Final Report

National Planning Commission Secretariat
M &E Division, SMES 2

Singha Durbar, Kathmandu

Impact Evaluation
of
Sunsari-Morang Irrigation Project

Submitted by

Project Research and Engineering Associates

Lagankhel, Lalitpur

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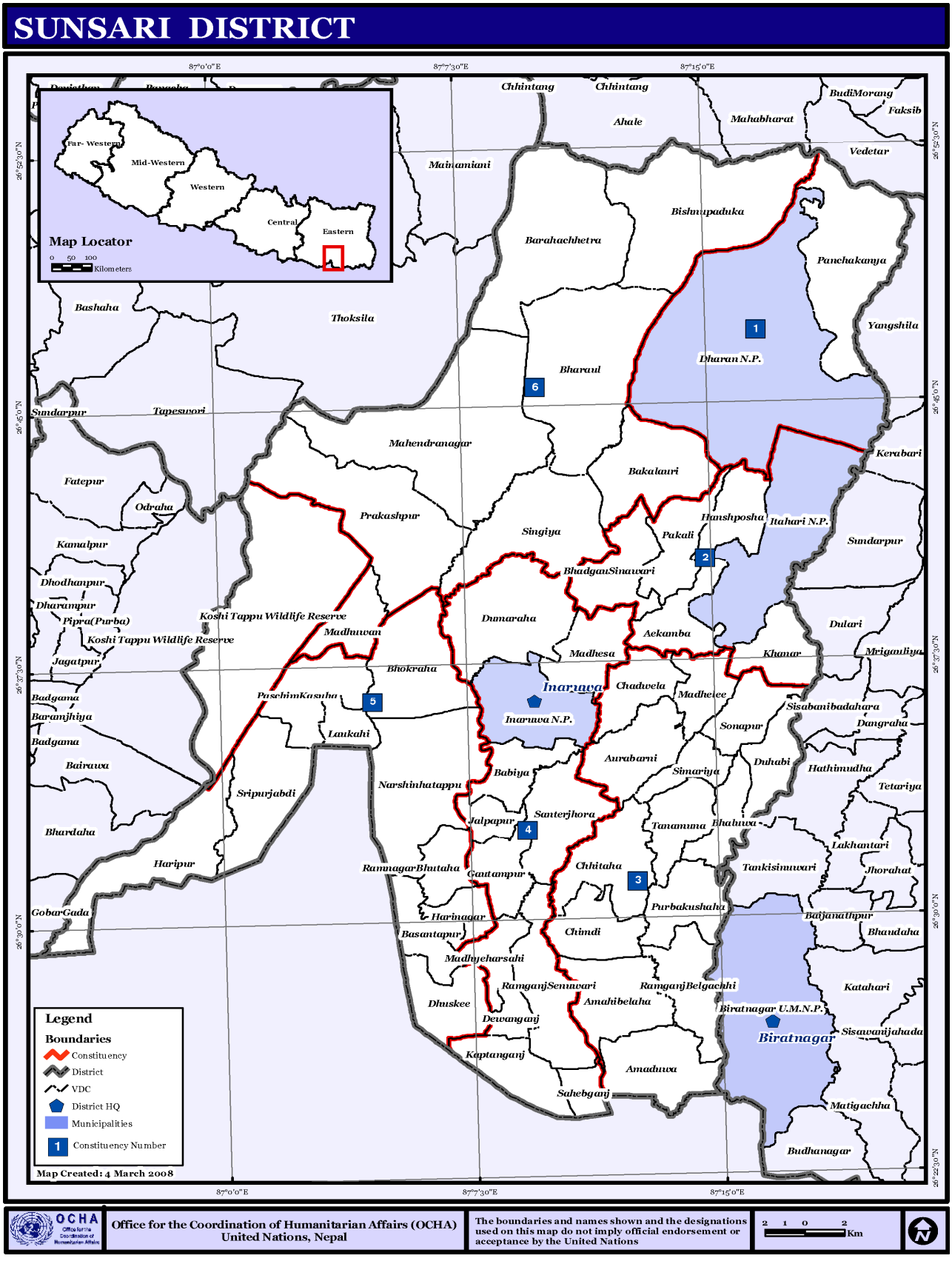
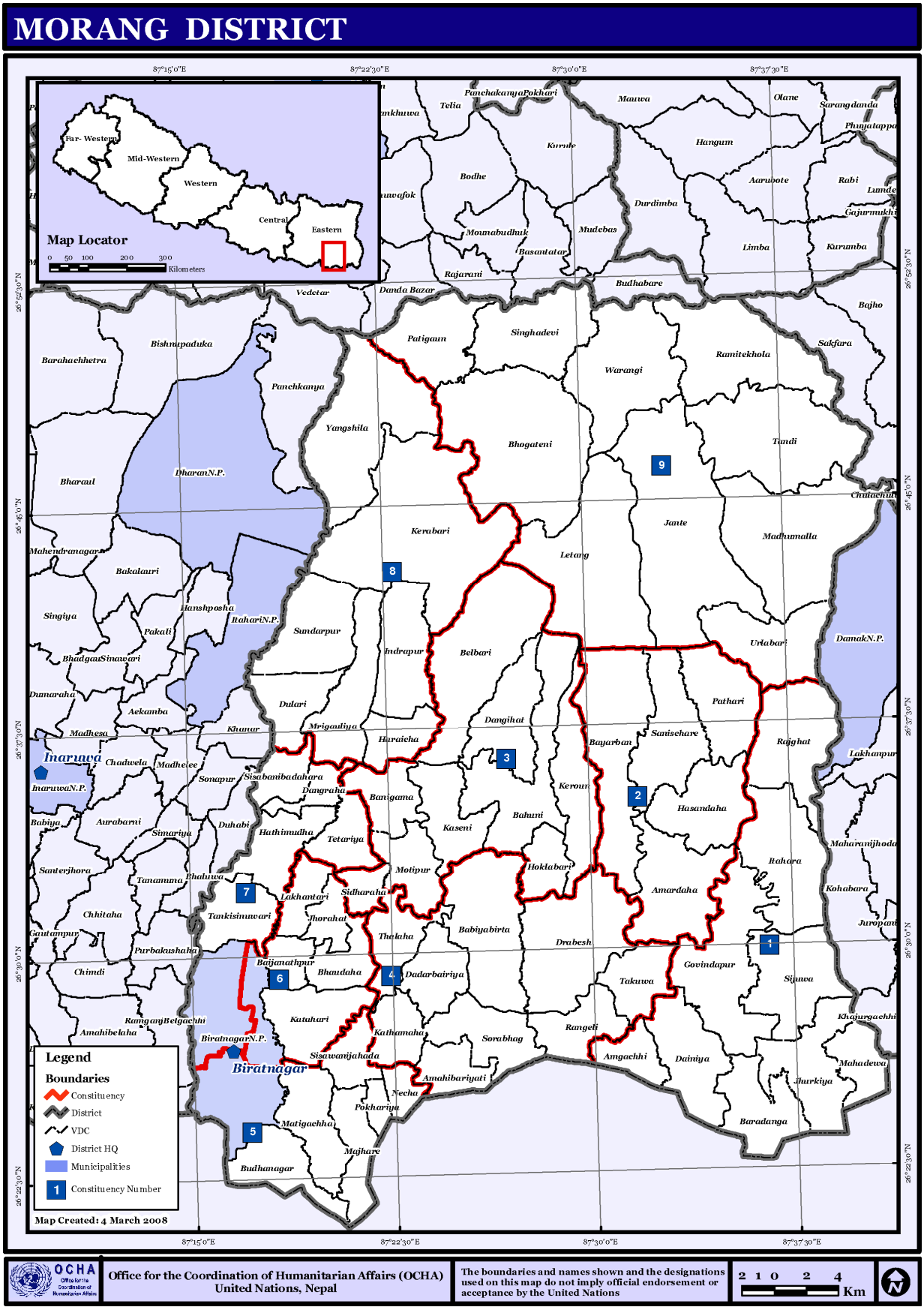
ABBREVIATION AND ACRONYMS

