Impact Study/Evaluation of Small Irrigation Special Program

FINAL REPORT

Submitted by:

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June, 2004
His Majesty's Government
National Planning Commission Secretariat
Central Monitoring and Evaluation Division
Singh Durbar, Kathmandu

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ACKNOWLEDGEMENT

We are highly privileged to have opportunity to undertake the study of "Impact Evaluation of Small Irrigation Special Programme". We sincerely express our gratitude to National Planning Commission Secretariat for entrusting us this study. We believe that the findings and recommendations made in the report will be very much useful in the preparation of similar projects in future.

We gratefully acknowledge the fruitful comments and suggestion provided by Hon’ble Member of NPC Dr. Hari Krishna Upadhyay during the presentation of the study report. We also acknowledge the NPCS officials Mr. Balananda Poudyal (Joint Secretary, CMED) Mr. Yam Nath Sharma (Under Secretary, CMED), Mr. Mahendra Gurung (SDE, MOWR), Mr. Chandreshwor Prasad Kurmi (Engineer, MoA), Mr. Shanti Ram Prasai (Section Officer, CMED) and Mr. Shekhar Karki (Section Officer, CMED) for their sincere support, cooperation and valuable comments during the various stage of the study.

We also express our thanks to officials and local community of the Ilam, Chitwan, Kavre, Palpa, Banke and Dadeldhura Districts for their cooperation and providing required information for the study.

Full Bright Consultancy (Pvt.) Ltd.
Gyaneshwor, Kathmandu
June 2004
EXECUTIVE SUMMARY

This study on the Small Irrigation Special Program (SISP) is carried out under the supervision of Central Monitoring and Evaluation Division (CMED) of National Planning Commission, HMG/N. The SISP was started in the Fiscal Year 2054/55 with an overall objective of increasing agriculture production of poor farmers through maintenance support to existing small irrigation systems and development of new small (micro) irrigations systems with appropriate technology. Till the FY 2056/57, the Department of Irrigation (DOI) implemented the program in all the seventy-five districts; thereafter the Department of Agriculture (DOA) is implementing the program.

The study examined fifteen SISP intervened irrigation systems located in six selected districts covering all the five Development Regions and both the ecological regions (hill and Terai) of the country. The overall objective of the study was to assess the impact of the SISP, particularly on agriculture production and employment creation for the poor farmer, examine issues concerning effectiveness of the program, and recommend future courses of action in this regards.

The study is based on the primary data collected in the field from the farmers of the irrigation systems that were visited. The respondents included households of the SISP supported irrigation scheme, key informants and user group in the area. Most of the descriptions presented in this study are obtained from direct observations, and through household survey based on the structured questionnaire and focus group discussions. Several information were also gathered from secondary sources.

The study suggests that the Small Irrigation (SISP) is in accordance with the PRSP/10th Plan of the Government, and the program is helpful in reducing poverty by increasing agricultural production and creating employment opportunities for the poor farmers. In general the socio-economic condition of the farmers has improved in the area of intervention.

Out of the schemes intervened under SISP, the small scale non-conventional irrigation schemes (such as treadle pump and plastic ponds) are relatively more sustainable from the perspective of appropriate technology for increasing agricultural production and maintaining the system compared to the intervention in existing FMISs. However, intervention is also equally essential in maintaining the present level of production, without which the irrigation facility being obtained from the FMISs will get reduced drastically.

SISP intervention in small irrigation systems is found to be environmental friendly. Even in the case of surface irrigation systems, as the magnitude of SISP intervention is small in scale, no negative environmental effect and health problems were found.

SISP has been helpful in increasing reliability of irrigation facility, which has resulted in increasing productivity, crop diversification and cultivation of cash crops including vegetable etc. The SISP intervention has helped in poverty reduction and gender upliftment.
The study suggests that the SISP needs to be continued with improved procedural guidelines for implementation. Several related activities such as institutionalization of the farmers groups for O&M of the scheme, agriculture extension, market promotion need to be strengthened for the schemes supported by SISP. Local NGOs and CBOs could be mobilized in implementing these activities.

In implementing the SISP, during the DOI period investment was more than at present (by DOA), but DOA is found more active in mobilizing peoples' participation. Peoples' participation is an essential component in such schemes. Coordination between these two organizations is essential for the success.

Finally, this study suggests developing mechanism for regular monitoring and evaluation of the SISP for its further improvements.
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<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
</tr>
<tr>
<td>APP</td>
<td>Agriculture Perspective Plan</td>
</tr>
<tr>
<td>BC I</td>
<td>Branch Canal No.1</td>
</tr>
<tr>
<td>CMED</td>
<td>Central Monitoring and Evaluation Division</td>
</tr>
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<td>DADO</td>
<td>District Agriculture Development Office</td>
</tr>
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<td>District Agriculture Office</td>
</tr>
<tr>
<td>DDC</td>
<td>District Development Committee</td>
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<td>DIO</td>
<td>Divisional Irrigation Office</td>
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<tr>
<td>DOI</td>
<td>Department of Irrigation</td>
</tr>
<tr>
<td>DOA</td>
<td>Department of Agriculture</td>
</tr>
<tr>
<td>FCGO</td>
<td>Financial Controller General's Office</td>
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<td>FMIS</td>
<td>Farmers Managed Irrigation System</td>
</tr>
<tr>
<td>FUG</td>
<td>Forest Users Group</td>
</tr>
<tr>
<td>HMG/N</td>
<td>His Majesty Government of Nepal</td>
</tr>
<tr>
<td>ILC</td>
<td>Irrigation Line of Credit</td>
</tr>
<tr>
<td>IS</td>
<td>Irrigation System</td>
</tr>
<tr>
<td>ISSP</td>
<td>Irrigation Sector Support Project</td>
</tr>
<tr>
<td>MOCA</td>
<td>Ministry of Agriculture and Co-operative</td>
</tr>
<tr>
<td>MOF</td>
<td>Ministry of Finance</td>
</tr>
<tr>
<td>MOWR</td>
<td>Ministry of Water Resources</td>
</tr>
<tr>
<td>MTEF</td>
<td>Medium Term Expenditure Framework</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
</tr>
<tr>
<td>NISP</td>
<td>Nepal Irrigation Sector Project</td>
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<td>NLIS</td>
<td>Narayani Lift Irrigation System</td>
</tr>
<tr>
<td>NPC</td>
<td>National Planning Commission</td>
</tr>
<tr>
<td>NWRS</td>
<td>National Water Resources Strategy</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>PPIS</td>
<td>Plastic Pond Irrigation System</td>
</tr>
<tr>
<td>SIMI</td>
<td>Smallholder Irrigation Market Initiative</td>
</tr>
<tr>
<td>SISP</td>
<td>Small Irrigation Special Project</td>
</tr>
<tr>
<td>STW</td>
<td>Shallow Tube Wells</td>
</tr>
<tr>
<td>TID</td>
<td>Tank Irrigation System</td>
</tr>
<tr>
<td>TW</td>
<td>Tube Wells</td>
</tr>
<tr>
<td>VDC</td>
<td>Village Development Committee</td>
</tr>
<tr>
<td>WUG</td>
<td>Water Users Group</td>
</tr>
<tr>
<td>WUA</td>
<td>Water Users' Association</td>
</tr>
</tbody>
</table>
CHAPTER I: INTRODUCTION

1.1 NATIONAL BACKGROUND

1.1.1 National Scenario

Nepal is divided into three distinct regions geographically running from east to west as the Mountain (35 %) in the northern side, the Hill (42 %) in the middle and the Terai (23 %) along the southern side of the country. Politically, it is divided into 5 regional development zones, 75 districts, 3915 Village Development Committees (VDCs) and 58 Municipalities. The country covers an area of 147,181 sq. km. Its length is about 885 km from east to west and width varies from 130 to 255 km. The census (1991) estimated the population of the country at 18.8 million, and the census of 2001 estimates the population at 23.2 millions out of which over 85% live in the rural villages. Land cover and population in the three physiographic regions i.e. mountain, hills and Terai of Nepal are 35%, 42%, 23% and 7.3%, 46% and 46.7% respectively.

Economic growth of the country has not kept up with the current population growth rate. The overall economic growth has been overshadowed by the population growth rate, which is estimated to be around 2.27% (NPC, 2002).

1.1.2 Socio-Economic Scenario

Nepal is one of the least developed and poorest country in the world, with a per capita GDP of Rs. 17800 in 2001/02, and an estimated 38% of its population lives below the line of poverty (NPC, 2002), the lowest in SAARC Countries. Human Development Report (2002) estimates a human poverty index (HPI) for Nepal at 43.4, with a rank of 76 out of 88 developing countries. This HPI value for Nepal is higher than for any other South Asian country, indicating the worse situation. Adult literacy of 41.8% and female literacy of 24% is one of the lowest in the SAARC region, whereas chronic malnutrition among children below 5 years of age (54.1%), the probability at birth of non-surviving to age 40 years (2.5%), and maternal mortality of 540/100,000 remain among the highest in the world (Human Development in South Asia, 2001, and Nepal Human Development Report 2002, UNDP 2002). Similarly the HDI of 0.49 (UNDP HDR 2002) ranks Nepal at position 142 worldwide. The infant mortality rate is 64.4 per 1000 live birth. The life expectancy at birth is 59.7.

Agriculture is the major sector of economy, which comprises 76.1% of economically active population and this sector has contributed 41% of the GDP. More than ¾ of the population is engaged in agriculture. High rates of unemployment (70% of rural labour force) and under-employment (46% of working days unutilised) have resulted into out-migration trend reducing the productive manpower in rural areas. This has caused lesser food production and persistent food deficits in poor rural areas. Tourism, small-scale industry, and commerce are the other areas of economic importance.
Poverty: Ecologically, poverty incidence is higher in the mountains followed by the Terai and the hills\(^1\). It is generally lower in central and eastern development regions compared with other development regions, due to the higher level of urbanization such as in Kathmandu valley. However, tracts and pockets of high concentration of poverty are widely found in rural areas in the hills. Poverty is also more concentrated among occupational castes (comprising 13% of the population) and marginalized and minority ethnic groups, with significant gender gap. It is also more prevalent among the landless, marginal and small farmers, under the country's skewed land ownership pattern where some 70% of landholders cultivate 30% of farmland. Given that over 90% of the poor live in rural areas and engaged mostly in agriculture, enhancing agricultural development is a key to reducing poverty.

1.2 AGRICULTURAL SECTOR

Agriculture accounts for 39% of the GDP, and provides employment for 80% of the active workforce in 2001. During the 9th five-year plan (FYP) period (1997-2002), the sector showed a sign of improved performance, with the average annual growth rate of 3.3%, compared with 1.8% between 1991-95. Yield growth of cereals picked up, with a stronger growth trend exhibited by commercial crops (such as oilseeds, potato and fruits) and livestock products, although there has not been much of a change in production mix. Agriculture exports also doubled, led by high value products such as pulses and vegetables, although its share to total agriculture production remains low at 4%, and agriculture imports stood at over 8% of total agricultural production mainly led by rice and milk products. Overall, however, while the agriculture growth rate during the 9th FYP period outperformed the annual population increase by 1.1%, it could not achieve the target of annual growth of 2.3% per capita. Productivity of paddy, maize and wheat, which accounts for over 80% of the cultivated land, still remains at 2.5 t/ha, 1.7 t/ha, and 1.6 t/ha, respectively, which is the lowest among the neighbouring countries in South Asia. The majority of agriculture is thus still subsistence oriented.

Production of high value market oriented commercial crops will help improve the income generation and food security situation, providing employment opportunities to women, helping increase value addition, bringing diversification and commercialisation in agriculture and possibility of earning more than food crops. In this background, the food crop oriented subsistence agriculture system has to be transformed to diversification and commercialisation in agriculture by adopting the production system of high value crops, which is comparatively more profitable than other crops in specific ecosystem. This will help promote agriculture industry, increase employment opportunities and improve economic growth rate.

As poverty reduction is the main objective of the Tenth Plan, the Plan has given priority to channelling resources to the rural areas where poverty is concentrated, to the agriculture sector, and to the mitigation of ignorance and diseases. Therefore, the shares of the

\(^1\) In 1996, the poverty headcount ration in the mountains, the Terai, and the hills was 56%, 42% and 41% in 1996 when the national average was 42%.
agriculture, irrigation, forestry and social sector in the total investment have been increased in comparison to the previous Plan.

1.3 IRRIGATION SECTOR

1.3.1 General

With the annual rainfall mostly concentrated in the monsoon season with highly erratic intra-seasonal pattern, irrigation is an essential element in enhancing agricultural productivity across the year in Nepal. Of the country’s cultivated land of 2.64 million ha, about 1.77 million ha (67%) is irrigable, whereas some 1.13 million ha (43%) has access to irrigation facilities. Among the area with irrigation access, about 28% or some 0.31 million ha has been developed and managed by the Department of Irrigation (DOI), while the rest is classified as farmer-managed irrigation systems (FMIS), mostly developed by farmers in the past and managed by them. However, the productivity of the irrigated area is also low, with the existing systems only able to deliver irrigation water to about 70% of the command area. Productivity of the traditional FMIS is further constrained due to the fragile and rudimentary intake and distribution systems that lead to highly unreliable water supply (due to frequent washout of diversion facilities by floods, siltation of canals, landslides etc.) with high distribution loss and operation and maintenance (O&M) costs. It is estimated that about 0.30 million ha of FMIS is in need of urgent rehabilitation and improvement.

In APP, providing reliable supply of irrigation water was prioritised as a prerequisite for enhancing agricultural production by reducing the risk of investing in the improved input packages. Accordingly, the Government prepared in 1997 a revised irrigation policy and a long-term Irrigation Development Plan (IDP) to accelerate irrigation development, with the principles of (I) participatory and demand-driven investments; (ii) transfer of DOI-managed systems to water user associations (WUA); and (iii) full O&M cost recovery by beneficiaries. To assist the implementation of these initiatives, ADB has supported FMIS improvement through Second Irrigation Sector Project (SISP), management transfer of DOI systems2, and groundwater irrigation development3, mainly covering the two eastern regions, along with capacity development of DOI4. The World Bank is assisting the package of similar interventions through Nepal Irrigation Sector Project (NISP)5, covering the three western regions, whereas the European Commission is also assisting the selected FMIS. Assistance to FIMS has drawn attention in view of their opportunities for enhancing productivity with relatively low cost, quick gestation period, and adopting a participatory approach building on the existing local institutions that have operated and maintained the facilities over the long term.

2 Loan 1311-NEP: Irrigation Management Transfer Project, for SDR8.9 million, approved on 13th September 1994 and to be closed on 30th June 2004, with parallel financing support by USAID.

3 Loan 1609-NEP: Community Groundwater Irrigation Development Sector Project, for SDR21.9 million, approved on 26th February 1998, with co-financing support by CIDA.

4 TA 2522-NEP: Capacity Development of DOI, for $ 600,000, approved on 11th January 1996.

5 The Project became effective in September 1998 with a total credit amount of $58.7 million.
1.3.2 Government Initiated Small Irrigation Schemes

Systems towards the end of first plan and started in the second plan in 1962. Since then several programs were launched. In recent years, several years, several NGOs and INGOs are also working in this sector. Followings are some of the past programs that focused on the development of small irrigation systems.

- Mechi Hill Irrigation funded by SNV
- Natural Resources Management Project implemented by CARE-Nepal.
- SINKALAMA funded by Asian Development Bank
- Irrigation Sector Programme (ILC, ISP, SISP, NISP)
- Integrated Rural Development Projects (Makali, Rapti)
- Second Hill Irrigation Project (Seti)
- Smaller holder Irrigation Market initiative (SIMI)

1.3.3 Farmer Managed Irrigation Systems (FMIS)

As mentioned above these schemes cover more than 70% of the irrigation-developed area. Their nature can be summarized as below:

- They cover remote areas.
- They serve poor and small farmer.
- These are mostly small schemes
- These are getting defunct or loosing their effectiveness/Capacity.
- Peoples' organizations have been sustaining them so far.
- These organizations are becoming weaker due to various reasons, resulting adverse effect on the sustainability of the FMIS.
- Peoples' participation can be increased if government support is provided for the repair/rehabilitation works that is not possible by farmers' centralisation only.
- Substantial benefit can be obtained from relatively small investment (by govt.) in these systems for periodic repairs which can not be carried out by the farmers.

Due to environmental degradation and decreasing farmers' participation in FMIS, they are loosing their capacity. Without these systems, the cultivated land in the inner hills (Tars, etc) will become barren and hill area will have to face acute shortage of food. Therefore, intervention by the government in FMIS to maintain their sustainability is essential.

1.4 THE PROJECT UNDER STUDY

1.4.1 Background

In Nepal, there is limited scope for expansion of agricultural land to increase agricultural production. Therefore, the only alternative available for increasing the agricultural production is to increase productivity and cropping intensity by adopting suitable measures like increase in irrigated land, intensive use of available irrigation infrastructure, improvement in water management practices, in farmers participation in
the irrigation systems, development of non-conventional irrigation methods and coordination in supply and management of agricultural inputs include marketing services. Farmer Managed Irrigation Systems (FMIS) have major contribution in providing irrigation facility in the country. But due to various problems outside the control of the farmers the FMIS are losing their capacity. His Majesty's Government of Nepal (HMG/N) has initiated Small Irrigation Special Programme (SISP) with the view of supporting the existing small irrigation systems and utilising small sources of water by making use of local technology and farmers' contribution. Under this program financial support is provided by the government to maintain/rehabilitate and improve the existing small irrigation systems, to construct new small systems and to develop non-conventional irrigation systems (like drip, sprinkler etc.) where feasible.

