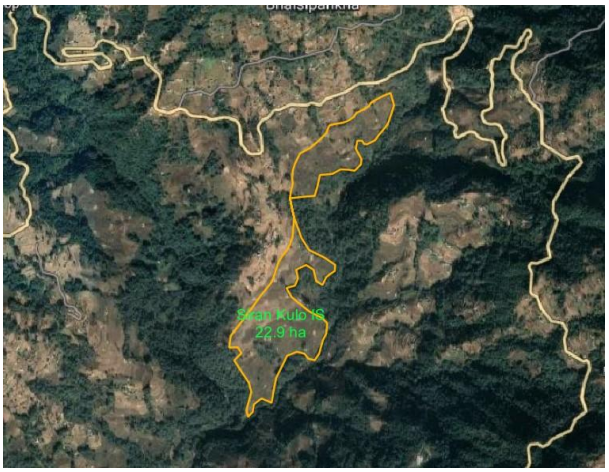


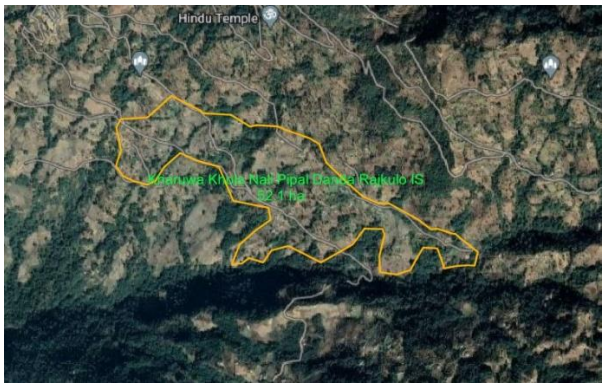
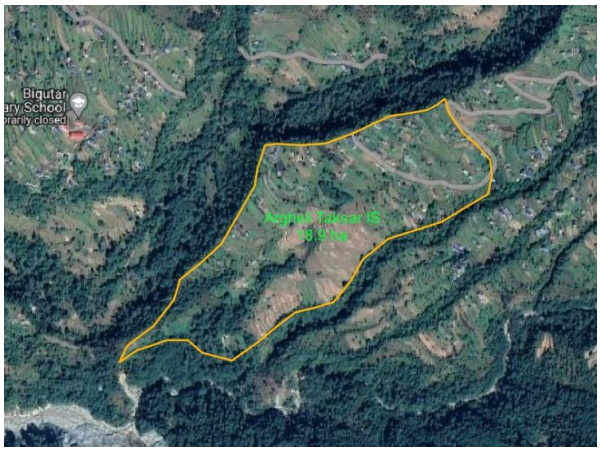
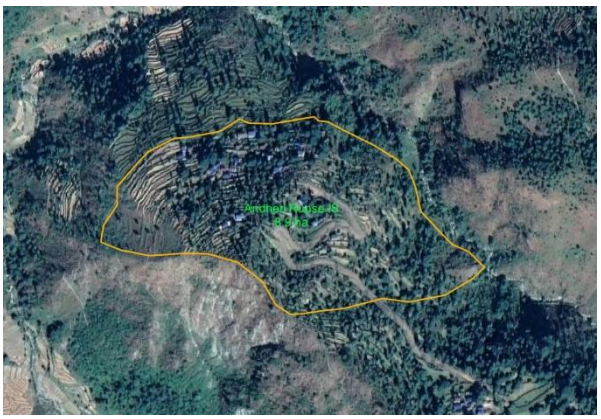