CA	Command Area
CAD	Command Area Development
CMC	Chatara Main Canal
DADO	District Agriculture Development Office
DDC	District Development Committee
DG	Director General
DOA	Department of Agriculture
DOI	Department of Irrigation
EEC	European Economic Commission
EER	Economic Rate of Return
FGD	Focused Group Discussion
FMIS	Farmers Managed Irrigation System
GDP	Gross Domestic Product
GOI	Government of India
GON	Government of Nepal
HR	Head Regulator
HRD	Human Resource Development
ICR	Implementation Completion Report
IDA	International Development Association
INGO	International Non Governmental Organization
IP	Irrigation Policy
IRR	Internal Rate of Return
ISF	Irrigation Service Fee
IWRMP	Irrigation & Water Resources Management Project
KII	Key Informants Interview
M & E	Monitoring and Evaluation
MOI	Ministry of Irrigation
MIS	Management Information System
MOU	Memorandum of Understanding
NEA	Nepal Electricity Authority
NPC	National Planning Commission
NPCS	National Planning Commission Secretariat
O &M	Operation and Maintenance
POE	Panel of Experts
RBME	Result Based Monitoring and Evaluation
RD	Reduced Distance
SAR	Staff Appraisal Report
SMES	Strengthening the Monitoring & Evaluation System
SMHP	Sunsari Morang Headworks Project
SMIDB	Sunsari Morang Irrigation Development Board
SMIP	Sunsari Morang Irrigation Project
TOR	Terms of Reference
WB	World Bank
WUA	Water Users Association
WUC	Water Users Committee
WUCC	Water Users Coordination Committee
WUCCC	Water Users Central Coordination Committee
WUG	Water Users Group