Main objectives of the Program are as follows:
- To increase agricultural production of poor farmers,
- To help poor families raise their income through vegetable and other high value crop production,
- To provide minor maintenance support to the existing small-scale irrigation system.
- To provide immediate support to rehabilitate the minor losses of irrigation channel caused by flood, landslide and soil erosion,
- To strengthen the effectiveness of agriculture extension program,
- To develop micro irrigation (drip, sprinkler, pump facility etc.) system in Terai, Hills and Mountains,
- To support rainwater harvesting, wherever possible.

1.4.2 Investment Modality

Budget for SISP is sent to the concerned District office (District irrigation office till FY 2056/2057 and district agricultural office from FY 2057/58 onward) and the district office selects the schemes to be financed under this program according to the directives issued for this purpose.

1.4.3 Up to date Investment

This program was started in Fy054/055. Initially, the Program was operated by the Department of Irrigation (DOI). From the fiscal year 2057/58 it is being operated by the Department of Agriculture (DOA) under the Ministry of Agriculture & Co-operatives (MOAC). The Program covers 75 districts of the Kingdom. It is being operated as a yearly program. During the second year of the Program, it was combined with other two components, namely 'Goat & Chicken Exchange' and 'Transport Support for Seeds and Chemical Fertilizers under the "Food and Nutrition Security Program". The proposed study intends to cover the impact of the SISP only.

The following table 1.1 presents the budget allocation and actual expenditure of this program till FY 2060/61 and table 1.2 presents budget allocation and expenditure in FY 2059/60 and 2060/61.
Table 1.1: Budget Allocation and Expenditure

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Ministry/Department</th>
<th>Budget Allocation</th>
<th>Actual Expenditure</th>
<th>Expenditure as % of Allocation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>HMG Foreign Grant</td>
<td>Foreign Loan</td>
<td>Total for SISP</td>
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<td>2054/55</td>
<td>DOI, MOWR</td>
<td>20,000</td>
<td>30,000</td>
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<td>2055/56</td>
<td>DOI, MOWR</td>
<td>10,000</td>
<td>20,000</td>
<td>50,000</td>
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<td>2056/57</td>
<td>DOI, MOWR</td>
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<td>2058/59</td>
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<td>2059/60</td>
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<td>2060/61</td>
<td>DOA, MOAC</td>
<td>67,885</td>
<td>100,000</td>
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<td>Total</td>
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<td>190,000</td>
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Source: Detail Budget Allocation Books of Various Years, MOF and information from MOA

Table 1.2: SISP Budget Allocation and Expenditure in Studied Sampled Districts

<table>
<thead>
<tr>
<th>Districts</th>
<th>2059/60 Allocation</th>
<th>2060/61 Expenditure</th>
<th>Exp. As % of Allocation</th>
<th>Budget</th>
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<td>Ilam</td>
<td>1200</td>
<td>696</td>
<td>58</td>
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<td>Chitwan</td>
<td>1000</td>
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<td>Kavre</td>
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<td>768</td>
<td>64</td>
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<td>Palpa</td>
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<td>96.17</td>
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<tr>
<td>Banke</td>
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<td>79.6</td>
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</tr>
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<td>Dadeldhura</td>
<td>1200</td>
<td>426</td>
<td>35.5</td>
<td>1300</td>
</tr>
</tbody>
</table>

Source: Department of Agriculture
CHAPTER II: PRESENT STUDY

The present study of the SISP has been carried out under the supervision of Central Monitoring and Evaluation Division (CMED) of National Planning Commission, HMG/N.

2.1 OBJECTIVE OF THE STUDY

The objectives of the study are as follows:

- To assess the impact of the SISP, in particularly on agriculture production and employment creation for the poor in the program area;
- To examine issues concerning the efficiency and effectiveness SISP to improve its future performance;
- To recommend future courses of action to be adopted by the Government keeping in view the factors such as sustainability, effectiveness and O&M of such irrigation systems.

2.2 COVERAGE OF THE STUDY

The following six districts were selected for the study after consulting CMED and DOA. Selection of the districts was based on the review of available documents and feedbacks from the DOI and DOA and efforts were made to cover different Development Regions and agro-ecological regions where SISP were or are under implementation.

1. Ilam - Eastern/Hill
2. Chitwan - Central/Terai
3. Kavre - Central/Hill
4. Palpa - Western/Hill
5. Banke - Mid-Western/Terai
6. Dadeldhura - Far-Western/Hill

2.3 SCOPE OF THE STUDY

The overall purpose of the survey is to examine the benefits and the effectiveness of the Program. Major activities proposed under the study include the following:

- Field observation to assess the reported and actual area under irrigation covered by the Program. The districts to be visited should be both the ones covered by DOI and DOA and should be representative of the total population;
- Impact assessment considering factors such as sustainability, operation and maintenance, agricultural output, environmental benefits, poverty alleviation,
beneficiaries’ participation and relative strengths and weaknesses of the program;
• Study of overall socio-economic benefits from the programs;
• Recommendation of measures to be adopted by the Government for planning and financing the programs of similar nature.

2.4 DETAILED ACTIVITIES/TOR

Remaining within the broad scope and the objectives of the study, the consultants will accomplish the following tasks:
• Review related government policies, available related appraisal reports, program performance audit reports and impact evaluation studies and other relevant reports available on different stages of program.
• Review investment pattern of the Government in small scale irrigation systems,
• Determine the impacts in terms of employment, income, health, environment and overall standard of living of the farmers of the program area,
• Assess benefits in relation to income poverty reduction,
• Determine efficiencies of water delivery and water use and management system,
• Assess the role and functions of Water Users Associations (WUAs) and non-government organizations (NGOs), if any, as well as their participation in the operation and management of irrigation systems,
• Determine the overall sustainability of the systems including the state of maintenance and cost recovery,
• Assess the appropriateness and the relevance of the design, inputs and implementation,
• Compare and contrast the sustainability, O&M and farmers’ participation in the irrigation systems constructed under the two implementers viz. DOA (present) and the DOI (in the past).
• Recommend appropriate policy measures to be adopted by the government in regard to construction and management of irrigation systems in future.

2.5 APPROACH AND METHODOLOGY

In keeping with the scope of work, the ToR and with the understanding of the objectives of the study, the approach and methodology that was adopted by the Consultants to accomplish the services are summarized in the following paragraphs.
2.5.1 Approach

The consultant's general approach to the fulfilment of the objectives of the study was as follow:

- Mobilisation of the study team.
- Continuous contact and consultations with the various concern agencies and the Client.
- Sharing of information throughout the study period with the Client and flexibility to respond to desired changes and directions.
- Regular briefing to the Client.
- Collection and review of reports, documents, government policies, plans and programs.
- Development of questionnaires and checklists for primary data collection.
- Interaction and interview with policy makers, planners, bureaucrats, development workers, traders and etc.
- Field survey in the selected areas.
- Analysis of secondary and primary data using appropriate tools.
- Participatory approach for data collection and verification.

2.5.2 Mobilisation

This task was started immediately after the Client’s notice to the Consultants instructing the Consultants to commence the services. The activities carried out were: setting up of working space and facilities, preparation of the list of the documents to be reviewed and the organisations to be visited, organising meeting of the Team Leader and the experts with the consulting firm to coordinate their works and review of available reports and data related to the study. Inception report was prepared and submitted to the Client. The report was updated on the basis of discussion with the Client.

2.5.3 Desk Study

The Consultants collected the relevant documents and reviewed them. While reviewing the documents special attention was given to find out the approach suggested for expanding small irrigation facilities in the country. Summary of the review of the documents is presented in chapter 3.

2.5.4 Selection Criteria for Schemes

The Consultant Team visited the concerned organisations for obtaining various information about the SISP. It was found that there is not any list of SISP schemes in the centre. Therefore, systems for the study were selected from the list available in the Districts. It was informed that district office selects the schemes and list of such schemes is maintained in the district only. While sampling the schemes, the study team aimed at including the schemes of following nature.

- Implemented by DOI and DOA.
- That uses various sources of water – surface, ground, rain etc.
- That use different technology.
- Where gender contribution can be assessed
- Poor farmers' are main beneficiaries.

Due to unstable political situation, the survey team faced difficulty in reaching the district headquarters, discuss with the concerned personals, select conduct and survey of the schemes. However, schemes of different natures have been selected and study has been ducted in maximum possible details.

In total 15 schemes have been studied. Two schemes each in five districts and five schemes in one (Banke) district where the schemes were small and enough information were not available.

2.5.5 Sample Size

Survey of the SISP schemes was to be carried out to examine in depth the overall benefit and effectiveness of the program. As under SISP the schemes to be financed are small irrigation schemes for repair/rehabilitation and small non-conventional irrigation schemes, the increase in agricultural production and related benefit accrued in the scheme area cannot be due to SISP intervention only. Therefore, the study team decided on the survey methodology and survey process by which information for assessment of overall benefit and effectiveness of the program could be collected. Keeping this in view, the sample size for the enumeration was finalised by the team. The sample has covered at least two VDCs of the selected district. The sample size in terms of the project was divided in three sub areas covering Head reach, Middle reach and Tail reach of the irrigation canal, at least one sample from each reach was selected. In each scheme minimum 6 households were surveyed keeping in view the area covered by the scheme.

2.5.6 Tools and Technique

**Study Indicators**

The study team has prepared a list of basic indicators for the purpose of the study. The indicators have been prepared considering SSIP system, people's participation, socio-economic characteristics, and improvement in the agricultural practices in the project area and future potentials.

**Household Sample Survey**

The Study team developed a structured questionnaire for the purpose of household survey, after organizing few rounds of discussion. The questionnaire included water availability, status of agricultural production, socio-economic condition, operation and maintenance of the systems and status of the basic services. The questionnaire was pre-tested before starting the actual survey. The consultant team organized a detailed orientation program for the enumerators about the purpose of field survey, questionnaire, and techniques to cross check the information provided by the respondents.

**Focus Group Discussion**

In order to obtain the information on the impact of irrigation systems on socio-economic activities, agricultural practices, and generate new ideas for the future development
potentials, the study team organized Focus Group Discussion with the different group of people in each of the 12 SISP irrigation systems. The people participated in FGD were VDC officials, social mobilizers, health workers, school teachers, WUA personnel, farmers, etc. depending upon their availability in the scheme area and duration of survey under study.

**Key Informants**

The consultants and enumerators interacted with a number of key informants to assess the impact of SISP projects. The interaction programs were conducted with the concerned officials, local people. The interaction also provided insights about the problems and solutions in the effective operation of the irrigation facilities provided by the project. The key informants of the study area include

1. Officials of DADO
2. Officials of Irrigation Office
3. Social mobilizers
4. VDC officials
5. WUA person and members
6. Health Workers and volunteers
7. School teachers
8. Local elites

The enumerators tried to contact the above informants as many as possible but due to the constraints on mobility and stay over by the enumerators it was not possible to contact them in every scheme. In most of the cases the informants did not like to expose their identity, as they were not sure about the intention of the enumerators. Therefore the enumerators noted their identity as “Farmers” and obtained the information as required.

**Field Observation**

The Consultant team collected primary information from the field through direct observation with the assistant of the enumerators also. Crosscheck of such information was carried out during the FGD and discussion with the key informants.

**2.5.7 Survey and Data Processing**

The following survey, interaction and interview were conducted:

a) Household Survey (HH)

The HH surveys collected data on various aspects of agricultural production related variables such as water availability, cropping pattern, use of fertilisers and other inputs and crop yields. HH also collected data on institutional sustainability, service delivery effectiveness, farmers’ participation and training. The other important feature of HH is that it has collected data on poverty indicators such as income level, food consumption sufficiency, housing condition, education and health status of the people in the command area. The enumerators who conducted the surveys prepared a summary of their overall
impression on system sustainability, agricultural development, institutional issues and poverty indicators.

b) Group Discussion and Interaction

The FGDs was conducted in order to get additional information on the issues like sustainability, operation and maintenance, environmental benefit, agricultural output and its impact on poverty reduction, community participation on need identification, planning, construction and operation and maintenance, institutional aspects of WUAs as well as NGOs, if any. The FGD was helpful in understanding the perception of farming community and service providers on the process, approaches adopted and impact of the programme.

c) In-Depth Interviews

In-depth and well organised interactions with the key informants were conducted in each of the 6 sampled districts. Discussions were held with DADO, concerned officials of DAO and DOI, service centre officials at the VDCs.

d) Observation

The Consultant team did in-depth and critical observations in the irrigation area on the impact of the SISP on the social life, environmental situation, health status and overall impression of the farmer about the SISP.

List and Details of Persons contacted for Households survey and focus group discussion is given in Appendix-3.

e) Data Organisation Processing and Analysis

All the information of household questionnaire collected from the field was edited and coded prior to entering it into computer under the close supervision of study team members. The data was entered into the computer using the data entry format developed into Microsoft Access software for easy data entry work. The validity of data entry work was assured by checking all the information of the randomly selected questionnaires. The data was analysed by the statistician through the computer using the data processing software (FoxPro ver.6) according to the dummy table prepared by the study professionals. Simple statistical tools like average and percentage have been calculated for different groups, sub groups and irrigation schemes considering the nature of the study. The open-ended questions of the questionnaire have been coded manually and later it was processed through computer.
CHAPTER III: DOCUMENT REVIEW

The Consultant has visited various concerned organizations to collect relevant information on the Small Irrigation Special Program (SISP). It was informed from the DOI and DOH that program performance audit and impact evaluation of SISP was not carried out before and review regarding this aspect could not be carried out. In the mean time, the consultant has also collected other several related reports. Following paragraphs provide summary of review of the key documents.

3.1 PLANS AND POLICIES OF IRRIGATION DEVELOPMENT WITH FOCUS TO SISP

His Majesty’s Government of Nepal has brought out several plans and policies for the development of irrigation and thereby irrigated agriculture in the country. Of them the Agriculture Prospective Plan (APP), National Water Resources Strategy (NWRS), 10th Development Plan, Medium-term Expenditure Framework (MTEF), Irrigation Policy, and Irrigation Regulation are note worthy. Following few paragraphs describe features of these plans and strategies.

3.1.1 Agriculture Perspective Plan (APP)

APP considers irrigation as one of the prime inputs for agricultural development. For irrigation, APP emphasizes on the development of year round irrigation with a special focus to small scale irrigation development manly by improving the existing FMISs and by expanding the installation of shallow tube wells, especially in the Terai. APP also emphasizes on improving water-conserving technology.

The Plan proposed to irrigate 612,000 ha of Terai land by groundwater by the year 2015 AD, mainly through shallow tube wells (STWs). In an average, the plan envisaged installing 8,800 shallow tube wells (each irrigating 2.5 ha of land) and 40 deep tube wells per year. The water balance study has shown that the available groundwater resource is adequate to support the proposed scale of groundwater irrigation development in the Terai.

With the development of controlled and year round irrigation along with other agricultural inputs, crop diversification and production of high value market oriented cash crops will be possible, which in turn will promote agriculture based industry, improve the income generation and food security situation, provide employment opportunities in the rural area including women, help increase value addition and commercialisation in agriculture and improve economic growth rate. In this background, the food crop oriented subsistence agriculture system has to be diversified to grow cash crops and comparatively more profitable high value crops in the specific ecosystems.
3.1.2 National Water Resource Strategy (NWRS)

Freshwater system in the country is undergoing continuous natural changes in terms of quality, quantity and morphology. These changes are further accelerated due to increasing human exploitation of water resources caused by increasing population pressure demanding more water for several uses such as irrigation, drinking water, hydropower, and others. Growing concern for environmental degradation has further increased pressure on water resources. To cope up with such phenomenon and to manage country’s water resources in a holistic approach, Nepal brought out its National Water Resources strategy (NWRS) in 2001.

In order to meet the above objectives, NWRS has adapted following strategies in irrigation sector.

- Integrate irrigation planning and management with agricultural development.
- Improve management of existing irrigation systems.
- Improve planning and implementation of new irrigation systems.
- Develop year-round irrigation in support of intensification and diversification of agriculture.
- Strengthen local capacity for planning, implementation and management of irrigation.
- Encourage consolidation of land to promote irrigation/agriculture efficiency.
- Improve groundwater development and management.

NWRS has also set the short, medium and long-term targets in the development of irrigation sector, which is presented in Table 3.1

<table>
<thead>
<tr>
<th>Short term (By the year 2007)</th>
<th>Medium term (By the year 2017)</th>
<th>Long term (By the year 2027)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Year round irrigation to 60% of irrigated land</td>
<td>1. Year round irrigation to two-thirds of irrigated areas</td>
<td>1. Provision of irrigation services to 90% of irrigable lands</td>
</tr>
<tr>
<td>2. 40% increase in average cereal yield in irrigated area</td>
<td>2. Provision of irrigation systems to 80% of all irrigable land</td>
<td>2. An average cropping intensity that exceeds 250%</td>
</tr>
<tr>
<td>3. Establishment of WUAs that are capable of managing irrigation systems up to 500 ha</td>
<td>3. 125% increase in average cereal yields in irrigated areas</td>
<td>3. An increase in irrigation efficiency to 60%</td>
</tr>
<tr>
<td>4. An average cropping intensity that exceeds 200% in year round areas.</td>
<td>4. An increase in the effective use of command area to 80%</td>
<td>4. An increase in the effective use of command area to 100%</td>
</tr>
<tr>
<td></td>
<td>5. An irrigation service contribution (ISC) by farmers that exceeds 20% of o &amp; m cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Establishment of WUAs that are capable of managing irrigation systems up to 5000 ha</td>
<td></td>
</tr>
</tbody>
</table>
3.1.3 PRSP/Tenth Plan

As more than 80 percent of the country’s population is engaged in agriculture, the Tenth Plan through its poverty reduction strategy targets to increase agricultural growth by about 4 to 5 percent. To achieve this target, the strategy focuses on: (i) increased investment from both the private and public sectors; (ii) streamlining the public expenditure in line with the APP investment plan; and (iii) improving the modality of implementation by emphasizing polycentric institutional arrangement. In order to achieve successful implementation of the APP, strong emphasis need to be laid on package program of fertilizer, irrigation, technology, rural agricultural roads, electricity and market access. The core objective of the Irrigation Sector in the Tenth Plan are to promote year-round irrigation in the arable land and to insure the sustainable management of the developed irrigation systems. The main strategies adopted by the tenth Plan to achieve these objectives are to expand new irrigation facilities with focus on APP where year-round irrigation is feasible, and to rehabilitate and strengthen public and community based irrigation systems, focusing attention on the preservation and full utilization of the existing irrigation systems. The programs outlined in the tenth plan with a focus to small-scale irrigation are as follows:

- Develop shallow tube-wells with appropriate subsidy support in poverty-stricken areas and bring 66,000 ha of additional cultivated land under irrigation.
- Rehabilitate existing FMISs covering an area of about 64,000 ha
- Implement non-conventional irrigation development program to bring an additional 10,000 ha under year round irrigation.