Pahare Kulo Tin Dobhane Muni IS, Udayapur

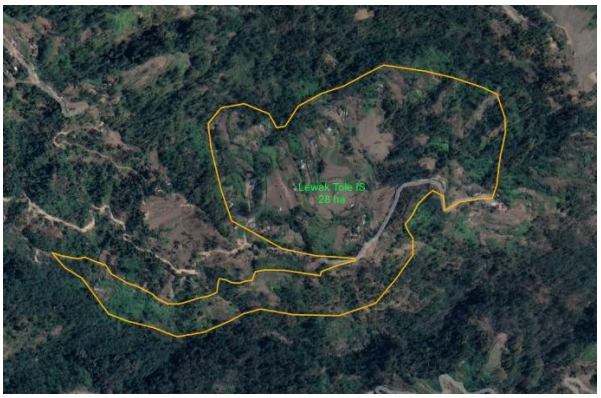
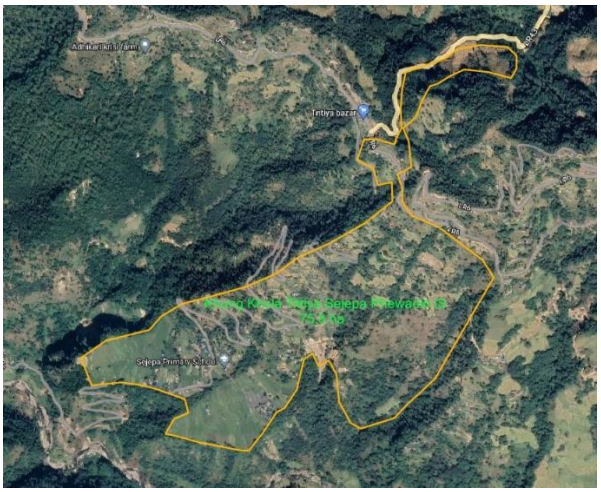



Katari Sichai Yojana IS, Udayapur


Taname Kulo IS, Tehrathum




| Siran Kulo IS, Bhojpur | Phakale Khola Dhonde IS, Dhankuta |
|---|---|
|  |  |
| Jaljale Chuchhe Dhuna Dobels IS, Khotang | Kharuwa Khola Nali Pipal Danda Rajkulo IS, Khotang |
|  |  |
| Khiku Khola Lamkola IS, Khotang | Argeli Taksar IS, Udayapur |
|  |  |

| Andheri Rupse IS, Udayapur | Kabre Mahabir Sichai Yojana IS, Udayapur |
|---|---|
|  |  |
| Lewak Tole IS, Ilam | Sanimai Kharibote IS, Ilam |
|  | |
| Khung Khola Titriya Sejepa Phewadin IS, Panchthar | |

# Appendix 4: List of Persons Contacted

List of Staff contacted from Small Irrigation Programme Clusters

| S. No. | Name | Positions |
|---|---|---|
| 1 | Suresh Chaudhary | Social Safeguard Officer, Cluster Coordinator, Udayapur Cluster |
| 2 | Adesh Jha | Irrigation Engineer Udayapur Cluster |
| 3 | Prakash Nepali | Senior Technical Officer, Udayapur Cluster |
| 4 | Vijayanand Chaudhari | Technical Officer, Udayapur Cluster |
| 5 | Punya Chaudhari | Irrigation Engineer, Dhankuta Cluster |
| 6 | Arjun Bajgain | Senior Technical Officer, Dhankuta Cluster |
| 7 | Kedar Dahal | Technical Officer, Dhankuta Cluster |
| 8 | Rama Magar | Social Safeguard Officer, Cluster Coordinator, Khotang Cluster |
| 9 | Krishna Tamang | Senior Social Officer, Cluster Chief, Okhaldhunga Cluster |
| 10 | Keshav Lama | Social Safeguard Officer, Cluster Coordinator, Phikkal Cluster |
| 11 | Hem Raj Bhatta | Irrigation Engineer, Phikkal Cluster |
| 12 | Laxmi Prasad Adhikari | Senior Technical Officer, Phikkal Cluster |
| 13 | Drishman Rai | Senior Technical Officer, Phikkal Cluster |

List of representatives of Local Government contacted

| S. No. | Name | Positions |
|---|---|---|
| 1 | Pushkar Khadka | Chairman, Ward No 3, Katari Municipality, Udayapur |
| 2 | Yuvaraj Adhikari | Member, Ward No 3, Katari Municipality, Udayapur |
| 3 | Tirtharaj Adhikari | Chairman, Ward No 4, Belaka Municipality, Udayapur |
| 4 | Bill Bahadur Magar | Acting Chairman, Ward No. 4, Chaudandigadhi Municipality |
| 5 | Ganga Kumari Bista | Member, Ward No. 4, Chaudandigadhi Municipality |
| 6 | Smriti Sayal | Member, Ward No. 4, Chaudandigadhi Municipality |
| 7 | Bhakti Raj Rai | Member, Ward No. 4, Chaudandigadhi Municipality |
| 8 | Mohan Kumar Rai | Ward Secretary, Ward No. 4, Chaudandigadhi Municipality |
| 9 | Sumi Limbu | Chairman, Ward No 8, Myaglung Municipality, Tehrathum |
| 10 | Umesh Kumar Shah | Myanglung Muncipality, Focal Person, SIP, Tehrathum |
| 11 | Ram Bahadur Khadka | Chairman, Ward No 8, Mahalaxmi Municipality, Dhankuta |
| 12 | Subindra Rai | Chairman, Ward No 10, Bhojpur Municipality |
| 13 | Lila Kumar Chauhan | Chairman, Ward No 8, Diktel Rupakot Majhuwagadhi Municipality, Khotang |