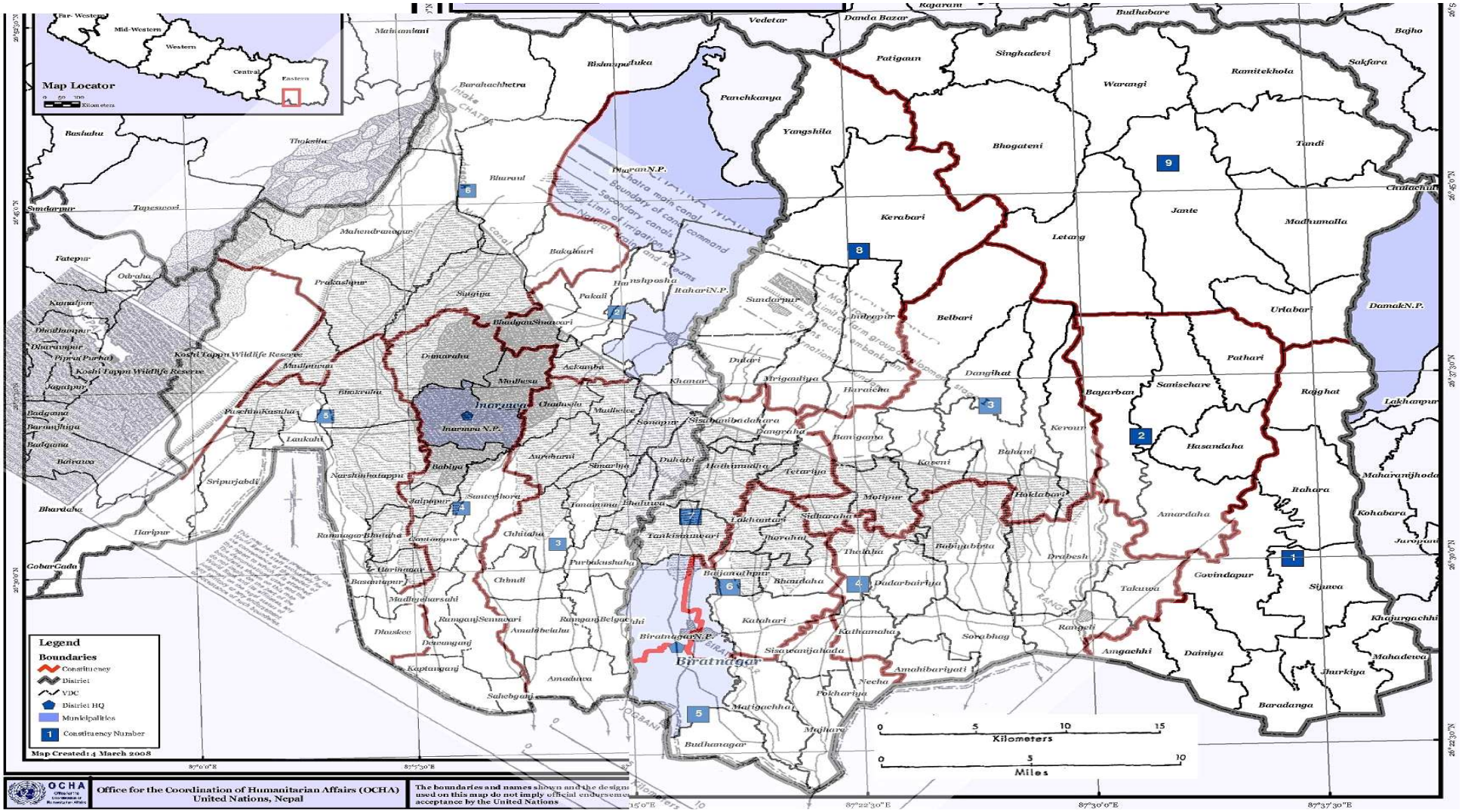
District Map :Sunsari District



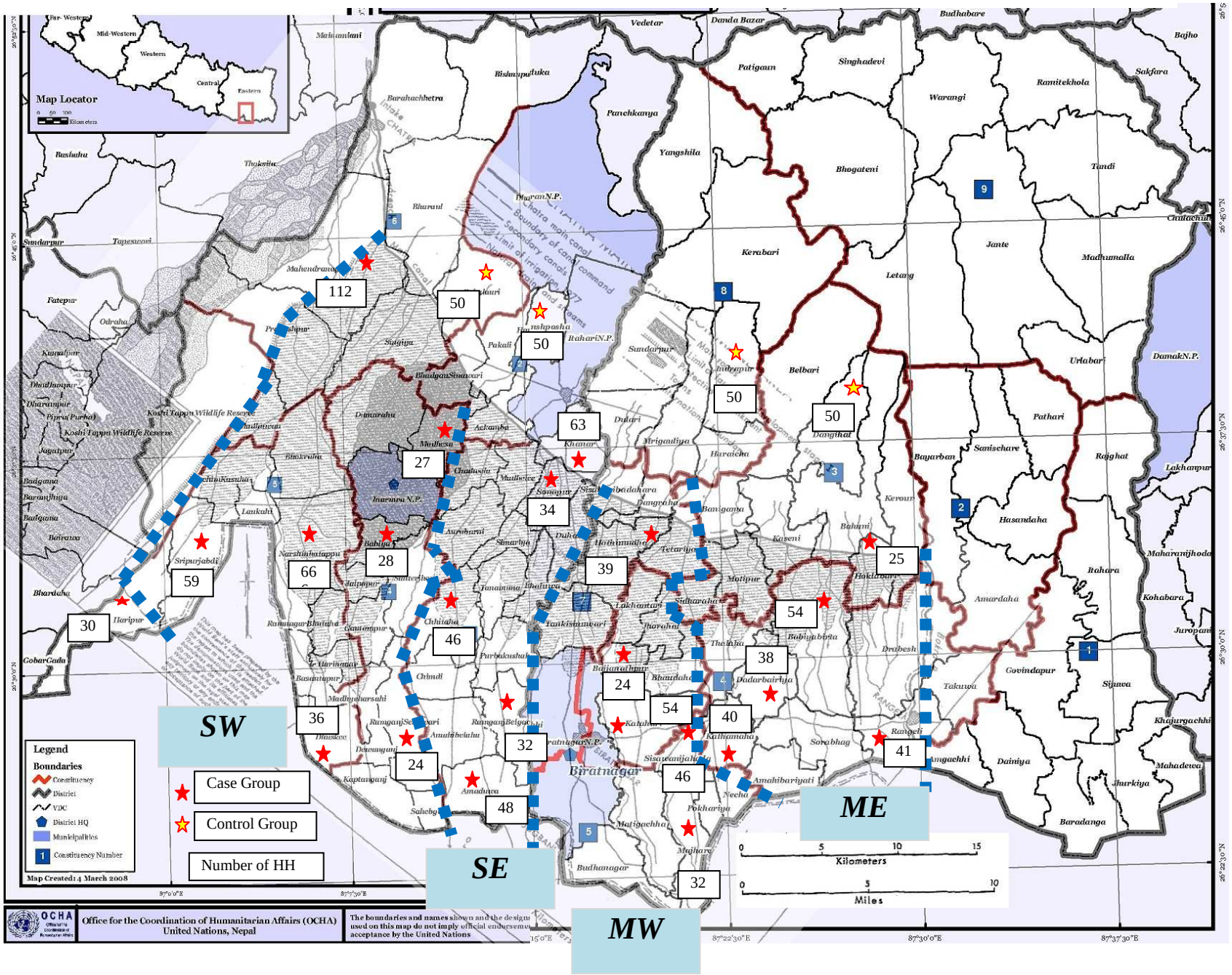
District Map: Morang District



Project Location of SMIP



Map of Study Site: Case and Control Group surveyed HH



Preface

Sunsari- Morang Irrigation Project (SMIP) is one of the largest irrigation projects of Nepal that covers 68000 ha. of arable land in Sunsari and Morang districts. National Planning Commission Secretariat (NPCS) assigned a task to conduct an impact evaluation study of SMIP to PRENA under the technical and financial support of SMES 2 during 2012.

An evaluation team comprising engineers, agronomist and socio-economist carried out an impact study of SMIP. Studies were focused mainly on the prescribed indicators of the project like relevance, effectiveness, impact, efficiency and sustainability. While conducting the studies special attention were also given to the SMIPs physical, socio-economic and technical dimensions. Conclusions and recommendation were made to improve the level of management of SMIP and to formulate the future plan of similar irrigation projects in the country.

We extend our sincere appreciation for the support by Mr. TeerthaDhakal, Joint Secretary, NPCS, Mr. Sushil C. Tiwari, Joint Secretary, MOI and Mr. Kamal Regmi Joint Secretary, MOI, Mr. Khom Raj Dahal DG, DOI and Dr Ryo Sasaki, Team Leader, SMES 2, NPCS. We are also thankful to Mr. Pashupati P. Bhandari, Under Secretary of NPCS, Mr. P. Maskey, SDE of MOI, S.D.H.G Mr. NirShakya of MOI, Mr. BadriDahal, Planning Officer (Eastern Regional Agriculture Directorate), Mr. ManojYadav, DADO (Morang), Mr. K.P. Dawadi DADO (Sunsari) for their valuable support while carrying out the study. Similarly, we are grateful to Mrs. IndraKumariThapaliya, Planning Officer NPCS, and KhagendraSubbha, PC SMES-2 and Mr. Bhim Kumar Shrestha, PO SMES-2 for their valuable support in filed work with us and to give fine shape of the study.