The major policies and activities to achieve these goals include: (i) expanding small surface irrigation systems in the hills and surface and ground water facilities in the Terai, and (ii) repair/rehabilitate and maintain the existing farmer managed and public irrigation systems. Empower WUAs to collect irrigation charges. In case of large and medium scale public irrigation systems, transfer management to the private sector. Increase involvement of NGO’S and the private sector in new irrigation development.

Of these programs, the non-conventional irrigation development program is the first of this kind initiated by the 10th plan. This program aims to promote non-conventional irrigation technology with an aim of developing year round irrigation on the marginal and small landholders’ land in water scarce locations for high value crop production. Such non-conventional technologies include water harvesting in the hills and river valleys, conjunctive management of surface and groundwater in the Terai, and drip/sprinkler irrigation in the hills.

The expected outcomes are that 50% of total irrigated land will receive year-round irrigation facilities by 2005, while farmers/WUA’S will be able to manage irrigation systems up to 500 ha during the same period. In the long run, maintenance, efficiency and utilization of irrigation facilities are expected to improve significantly.
3.1.4 Medium Term Expenditure Framework (MTEF)

The Medium Term Expenditure Framework (MTEF) is a complementary tool brought out by the National Planning Commission in order to operationally the targets set by the Tenth Plan. While doing so it links the annual program and budget with the periodic plan; prioritise programs and expenditure in relation to the periodic plan's goal and objectives, and resources availability; and provide funding guarantee to the prioritised activities. The first MTEF covered the initial three years (FY 2002/03 to 2004/05) of the Tenth Plan and the second MTEF, which is now being prepared, covers from FY 2003/04 to 2005/06.

In irrigation sector, MTEF granted highest priority to small-scale irrigation development programs.

3.1.5 The Policy Reform

Most of the present irrigation development in Nepal is the outcome of past policies and planning at higher level. It is therefore useful to look back at these policies to understand the development of small-scale irrigation in the country.

Until 1950s, irrigation development in Nepal was a result of farmers' own initiation and investment in the construction and management of farmer managed irrigation systems (FMISs). It was only with the start of the first five-year plan in 1957 that the government started developing irrigation systems in a planned manner. Since then several medium and large irrigation systems have been developed with internal financial resources and donor assistance.

Laghu Sinchai (Minor irrigation Program)

As the development of large irrigation schemes entailed huge amount of resources and took longer time for their completion, Nepal's Second Plan (three year development plan) (1962-1965) introduced laghu sinchai karayakram (minor irrigation development program) to provide low cost irrigation facilities to farmers within the short period of time. The program included the construction of gravity canal with diversion structure at intake, small wells, irrigation tanks and reservoirs, small-scale lift schemes, and other low cost and short duration schemes.

In the Third Plan (1966-70), the program was implemented throughout the country with the emphasis on participation of the farmers. A central board for minor irrigation was created to administer the program, but the investment decisions were made at local level. As a result, the program was greatly appealed by the local politicians.

After the Third Plan period, the government's attention was shifted towards the development of large-scale irrigation system with focus on the construction of infrastructures while their management aspects received very little attentions. As a result, performances of many of these systems were not satisfactory.

6 Improved modality of implementation also means involvement of private sector and NGOs in the existing programs being implemented by the government.
The First Irrigation Policy

With the then growing awareness about irrigation management, the government for the first time brought out an Irrigation Policy in 1989 with a focus to management, which was revised in 1997 and lastly in 2003.

The 1989 and 1997 Irrigation Policy clearly laid emphasis on participatory approach for irrigation management. The idea behind this participatory approach was to ensure greater farmer participation in irrigation management by increasing their sense of ownership and control over the system. It was presumed that such approach would lead to better use of the scarce water resources and help in increasing agricultural production as farmers will manage distribution according to the need of the crops.

Despite the greater focus on the participatory irrigation management, level of performance of irrigation systems still remained much below than the expectation. So, the basic question in the past and in the present has always remained the same, that is: How can the performance of our irrigation systems be raised in a sustainable manner?

To this end, following the adaptation of the National Water Resources Strategy (NWRS) and launching of 10th plan, the government brought out new irrigation policy – 2003 mainly to achieve sustainable development of irrigated agriculture.

New Irrigation Policy-2003

1. The new irrigation policy – 2003 adapts the guiding principles as set out by NWRS, 10th five year development plan and APP, and also incorporates the experiences of implementing past policies. The objectives set by the irrigation policy 2003 are: to provide year round irrigation to develop institutional capacity of WUA and enhance knowledge, skill and capability of persons and institutions involved in irrigation sector.

Many of the past important policy tools such as participatory approach of irrigation management, focus to ground water development (mainly shallow tube wells) for year round irrigation, river basin based approaches of irrigation development, capability building of water users and so on are also retained by the new policies. Followings are some of the new provisions adapted by the new policy from the perspective of small-scale irrigation development.

1. It aims to promote small scale non-conventional irrigation development program with a focus on providing year round irrigation on the marginal and small landholders’ land in water scare locations for high value crop production. Such non-conventional technologies include water harvesting in the hills and river valleys, conjunctive management of surface and groundwater in the Terai, and drip/sprinkler irrigation in the hills. Further, the policy aims to implement this program through NGOs and private sector.

2. It aims at empowering WUAs with required legal authority for administrating system management.
Recognizing the importance of decentralization in local development, it aims to involve local bodies (VDCs and DDCs) in the development and management of small irrigation systems.

It aims at adopting a system of monitoring irrigation services provided to users through quantity of water delivery for crops, irrigated area, and incremental agricultural production.

Certainly, these new policy tools represent major reform, and they clearly target for sustainable development of small-scale irrigation system. However, the new policy is not yet operational in the field. Their effects in the field are yet to be seen.

3.1.6 The Irrigation Regulation –2056 (Revised in 2060)

Review of new irrigation policy suggests that major reforms are essential in the prevailing Water Resources Act (WRA) and subsequently in Irrigation Regulations (IR) for its successful implementation. Among such reforms provision of legal authority to WUAs for administrating management of irrigation system and mobilizing local resources (irrigation service fees etc.) for sustainable management of irrigation systems are urgently required. Discussions with HMGN personnel suggest that, at present, it was not possible to revise the Water Resources Act. However, in order to operationally the new irrigation policy, government revised the irrigation regulation- 2056 in 2060 within the framework of existing water resources act. However, its actual implementation is yet to be seen.
CHAPTER IV: STATUS OF IRRIGATION SCHEMES STUDIED

The schemes in the selected districts were surveyed by the study team after getting orientation about the purpose of the field survey; focuses group discussion and other techniques for obtaining relevant primary information from the field. The physical infrastructures of the scheme were inspected, farmers household survey and focus group discussion were carried out. On the basis of the information collected in the field and processed in consultants' office, the status of the different schemes is presented in the following paragraphs:

4.1 ILAM DISTRICT

4.1.1 Dhanaraje Irrigation System (DIS)

(a) Intervention

Dhanaraje Irrigation System is located in ward number 7 of the Ilam municipality in Ilam District. The system irrigates about 15 ha of land belonging to about 27 families. The system has 1 km long earthen main canal and 5 branch canals with a total length of about 2 km. A temporary nature of the headwork, built across Dhanaraje Kholsi diverts water into the main canal. The discharging capacity of the main canal is about 40 liters per second. During the monsoon season, there is no scarcity of water at the source. So, the system can divert as much water as it needs. While during the winter and spring season, availability of water in the source is scarce. Paddy in the monsoon and wheat in the winter are the main irrigated crops.

Temporary nature of the intakes at the sources and fragile alignment of the main canal causing frequent landslides are the main physical weakness of the system. As a result of this, reliability of water delivery to its users was very poor. In order to overcome this weakness, farmers of the area have been approaching several institutions for external assistance.

In the year 2054, the District Irrigation Office (DIO) made the first intervention in the system by spending Rs. 160,000. Soon after that, in the year 2057, there was a landslide in the main canal and the Ilam Municipality provided some financial assistance to buy polythene pipe for conveying water across the landslide zone. In the year 2059, farmers again approached DADO for support under SISP for strengthening the main canal. The estimated cost of the strengthening project was Rs. 86,212. Of the total estimated cost, DOA provided financial assistance of Rs 73,000 through SISP, and farmers contributed Rs. 13,212. With this resource, a small stretch of the main canal (about 30 meters) is lined and about 20 meters is covered to protect from landslide.

Maintenance of the system involves repair of the head works, removal of landslides along the main canal alignment, and desilting the canals. The headwork needs to be repaired once a year and requires about 15 man-days of
human resources. Similarly, the main and branch canal also need to be maintained regularly, but its frequency depends on the occurrence of landslides in the alignment. Beneficiary farmers are mobilized to provide voluntary labour to maintain the irrigation system. The basis of farmers' labour contribution is their landholdings.

(b) Socio-Economic Impact

Dhanraje irrigation canal has been operating for the last 70 years with the initiation and participation of local farmers. The capacity of this irrigation system and water availability increased substantially in 2054 after the major improvement of the canal through DOI support. The SISP investment in 2059 was used in maintaining the canal and in making operation of the canal regular and reliable.

Paddy is the main summer crop and wheat is the main winter crop in the command area. Potato, oil seed and vegetables are also grown in the winter. Paddy, vegetables and maize are grown in the spring. The crop intensity in the command area has increased significantly due to the availability of irrigation facility in the winter and spring seasons. The yield of the summer paddy increased by 67% compared to before intervention situation. Similarly winter wheat and winter potato yield increased by 67% and 43% after SISP intervention.

There are two credit Banks, three co-operatives, three Forest Users groups one Agricultural Service Centre, one hospital, one Post Office and one Ranger Office in Ilam Municipality ward no. 7. Peoples' participation including female activities in community development is found increased in this area. The arrival of new NGOs is not increased after the intervention of SISP.

4.1.2 Tank Irrigation System (Shrijana Resham Bikash Krisak Samuha) (TIS)

(a) Intervention

The Tank Irrigation System of the Shrijana Resham Bikash Krisak Samuha is located in the ward number 4, Kolbung VDC, in the Ilam District. The system irrigates Kimbu garden cultivated in about 3 ropani of land belonging to 26 farmers. The system includes 400 meters long earthen feeder canal, a water tank with a capacity of 8000 liters, and about 75 meters long pipe distribution system. The tank consists of an outlet constructed close to its bed and an overflow side spillway. It is constructed simply by excavating earth in a natural ground. The tank is lined with stone masonry.

The tank receives water from a local spring named "Hiti Dhara Kholsi" through a 400 meters long feeder canal. During the dry season, flow available in the spring is about 1.0 lps.

For daily operation of the tank, its outlet is closed and water from the source is stored during the day and night. In the following morning, the stored water is released for irrigation till the tank becomes practically empty. This cycle is repeated daily.
The Shrijana Resham Bikash Krisak Samuha was established during the early 1990s with an objective of cultivating mulberry and thereby producing silk in the area. In the fiscal year 060/61, the Shrijana Resham Bikash Krisak Samuha approached the DADO of the Ilam District for assistance to construct water tank. Estimated cost of the water tank project was about Rs. 100,000. Of the total cost, DADO approved Rs. 58,000 from SISP and farmer's contribution was about Rs. 42,000.

The mulberry garden is still in the young stage. It takes a few years for its full development. The tank is used for supplying drinking water also to four households.

Maintenance of the system involves cleaning of the tank and repair of supply and distribution canals. Voluntary labour contribution from the beneficiaries is obtained for maintaining the system.

(b) Socio-Economic Impact

Farmers in this area have been planting and growing mulberry trees for raising silk worms. Farmers are earning their incomes by selling silk worms. Actual production of silk thread has not started yet. Greater impact of silk development on the income level of the people in the area will appear after some years when the trees grow bigger.

There is one co-operative, one Irrigation office, one WUA, one Agriculture Sub Center, one Sub Health Post, one Post Office in the area, Mulberry Plantation has been carried out in this area and there is active participation from the women farmers'.

4.2 CHITWAN DISTRICT

4.2.1 Dabka Ghol Irrigation System (Siddheswar Jal Upabhokta Sangh) (DGIS)

(a) Intervention

The Dabka Ghol Irrigation System, located in the ward number 6-7 of the Gitanagar VDC in the Chitwan District, irrigates about 50 ha of cultivated land. The system has 3 km long earthen main canal of which the first 700 m is the idle length. The discharging capacity of the main canal is about 150 liters per second. Most of the canal is earthen, while part of it is lined. Except a few road-crossing structures, the system does not have major conveying and cross drainage works.

The Dabka Ghol Irrigation System was constructed in the year 2022 with the leadership of a progressive farmer named Rudra Nath Koirala. Since then its command area and users have increased by many folds.

It is a run-of-the-river type of surface irrigation system and receives water from the Dabka ghol. Locally, ghol refers to the low land, while tandi refers to the higher land (Figure 4.1). When water is applied to the higher land (tandi) - either from a canal or from rain - part of this water automatically reaches the ghol area through overland surface runoff and subsurface flow, which ultimately reaches at the lowest elevation and forms the local drain. So, this type of ghol starts flowing only with the start of the monsoon season. This
suggests that during the monsoon season the irrigation system can divert as much water as it needs from the source, while during the winter and spring seasons the system remain dry. So, irrigated paddy followed by rainfed wheat and maize is the popular cropping pattern in the area.

The system has a permanent intake. As the source river is a local drain, there is not much of problem in it. The 3 km long leaky earthen main canal is the main physical weakness of the system. As a result, the efficiency of conveyance is very poor. In order to overcome this weakness, farmers of the area have been approaching several institutions for external assistance.

The system was first intervened by an irrigation development program called "Laghu Sichai Karyakam" in the year 2028. At that time its headwork was constructed. In the fiscal year 056/57, farmers again approached DIO for external assistance. In the same year, DIO provided Rs 77,000 from the Special Irrigation Support Project (SISP), which was used in lining (one side) part of the canal. Soon after that, (in 059/60), the farmers of the area again managed to receive financial grant assistance of Rs. 10,000 from their VDC, which was used for general maintenance of the system. Presently (in the FY 060/61), the Chitawan DDC has allocated Rs 35,000 for the system, which is yet to be used.

Maintenance of this system involves repair of the head works and desilting of the main and branch canals. The head works need to be repaired three times a year, while the desilting of the canal is done twice a year. The general maintenance cost of the system is about Rs. 50,000 per year.
(b) Socio-Economic Impact

Summer paddy is the main crop; wheat and oilseeds are major winter crops in the irrigated area; and maize is the main spring (chaite) crop. The productivity of summer paddy has increased by 100% because enough water is available through this irrigation system and farmers use high yield seeds and fertilizer for their crops.

Some of the farmers in the irrigation area hire labour to work in their farms and this has created employment opportunity for the landless and small farmers of the area.

On-farm employment activities of the farmers have increased. Agriculture production constitutes the major part of the total income of the households in the area and their livelihood depends on agriculture. Some farmers in the area also have employment outside the farm and they have been able to increase their income levels and living standards.

There are only the formal organizations existing in this Gita Nagar VDC ward number 6 & 7. Though the arrival of new NGOs for development programme is lacking, the community development programme and people participation in development activities is found increasing in this VDC after SISP. Female participation is found active in community development activities in the area.

The Water User Groups are maintaining the canal by collecting irrigation fees (Rs. 25 per ropani / per year) and mobilizing voluntary labour from the users. Mobilization of the capital resources (with respect to landholding) is the main source for system maintenance. Certainly, the practice of raising capital resource for maintaining the system is encouraging.

4.2.2 Branch Canal BL1 of NLIS (Nava Durga Krishi Samuha) (NDKS)

(a) Intervention

Nava Durga Krishi Samuha is a group of farmers formed within the branch canal named ‘BL1’ of the Narayani Lift Irrigation System. The Narayani Lift Irrigation System is a government managed large-scale pump irrigation system with an irrigated area of about 5000 ha. The system has two branch canal: branch canal B and C. The branch canal B has nine sub-branch canals, of which BL1 is the first and the smallest branch.

The system operates only during the monsoon season for cultivating monsoon paddy. Thus, paddy followed by rain fed wheat/pulses in the winter season and rain fed maize in the spring season is the principal cropping pattern.

The branch canal BL1, located in the Bharatpur Nagar Palika in the Chitwan District, irrigates about 23 Bigha of cultivated land. This sub-system has 1.2 km long main canal of which about 90 meters is lined and the rest is earthen. The discharging capacity of the canal is about 25 liters per second. It has five field channels.

The BL1 sub-system has adequate water control structures required for a modern irrigation system. The only physical weakness of the system is the leaky earthen canal.
As a result, the efficiency of conveyance is very poor. In order to overcome this weakness, farmers of the area have been approaching several institutions for external assistance.

In the year 060/61, farmers of the ‘Nava Durga Krishi Samuha’ approached DOA for external assistance. In the same year, DOA provided Rs 20,000 from the Special Irrigation Support Project (SISP). As this money was not sufficient, farmers also raised another Rs. 40,000 from their own resources. This resource (Rs. 60,000) is used in lining part of the canal.