| S. No. | Name | Positions |
|---|---|---|
| 14 | Badri Katuwal | Chairman, Ward No 8, Dipungchuichuma Rural Municipality, Khotang |
| 15 | Chandra Bahadur Thapa | Chairman, Ward No 8, Khogehang Rural Municipality, Khotang |
| 16 | Bhal Bahadur Katuwal | Chairman, Ward No 7, Siddhicharan Municipality, Okhaldhunga |
| 17 | Ramesh Dhamala | Chairman, Ward No 8, Siddhicharan Municipality, Okhaldhunga |
| 18 | Bhim Bahadur Balami Magar | Chairman, Ward No 8, Manebhanjyang Rural Municipality, Okhaldhunga |
| 19 | Lila Bahadur Burja | Chairman, Ward No. 3, Sandakpur Rural Municipality, Ilam |
| 20 | Rajendra Kumar Thapa | Chairman, Ward No 11, Phidim Municipality |

List of farmers contacted from irrigation schemes.

| S. No. | Name | Positions |
|---|---|---|
| | ***Hadaiya Sana Sinchai Aayojana IS, Udayapur*** | |
| 1 | Man Bahadur Tamang, | Treasurer, WUA |
| 2 | Mahabir Adhikari | Member, WUA |
| 3 | Durga Prasad Bastola | Chairman, WUA |
| 4 | Mangal Krishna Adhikari | General User |
| 5 | Madhav Prasad Ghimire | General User |
| 6 | Sukdev Adhikari | General User |
| 7 | Drona Prasad Subedi | General User |
| 8 | Sukhilal Sada | General User (Motivator) |
| | ***Pahare Khola Tin Dobhane Muni IS, Udayapur*** | |
| 1 | Shankar Bahadur Basnet | Treasurer, WUA |
| 2 | Geeta Rai | Member, WUA |
| 3 | Dharma Singh Rai | General User |
| 4 | Sher Bahadur Magar | Chairman, WUA |
| 5 | Dhan Kumari Rai | Vice Chairman |
| | ***Katari Sinchai Yojana IS, Udayapur*** | |
| 1 | Santosh Kumar Acharya | Chairman, WUA |
| 2 | Nabaraj Luintel | Member, WUA |
| 3 | Prem Timsina | General User |
| 4 | Durga Bahadur Bishnkhe | General User |

| S. No. | Name | Positions |
|---|---|---|
| 5 | Devraj Chaulagain | General User |
| 6 | Shivlal Chaulagain | General User |
| 7 | Roman Rai | General User |
| 8 | Meghraj Ghimire | General User |
| 9 | Gobinda Ghimire | General User |
| | ***Taname IS, Tehrathum*** | |
| 1 | Dambar Bahadur Shrestha | General User |
| 2 | Til Bikram Shrestha | Treasurer, WUA |
| 3 | Narayan Prasad Shrestha | Member, WUA |
| 4 | Bijule Limbu | Member, WUA |
| 5 | Dhak Bahadur Shrestha | General User |
| 6 | Nar Bahadur Shrestha | General User |
| 7 | Sujan Limbu | General User |
| 8 | Tika Limbu | General User |
| 9 | Bhoj Kumar Shrestha | General User |
| 10 | Man Bahadur Shrestha | Ward Member, Ward No 8 |
| 11 | Ram Bahadur Magar | General User |
| 12 | Raj Kumar Shrestha | General User |
| 13 | Indra Shrestha | General User |
| | ***Pakhale Khola Dhonde IS, Bhojpur*** | |
| 1 | Bal Bahadur Lungeli | Teacher/General User |
| 2 | Yashoda Aale Miringching | General User |
| 3 | Lakshmi Maya Pulami | General User |
| 4 | Binu Miringching | General User |
| 5 | Mankumari Miringching | General User |
| 6 | Aliza Ghale | General User |
| 7 | Sonika Thapa | General User |
| 8 | Shyam Kumar Miringching | General User |
| 9 | Ganga Lungeli | General User |
| 10 | Dambar Bahadur Thapa | Chairman, WUA |
| 11 | Dambar Bahadur Thapa - 2 | General User |
| 12 | Ganga Bahadur Miringching | General User |
| 13 | Yogendra Aale | General User |
| 14 | Padam Bahadur Thapa Magar | General User |
| 15 | Rudra Bahadur Thapa Magar | General User |
| 16 | Manisha Miringching | General User |
| 17 | Bhumika Thapa | General User |