We are also indebted to Mr. P.K. Shahi, Project Manager, Mr. S.N. Yadav, SDE and all concerned field and station based staffs of SMIP for their cooperation throughout the study period. We would like to heart full gratitude to Mr. ArjunNarsingRayamajhi, Team Leader, Dr. Kiran Joshi, Agri-economist, Mr. Tika B. Karki, Senior Agronomist and HemantaKharel, socio economist for their meticulous and timely help bestowed throughout the course of study in the preparation of this manuscript.

We owe profound thanks to Mr. Ram P. Meheta, the Chairman and other committee members of WUCCC, beneficiaries and civil societies, political parties who selflessly helped while carrying out the field studies and preparing the report.

Project Research and Engineering Associates

Executive Summary

Sunsari-Morang Irrigation Project is one of the largest irrigation projects of Nepal to provide irrigation facilities for 68000 ha. of Sunsari and Morang district. The original project was constructed by the Government of India (GoI) and handed over to the Government of Nepal (GoN) in 1975. The system diverts water from the left bank of the Koshi River at Chatara. The intake and main canal were designed for a discharge capacity of 45.3m^3/sec. for continuous supply over the whole original CA. GoN requested IDA assistance to overcome the shortcomings of the original project.The project was constructed on 3 Stages (Stage I, II, and III). At present, Phase II of Stage III is ongoing with GON budget. The developed CA of the SMIP is 39,961 ha.

The evaluation was carried out to find out the (i) fact findings of the project (ii) measure Relevance, Effectiveness, Impact, Efficiency, and Sustainability of the project, (iii) find whether the project target was met or not in-terms of area of irrigated land, product and productivity of crops, and (iv) the recommendations to improve present status of SMIP and utilize the lesson learned in future projects of similar in nature.