Maintenance of this BL1 sub-system involves strengthening of the bank and desilting the canal, which needs to be done once a year. Farmers collect maintenance fee.

(b) Socio-Economic Impact

The farmers in this command area cultivate summer paddy and they grow wheat and oil seed in winter. Maize is the main spring crop and vegetables are also grown in this season. The availability of irrigation facility has increased the yield of summer paddy by 57%. As a result farmers' income level has gone up.

Non-agriculture employment is the main source of income in the command area. The share of agriculture production in total income is secondary for the farmers. The socio-economic status of the people has improved with the combination of agriculture and non-agriculture income.

Any type of formal/informal organizations are lacking in this area. Though the community programme is same after the SISP in this area people's participation in development activities is found increased through the Nawa Durga Krishi Samuaha. Female were found invert in-group discussion relating to community development.

Farmers are maintaining the canal by collecting irrigation fees and mobilizing voluntary labour from the users.

4.3 KAVREPALANCHOWK DISTRICT

4.3.1 Cha Khola Irrigation System (CKIS)

(a) Intervention

The Cha Khola Irrigation System is located in Ward Number 3 of Jaishi Thok VDC in the Kavre District. The system was constructed long ago by the farmers of the area. It irrigates about 5 ha of cultivated land. The system has 500 meters long earthen main canal with a discharging capacity of about 25 liters per seconds. Except one aqueduct, the system does not have other major structure.
Figure 4.2 presents layout of the Cha Khola Irrigation System

It is a run-of-the-river type of surface irrigation system. It receives water from the Cha Khola. During the monsoon season, enough water is available in the source for supplying it to the system. While during the winter and spring season, availability of water in the source is moderate to scarce.

Temporary nature of the headwork and other structure were the most important physical weakness of the system. Both these structures required frequent maintenance. As a
result of this, reliability of water delivery to its users was very poor. In order to overcome this weakness, farmers of the area approached District Agriculture Office for external assistance.

In the fiscal 059/60, DOA granted NRs 20,000 (under SISP) for intervening into the system. As the grant available from DOA was very small compared to the estimated cost of rehabilitation, farmers decided to mobilize additional resources from within the system area. Accordingly, farmers levied NRs 1,500 per ropani of irrigated land from its users, and generated additional resources of NRs 200,000. Using this resource (NRs 220,000), farmers constructed 15 meter long and 3 meters high stone masonry weir across the river to divert water into the canal. Financial assistance received from DOA was used to pay the labor charge, while the resources generated internally was used to buy the construction material. Further, the temporary aqueduct was also replaced by 30 meters long polythene pipe aqueduct. With this intervention reliability of irrigation services to users has increased.

Every year farmers collect Rs 20 per ropani of irrigated land from its users as irrigation service fees. This resource is used for annual maintenance of the system. Certainly, in a FMIS such practice of collecting irrigation service fees from its members is highly encouraging and it is a positive sign from the sustainability point of view. Thus, this practice needs to be continued.

(b) Socio-Economic Impact

Paddy is the main summer crop. Main spring crop is maize in which yield increase by 200% after gating irrigation facility. Likewise yield of winter potato increase by 44% compare to before SISP situation. The irrigation facility, improved seeds and fertilizer are the main factors in raising crop yield and agricultural production in this area. More importantly, the cultivation of potato has been possible only because of irrigation facility available in the winter season through SISP support.

The increased agricultural production is the main contributing factor in raising the income of the people in the area. There is increased on-farm employment of the households. The survey result indicates that there is improvement in the living standard of the people.

There do not exist any Gos/NGOs except one VDC office and one school in Jaisilthok VDC, ward no. 3. All the formal/informal organizations are lacking in this VDC to provide services related to agriculture. Even then community development programme and people participation in development activities is found increased in this VDC after SISP.

The Water Users' Groups are maintaining the canal by collecting irrigation fees and mobilizing voluntary labour from the users (fee Rs. 20 per ropani / per year)
4.3.2 Panchkhal Hokse Raj Kulo (PHIS)

(a) Intervention

Panchkhal Hokse Raj Kulo, located in the ward number 6 of the Panchkhal VDC in the Kavre District, irrigates 250 ha of cultivated land. It is located adjacent to the Aarniko Highway. By virtue of the name given to it as “Raj Kulo”, one can very easily understand that the system has historical significance, and is constructed long back by royal directive. The system has 4 km long earthen main canal and ten branch canals. The discharging capacity of the main canal is about 60 liters per second. Paddy in the monsoon and wheat in the winter were the main irrigated crops.

![Diagram of Hokse Rajkulo Irrigation system]

Figure 4.3 presents layout of the Hokse Rajkulo Irrigation system

It is a run-of-the-river type of surface irrigation system and receives water from the Jhiku Khola. During the monsoon and winter seasons, there is no scarcity of water at the source. So, the system can divert as much water as it needs. But, during the winter season, availability of water in the source is moderate. The system has two head works...
made of gabion weir, one at Jhiku Khola and the other at Dhor Khola. A feeder canal conveys water from Jhiku Khola and discharges into the Dhor Khola, which further conveys the water in its downstream. A second headwork constructed at the Dhor Khola re-diverts the water back into the main canal.

Temporary nature of the intakes at the sources made of gabion works, long and leaky earthen main canal, temporary nature of several cross drainage structures are the main physical weakness of the system. As a result, efficiency and reliability of water delivery to its users was very poor. In order to overcome this weakness, farmers of the area have been approaching several institutions for external assistance.

In the fiscal 056/57, farmers approached DIO for external assistance. DIO provided the gabion boxes of worth Rs. 34,200 from SISP, and farmers mobilized Rs. 22,000 for buying and filling boulders in the gabion. The work was done in the river to strengthen the first intake. In the following year (057/58), the Kavre District Development Committee (DDC) granted Rs. 300,000 for improving the system. The resource was used to improve several cross drainage works of the main canal. Soon after that, in 059/60, the system also received Rs. 40,000 from the local diary committee, which was also used for rehabilitating the system.

Maintenance of the system involves repair of the head works, and desilting the canals and strengthening of the main and branch canal bank. The head works need to be repaired about five times a year and utilize about labour input of 200 mandays is required for such repairs. Similarly, the main and branch canal needs to be maintained twice a year requiring mobilization of about 450 man-days. So, the average maintenance cost of the system comes out to be about Rs 100,000 (about Rs. 400 per ha per year).

Repair and maintenance is carried out mainly with the help of voluntary labour. Voluntary labour is organized on the basis of the land holdings. In addition to voluntary labour, every year farmers collect irrigation service fee at the rate of Rs 15-20 per ropani of irrigated land from its users. This resource is used when capital cost is needed for up keeping the system.

(b) Socio-Economic Impact

Paddy is the main crop in the summer season and potato is grown in winter. Maize and vegetables are the main spring crops. After the SISP support summer paddy yield increased by 23% and winter potato by 29%. There is increased crop diversification. The farmers in this area have been using the improved variety seeds and fertilizers. Different vegetable varieties are grown in this area and high breed varieties are used.

The farms in this irrigation area hire outside labour to work in their farms. This has created employment opportunity for landless and small farmers. The standard of living of the people in the command area has improved. The nutritional status has also increased.

There are Forest Users Group and other formal organizations such as Post Office, Sub-Health Post, VDC etc in Hokse VDC.
The Water Users Group are maintaining the canal by collecting irrigation fees (Rs. 20 per ropani per year) and by mobilizing voluntary labour from the farmers.

4.4 PALPA DISTRICT

4.4.1 Barikhet-Ulte Kulo Irrigation System (BUKIS)

(a) Intervention

Barikhet-Ulte Kulo Irrigation System (BUKIS) (Fig. 4.4) is one of the completed Small Irrigation Special Projects (SISP) in Palpa district of Western Nepal. The project area is located in ward no 7 Kaseni VDC. The system is a run of the river diversion irrigation scheme, which provides irrigation to 24 ha of tar land. The irrigated area is located in two different patches, one on the left bank of the source-river Bagajori Khola another on its right-bank. There are two simple temporary intakes for water diversion, which divert water towards main canals having length of 2.5-km and 1.5-km right and left bank respectively. In several locations lining has been done in the main canal. The total length of lining is about 1200 m on the Ulte kulo area while it is only 300 in Bari khet area. During the field observation the measured discharge at the source was as little as 8 and 10 lps in Bari khet and Ulte kulo intake points respectively.

Farmers initially developed the scheme with their own resources. The first public intervention was introduced under ILC program in 1995/96 that aimed to provide the irrigation facilities for 24 households. Due to highly porous soil along the main canal alignment coupled with limited amount of water at the source lining was become essential for the efficient utilization of available water resources. Hence, farmers have requested repeatedly to various line agencies to support in their main canal. In ILC program about 800-m canal was lined while the On-farm water management program constructed another 450-m length of the canals. In addition to lining ILC has constructed gabion intakes at two locations.

In the fiscal year 2059/60, the SISP has again provided financial assistance of Rs 50,000. This amount was basically spent on the procurement of the construction materials for lining. Farmers have also contributed significant amount of labor resources to the lining work, which constituted about 40% of the total capital cost of the lining.

Farmers collect Rs 10 on monthly basis from each household and deposit it on common maintenance fund that is used later for system maintenance. For regular cleaning and desilting of canals farmers mobilize labor resources from themselves. Considering social capital of the area repeated intervention use to come in their system from various line agencies of the district. Farmers have still several problems in their physical systems. The most important is the temporary nature of diversion structure at the intake points, which is susceptible to flood damage in every monsoon season.

7 ILC is Irrigation Line of Credit Program of the government implemented with the loan assistance of the World Bank in 1993-1997.

8 On-farm water management is being implemented jointly by the Department of Irrigation and Department of Agriculture in 20 district of Western, Mid-western and Far-western development regions. The World Bank finances the program and technical assistance is provided by FAO.
(b) Socio-Economic Impact

Farmers are cultivating summer as well as spring paddy after SISP support. In summer paddy increase in yield was reported as 130%. With the availability of irrigation facility, the farmers grow more crops in the winter. In addition to wheat, they also grow maize, potato, oilseed and vegetables in the winter. Maize is the main spring crop. Farmers in the command area combine improved seeds and fertilizer resulting in higher yields of these crops. There is more crop diversification and crop intensity has increased. The irrigation facility and other input combinations have resulted in higher agricultural production in the area.
There is WUA and Barikhet Forest Users Group as well as one sub-health post in Kareni VDC ward no. 7. The arrival of NGOs is not increased in this area after the intervention of SISP but community development programmes and people participations is increased through WUA and FUG. Females are also equally active in community development in this area.

The water users group members (Magar ethnic majority/locality) are maintaining the canal by collecting irrigation fees (Rs. 120 per year) and mobilizing voluntary labour among themselves. The majority of beneficiary farmers are Magar ethnic groups, they have good feeling of community participation and have better cohesion in the society. In addition, many farmers are retired army personnel making them easier to form disciplined Water Users Association (WUA) and set social norms to best operate and maintain the irrigation system.

4.4.2 Plastic Pond Irrigation System (Bade Aanap Krishi Samuha) (PPIS)

(a) Intervention

The Plastic Pond Irrigation System, first conceived by the Bada Aanap Krishi Samuha, is located in the Palpa District. The system irrigates about 8 ropani of cultivated land belonging to an individual farmer.

In the fiscal year 057/58, the Bada Aanap Krishi Samuha approached the DADO of the Palpa District for assistance to construct plastic pond. According to their request, the DADO approved three plastic ponds for construction under SISP. Total cost of the project was Rs. 12,000. Of the total cost, grant assistance from the project was Rs. 9,000 and farmers' contribution was Rs. 3,000. In the mean time, several members of the Bada Aanap Krishi Samuha withdraw their desire to have plastic pond. As the DADO has already approved three plastic ponds, three farmers accepted the grant. So, each farmer had one pond.

Plastic ponds are usually constructed by excavating the normal ground (Figure 4.5). Their sizes vary between 60,000 and 190,000 liters. Following are some of the important criteria for selecting site for pond.

- It should be located at higher elevation than the proposed irrigated area
- It should be close to the house so that roof top rainwater can be collected and conveyed easily to the tank.
- The elevation of the pond should be sufficiently lower than the source of water if any (such as spring source, taps of domestic water supply etc) so that such water can be collected in it.
The plastic pond, constructed under the SISP, has the capacity of 190,000 litters. The pond is lined with 450 microns plastic sheet in its internal surface. A ½" siphon pipe laid over the bank of the pond draws water from it, which is then conveyed to the field through a 150 meter long pipe for direct application to the plants, especially to irrigate off season vegetable. By doing this, there is no need to make hole in the plastic liner, which in turn increases the life of the pond. An overflow spillway has also been constructed to release excess water from the pond.

Following are the three sources of water for the pond:

- Rainwater harvesting from the roof gutter
- Rainwater harvesting from a small catchment collected through road culvert.
- Unused domestic water supply

During the monsoon season, there is no scarcity of water. The pond can supply as much water as required by the farmers. However, during the winter and spring seasons, water is really scarce.

Maintenance of the system involves cleaning of the pond and repair of supply and distribution canals. Usually, plastic liner works for about 10 years without repair. But, sometimes it may be torn out due to some reason, which needs maintenance. The resource involve for maintenance of the system is negligible.

(b) Socio-Economic Impact

The individual farmer who has participated in this program has applied an innovative technique for irrigation. He grows vegetable in spring and winter seasons by using the plastic pond irrigation facility and has been able to increase the vegetable production in
many folds. The yield level and productivity are very high. Other farmers in the area have learned from this farm and they are adapting this irrigation technology. The income of the individual farmer has increased. As a result, his standard of living is higher.

There is one cooperative and one Forest Users group in this area as well as Agriculture Service Centre, Sub-health Post and Post Office as a formal organization within the VDC. Banking service and credit facility has just started. The arrival of NGOs is not increased here after SISP but community development programmes and peoples participation is increased in this area.

The plastic pond irrigation system does not need regular maintenance like in other systems except cleaning of the pond. This system in Palpa now has become personal among the farmers. So they maintain the pond by themselves. The farmers (Nagendra Raj Pandey supply the plastic needed for the pond and also provide the technical assistant, he has learnt it by doing. This Bade Aanap Krishi Samuha is lead by female. Female participation in community development is found active in this area.

Both the labour and cash contribution will be available from the beneficiaries for the maintenance of the system. At the same time cash/commodities will be available in terms of irrigation fee.

4.5 BANKE DISTRICT

4.5.1 Jhijhari Bangesal Irrigation System (JBIS)

(a) Intervention

The Jhijhari Bangesal Irrigation System, located in the ward number 2 of the Mahadevpur VDC in the Banke District, irrigates about 100 ha of cultivated land. The system has a 2.5 km long main canal, of which about 50 meters is lined and the rest is earthen. A semi permanent headwork (gabion weir with concrete core wall) diverts water from the source river to its main canal. The discharging capacity of the main canal is about 200 liters per second.

It is a run-of-the-river type of surface irrigation system and receives water from the Bangesal River. The source river has enough water during the monsoon season, while during the winter and spring season, availability of water at the source is moderate to scarce.

The leaky main canal, badly maintained irrigation structures like bridges, siphon and culverts, and rusted/broken gabion wires of the semi-permanent headwork are main physical weakness of the system. As a result, tail end farmers are not getting adequate amount of water. In order to overcome this weakness, farmers of the area have been approaching several institutions for external assistance.

The system was first intervened in the fiscal Year 051-052 by the Department of Irrigation under the World Bank funded Irrigation Line of Credit (ILC) program. At that time the system's semi permanent headwork was constructed. In 057/058, farmers again
approached DOA for external assistance. In the same year, DOA provided Rs 40,000 from the Special Irrigation Support Project (SISP), which was used to maintain the siphon.

Maintenance of this system involves repair of the head works and other structures, and desilting of the main and branch canals. The system needs to be maintained three times a year, and each time about 50 labors are mobilized. Basis of labor mobilization is with respect to landholding. The general maintenance cost of the system is about Rs. 30,000 per year (Rs. 300 per ha).

(b) Socio-Economic Impact

The irrigation facility has resulted in increased yield level. There is increased crop intensity and crop diversification as well. In addition to regular crops, the production of vegetables has increased.

There is one WUA, one FUG, one Agriculture service center, one health post, one post office, and one Ranger office in this Mahadevpur VDC ward no. 2. The arrival of NGOs after SISP for development programme is not found increased neither the community development activities nor the peoples participation is found increased.

The water user groups are maintaining the canal by mobilizing voluntary labor from the farmers according to the land holding.

4.5.2 Tube Well Irrigation System (Himali Krisak Samuha) (HKS)

(a) Intervention

The Himali Krisak Samuha Tube Well Irrigation System is located in the ward number 10 of the Mahadevpur VDC in the Banke District. The system irrigates about 6.5 ha of land belonging to 8 users. The system has a temporary thatched roofed pump house, a shallow Tube Well with a discharging capacity of about 10 lps, and about 1.50 km long earthen distribution canal. The banks of the distribution canal are narrow which is frequently overtopped by the flow. As a result, breaching of the canal banks is common.

This Tube Well was first constructed in 2050 by the farmers of the area with the loan assistance from the Small Farmer Development Program. At that time the Tube Well (with the diesel pump) used to irrigate about 3 ha of land belonging to 4 users. In the year 2000, SISP (through DADO Banke) provided grant assistance of Rs. 349,16 to the users of the Tube Well for replacing the diesel pump by a 5 lIP electric pump. Total cost of the project was Rs. 48,882 of which Rs. 11,638 was contributed by the farmers.

Maintenance of this system involves repair of the pump, pump house and the distribution canals. The distribution canal needs to be maintained 3 times a year, which is done by mobilizing labor resources. Basis of labor mobilization is equal to every household.