| S. No. | Name | Positions |
|---|---|---|
| 18 | Sita Thapa | General User |
| 19 | Tankamaya Miringching | General User |
| | ***Sirankulo IS, Bhojpur*** | |
| 1 | Dilip Rai | General User |
| 2 | Jirang Rai | General User |
| 3 | Bhakta Kumari Shrestha | Member, WUA |
| 4 | Devendra Shrestha | General User |
| 5 | Sitaram Rai | Chairman, WUA |
| 6 | Nirmala Shrestha | General User |
| 7 | Man Kumari Shrestha | General User |
| 8 | Tilak Bahadur Shrestha | General User |
| 9 | Kumar Shrestha | General User |
| 10 | Madan Bahadur Shrestha | General User |
| 11 | Bishnu Kumar Shrestha | General User |
| 12 | Samar Bahadur Shrestha | General User |
| 13 | Hari Chandra Rai | General User |
| | ***Jaljale Chuchhe Dhuna Dobela IS, Khotand*** | |
| 1 | Sushma Shrestha | Chairperson, WUA |
| 2 | Indra Kumar Shrestha | General User |
| 3 | Gobind Shrestha | General User |
| 4 | Dasharath Shrestha | General User |
| 5 | Dhan Bahadur Deuja | General User |
| 6 | Parshuram Shrestha | General User |
| 7 | Raju Shrestha | Member, WUA |
| 8 | Devi Shrestha | Member, WUA |
| 9 | Babita Shrestha | General User |
| 10 | Moti Kumar Shrestha | General User |
| 11 | Lal Bahadur Kathayat | General User |
| 12 | Menuka Shrestha | Secretary, WUA |
| 13 | Pabitra Shrestha | General User |
| 14 | Lakshmi Shrestha | General User |
| 15 | Krishna Kumari Kathayat | General User |
| | ***Kharuwa khola Nali pipal danda rajkulo IS, Khotang*** | |
| 1 | Sher Bahadur Thapa | Chairman, WUA |
| 2 | Bam Bahadur Thap | General User |
| 3 | Hira Devi Thapa | General User |

| S. No. | Name | Positions |
|---|---|---|
| 4 | Shrijana Thapa | Treasurer, WUA |
| 5 | Asmita Thapa | General User |
| 6 | Bal Bahadur Raut | Member, WUA |
| 7 | Ajay Rai | Secretary, WUA |
| 8 | Mira Rai | Member, WUA |
| 9 | Gita Nepali | General User |
| 10 | Ajambar Shrestha | Member, WUA |
| 11 | Lakshmi Rai | Member, WUA |
| 12 | Birendra Khadka | Member, WUA |
| 13 | Dhan Bahadur Thapa | Member, WUA |
| | ***Khiku Khola Lamkulo IS, Khotang*** | |
| 1 | Padam Adhikari | General User |
| 2 | Hari Prasad Rai | Vice Chairman, WUA |
| 3 | Ganesh Adhikari | General User |
| 4 | Tej Bahadur Pariyar | General User |
| 5 | Narad Adhikari | General User |
| 6 | Dipesh B. K. | General User |
| 7 | Renuka Thapa | General User |
| 8 | Narendra Kumari Thapa | General User |
| 9 | Bhagabati Katuwal | General User |
| 10 | Umesh B. K. | General User |
| 11 | Ganga Bahadur B. K. | General User |
| 12 | Dambar Bahadur B. K. | General User |
| | ***Argeli Taksar IS, Okhaldhunga*** | |
| 1 | Ram Chandra Shrestha | Chairman, WUA |
| 2 | Lakpa Dawa Sherpa | Secretary, WUA |
| 3 | Dareli Sherpa | Treasurer, WUA |
| 4 | Pasang Furi Sherpa | General User |
| 5 | Nim Dawa Sherpa | General User |
| 6 | Dolma Sherpa | General User |
| 7 | Tej Bahadur Biswakarma | General User |
| 8 | Furba Sherpa | General User |
| 9 | Dalaki Sherpa | General User |
| 10 | Pitambar Dahal | General User |
| 11 | Shange Sherpa | General User |
| | ***Andheri Rupse IS, Okhaldhunga*** | |
| 1 | Bishnu Bahadur Thapa Magar | General User |