The evaluation of SMIP based on the five major criteria and their findings;

Evaluation criteria	Evaluation Result[1]	Main findings (Major fact identified)
1. Relevance	Highly Relevancy (A)	Relevance according the national policy and plans for irrigation. Also the logic of intervention for improvement of agricultural production/productivity and socio-economic situation is rational.
2. Effectiveness (Short-term/Direct effect)	Effective (B)	Significant improvement has been realized on Productivity, productivity, crop intensity, crop pattern from agriculture by irrigation facilities. Paddy Productivity increment on control (without irrigation) 10.38 (mound/bigha)[2], case (with irrigation) 52.39 (mound/bigha). Wheat Productivity increment on control 3.29 (mound/bigha) and Case 3.14 (mound/bigha). New agriculture products are introduced like; banana, vegetables and sunflower etc.
3. Impact (Long-term/Indirect effect)	Moderately Impacted (C)	Socio-economic situation of farmers has been moderately impacted and improved. Responses of farmers are as follows (using Likert scale questions). (+Positively Impacted; Δ Not Significant; - Negatively impacted) + Household income is higher (Case 2.01 and Control 1.31). + Expenditure on family health is better (Case 1.35 and Control 1.24). + Construction and maintenance of house is higher (Case 1.96 and Control 1.64). + Women's drudgery is significant (Case 1.78 and Control1.43). Δ Purchase of household goods is not significant (Case 2.14 and Control 2.10). ΔFamily Education is not significant (Case 2.02 and Control2.07). ΔMajor investment is not significant (Case 2.27 and Control 2.06).
4. Efficiency	Highly efficient	ERR at present is 26 % (planned 17 %) for Stage I

(Cost-benefit comparison etc.)	(A)	ERR at present is 19% (planned 16 % on base case) for Stage II.
5. Sustainability	Sustainable(B)	New intake and silt removable system is sustainable for project. Some structures on CMC need repair and maintenance which could operate for 20-25 years. WUAs are organized and active needs to be coordinated with project and farmers.
Overall conclusion	Satisfactory(B)	SMIP provides irrigation facilities to Sunsari and Morang district which increase the agriculture Productivity and productivity with highly efficiency, and it moderately improved the socio-economic condition of farmers.

[1]Note: Rating criteria:
Relevancy: Highly relevant (A), Relevant(B), Moderately relevant(C), Not relevant(D)
Effectiveness: Highly effective(A), Effective(B), Moderately effective(C), Not effective(D)
Impact: High impact(A), Impacted(B), Moderately impacted(C), and Not impacted/Negative impact (D)
Efficiency: Highly efficient(A), Efficient(B), Moderately efficient(C), Not efficient(D)
Sustainability: Highly sustainable(A), Sustainable(B), Moderately sustainable(C), Not sustainable(D)
Overall conclusion: Highly satisfactory(A), Satisfactory(B), Moderately satisfactory(C), Unsatisfactory(D)

[2]Note: conversion factor
1 Mound = 37.32 kg
1 Bigha = 0.66 hectare

Cropping intensity increased significantly over the projects full development stage. Single cropped area increased from 30728 ha in 1998/99 to 34508 ha in 2011/12, indicating the area under vegetables increased significantly. Overall cropping intensities increased from 184% to 210% in the same period. Grain yields of major cereals and vegetables were found to be increased except in early rice from the base year of 1998/99 to 2011/12. It was due to lower use of input mainly inorganic fertilizers, weed infestation and poor quality seeds of local varieties of early paddy in the CA.

The impact of the irrigation to the socio-economic status of the farmers was improved due to mainly increased in crop productivity thereby farm income, level of expenditure on education, health, house construction/maintenance, women's drudgery, purchased of household goods and major investments.

The efficiency of the project investment based on the cost-benefit analysis indicated thatERR of the Stage I is 26 % (planned 17 %) and Stage II is 19 % (planned 16 %). The present ERR was found to be higher than the ERR indicated as planned of Stage I and II.

Besides the positive impact on agriculture, it also improved the water table of the soil and made available to the crops even when irrigation is not given. Similarly, the impact might be extremely beneficial under the situation of Global Climate Change (GCC). Since, it is said that the water availability to the agriculture is being decreased in coming days the SMIP will directly mitigate the ill impact of GDD. Farmers from CA are experiencing such effect in their farm.

Construction of road along the canal served as transportation of their farm products to the markets and carrying in the daily necessity and agricultural inputs in time and required quantity with reasonable prices.

SMIP has been facing the financial shortage for the development of Stage III-Phase II in order to further extend the remaining area of 29,039 ha. ISF has not been effectively collected for the internal financial management. The durability of the structures at both of the intakes is good. Barrage type diversion system could solve the problem of low flow of water from Koshi to CMC during the dry season. The present supply is around 40-45 m^3/sec, however, the required dischargeis 60 m^3/sec. The discharge in the main canal is low due to the heavy siltation and leakages at several points. The tail portion of SMIP is badly affected due to the low flow of water in the main canal. At several places along the canals the side slope is not maintained which causes leakages of water due to the disturbance in the seepage line. The tail- enders are compelled to adopt the 'Rotation' system to irrigate the crops.