(b) Socio-Economic Impact

Agriculture production and productivity has increased in this area due to the availability of irrigation facility. Paddy is the main summer crop and its yield increased by 25% after the
programme. Maize is grown in the spring season. Farmers grow wheat in the winter season because of the availability of irrigation facility its yield increased by 125%. Potato and pulses are also cultivated in this season.

The increase in agriculture production due to irrigation facility has resulted in increase in income level. There is one co-operative, one WUA, one FUG, one agriculture service center, one health sub-post, one post office and one Ranger office in this VDC. After SISP the arrival of NGOs for development activities, and peoples participation is found increased in this area. The water user groups are maintaining the canal by mobilizing voluntary labor mobilization depending on equality basis.

4.5.3 Tube Well Irrigation System (Kalabanjar Krisak Samuha) (KIS)

(a) Intervention
The Kalabanjar Krisak Samuha Tube Well Irrigation System, Banke District, irrigates about 6.5 ha of land belonging to 13 users. The system has a shallow Tube Well with about 0.3 km long earthen distribution canal. Earlier, the tube well used to be operated by a community owned diesel pump. Since a last few years, the diesel pump has not been working.

In the year 2060, users of the Tube Well approached DOA for assistance under SISP for the procurement of two units of 1.5 HP electric pumps. The total cost of the project was Rs. 59,335. Of which, SISP provided Rs. 44,501 and farmers contribution was Rs. 14,833.

Despite this intervention, the electric pump is not operating. This is because the area still does not have electricity supply. Presently, individually owned diesel pump is used to pump water for irrigating one’s land. Virtually, the Tube Well is operating as an individual well. So, the concerned users carry out the maintenance activity (if any) on their own.

(b) Socio-Economic Impact
The electric pump provided under SISP program has not started operating. So benefits due to SISP program has not started flowing. However, the Tube Well is being operated by the individual farmers with their diesel pumps for irrigating their lands.

4.5.4 Tube Well Irrigation System (Mahadevpuri Sahakari Sanstha) (MPSS)

(a) Intervention
The Mahadevpuri Sahakari Sanstha Tube Well Irrigation System is located in the Banke District. The system irrigates about 6.5 ha of land. The system has a temporary thatched roofed pump house, a shallow Tube Well with a discharging capacity of about 15 lps, and about 0.50 km long earthen distribution canal. Earlier, the Tube Well used to be operated by a community owned diesel pump.

In the year 2060, users of the Tube Well approached DOA for assistance under SISP for the procurement of 5 HP electric pump. The total cost of the project was Rs. 68,000. Of which, SISP provided Rs. 50,000 and farmers contribution was Rs. 18,000.
Maintenance of this system involves repair of the pump, pump house and the distribution canals. The pump and the valves are maintained as and when required, while the canals are cleaned twice a year by mobilizing labor resources. Basis of labor mobilization is with respect to landholding.

(b) Socio-Economic Impact

Paddy is the main summer crop and its production has increased by 29% after irrigation. The yield of summer maize increased by 122% and that of winter wheat increased by 115%. Farmers in the area have used fertilizers and improved seeds in their cultivation. The higher agricultural productivity in this area is the result of appropriate input combinations, that is irrigation, fertilizer and improved seed.

Agricultural production has contributed significantly in raising the income of the farmers in the area.

There are one co-operative, 4 WUAs, 3 FUGs, one Agricultural service sub-centre, one Ranger office and one village bank in this VDC. The arrival of NGOs for community development activities and people’s participation is found increased in this area. The water users groups are maintaining the irrigation system (Tube well) by mobilizing voluntary labor.

4.5.5 Laxmi Dhiki (Bhagawati Mahila Krishak Samuha) (BMKS)

(a) Intervention

Bhagawati Mahila Krishak Samuha is one of the users group which is benefited from Small Irrigation Special Project in Banke district of Mid-western Nepal. The project area is located in Hirminiya VDC ward no 1 Bankatuwa village that is 5 km far from district head quarter Nepaljung. The project intervention is of special type, which has provided 11 numbers of treadle pumps to the users group. Treadle pump is a manually operated modified Tube Well aimed to irrigate small land fragments (Figure 4.6). It is two cylinder-reciprocating pumps designed to discharge continuously through the pistons or plungers operating in these cylinders. The working principle of the treadle pump is same as that of simple shallow Tube Wells. The other elements of treadle pump are super structure with two treadle poles and separation poles designed to operate by human foot. The discharging capacity of the treadle pump depends upon the frequency of manual operation and static water level. A bamboo structure is built over the well with the piston rods attached to pivoted bamboo poles.

Treadle pumps can be used wherever the depth of static water table is within 6 m. Treadle pump is locally named as Lakshmi Dhiki or Dhiki\(^9\) pump after the name of Lakshmi, the Goddess of wealth. The irrigated area of each treadle pump is 2 kattha that comes about 0.07 ha. Hence, the total irrigated area of the project is 22 kattha (0.75 ha). The project area has good potential for farming vegetable crops. The estimated discharge of one pump is about 3 Ips. The delivered water from the pump is canalized through the small ditches made by the farmers themselves. In all cases the field channels are unlined and irrigation is usually carried out as furrow irrigation methods.
Considering the popularity of the treadle pump in Terai and demand of the farmers, District Agriculture Office Banke has decided to provide treadle pumps to marginal farmers in this fiscal year 2060/61. The investment for one treadle pump is NRs 1700 that gives total investment of Rs 18,700. Farmers have also contributed bamboo materials and labor cost for installation of the pumps. The main investment is on the procurement of the pumps and its installation. The cost of boring ranges from Rs. 5 to Rs 7 per running feet of pump depth. According to local inquiry the cost breakdown of each treadle pump is illustrated herewith.

Table 4.1: Cost Breakdown of Treadle Pump

<table>
<thead>
<tr>
<th>S.N</th>
<th>Description of items</th>
<th>Estimated cost (NRs)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump head</td>
<td>700.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.5&quot; GI/Polythene pipes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Screen (locally available)</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Labor charges</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1500 to 1700</strong></td>
<td>Based on depth of pipe to be inserted.</td>
</tr>
</tbody>
</table>

(b) Socio-Economic Impact

The irrigation facility has been main contributing factor in raising the agricultural production in this area. Paddy is the main summer crop its yield has increased by 83% after the intervention of SISP. In winter and spring, farmers in this area mainly cultivate vegetables and this is the vegetable pocket area.

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9 Dhiki is a typical Nepali foot operated paddy-milling device, generally used in rural areas of the country.
Increased agriculture production, especially the vegetable production, has resulted in higher income and improved standard of living of the farmers in the area.

There are one WUA, one agriculture service center, one sub health post, and one post office in this VDC. The arrival of NGOs for community development and people's participation is found increased in this area. About 27 farmers have organized into a woman group to seek the project. But only 11 farmers could get this opportunity of having treadle pump. The project is demanded through women users group the maintenance of the pumps is also being carried out by themselves. However, it is not yet essential to repair and maintain the pumps.

4.6 DADELDHURA DISTRICT

4.6.1 Beltada Irrigation System (BIS)

(a) Intervention

Beltada Irrigation System (BIP) lies in one of the remote districts of the Far-Western Region, Dadeldhura. The system is situated on ward no 7 of Nava Durga VDC. BIP is a run of the river diversion irrigation scheme irrigating about 30 ha of cultivated lands in tar and hill slopes. The source of water for irrigation is Sakayal khola having sufficient flow at the point of diversion. The system has 4-km long main canal that crosses several streams and rock cliff areas. There is only one permanent super passage to pass the stream flood and have few meters of lining in the main canal at the landslide areas. The flow carrying capacity of the canal is 50 to 60 lps which is sufficient to provide supplementary irrigation to the field.

Figure 4.7 Presents Layout of the Beltada Irrigation System
The system was initiated and developed by farmers themselves in the year 1990 BS. Due to insufficient exposure to the line agencies no public intervention was made prior to SISP in fiscal year 2059/60. Due to limited resources of intervention in SISP only 50-m long lining and one 20m long culvert were constructed. The condition of these structures is satisfactory to deliver the water towards the field through its four branch canals. The total cost of the project was Rs 69,455 excluding the cost of labor contribution from the farmers. During the construction all farmers had spent 3 man-days per household in earthwork and transportation of local materials. This year VDC has also assured to provide Rs 31,000 for canal maintenance.

Due to limited intervention farmers are mostly dependent on their own resources for system operation and maintenance. A significant amount of labor days are being spent every year to keep the system intact. However, decreasing labor force from agriculture activities in the area makes farmers challenging to sustain their system. In addition, frequent landslides and floods make the system more labor intensive. Despite several problems associated with weak infrastructure development farmers are courageous and trying to draw attention of line agencies in the district. Crop diversification program has also been launched in that area which has introduced new crop varieties along with other agriculture extension activities. Farmers have constituted their own committee to take lead role on irrigation and agriculture interventions. For canal maintenance farmers use to gather and mobilize as per instructions of the committee. The performance of SISP intervention is satisfactory in assisting farmers in their maintenance needs. However, it is not sufficient to fulfill the need of the system.

(b) Socio-Economic Impact

Paddy is the main summer crop in the command area and wheat is the main winter crop along with some potato cultivation. After SISP intervention wheat production increased by 10%. Although this area has high potential for cash cropping especially vegetable farming, the survey revealed that farmers are not aware of potential for cash crops. Agricultural extension service is available in the command area, but there is not much effect on bringing the desired changes in the farming practices and farmers’ attitude.

Most of the farmers are subsistence farmers in the command area and they depend on agriculture for their livelihoods and agriculture provides the major part of their incomes. There has not been significant change in improving the livelihood of the people in the area. If the existing irrigation system is fully utilized there is high potential for increasing agricultural production. But the level of SISP investment in improving the existing irrigation system is quite inadequate to have significant effect on agriculture production.

There are two Forest user groups, one agricultural sub-center, one sub-health post and one range post office in this VDC. The water user groups are maintaining the system by mobilizing voluntary labor according to the need of the irrigator and the VDC has assumed to provide the necessary amount to maintain.
4.6.2 Lambodar Bandh Irrigation System (LBIS)

(a) Intervention

Lambodar Bandh Irrigation System (LBIS) is one of the completed Small Irrigation Special Projects (SISP) in Dadeldhura district of Far-western Nepal. District Irrigation Office Dadeldhura has implemented this project in fiscal year 2055/56. The project area is located in Chamsal VDC. The system is a run of the river diversion irrigation scheme, which provides irrigation to 15 ha of tar land. The system has permanent headwork, Bandh across the source river, Doti gad, which supplies water to the irrigated area through a 1.2-km long canal. The canal is of earthen type with 75 m of stone masonry lining at the head reach portion. The discharging capacity of the main canal is about 50 lps which is enough to irrigate 15 ha of tar land. There is no other permanent structure in the system other than headwork. Water is sufficient at the source to provide year round irrigation, but due to wide headwork it is difficult to divert water into the main canal.

Figure 4.8 Presents Layout of the Lambodar Bandh Irrigation System

The beneficiary farmers constructed Lambodar irrigation system some 80 years ago. Farmers could not remember the exact date of construction. Only in the year 2039 BS government has supported the system to build its headwork. The supported amount was Rs 80,000, which was spent to construct gabion weir on the headwork. Later on, in the fiscal year 2055/56 SISP supported the system with an amount of Rs 230,000. The investment was made mainly on the headwork construction and on the widening of the existing main canal. Farmers had also contributed significant amount of labors during the construction of the headwork and the main canal, which were approximately 30 % of the total cost of the project. Since then there is no any public intervention in the system and farmers have asked the team to help in this respect.

The system is being operated and maintained by the farmers themselves with their own resources. Gabion work at the headwork is being deteriorated due to lack of proper maintenance and farmers could not afford to replace it. The command area of the system
is also threatening from the river attack. However, the standard of maintenance in the main canal is satisfactory. Labor mobilization from 60 households is the only way of maintaining the system. The basis of labor mobilization is one labor per household irrespective of the size of the land. According to local inquiry farmers have spent 180 labor-days in system maintenance during the last monsoon season. Farmers have good understanding of community participation. Majority of population is from Chhetri ethnic group. During transact walk and focus group discussions Boharas were present. For annual maintenance each household has to spend 3 to 4 man-day on an average basis.

(b) Socio-Economic Impact

Paddy is the main summer crop; and wheat and potato are major winter crops in the command area. Because of the irrigation facility in the command area, farm plots here are used to grow the rice saplings in spring season for summer paddy plantation. The irrigation facility has contributed to raising agricultural productivity of paddy, wheat and potato crops in the area. Farmers have been using fertilizers and improved seeds as well. Wheat production increased by 8% after irrigation.

The arrival of NGOs, after SISP to mobilized community development activities and people’s participation is found increased in this area. The water user groups are maintaining the system by mobilizing voluntary labor according to the need because this system is being operated by the farmers themselves.
Chapter V: Study Results

5.1 Sustainability: Technological and Environmental

The term ‘sustainability’ has several meanings and it is widely used term in development literature. Looking at sustainability from the holistic perspective, this study suggests that an irrigation system can be said to be sustainable only if its water users association (WUA)/farmers’ organization responsible for operating the system, can keep the system regularly without external assistance, and the system is capable of delivering water to its users as per their need. This requires examining following issues, which are dealt with separately in the following subsections.

- Effect on irrigation system due to externalities, which is reflected on O&M need due to environmental degradation, changing socio-economic conditions, increasing dependency of small irrigation systems over the state, local polities and so on.
- Appropriateness (effectiveness) of technological intervention
- Efficiency and equity of irrigation system in terms of water delivery to its users.

5.1.1 Interventions, maintenance need and externalities

Intervention improves the physical infrastructure of the irrigation system. However, effectiveness of external intervention has implications for sustainability of the irrigation system in terms of maintenance need. Sustainability in this respect is the farmers’ capability in terms of effective institutional and organizational arrangements to generate internal resources to operate and maintain the infrastructure.

If institutional and organizational arrangements became weak after intervention, internal resources cannot be mobilized for up keeping the system. In such a situation, sustainability of the intervened irrigation systems becomes questionable. The pattern and scale of resource mobilization in different types of irrigation technologies after intervention indicate that there has been a shift from internal resource mobilization to external resource mobilization, especially in the case of surface irrigation system. Sustainability of external intervention on different irrigation technologies is discussed below.

Surface Irrigation System

All the surface irrigation systems studied belongs to the categories of farmer manage irrigation systems (FMIS). They were developed long ago by the farmers. Local skills have been applied over ages to develop their infrastructure. Strong community participation, self governance, and equitable distribution of irrigation facilities to its users are common features of these systems.

These FMISs are of run-of-the-river type of surface irrigation systems and rely on intensive labor mobilization for their operation and maintenance (O&M). The extent of labor mobilization primarily depends on the length of the conveyance canal, the terrain it
crosses and the size of the irrigation system. The longer the conveyance canal, the more labor is required for its maintenance, especially when the canal is earthen. In general, Table 5.1 suggests that average maintenance cost of surface irrigation system is about Rs. 660 per ha. Thus, in the case of run-of-the-river type of surface irrigation system, minimization of labor resource for maintaining the system has been one of the prime considerations for demanding more external intervention.

Table 5.1: Average maintenance cost of some of the surface irrigation system

<table>
<thead>
<tr>
<th>SN</th>
<th>Name of Irrigation System</th>
<th>Irrigated area (ha)</th>
<th>Maintenance cost per ha (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cha Khola Irrigation System</td>
<td>5</td>
<td>400</td>
</tr>
<tr>
<td>2</td>
<td>Panchkhal Hokse Raj Kulo</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td>3</td>
<td>Siddheswar Jal Upabhokta Sangh: Dabka Ghol Irrigation</td>
<td>50</td>
<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>Jhijhari Bangsal Irrigation System</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td>Lamodar Bandh Irrigation System</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
<td>660</td>
</tr>
</tbody>
</table>

As noted above, minimization of labor resources for maintaining the system has remained one of the key factors for demanding more and more external intervention, especially in the case of run-of-the-river type of surface irrigation system. Although minimization of labor resource for maintenance of the system may not be the agency's stated objective, it has helped the farmers tremendously. In view of the changing socio-economic condition of the rural community, and further in view of the hardships being faced by the local communities in crop production and thereby the serious problem of out-migration, such minimization in labor mobilization is highly justified. But, if one look at the basic characteristics these surface irrigation system where strong community participation is important and common features for their management, minimization of labor resources for up keeping the system by external intervention may deteriorate users group cohesion and thereby ownership towards the system.