| S. No. | Name | Positions |
|---|---|---|
| 2 | Keshav Magar | General User |
| 3 | Gande Magar | Chairman, WUA |
| 4 | Gopal Bahadur Thapa Magar | General User |
| 5 | Dode Magar | General User |
| 6 | Aaite Magar | General User |
| 7 | Sure Bahadur Magar | General User |
| 8 | Ganesh Kumar Thapa Magar | General User |
| 9 | Mangali Maya Thapa | General User |
| 10 | Nisha Thapa Magar | General User |
| 11 | Kali Maya Thapa Magar | General User |
| 12 | Mati Maya Thapa Magar | General User |
| 13 | Pahal Bahadur Magar | General User |
| 14 | Dik Bahadur Magar | General User |
| 15 | Ranimaya Magar | General User |
| | ***Kabre Mahabir Sichai Yojana IS, Okhaldhunga*** | |
| 1 | Bhagbati Timilsina | Secretary, WUA |
| 2 | Ram Bahadur Magar | Chairman, WUA |
| 3 | Chandramaya Magar | General User |
| 4 | Dilmaya Magar | General User |
| 5 | Ranjan Ale Magar | General User |
| 6 | Dipendra Magar | General User |
| 7 | Gyan Bahadur Thapa Magar | General User |
| 8 | Hom Bahadur Thapa Magar | General User |
| 9 | Budhamaya Thapa Magar | General User |
| 10 | Ganesh Bahadur Thapa Magar | General User |
| 11 | Jain Bahadur Magar | General User, Ward No 8 Member |
| 12 | Navaraj Rai | General User |
| 13 | Kajiman Rai | General User |
| 14 | Lok Bahadur Shrestha | General User |
| 15 | Dambar Bahadur Shrestha | General User |
| 16 | Makar Bahadur Shrestha | General User |
| 17 | Ganesh Bahadur Thapa Magar | General User |
| | ***Lewak Tole IS, Ilam*** | |
| 1 | Bina Rai | Treasurer, WUA |
| 2 | Bikas Rai | Member, WUA |
| 3 | Samjhana Rai | General User |

| S. No. | Name | Positions |
|---|---|---|
| 4 | Kritika Rai | Member, WUA |
| 5 | Lal Man Rai | General User |
| 6 | Ganga Bahadur Rai | Secretary, WUA |
| 7 | Ram Bahadur Rai | Member, WUA |
| 8 | Giriraj Pradhan | General User |
| 9 | Dhan Kumar Rai | Member, WUA |
| 10 | Bishal Rai | General User |
| 11 | Padam Rai | General User |
| 12 | Tek Bahadur Rai | General User |
| 13 | Ishwore Rai | General User |
| 14 | Pramila Rai | General User |
| 15 | Divas Rai | General User |
| 16 | Subash Rai | General User |
| | ***Sanimai Kharibote Sana Sinchai IS, Ilam*** | |
| 1 | Som Sauden | Chairman, WUA |
| 2 | Lal Kumar Sauden | General User |
| 3 | Tank Bahadur Sauden | General User |
| 4 | Prem Kumari Sauden | General User |
| 5 | Bhawani Sauden | General User |
| | ***Khung Khola Titriya Sejepa Phewadin IS, Panchthar*** | |
| 1 | Devendra Tamang | Secretary, WUA |
| 2 | Chhabi Adhikari | General User |
| 3 | Vijay Tamang | General User |
| 4 | Shyam Bahadur Nembang | General User |
| 5 | Deep Prasad Neupane | Member, WUA |
| 6 | Dhanendra Adhikari | General User |
| 7 | Chandra Prasad Bhattarai | General User |
| 8 | Yagya Bikram Neupane | General User |
| 9 | Bed Prasad Bhattarai | General User |
| 10 | Purna Bir Nembang | General User |
| 11 | Dipesh Subba | General User |
| 12 | Agni Prasad Adhikari | General User |
| 13 | Lila Maya Adhikari | Member, WUA |