For the sustainable operation of SMIP, diversion weir system is required. SMIP must prepare a 'Maintenance Plan' and allocation of budgets as per the plan must be made internally and externally. For the removal of the deposited silt, operation of two dredgers must be continued. Proper drainage development works should be carried out to minimize water logging and to reduce the retrogression of the rivers/rivulets and developed drains located in the CA.For this the slope of designed side of all the canals must be properly maintained. The encroachment of the canal land must be stopped. The farmers must be persuaded to construct field channels to irrigate their lands as this will improve the efficiency of water delivery. Conjunctive use of surface and groundwater at the tail ends is recommended by developingshallowtube wells.

In order to develop the ownership feeling among the beneficiaries, periodic cash contribution system must be provisioned in each WUAs of CA. There must be provision of granting matching funds from the GON equivalent to the amount of charges incurred for water.

Technological interventions in terms of high yielding and improved varieties of major crops and their crop management technologies are to be developed and promoted through farmer's participatory research approach.Larger plot demonstrations of the best-bet technologies, seed-kit distribution and farmers training and visits are the key approaches to upscale the farmers' technical know-how. Agriculture inputs must be accessible at required quantities with affordable prices.

The organizational structure of SMIP must be output oriented and job specific for each and every staff must be developed and enacted. Based on the performance of the staffs reward and punishments should be enforced. MIS should be developed for effective communication, information dissemination, decision making process on water management, repair and maintenance, CMC management, WUA coordination etc. In order to up-scale the staff capacity, periodic need-based trainings must be organized by SMIP. The elections of executive committees of WUAs should be held as mentioned in their by-laws.

For the successful implementation of larger projects, like SMIP, there should be active participation of all the key stakeholders from initial stage of project identification, planning, implementation, operation and maintenance. The beneficiaries must be organized as WUAs in different levels of irrigation system that are capable of carrying out water management. It is also recommended that WUAs must be responsible not only for the maintenance of canal up to the water course level but should be responsible for the repair and maintenance works up to tertiary level.

Chapter I

Introduction

1.1 Background of the Impact Evaluation

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

Of the all factors of productivity, irrigation plays the vital role and at present of the total cultivated area of 2642000 ha. 2/3rd of is potentially irrigable, however, only 17 % area has year round irrigation. About 4/5th of the agriculture land is under rain fed conditions. An estimate shows that < 8% of the country's water potential is used for irrigation (WECS, 2011). The crops productivity under rainfed is fairly low as compared to irrigated. Under such condition, increase of area under irrigation through new projects or efficiency of existing projects need to be improved. Of the few irrigation projects, SMIP has been one of the largest projects so far in the country.

The Project was started in 1978 and completed its three stages in 2002. The developed command area is 39,961 hectare (Status Report of SMIP, 2069). At present the second stage of the third phase is ongoing. Now the Project is funded by Government of Nepal and only maintenance works are carried out.

The main objectives of the Project were to ensure reliable and equitable water supply, to protect the system from siltation, to improve operation and maintenance procedures with beneficiary participation, to strengthen local capacity through trainings and finally to strengthen linkages between the Department of Agriculture and Department of Irrigation.

Every year Government of Nepal is allocating a substantial amount of budget for several high priority projects. Sunsari-Morang Irrigation Project is one of the recipients of the budget from last 15 years. Further expansion of command area depends from its operation, effectiveness, sustainability and other relevant impacts.

With the introduction of Result Based Monitoring and Evaluation (RBME) guideline, National Planning Commission has started evaluation of high priority and peoples concerned program from independent consulting firms. For future planning of the Sunsari-Morang Irrigation Project, NPC is intended to assess the impact of the Project on agricultural production, employment generation, relevancy, efficiency, sustainability, effectiveness and others aspects. The Ground Water Irrigation Schemes, Farmers Managed Irrigation Systems and other tradtional irrigation

systemsare not considered for evaluation works.The results of the evaluation help for future investment and adaption of necessary policies.

The salient Features of the Sunsari Morang Irrigation Project are given below;

Command Area	
Sunsari District:	40,000 hectare
Morang District	28,000 hectare
Total	68,000 hectare
Chatara Main Canal	
Total length	53 km.
Super Passage Number	8
Aqueduct Number	36
Syphon Number	2
Control Cross Regulator	16 nos
Branch Canal	
Total Length	332 km
Number of Canal	12
Secondary Canal	222 km
Tertiary Canal	185 km
Drop Structure	185 nos
Drop Structure with bridge	74 nos
Number of Bridge	32
Aqueduct Number	36
Drainage System	
Total Length	825 km
Head Reach Intake	
Water Discharge	
Head Reach at Main Canal	
Starting	45.3 Cumex
Present	60.0 Cumex
Flushing Sluice Date 4	1
Pre-settling Basin	300 meter
Regulating Structure	1
Settling Basin	950 m X 60 m
Sediment Discharge Dredger	2 nos
Hydro Power Plant	3.2 MW
New Intake	60m

IDA involvement in the project has been divided into different stages as follows;

Table 1.1: Phase Construction and command are of SMIP

S.N.	Phase	Command Area	Period	Total Investment
1	SMIP-I	9,750 ha	1978-1985	37.5 million USD
2	SMIP – II	16,600 ha	1986- 1997	49.9 million USD
3	SMIP- III (First Phase)	13,611 ha	1997- 2001	39.12 million USD
4	SMIP- III (Second Phase)	Repair & Maintenance	1997- ongoing(recurrent maintenance	NPR, 21,91,77,000 (Government Budget)
	Total	39,961 ha		

Source: SMIP Status Report, 2069.