Although the external intervention considerably reduces the resources mobilization for maintenance by replacing the temporary nature of irrigation infrastructure by a more permanent one, it increases the amount of capital resource required for maintenance. This is because the permanent structures constructed with cement cannot be maintained with labor resource alone. However, such institutional set-ups are not emerging in actual practice. This study shows that intervened irrigation systems are never maintained as needed and farmers continue to rely on the labor resource for their maintenance. As a result, the condition intervened irrigation system is deteriorating and at the same time farmers are seeking external resource for further rehabilitation. Thus, in many surface irrigation system, a cycle of rehabilitation-deterioration-rehabilitation has been created, implying a high degree of unsustainability. Note that, five out of nine surface irrigation systems studied have received external support for maintenance three times within a span of six year, and two irrigation systems received the external support twice within the same time frame (Table 5.2)
Table 5.2: Cases of multiple interventions

<table>
<thead>
<tr>
<th>SN</th>
<th>Name of system</th>
<th>Detail of intervention</th>
<th>Year</th>
<th>Amount (NRs)</th>
<th>Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cha Khola Irrigation System</td>
<td></td>
<td>059/60</td>
<td>20,000</td>
<td>DOA</td>
</tr>
<tr>
<td>2</td>
<td>Panchkhal Hokse Raj Kulo</td>
<td></td>
<td>056/57</td>
<td>34,200</td>
<td>DOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>057/58</td>
<td>300,000</td>
<td>DDC Kavre</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>059/60</td>
<td>40,000</td>
<td>Local Dairy</td>
</tr>
<tr>
<td>3</td>
<td>Siddheswar Jal Upabhokta Sangh: Dabka Ghol Irrigation System</td>
<td></td>
<td>056/57</td>
<td>77,000</td>
<td>DOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>059/60</td>
<td>10,000</td>
<td>VDC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>060/61</td>
<td>35,000</td>
<td>Chitwan DDC</td>
</tr>
<tr>
<td>4</td>
<td>Nava Durga Krishi Samuha: Branch Canal BL1 of NLIS</td>
<td>Annually Not fixed</td>
<td></td>
<td></td>
<td>NLIS/DOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>060/61</td>
<td>20,000</td>
<td>DOA</td>
</tr>
<tr>
<td>5</td>
<td>Bade Aanap KS: PPIS</td>
<td></td>
<td>057/58</td>
<td>12,000</td>
<td>DOA</td>
</tr>
<tr>
<td>6</td>
<td>Barikhet-Ulte Kulo Irrigation System</td>
<td></td>
<td>1995/96</td>
<td>Not known 800 m lining by ILC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NISP</td>
<td>Not known 450 m lining by OFWM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2059/60</td>
<td>50,000</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td>7</td>
<td>Shrijana Resham BKS: TIS</td>
<td></td>
<td>060/61</td>
<td>58,000</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td>8</td>
<td>Dhanaraje Irrigation System</td>
<td></td>
<td>2054</td>
<td>160,000</td>
<td>DOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2057</td>
<td>Not known</td>
<td>Ilam Municipality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2059</td>
<td>73,000</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td>9</td>
<td>Jhijhari Bangesai Irrigation System</td>
<td></td>
<td>051/52</td>
<td>Not known</td>
<td>ILC/DOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>057/058</td>
<td>40,000</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td>10</td>
<td>Himali K. Samuha: TWIS</td>
<td></td>
<td>2057</td>
<td>39,000</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td>11</td>
<td>Kalabanjar K. Samuha: TWIS</td>
<td></td>
<td>2060</td>
<td>50,000</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td>12</td>
<td>Mahadevpuri SS: TWIS</td>
<td></td>
<td>2060</td>
<td>18,700</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td>13</td>
<td>Bhagawati Mahila KS: LD</td>
<td></td>
<td>2060/61</td>
<td>69,455</td>
<td>SISP (DOA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2060/61</td>
<td>31,000</td>
<td>VDC</td>
</tr>
<tr>
<td>14</td>
<td>Beltad Irrigation System</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Lamodar Bandh Irrigation System</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.2 indicated several cases of multiple interventions, especially in the case of run-of-the-river type of surface irrigation system. While, no such repeated intervention were seen in the case of Tube Well, Pond and Laxmi Dhiki irrigation. Repeated intervention in surface irrigation system may have been caused due to insignificant incremental production after intervention, changing socio-economic conditions, deteriorating group cohesion, and free grabbing of external resources. Irrespective of the causes, the important issue in this respect is whether the farmers' institution would be able to sustain these systems in future since they were not concerned about proper maintenance of their system. This would have serious implications for long-term sustainability of the irrigation systems.

**Tube Wells**

Unlike in the run-of-the-river type of surface irrigation system, general maintenance cost of the shallow Tube Well is relatively very low. The Tube Well as such is free of maintenance. But, its pumping equipment and distribution canal need some maintenance. Maintenance of distribution canal includes its cleaning and re-shaping.

Sustainability of diesel engine operated shallow Tube Wells, with respect to cost and benefit, has already been well established (Koirala, G.P, 1998; DOI, 1997; Gautam and Shrestha, 1997). Irrigation Master Plan computed the economic returns on shallow Tube Well to be 40 per cent in normal case and 20 per cent under conjunctive use (Koirala G.P, 1998). This is an impressive return. Other studies have also reported significant increase in cropping intensity, fertilizer use, and yield levels even for traditional crops like paddy, wheat and maize. (DOI, 1997; ADBN, 1988; APROSC, 1995; Regmi, S.B. et al, 2000; Gautam and Shrestha, 1997) which further confirm sustainability of Tube Well.

In the case of Tube Well, the SISP (the Small Irrigation Special Project) had concentrated on replacing the diesel pumps by electric pumps. Following are the advantages of electric pumps over the diesel pumps.

- Electrical engine represent highly divisible technology compared to diesel engines and can meet the capacity requirement of even small land holders;
- The investment cost and the cost of repair and maintenance of electrical engines are relatively cheap compared to diesel engines and thus also save the hourly operational costs through the savings in the indirect (fixed) operational costs whose share is nearly four-fifths of the total costs.
- The electricity tariff for irrigation has been cross-subsidized at a level nearly 50 per cent of that for domestic use and, therefore, the hourly power bill would certainly lower than cost of diesel;
- Electrical engines are easy to start and operate
- While diesel has to be bought cash down, farmers can pay the electricity bill on a monthly basis

Because of the above-mentioned reasons, sustainability of electrically operated Tube Wells is further justified.

**Plastic Pond**

From the cost benefit point of view, plastic pond is also highly sustainable compared to other irrigation technologies. Once the plastic pond is constructed, it works continuously for about 10 years without any major repair works. Table 5.3 presents construction cost of a plastic pond with a capacity of 60,000 litters.
Table 5.3: Construction cost of 60,000 litters plastic pond

<table>
<thead>
<tr>
<th>SN</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Earthwork for making pond</td>
<td>3445.00</td>
</tr>
<tr>
<td>2</td>
<td>Clay lining in the pond</td>
<td>704.00</td>
</tr>
<tr>
<td>3</td>
<td>Cost for gutter pipe and its fixing</td>
<td>1916.00</td>
</tr>
<tr>
<td>4</td>
<td>Inlet pipe to the pond</td>
<td>1350.00</td>
</tr>
<tr>
<td>5</td>
<td>300 micron plastic liner</td>
<td>7989.84</td>
</tr>
<tr>
<td></td>
<td><strong>Total cost (Rs.)</strong></td>
<td><strong>15,404.84</strong></td>
</tr>
</tbody>
</table>

Maintenance of the plastic pond involves its cleaning and repair of supply and distribution canals. Usually, plastic liner works for quite a long period. But, sometimes it may tear out due to some reason, which needs maintenance. The resource involve for maintenance of the system is almost negligible.

In the study area, even the poor farmers have now direct access to irrigation water due to plastic ponds. As a result, farmers could cultivate high yielding vegetable crops during the dry season. This study has suggested that average annual income of a household cultivating vegetable crops with a plastic pond of 190,000 litters capacity is about Rs. 70,000.00. This confirms sustainability of plastic ponds from the point of view of cost and benefit.

The Agriculture Development Office of the Palpa District (DADO) also has similar findings. The DADO notes that a farmer having plastic pond of 60,000 litters can earn up to NRs 30,000 per year by cultivating off-season vegetable.

Further, followings are the advantages of plastic pond over other irrigation technologies:

- Reduced hardship and saving of time in acquisition of water by people, particularly the women-flocks and girl-children
- Use of water for diversified purposes, including irrigated agriculture and other income generation activities
- Conservation and use of water as local resource.
- Improvement in environment
- Conservation of soil by arresting the soil losses through soil erosion, landslides, floods etc
- Can be used to recharge the springs and ground water as also to increase soil moisture
- Simple and low cost
- Can be constructed with local materials and skills.
- Can be operated, managed and maintained by local people
- Social-cultural harmony and cohesion.
Certainly, from the point of view of cost and benefit, plastic pond is highly sustainable provided that the area has efficient agricultural extension and other input services including market facilities for cultivation of cash crops. Further, the technology of plastic pond is also environmental friendly.

**Treadle Pump: Laxmi Dhiki**

The treadle pump is operated by a stair-step walking motion on two long bamboo poles or treadles, which in turn activates two steel cylinders. Groundwater is suctioned into the cylinders and dispelled into a field channel. Table 5.4 presents cost of a Treadle Pump.

**Table 5.4: Cost breakdown of Treadle Pump**

<table>
<thead>
<tr>
<th>S.N</th>
<th>Description of items</th>
<th>Estimated cost (NRs)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump head</td>
<td>700.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.5&quot; GI/Polythene pipes</td>
<td>10 to 15 per feet</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Screen (locally available)</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Labor charges</td>
<td>200 to 300</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>1500 to 1700</td>
<td>Based on depth of pipe to be inserted.</td>
</tr>
</tbody>
</table>

The treadle pump has enabled very poor farmers of the study area to have direct access to groundwater irrigation for the first time. As a result, farmers could cultivate high yielding vegetable crops during the dry season. This study has suggested that average annual income of the farmers cultivating vegetable crops with treadle pump irrigation is about Rs. 6,000 per household. In Bangladesh also, farmers investing in the treadle pump have experienced similar increases in net income averaging approximately US $100 per year (Postel, S. et al, 2001).

Certainly, from the point of view of cost and benefit, treadle pump is highly sustainable. Further, as this is a simple, low cost, divisible, and environmental friendly technology, treadle pump is socially and environmentally sustainable.

### 5.1.2 Appropriateness (Effectiveness) of Technological Intervention

Appropriateness or effectiveness can be examined from different perspectives. One can examine the appropriateness of technological intervention from the perspective irrigation management. For example, to be appropriate from the management perspective, the technology must be simple, affordable, and it should be able to deliver reliable and equitable water to its users. Appropriateness of technological intervention can also be examined from the perspective natural science, meaning the hardware engineering. Further, appropriateness can also be examined from the perspective of meeting the objective of intervention. For example, the objective of irrigation development is to increase agricultural productivity. So, in this case, the technological intervention, which could increase the agricultural productivity, could be the most appropriate one. This study therefore examines appropriateness of technological intervention from the perspective of increasing agricultural productivity through surface irrigation, Tube Wells, plastic ponds.
and treadle pump. The study also briefly examines appropriateness of technology from the perspective of ecological belt of the country.

**In Terms of Agricultural Productivity**

Productivity of an irrigation system is judged by the cropping intensity and crop yield. Of these indicators, this study mainly concentrates on cropping intensity. This is because, other than irrigation, increase and decrease in crop yield is also shaped by many other factors. But, increase in cropping intensity without irrigation is not likely.

Cropping intensity is defined as the number of crops harvested per unit of land per year. It is the percentage of cropped area divided by the command area. Before examining then cropping intensity of the SISP intervened irrigation systems, it is worth looking at the relationship between water availability (rainfall) and evapotranspiration in the country.

Figure 5.1 presents a general pattern of monthly variations in the rainfall, temperature, and evapo-transpiration in the sub-tropical and warm temperate climatic zones. In these zones, the mean monthly rainfall varies from a few millimetres (mm) in November to about 500-700 mm in July, with the average annual rainfall varying between 1,600 and 2,500 mm. About 80 per cent of this rainfall occurs during the monsoon season.

![Figure 5.1: Monthly Variations in Rainfall, Temperature, and Evapotranspiration in Nepal](image)

Figure 5.1 shows that, the mean annual rainfall is much above the average evapo-transpiration between June and October. The figure generates a question: 'Why is an irrigation system needed when rainfall exceeds evapo-transpiration?' The answer is, the rainfall is so erratic that its effectiveness is little for paddy cultivation, especially in the hills. Relatively short dry spells during this period lead to water stresses. Figure 1 further suggests that the annual rainfall from November to May is much below the average evapo-transpiration for cultivating the winter and spring crops. This implies that irrigation is essential for cultivating the winter and spring crops. Although during the winter season a few water resistance crops like pulses, oilseeds and some cereals can be cultivated using the residual moisture, cultivation of high value crops in both the winter and spring seasons without irrigation is not possible. This implies that winter and spring irrigation is also essential for increasing the cropping intensity.

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11 See sheet number T26 of sisp-output01.xls

Full Bright Consultancy (Pvt.) Ltd.
The following few paragraphs present cropping intensity which has direct relations with agricultural productivity, in surface irrigation, Tube Wells, treadle pumps and plastic ponds.

a. Surface Irrigation System

Foregoing discussion suggests that winter and spring irrigation is essential for increasing cropping intensity of an irrigation system. Table 5.5 presents percentage of farmers growing principal winter and spring crops before and after SISP intervention in some surface irrigation systems.

Of the eight surface irrigation systems presented in Table 5.5, the water sources of the two irrigation systems remain dry during the winter and spring seasons. So, winter and spring irrigation in them is out of question. Thus, the spring maize and winter wheat grown in them has to be rainfed.

Though the source Rivers of Panchkhal Hokse, Beltada, and Lambodhar irrigation system have plenty to moderate supply of water during winter and spring season, there has not been any change in the cropping pattern in them. Area under maize and vegetable grown in the Panchkhal Hokse irrigation system remain same before and after SISP intervention. Similarly, the areas under wheat grown in the Beltada and Lambodhar Irrigation Systems also have no change after SISP intervention. This suggests that in these systems, there has not been any change in the availability of water during the winter and spring season.

After the SISP intervention, the Bari Khet Ulte Kulo showed 100 percent increase in the cultivation of the spring maize and winter potato. Similarly, cultivation of the winter wheat has been increased by 33 percent. But, the availability of water at the source river of this system is scarce (during both the winter and spring seasons). This suggests that these crops are also most likely rainfed.

The only systems, which show some changes in water availability after SISP intervention, are Dhanraje and Chakhola Irrigation Systems. In the Chakhola Irrigation System, during the spring season, about 83 percent farmers changed their cropping pattern from spring maize to spring paddy, while during winter season, all farmers switched to potato. Similarly, in the Dhanraje Irrigation System, there has been 10 percent increase in the cultivation of spring paddy and 20 percent increase in the winter potato. Certainly, these changes became possible only due to availability of additional water.

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12 These systems are: Siddheswar Jal Upabhokta Sangh Dabka Ghol Irrigation System and Nava Durga Krishi Samuha Branch Canal BL1 of NLSl. Both these systems are located in the Chitwan District.

13 Note that this system has quite a long main canal (1.5 and 2.5 km). In general, conveying scarce water in such a long canal, especially during dry season, is not feasible unless an appropriate technology like a closed conduit is available.
Table 5.5: Percentage of farmer growing principal winter and spring crops before and after intervention

Percentage of farmer growing principal winter and spring crops before and after intervention

<table>
<thead>
<tr>
<th>Name of System</th>
<th>Area (ha)</th>
<th>Main Canal (Km)</th>
<th>Water availability at source</th>
<th>Spring crop</th>
<th>Winter crops</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Paddy</td>
<td>Maize</td>
</tr>
<tr>
<td>Dhanraje Irrigation System</td>
<td>15</td>
<td>1</td>
<td>P</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>Chakhola Irrigation System</td>
<td>5</td>
<td>0.5</td>
<td>P</td>
<td>0</td>
<td>83</td>
</tr>
<tr>
<td>Panchkhal Hokse Rajkulo</td>
<td>250</td>
<td>4</td>
<td>P</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Beltada Irrigation System</td>
<td>30</td>
<td>4</td>
<td>P</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lambodar Bandh</td>
<td>15</td>
<td>1.2</td>
<td>P</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bari Khet Ulte Kulo</td>
<td>24</td>
<td>2.5/1.5</td>
<td>P</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SiddheswarJUS: Dabka Ghol</td>
<td>50</td>
<td>3</td>
<td>M</td>
<td>0</td>
<td>83</td>
</tr>
<tr>
<td>Nava durga Krishi Samuha</td>
<td>14</td>
<td>1.2</td>
<td>P</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note on water availability at source: P: Plenty; M: Moderate; S: Scarce; N: Not available

Note on water availability for crops: B: Before intervention and A: After intervention
b. **Tube Well, Plastic Pond, and Treadle Pumps**

As in the case of surface irrigation, agricultural productivity of Tube Well, plastic pond and Treadle Pumps are also judged by examining their increasing in cropping intensity.

Capability of providing year round irrigation by both the Tube Well and Treadle Pump are already well established. So, in theory, these technologies certainly increase cropping intensity. But in practice, due to several reasons, year round irrigation may not be achieved. For example, in the Kalabanjar Krishak Samuha Tubewel, SISP provided electric pump for more efficient and cheaper pumping of water. However, the area still does not have electricity line. This means the Tube Well is certainly not operating as designed.

In the case of plastic pond, capacity of providing year round irrigation depends on the size of the pond and source of water, which is very much site specific. Figure 5.2 presents change in cropping intensity of these irrigation technologies.

![Change in Cropping Intensity](image)

*Figure 5.2: Change in cropping intensity after and before SISP intervention*

Table 5.2 suggests that increase in cropping intensity (cropped area) is not much during the summer season for all the three technologies (TW, Treadle pump and Pond). This is mainly because, during the summer season, there is high rainfall in the area and use of these technologies may be required only during the period of long dry spell. Unlike in the summer season, cropping intensity (cropped area) of all these three irrigation technologies increased considerably in both the winter and spring season. Increasing in cropping intensity means increasing in agricultural productivity.

Thus, from the perspective of meeting the objective of irrigation development the Tube well, Treadle pump and Plastic Pond are highly appropriate.
In terms of the country’s ecological belt

As noted above, this study has examined four irrigation technologies. They are: run-of-the-river type or surface irrigation system, shallow tube well, irrigation pond and treadle pump. Of these technologies, the shallow tube wells and the treadle pumps use groundwater, plastic ponds harvest rainwater, and the surface irrigation system receives water from river or stream.

If one looks at the country from the physiographical perspective, traditionally Nepal is divided into three ecological regions: Terai, mid-hills and high Himalayas, each of which runs across the country from east to west.