1.2 Objective of the Impact Evaluation

The main objective of the impact evaluation is to asses the impact of irrigation and its impact on agriculture production and employment creation in the project area. Under this evaluation, output of the project and relevancy, effectiveness, efficiency, sustainability, and impact aspects was examined and investment in the program and benefit accured in the concerned areas was worked out in order to guide the policy for the future investment and project modality.

The scope of the evaluation was to find (i)fact findings of the project (ii) measure Relevance, Effectiveness, Impact, Efficiency, and Sustainability of the project, (iii) find whether the project targeted was met or not in-terms of area of irrigated land, and product and productivity of crops, and (iv) give the recommends to improve the implementation and further plan of similar project.

Fact Findings

The following facts were determined

- Actual number of households benefited.
- Participation and involvement of women, poor families and under privileged castes.
- Role of Water Users Groups.
- Attitude of the beneficiary towards the Project.
- Area covered by irrigation and production and productivity of the land.
- Collection and utilization of the Service fee.
- Other relevant information if any.

Evaluation

The evaluation criteria are as follows:

- Relevance (Consistency with Policies).
- Effectiveness (Short term and Direct effect)

- Impact (Long term and Indirect effect).
- Sustainability (Financial, Technical, Organizational arrangement and Environmental aspects).
- Overall conclusion (integration of five evaluation results)

1.3 Description of Evaluators

The experiences and field of expertise of the principal professionals involved are summarized below.

Mr. Arjun Narsing Rayamajhi: Team Leader:

Mr. A.N. Rayamajhi holds a Master Degree in Hydro-Engineering from Warsaw Technical University, Poland. He also completed Diploma in Sanitary Engineering (equivalent to Master Degree) from I.H.E. Delft (The Netherlands). He has professional experience in the field of water supply and irrigation over 35 years. He had worked with the Department of Irrigation for more than 13 years. He worked as Senior Divisional Engineer in Bhairahwa-Lumbini Ground Water Project, Rajapur Irrigation Project and Bagmati Irrigation Project. His experiences in Rural Water Supply and Sanitation Fund Development Board financed by IDA/ WB will help to carry out the evaluation works and in identifying the problems of WUA and beneficiary farmers and finding solutions with active participatory approach.

Dr. Kiran Raj Joshi- Agri-economist:

Dr Kiran Raj Joshi holds Ph.D in Economics in 1991from USSR. He has M.Sc. in Agri-economics in 1983 and working with Nepal Agriculture Research Council (NARC) as Chief of Monitoring and Evaluation division. He has wide experience on agriculture sector especially on project development, research as well as monitoring and evaluation of various projects.

Mr. Tika Bahadur Karki- Senior Agronomist:

Mr. Tika Bahadur Karki, Ph. D. scholar at Tribhuvan University, IAAS, Rampur, Nepal has a great deal of experience in formulating, designing and implementation agriculture projects across the country. He has been also involved in carrying out the impact studies of various projects run by I/NGOs and GOs.

Mr. Hemanta Kharel-Management

Mr. Hemanta Kharel holds a Master Degree in Economics from Tribhuvan University Nepal. He has completed Professional Coursce in Management of Agriculture and Rural Development from the University of Manchester, UK. and also completed the Professional Course in Management of Local Development from the University of Connecticut, U.S.A. He had worked in the field of Community and Rural Development over 33 years with the Government of Nepal. He has wide experience on management, planning, monitoring and beneficiaries organization.

Mr. Raghab Bista - Project Analyst

Mr. Raghab Bista holds MBA from Tribhuvan University and working as local infrastructure planner and project analyst of the different sectoral and sub-sectoral projects in Nepal since 20 years. He has professional experience on rural transport planning, socio-economic study, cost benefit analysis of the project, impact evaluation of the projects. He worked as team leader on various studies and preparation of DTMP, periodic plans, energy plan with different donor agencies.

1.4 Approach and Methodology of Evaluation

The study approach and methodology of the impact evaluation study has been carried out based on the scope of services of the study. The Consultant's efforts during the assignment arecomprehensively streamlined to meet the objectives by covering scope of services outlined in Terms of Reference.

The Consultant feels that the timely completion of the present assignment is extremely important in the overall implementation of the Impact Evaluation work of Sunsari-Morang Irrigation Project. The inputs of professional manpower and resources were mobilized in order to carry out the evaluation activities as scheduled. The Consultant carried out coordination meetings with the Client agencies, local bodies, users' committees and farmers.

The following general approaches were followed during the study period:

- Selection of those methods and technologies which have been tested and are effective.
- Application of an optimal combination of the methods and technologies based on practicality, project aim, site-specific analysis, and sound professional judgment.
- Selection and mobilization of appropriate technical professional personnel.
- Full use of available and applicable reports, standards, maps/drawings, specification, other information as well as lesson learned in similar projects.
- Completion of the proposed services within the stipulated time and budget.

1.4.1 Management Approach

The following management approaches were pertinent and adopted by the Consultant during the service period:

- Clearly defined roles and responsibilities for each member of the proposed Team
- Work products of high quality with systematic procedures to meet all project objectives.
- Application of financial and management information system at all times.
- Strict adherence to the work schedule.
- Final Report tol be submitted after the approval of the Draft Report.

1.4.2 Approach to Field Works

The field works were planned meticulously and implemented systematically.