As groundwater can be extracted very easily in the Terai ecological belt, use of tube wells and the treadle pumps have been found popular in the Terai. Certainly, these technologies are highly appropriate over there. Similarly, due to easy access to groundwater resources, rainwater harvesting is not very much appropriate in the Terai. This is because availability of water is highly restricted in the plastic pond compared to the groundwater. As a result, plastic ponds are not appropriate in Terai and they are found only in the mid-hills. As far as surface irrigation systems are concerned, they are found highly appropriate for all the ecological regions. Thus, other than surface irrigation systems, shallow tube wells and treadle pumps are highly appropriate in the Terai, while appropriateness of plastic ponds are more in the mid-hills compare to Terai.

5.1.3 Efficiency of Water Management

The term efficiency is commonly used in discussing irrigation performance (Oweis, et, al, 1999) and the objectives of this study enunciate to assess the efficiency of water management in SISP projects. The concept of SISP combines small-scale projects with farmer management. Such type of intervention aims to improve the farmer’s production where water shortage is a major constraint (Smout, 1990). It is performed through the investment in irrigation infrastructure, which improve efficiency of water management at the farm field. The studied 15 systems cover a wide range of intervention from small Laxmi Dhiki irrigating fractions of hectare to medium scale surface irrigation system having irrigated area of 250 ha. It covers support to both traditional irrigation systems built from indigenous technology and new appropriate technology like tank, pond and treadle pumps. Hence, efficiency of water management has also wide range of complexity from irrigation to vegetable crops in spring season to flood irrigation in monsoon paddy. Following section deal with the impact of water management efficiency, which may cover reliability and availability of irrigation water.

Reliability of Water

Reliability of water supply is one of the major issues of irrigation water management. Reliability means the degree to which the irrigation system and its water deliveries conform to the prior expectations of the users (Rao, 1993). In most cases, water users are dependent on irrigation system in regard to timing and quantity (Horst, 1998) of water to be delivered. Hence, to delivery water for irrigation in right time and in required
quantity improvements in the irrigation systems is essential. In most of the 15 studied systems reliability of water supply is in satisfactory level. In run-of-the-river irrigation schemes reliability is improved through the introduction of linings, intake repair and construction of cross drainage works. In hill irrigation schemes of Dadeldhura district main canal was the major constraint for the farmers, which has created questions in reliability of water supply. Of three studied schemes in Dadeldhura two schemes are lined, where farmers have responded more than 70 % reliability in water supply. Lambodhar Bandh in the same district where intake is repaired accounts better results in reliability of water. In Chitawan district lining has got the priority in two studied surface irrigation schemes and farmers have responded it in highly reliable systems. Similarly, in Kavrepalanchowk district two studied schemes of surface irrigation scored high rank in water reliability. In both these projects intake and cross drainage works are repaired with SISP intervention. Panchkhal Hokse Raj Kulo is comparatively large farmer managed irrigation system in the hills having irrigated area of 250 ha where intake was repaired by SISP investment. In Dhanaraje Irrigation Project of Ilam district farmers have responded excellent with respect to its water supply reliability.

On the contrary, the reliability of groundwater irrigation is not satisfactory in the studied projects. An electric pump has been supplied to replace the diesel-operated pumps. Out of three pumps one pump in Kalabanjar Krisak Samuha has not yet installed and rest two has also low level of water supply reliability. Replacing the diesel pumps with electric operated pumps sounds good with respect to environmental consideration and operational point of view. However, due to complexity to operate and maintain the pump, its life is not much reliable as other sources of irrigation water.

In small-scale new technology schemes like Dhiki pump, pond and tank irrigation schemes, reliability of water for irrigation is better. Dhiki pump in Banke district is an excellent practice of efficient water use. Human energy is applied to operate the pump, which in effect leads towards efficient utilization of extracted ground water. Moreover, women group uses to operate the pumps to irrigate vegetable crops in their kitchen garden or in other farm plots adjacent to the house. The tank irrigation in Ilam district is reliable method of local water harvesting, which supports supplemental irrigation for Silviculture (Resham Kheti). However, it has not yet developed for irrigation water requirement.

In general, more than 90 % of the responded farmers of all studied projects have expressed reliable supply of water for irrigation.

Availability of Water

Availability of water for irrigation is another aspects of water management efficiency. Water availability is affected by location within the systems, alternative water sources, conditions of the canal network, and cropping pattern (Meinzen-Dick, 2002). Hence, availability of water is evaluated based on location of farmer respondent, the general condition of the canal, and cropped area increased after intervention of SISP projects.
In all studied SISP projects water availability is the major issue. The availability of water is better in surface irrigation schemes especially in summer season. However, in Bari Khet Ulte Kulo irrigation system of Palpa district water is scarce and its availability depends much on the conveyance efficiency of the scheme. To increase the main canal efficiency lining has been done under the project. After the project intervention availability of water in winter season and spring seasons has been increased. Furthermore, this increase has significant impact on small-scale surface irrigation schemes like Cha Khola in Kavrepalanchowk district. In such schemes vegetables and potato are grown in winter season.

Availability of water for groundwater schemes is good for shallow tube wells. However, it is slightly lower in Laxmi Dhiki. This is mainly due to energy constraint in Laxmi Dhiki. Manual operation of Dhiki is not comparable with an electrically equipped shallow tube well. The overall increase in water availability in three different seasons is best illustrated in tabular form (Table 5.6). The water availability is grouped into four technological categories and assessed accordingly. Due to increased water availability more area has been irrigated. The cropping intensity is significantly increased in winter and spring season. In summer season rainfall fulfills the most of water requirement and there is no significant impact of SISP intervention.

Table 5.6: Water availability in different seasons

<table>
<thead>
<tr>
<th>SN</th>
<th>Irrigation technology</th>
<th>Increase in water availability after SISP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Summer season</td>
</tr>
<tr>
<td>1</td>
<td>Surface</td>
<td>No change</td>
</tr>
<tr>
<td>2</td>
<td>Tube well</td>
<td>&gt; 50%</td>
</tr>
<tr>
<td>3</td>
<td>Laxmi Dhiki</td>
<td>About 25%</td>
</tr>
<tr>
<td>4</td>
<td>Pond / Tank</td>
<td>No change</td>
</tr>
</tbody>
</table>

Source: Field survey, 2061

Above table shows that water availability is increased significantly in pond and tank irrigation, which are designed only for scarce water management during winter and spring seasons.

5.1.4 Equity in Water Distribution

Equity aspect is also defined as fairness in water distribution. The equity aspect relates to both technical as well as social aspects of an irrigation system. Equity is more significant than adequacy. Equity does not mean equal distribution of water to every body (Pradhan, 2003). It has different dimensions for water allocation and distributions (Rao 1993), which is governed by the system of rules within the community. It is believed that the national goal of poverty reduction is achieved through the equitable access to natural resources, its distribution and management. In the context of irrigation technology equity is assessed...
on the basis of water distribution on head, middle and tail parts of the system. In addition, it could be assessed on the extent of water related conflicts between farmers of various category. Following paragraphs describe briefly the equity aspects in studied SISP projects, which has significant impact on water use efficiency.

In FMIS water distribution is managed applying various practices of equity that are accepted in the community. The most common practice is irrigation from head to tail and is implemented through mutually agreed norms. In Lambodar Bandh and Boltada Irrigation Systems in Dadeldhura District equity issue is critical despite equal share in canal maintenance. Farmers do maintain the irrigation system based on the household, but water distribution is not equitable with respect to head, middle and tail. In other surface irrigation schemes farmers have responded better water distribution and are satisfied with their own practices.

In shallow tube well projects of Banke district water distribution is not a problem despite uneven distribution of irrigated land on head, middle and tail parts of the project. All these tube wells are recently installed and there might not be the issue of water distribution.

Water disputes are increased only in three surface irrigation schemes, Chakhola in Kavrepanchok, Dhanaraje in Ilam and Beltada in Dadeldhura districts. Water disputes are related mainly with water distribution practices. The magnitude of disputes are higher in Dhanaraje irrigation system, where 30%, 50% and 20% farmers live in head, middle and tail parts of the canal system respectively. The greater share of household in the middle and tail parts contribute to increase the disputes.

5.1.5 Overall sustainability

The foregoing sections examined the SISP intervened irrigation systems from the perspective of maintenance need and externalities; appropriateness of technological intervention, and efficiency and equity in water delivery. The study suggests that:

- Surface irrigation systems (FMISs) undergo multiple interventions. Changing socio-economic conditions, deteriorating group cohesion, and free grabbing of external resources are some of the causes for repeated intervention. Unlike the surface irrigation systems, no such repeated interventions were seen in the case of Tube Well, Pond and Laxmi Dhiki irrigation. Further, from the maintenance need and cost benefit point of view, these technologies are highly sustainable.

- SISP intervention on Treadle pump, Plastic Pond, and micro surface irrigation systems (with small area and short canal length) are highly appropriate in increasing the agricultural productivity. Similarly, SISP intervention in tube well increased its efficiency by minimizing the energy need (except in one case). However, intervention in larger surface irrigation systems has not shown promising results from the perspective of increase in agricultural productivity. But, such intervention has been successful in maintaining the present level of agricultural productivity, without which productivity could have been reduced drastically.
• Increase in the reliability and availability of water has been taken as proxy indicators for examining system efficiency. In general, it has been found that in all the system studied reliability of water supply has increased after SISP intervention. Similarly, increase in water availability is significant in tube well, treadle pump and plastic pond. However, increase in water availability is marginal in the case of surface irrigation systems. Further, this study suggests that water distribution in most of the SISP intervened irrigation systems are found to be equitable.

• SISP intervention in Treadle Pump, Tube Well and Plastic Pond are found to be simple in nature, low cost and environmental friendly. Even in the case of surface irrigation systems, as the magnitude of SISP intervention is small in scale, no negative environmental impacts were found.

Foregoing observations suggest that SISP intervention in treadle pump, plastic pond; Tube Well and micro surface irrigation systems (with small area and short canal length) are relatively more sustainable compared with intervention with larger surface irrigation systems.

5.2 SOCIO-ECONOMIC

The indicators used in the household survey conducted by this study showed that there are significant effects of SISP irrigation facility on agricultural production. The total overall cropping intensity in the surveyed area before the SISP intervention was 204 and it reached 247 after the intervention.

Paddy is the main summer crop in 95 SISP supported sampled farms; wheat is the main winter crop in 70 percent of the sampled farms. Potato is the other important winter crop as the survey revealed that 63 percent of the household cultivated potato in the winter. There is growing interest in vegetable farming in the winter as the survey show that there is 50 percent increase in the number of household who grow vegetables compared with before situation. With respect to the spring cropping, maize is the main spring crop in SISP supported farms as 40 percent of the households are found to be cultivating maize. The cultivation of spring paddy is the direct function of irrigation facility. Only 17 percent of the household have been able to grow spring paddy due to the limited irrigation facility available in few of the SISP supported schemes. There is rising interest in vegetable cultivation in spring and there is 40 percent increase in the number of households who grow vegetables compared with the before situation. Lack of adequate irrigation facility has constrained vegetable production in the spring.

The survey showed that there is 41 percent increase in the winter wheat cropped area because of water availability under SISP. This percentage increase is 42 for winter potato and 66 for winter vegetable. The yield of winter wheat increased by 78 percent compared with before intervention situation and the rate for potato is 186 percent and vegetable is 93 percent. Thus, there is increase in cropped area and yield as a result of irrigation.
With regard to spring cropping, the survey revealed that there is 150 percent increase in spring paddy cropped area after SISP support. This increase in 250 percent for spring vegetable cropped area. The yield of spring crop in irrigated land increased significantly. The yield of spring paddy increased by 60 percent and the yield of vegetables increased by 32 percent. Thus, the simultaneous effect of irrigation to increase cropped area and yield has resulted in increased production of spring crops in the SISP supported command area.

Regarding summer cropping there is not much change in the cropped year, however the yield level has increased significantly in irrigated land compared with before intervention situation. The yield of summer paddy increased by 46 percent in irrigated land. The effect of irrigation on summer crop is more on increasing yield rather than increasing the cropped area.

It is not only the irrigation that has contributed in raising agriculture productivity in the SISP irrigated farms. The farmers in these farms have combined irrigation with fertilizer and improved seed as well. The survey showed that 90 percent of the households used fertilizers and 67 percent used improved seeds.

Income and Employment

In SISP area, especially in small schemes, cropping intensity has increased. Such increase in cropping intensity has resulted in proportionate increase in demand of labour in the irrigated farms. The study shows that 20 man-days of labour on an average has been hired by each farm household in the study year. This has helped to reduce high underemployment within the farm family and has created employment opportunities for the landless labour and small farmers. The details about labour hired are given in table 5.7 below.

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Sample</th>
<th>Labor Hiring Household</th>
<th>No. of days</th>
<th>No. of days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhagawati Mahila Krishak Samuha: Laxmi Dhiki - Banke</td>
<td>4</td>
<td>1 25</td>
<td>0 0</td>
<td>20 5</td>
</tr>
<tr>
<td>Kalabajar Krisak Samuha: Tube Well Irrigation System - Banke</td>
<td>2</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>Mahadevpuri Sahakari Sanstha: Tube Well Irrigation System - Banke</td>
<td>4</td>
<td>2 50</td>
<td>4 1</td>
<td>6 1.5</td>
</tr>
<tr>
<td>Himali Krisak Samuha: Tube Well Irrigation System - Banke</td>
<td>2</td>
<td>1 50</td>
<td>70 35</td>
<td>75 37.5</td>
</tr>
<tr>
<td>Dhanaraje Irrigation System - Ilam</td>
<td>10</td>
<td>2 20</td>
<td>60 6</td>
<td>125 12.5</td>
</tr>
<tr>
<td>Cha Khola Irrigation System - Kavrebalanchowk</td>
<td>6</td>
<td>3 50</td>
<td>450 75</td>
<td>50 8.3</td>
</tr>
<tr>
<td>Panchkhali Hokse Raj Kulo - Kavrebalanchowk</td>
<td>6</td>
<td>6 100</td>
<td>410 68.3</td>
<td>660 110</td>
</tr>
<tr>
<td>Beltada Irrigation System - Dadeldhura</td>
<td>10</td>
<td>5 50</td>
<td>70 7</td>
<td>70 7</td>
</tr>
<tr>
<td>Lambodar Bandh Irrigation System - Dadeldhura</td>
<td>10</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>Scheme</td>
<td>Sample</td>
<td>Labor Hiring Household</td>
<td>No. of days</td>
<td>No. of days</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>--------</td>
<td>------------------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Barikhet-Ulte Kulo Irrigation System - Palpa</td>
<td>3</td>
<td>1</td>
<td>33.3</td>
<td>100</td>
</tr>
<tr>
<td>Bade Aanap Krishi Samuha: Plastic pond Irrigation System - Palpa</td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>Siddheswar Jal Upabhokta Sangh: Dabka Ghol Irrigation System - Chitwan</td>
<td>6</td>
<td>2</td>
<td>33.3</td>
<td>300</td>
</tr>
<tr>
<td>Nava Durga Krishi Samuha: Branch Canal BL1 of NLIS - Chitwan</td>
<td>6</td>
<td>5</td>
<td>83.3</td>
<td>700</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>70</td>
<td>29</td>
<td>41.4</td>
<td>2664</td>
</tr>
<tr>
<td><strong>Surface Irrigation System</strong></td>
<td>57</td>
<td>24</td>
<td>42.1</td>
<td>2090</td>
</tr>
<tr>
<td><strong>Tube well</strong></td>
<td>8</td>
<td>3</td>
<td>37.5</td>
<td>74</td>
</tr>
<tr>
<td><strong>Laxmi Dhiki</strong></td>
<td>4</td>
<td>1</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td><strong>Pond</strong></td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>70</td>
<td>29</td>
<td>41.4</td>
<td>2664</td>
</tr>
</tbody>
</table>

There is substantial increase in the income level of the farmers in the SISP command area due to the increased agriculture production. Of the total income the contribution of crop is 46 percent and livestock 12 percent and the remaining is mainly from the income earned through working in off-farm jobs.

**Poverty Reduction**

To determine the impact of SISP investment on poverty reduction, sufficiency of food items is used as main indicator. As poverty is the function of income, employment, education, health, sanitation, housing facilities and other social and economic factors, the survey conducted for this study mainly focuses on agriculture production and consumption of food items and their sufficiency to measure reduction in poverty. The household survey revealed that there is substantial contribution of SISP in reducing the poverty and raising their living standards by increasing agricultural production.

The effect on Poverty Reduction has been judged by the sufficiency of food items in the SISP scheme area and also availability of facilities like electricity and Toilet before and after the Programme which has been presented in the Appendix-1 and Appendix-2.

### 5.3 COMPARISON OF THE SISP PROGRAM IMPLEMENTED BY DOI AND DOA

As noted above, the program was started in FY 054/055. Initially, the program was operated by the Department of Irrigation (DOI). From the fiscal year 2057/58 it is being operated by the Department of Agriculture (DOA) under the Ministry of Agriculture & Cooperatives (MOAC). Following few paragraphs present the comparison of modalities of implementation of the program by DOI and DOA.
A. **Implementation process**

Commitments of farmers' participation and genuine demands were the basis for selection of the schemes for intervention while implementing the program by DOI. Interview with DOI personnel suggests farmers had to contribute 25% of the total costs. The District Irrigation Engineer used to approve the project.

Information dissemination, demand collections, preliminary evaluations of demands and feasibility study were the basis of scheme selection when intervened by DOA. The project is first approved by the Agricultural Committee which is then endorsed by the DDC. Following are the detailed selection criteria followed by two departments:

**Under DOI, from 2054/55 to 2056/57**
- Small Irrigation projects are defined those irrigating less than 100 hectares
- FIMS will have priority over new schemes
- Priority should be given to the schemes where higher increase in irrigation area is more with given expenditure. (Investment should not be more than Rs. 20,000 per hectar.)
- Intervened work should be completed in one fiscal year.
- Peoples' participation in the ratio of SISP investment should be 30% in hills and 15% in mountain area.
- Investment should be planned to remain within the SISP allocation for the concerned district.
- Scheme intervened under SISP should not affect second irrigation sector project, Nepal irrigation sector project and other irrigation projects under implementation.

**Under DOA from FY 2057/58 onwards**
- Necessary for farmers but implement able with local skill and experts without any detailed engineering study.
- Schemes should be of public use.
- Schemes include small temporary intakes, kulo improvement/protection, Hume pipe/polyethylene pipe, sprinkler, drip irrigation, pond, rainwater harvesting, protection irrigation canal from landslide.
- Investment limit Rs. 75,000 in one scheme.
- Priority districts for SISP are 21 districts where special Agricultural Production Program is being carried out and 5 districts of Karnali zone under special Agricultural Development Program.
- Scheme should be selected on demand of the beneficiary farmers.
- Farmers' participation is compulsory.
- There should be no duplication with other program.
- Selection should be approved by the District Agriculture Development Program Implementation committee.
- Program should be completed in one year.
B. Implementation capacity

Table 5.8 below shows the allocation and expenditure of SISP resource in the last seven years. The table showed that during the DOI implementation period, percentage expenditure with respect to allocation varied between 81 and 93 per cent. However, during the implementation period of DOA, percentage expenditure with respect to allocation varied between 28 and 61 per cent. This shows that during the implementation by DOI, investment was more with respect to allocation. Availability of technical personnel and experiences with DOI in implementing such projects may be the main reasons for this.

Table 5.8: Budget Allocation and Expenditure (in 000)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Agency involved for intervention</th>
<th>Allocation / Expenditure</th>
<th>Expenditure as a % of Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Allocation</td>
<td>Expenditure</td>
</tr>
<tr>
<td>2054/55</td>
<td>DOI</td>
<td>50,000</td>
<td>44,577</td>
</tr>
<tr>
<td>2055/56</td>
<td>DOI</td>
<td>50,000</td>
<td>40,674</td>
</tr>
<tr>
<td>2056/57</td>
<td>DOI</td>
<td>50,000</td>
<td>46,649</td>
</tr>
<tr>
<td>2057/58</td>
<td>DOA</td>
<td>80,000</td>
<td>44,111</td>
</tr>
<tr>
<td>2058/59</td>
<td>DOA</td>
<td>70,000</td>
<td>19,796</td>
</tr>
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Further, this study suggests that this program needs substantial engineering input in the schemes, which involve the construction of permanent structures. Such input is not available in DOA.

C. Farmer participation

Table 5.9 presents farmers' contribution in implementing SISP schemes under this study.

<table>
<thead>
<tr>
<th>District</th>
<th>System Name</th>
<th>Type</th>
<th>Year</th>
<th>Agency</th>
<th>Invest (000)</th>
<th>HMGN</th>
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<tbody>
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<td>73</td>
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<td>Pond</td>
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<tr>
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<td>Surface</td>
<td>56/57</td>
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<td>34.2</td>
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<tr>
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<td>CKIS</td>
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<td>20</td>
<td>200</td>
<td></td>
</tr>
<tr>
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<td>NDKS</td>
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<td>20</td>
<td>40</td>
<td></td>
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<td>Chitwan</td>
<td>DGIS</td>
<td>Surface</td>
<td>56/57</td>
<td>DOI</td>
<td>77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palpa</td>
<td>PPIS</td>
<td>Pond</td>
<td>57/58</td>
<td>DOA</td>
<td>9</td>
<td>3</td>
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<tr>
<td>Palpa</td>
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<td>50</td>
<td>40%</td>
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<td>Surface</td>
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<td>DOA</td>
<td>50</td>
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<td>DOI</td>
<td>69.5</td>
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<td>Labor</td>
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<td>DOA</td>
<td>230</td>
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<td>30%</td>
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</table>
This table suggests that during the implementation by DOA farmers' contribution varied between 15 and over 100 percent while farmers' contribution in implementing the program by DOI varied between 25 and 40 percent. This suggests that DOA could mobilize more farmers' contribution compared to DOI.

In summary, the study suggests that, DOI had been more efficient in implementing the program and DOA has been more efficient in mobilising others participation for implementing the program. After intervention, the irrigation schemes are to be operated and maintained by the farmers, so for the sustainability of the schemes farmers' participation is an essential component. Therefore, continuation of DOA for implementation seems desirable and arrangements should be made to obtain technical support from DOI.

D. Change in technology and coordination between DOI and DOA

Foregoing sections suggest that there has been change in the adaptation of irrigation technology with the shifting of the SISP implementation responsibility from the Department of Irrigation (DOI) to the Department of Agriculture (DOA). Use of irrigation technology like the treadle pump and Plastic Ponds by DOA are examples of this. Earlier, when the program was implemented by DOI, focus was only on the rehabilitation of FMISs.

Further, with the shifting of SISP implementation responsibility to the DOA from DOI, coordination between these agencies seems to have increased. This is because, the DOA does not have engineering technical personnel at the field level, so DOA field offices normally obtain technical advice from DOI personnel whenever necessary. This interdependency has resulted in increased level of coordination. However, the level of coordination should not only be limited to the exchange of technical advice, there should be meaningful coordination for implementing the entire SISP program.

E. Allocation of fund

- During the implementation by DOI, investment was decided on the basis of list cost. A ceiling of to be 20000 per ha. was decided for this purpose. DOA has not fixed such ceilings.
- DOI had fixed people minimum participation 30% in the hills and 15% in the mountain area. At present DOA criteria has not fixed the limit of such contribution.
CHAPTER VI: FINDINGS AND LESSONS LEARNT

Followings are the findings and lessons learnt from this study:

- The program is being implemented by the Department of Agriculture (DOA) and budget is being allocated on an annual basis in order to provide financial support to the existing small irrigation schemes and to develop new small schemes with appropriate technology.

- The SISP is covering all the seventy-five districts. Priority has been given to the 21 districts where Special Agricultural Production Program is being implemented and to the five Districts of Karnali Zone under Special Agricultural Development Program. Budget is being sent without identifying the need of the districts.

- Prevailing irrigation policy of His Majesty's Government of Nepal has waived out subsidy in the development and management of groundwater resources through shallow tube well. However, this study has found that substantial amount of subsidy has been given to STW and treadle pump. Thus, in SISP subsidy policy of the government is not followed strictly.

- At present SISP is being implemented with the idea that very small irrigation projects will be intervened and local skill and technological support will be enough for carrying out the works. But in some cases more complicated structures are found being constructed by SISP funds. Such projects cannot be technologically sound and are not sustainable. Therefore, technical support from the concerned department is also necessary where major construction works are financed.

- Systems studied are being managed by traditional organization with socially accepted norms and values. These organizations needs to be recognized by the state and their capacity is to be strengthened.

- The study examined four irrigation technologies namely surface irrigation systems, treadle pumps, shallow Tube Wells and plastic ponds. This study suggests that SISP intervention on Treadle pump, Plastic Pond, and micro surface irrigation systems (with small area and short canal length) are highly appropriate in increasing the agricultural productivity. Similarly, SISP intervention in Tube Well increased its efficiency by minimizing the energy need (except in one case). However, intervention in larger surface irrigation systems has not shown promising results from the perspective of increase in agricultural productivity. But, such intervention has been successful in maintaining the present level of agricultural productivity, without which productivity could have been reduced drastically.
• SISP intervention in small irrigation systems is found to be environmental friendly. Even in the case of surface irrigation systems, as the magnitude of SISP intervention is small in scale, no negative environmental effect and health problems were found.

• In the scheme (system) area reliability of irrigation facility has increased, resulting in increase in productivity, crop diversification, cultivation of cash crops including vegetable etc. Supply of other agricultural inputs and market facility needs to be improved.

• The schemes supported are found helpful in poverty reduction and gender friendly by increasing agricultural production, creating employment opportunities etc. In general the socio-economic conditions of the farmers has improved in the area of intervention. Because DOA has emphasized on agricultural production return rather than the technology as emphasized by DOI.
CHAPTER VII: CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSION

- Intervention by the government in the existing small irrigation project is found in accordance with the PRPS/Tenth Plan and broad policy of the government.

- The schemes supported are found helpful in poverty reduction by increasing agricultural production and creating employment opportunities. In general the socio-economic conditions of the farmers has improved in the area of intervention.

- SISP intervention in small surface irrigation schemes (FMIS) and small scale non-conventional irrigation schemes (such as treadle pump and plastic ponds) are relatively more sustainable from the perspective increasing agricultural productivity and maintenance requirement of the systems compared to the intervention in larger FMIS. However, interventions in these larger FMIS systems are also essential in maintaining the present level of agricultural production, without which production could have been reduced drastically.

7.2 RECOMMENDATIONS

- Intervention in small scale FMIS and non conventional irrigation systems such as treadle pumps, plastic ponds, drip/sprinkler irrigation, needs continuation under SISP. Similarly, intervention in larger farmer managed irrigation systems (FMIS) also needs to be continued. However, appropriate guidelines should be developed in selecting FMISs for intervention to avoid repeated intervention. Further, intervention in FMISs should concentrate more on opening the bottle neck constraints rather than investing the scare resources in general maintenance works.

- SISP investment should be used only to meet the capital cost. All local cost of the project should be born by the users themselves.

- SISP investment should be decided on the basis of people participation and economic return from such investment. The present criteria of limiting the maximum investment in one scheme to Rs. 75,000 needs to be increased.

- In the irrigation schemes intervened by the SISP, agriculture extension, market promotion and institutional development activities needs to be carried out by mobilizing local NGO and CBO.
The local governance act and the new irrigation policy (2003) gives mandate to local units (DBC, VDC) for implementing such small irrigation development programs. However, present arrangement of implementation by DOA and any further arrangement will need technical support from DOI for carrying out complicated works in the schemes. Required co-ordination in this regard seems essential.

Presently the Department of Irrigation (DOI) is also implementing such program under the heading entitled 'Modern (non-conventional) Irrigation System Promotion Programs' as set out by the Tenth Plan. Thus, SISP needs to be implemented in coordination with DOI for policy coordination purposes.

Mechanism should be developed to monitor and evaluate the SISP program regularly and to make necessary improvements in the implementation procedures.
REFERENCES


APPENDIX
APPENDIX-1:

Sufficiency of Food Items
# Appendix-1a: Sufficiency of Food Items

<table>
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<tr>
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<th>Cooking Oil</th>
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<th>Fish</th>
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<td>Before</td>
<td>After</td>
<td>Before</td>
<td>After</td>
<td>Before</td>
<td>After</td>
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<td>%</td>
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## Appendix-1b: Sufficiency of Food Items

### Cont...

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<th>Scheme</th>
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APPENDIX-2:

Number and Percentage of Farmers having Electricity and Toilet Facilities
### Appendix-2: Number and Percentage of Farmers Having Electricity and Toilet Facilities

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<th>Scheme</th>
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<td>No: 2, %: 50</td>
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<td>No: 12, %: 120</td>
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<td>Barikhet-Ulte Kulo Irrigation System - Palpa</td>
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<td>Sudheswar Jal Upashodha Sanstha: Dabka Ghol Irrigation System - Chitwan</td>
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<td><strong>Total</strong></td>
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APPENDIX-3:

List and Details of Persons Contacted for Households Survey and Focus Group Discussion
List and Details of Persons Contacted for Households Survey and Focus Group Discussion - Impact Evaluation of SISP

Impact Evaluation of Small Irrigation Special Programme

District: Kavre
Enumerators/Surveyors: Kiran Pradhananga

<table>
<thead>
<tr>
<th>Houseold No</th>
<th>Name of Person</th>
<th>VDC/Municipality</th>
<th>Address Ward No</th>
<th>Name of the Locality</th>
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**Focus Group Discussion- Chakhola Small Irrigation**
1. Dr. Sandhya Basnyat
2. Kiran Pradhananga

**List of Participants in FGD**
1. Bhesh Nath Kafale Farmer
2. Bhim Narayan Nepuane Farmer
3. Anu Pr. Kafale Farmer

**Focus Group Discussion- Panchakhal Hoske Raj Small Irrigation**
1. Dr. Sandhya Basnyat
2. Kiran Pradhananga

**List of Participants in FGD**
1. Ramesh Pr. Kafale Farmer
2. Laxmi Pr. Adhikari Farmer
3. Bidur Nepal Farmer
4. Dhurba Pr Kafale Farmer
List and Details of Persons Contacted for Households Survey and Focus Group Discussion - Impact Evaluation of SISP

**District:** Ilam
**Enumerator/Surveyor:** Madan Khaniya

**Impact Evaluation of Small Irrigation Special Programme**

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<th>Household</th>
<th>Name of Person</th>
<th>Address</th>
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<th>Project Name</th>
<th>Type of Project</th>
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<td>Dhanraje Scheme</td>
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**Focus Group Discussion- Dhanraje Small Irrigation**
1 Madan Khaniya

**List of Participants in FGD**
1 Krishna Bhd Rimal Farmer
2 Laxman Khawas Farmer
3 Yam Bdr Adhikari Farmer
4 Padma Thapa Farmer
5 Radha Khawas Farmer
6 Devendra Rimal Farmer
7 Dhan Bdr BK Farmer
8 Khum Bdr Rimal Farmer

**Focus Group Discussion- Pani Pokhari Small Irrigation**
1 Madan Khaniya

**List of Participants in FGD**
1 Kishor Kumari Khadka Farmer
2 Tika Rai Farmer
3 Netra Eikram Rai Farmer
4 Tara Kumari Rai Farmer
5 Chhabi al Aryan Farmer
6 Dhana Rai Farmer
### List and Details of Persons Contacted for Households Survey and Focus Group Discussion - Impact Evaluation of SISP

**District**: Banke  
**Enumerators/Surveyor**: Indra Raj Adhikary

#### Focus Group Discussion - Banke
1. Dr. K. R. Pantha  
2. Indra Raj Adhikary

#### List of Participants
1. Bhagawati Mahila Krishak Samuha  
2. Kalabanjar Krishak Samuha  
3. Mahadevpuri Biu Aaloo Ut. C.L  
4. Himal Krishak Samuha

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List and Details of Persons Contacted for Households Survey and Focus Group Discussion - Impact Evaluation of SISP

**Impact Evaluation of Small Irrigation Special Programme**

**District:** Dadeldhura  
**Enumerator/Surveyor:** Narayan Lamsal

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**Focus Group Discussion: Bettada Small Irrigation**

1. Dr. K.R. Panta  
2. Narayan Lamsal

**List of Participants**

1. Ishowar Upreti  
2. Min Bahadur Bista  
3. Ban Bahadur Bista  
4. Baharat Bahadur Lohar  
5. Tap Raj Upreti  
6. Jaya Bahadur Dhamai  
7. Tilak Bahadur Dhamai  
8. Bhoj Raj Upreti  
9. Tek Bahadur Dhamai  
10. Shiva Raj Olha

**Focus Group Discussion: Lambodao Small Irrigation**

1. Dr. K.R. Panta  
2. Narayan Lamsal

**List of Participants**

1. Krishna Prashad Bohara  
2. Min Raj Bohara  
3. Ganesh Raj Bohara  
4. Ram Chandra Bohara  
5. Tara Datta Bohara  
6. Namkar Datta Bohara  
7. Jaya Raj Bohara
List and Details of Persons Contacted for Households Survey and Focus Group Discussion - Impact Evaluation of SISP

Impact Evaluation of Small Irrigation Special Programme

District: Palpa

Enumerator/Surveyor: Kiran Pradhananga

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</table>

Focus Group Discussion-
1. Dr. Sandhya Basnet
2. Kiran Pradhananga

List of Participants
1. Birendra Ghimire
2. Chebi Ram Rana
3. Keher Sing Didi
4. Kul Man Chila
# List and Details of Persons Contacted for Households Survey and Focus Group Discussion - Impact Evaluation of SISP

## Impact Evaluation of Small Irrigation Special Programme

**District:** Chitwan  
**Enumerator/Surveyor:** Kiran Pradhananga

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Name</th>
<th>District</th>
<th>VDC/Munic</th>
<th>Ward No.</th>
<th>Tole</th>
<th>Occupation</th>
<th>Name of the Project</th>
<th>Type of Small Irrigation</th>
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<td>Nav Duga Kishna Samuha</td>
<td>Lift up Sub branch</td>
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<td>Flood water Harvesting</td>
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</tbody>
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**Focus Group Discussion - NAV Durga Kishna Samuha**  
1. Dr. Sandhya Basnet  
2. Kiran Pradhananga  

**List of Participants**  
1. Dilli Ram Sapkota  
2. Gobinda Kandel  
3. Tik Ram Niure  
4. Prem Kumar Ghimire  
5. Tirtha Prashad Baniya  
6. Jit Bahadur KC

**Focus Group Discussion - Siddhesawar Jal Upabhokta**  
1. Dr. Sandhya Basnet  
2. Kiran Pradhananga  

**List of Participants**  
1. Dilli Nath Koirala  
2. Phanindra Raj Adhikari  
3. Hari Bilesh Koirala  
4. Rishiram Ghimire  
5. Upendra Koirala  
6. Radha Krishna Acharaya
APPENDIX-4:
Photographs
Photo-01: Temporary Head Work of Panchkhal Raj Kulo, Kavre

Photo-02: Pipe cross drainage at Cha Kholo (Bokse Kholo Irrigation Project, Jaishi Thok, Kavre)

Photo-03: Feeder Canal dropped Cha Khola (near Tree), Panchkhal Raj Kulo, Kavre

Photo-04: Group discussion, Panauti, Kavre
Photo-05: Canal Lining (60.0 m), Nava Durga Kishan Samuha, Chitwan

Photo-06: Command Area, Nava Durga Kishan Samuha, Chitwan

Photo-07: Rain Water Harvesting Plastic Pond, Madan Pokhara, Palpa

Photo-08: Lined Canal and Super passage, Ulti Kulo, Palpa

Photo-09: Head works of Beltada Irrigation Project, Dadeldhura

Photo-10: Main Canal of Beltada Irrigation System, Dadeldhura