- Effective co-ordination and liaison with the Client, field staffs, beneficiaries and Water Uses Groups.
- Close interaction between the team members.
- Good management of logistics.
- Repetition of works to be minimized by good planning and timely communication.
- Preparation and use of standard workable formats.
- Planning of work in such a way that timing is optimized.
- Approach to evaluate routine operation and maintenance plan of action.
- Assess the ownership of project.

1.4.3 Methodology

The methodology has been outlined in the following sub-sections in order to carry out the tasks and activities to meet the scope and objectives of the evaluation. The methodology is based on the analysis of qualitative, quantitative and triangulation of the data and information of the project impact on five evaluation criteria.

1.4.3.1 Desk Study Stage

During this stage of study, the following tasks were performed.

Task-1- Preparatory Meetings

The study team meetings was held at project office and discussed on the study methodology, work plan and preparation of inception report. The tentative field plan was discussed and finalized to carry out the filed work in Sunsari and Morang district. The necessary logistics of the field and office work was managed.

Task-2- Review of the Documents and Information

The secondary information were collected from various sources as; SMIP office, DOI, Ministry of Irrigation, DADO office Sunsari and Morang, web-site and other sources. The document wasreviewed by the team and discussed. The consultant reviewed the reports, documents and publications (referBiblography).

Task-3- Preparation of Questionnaire and Checklist

The team member developed the semi-structured questionnaire for the household survey in order to collect the household information, socio-economic, agriculture production/productivity, impact of irrigation on production, livelihood change etc. Checklist was prepared for the Focused Group Discussion (FGD), discussion with Water User Committee, SMIP staffs, Mixed Groups and other stakeholders. Technical Assessment checklist was prepared to carry out technical observation and assessment.

1.4.3.2 Field Work

The main objectives of the field studywas to assess the existing irrigation system, data collection, observation, focused group discussion, meetings with project office, meeting and discussion with Water User committee and other stakeholders. The field team also verified the data collected during the desk study stage, seked additional data and also carried out observation in the filed data and information relating to the issues as mentioned in TOR.

1.4.3.3Team Field Visit

The study team headed by Team Leader, Agro-economist, Agriculturist, Socio-economist, Project Analyst visited in the Sunsari- Morang Irrigation Project Office and its field offices and interacted with Office in- Charges, technicians, concern officials, farmers and Water User Association officials. The interaction was focused on procedures so far adopted in project identification, implementation, monitoring etc. Other aspects such as role of WUA in project process, level of their participation, linkages and coordination with stakeholders was discussed. The team carried out the discussion, meetings, mini-workshop, observation, technical audit and interaction with Water User's Committee in order to identify the fact finding of the irrigation system in Sunsari and Morang districts. The team divided into groups of technical team, project analyst team and agriculture team in the field. The evaluation was carried out based on the criteria of relevance, effectiveness, impact, efficiency and sustainability of Sunsari-Morang irrigation project. The checklists for different evaluations were used (Annex II). The Consultants visited both districtsand concern institutions in order to collect the data and information. The Consultants reviewed Investment pattern of Government, farmers, private sector within the project area.

Technical Team

The Technical team with SMIP official, visited the Intake and main canal (certain sections) and gave their general assessment of the irrigation system. For, branch canal as a sample, the best performed and worst performed branch canal section in both districts were observed. The structures located in the studied section of the canal were also being observed. Measurement of discharge at Head, Middle and Tail of one branch canal in each district is conducted to find the efficiency of the canal. Water management aspect is also being generally assessed.

Agriculture Team

Agriculture team visited the command area and observed the agriculture field in respect with the production and productivity,cropping pattern, crop intensity, crop diversification, modernization and commercialization of agriculture products. The team assessed the impact of agriculture on livelihood of farmers.

Project analyst Team

Project analyst team visited the field to collect the socio-economic benefits of the irrigation system, project investment, cost involvement on repair and maintenance, income of WUA, budget and financial aspect of the project.

1.4.3.4 Data Collection

Secondary Data collection

The information was collected from the World Bank, Department of Irrigation, Sunsari-Morang Irrigation Project, Water Users Associations etc.

Primary Data collection

Primary Data Collection has been carried out from field visit of the project area. The household survey, Focused Group Discussion, Key Informants Interview werecarried out to the respective informants. Household survey is carried out as **case group**for the beneficiary households who have irrigated land provided by the project and **control group** who have not been provided with the irrigation facilities in Sunsari and Morang district. Local supervisor(2) and surveyors (12) were mobilized for data collections. Semi-Structured questionnaire were used for data collection.(Annex-I).

The surveyors were selected for the data collection in the respective VDCs of Sunsari and Morang district. The selection was based on the qualification and experience of the surveyors. The selected surveyors were provided two days intensive data collection training in Sunsari and piloting at Madhesa and Khanar VDC.

Survey Design

The household are identified with the representative sample household for the survey. Probability sampling design is applied to draw the sample sized of the area. Under the Probability sampling design, Multistage sampling is applied to draw the required sample size. The basic design of the impact evaluation is Matched control (with-without irrigation facilities comparison and Before-after irrigation comparison.

Sample Size

The sample size is representative of the project districts (Sunsari and Morang) and case/control group. The sample size is calculated with statistical estimation by using the formula as follows;

For estimation of population ratio

Condition: Sampling error = 0.05; p=0.5 (if p is unknown, it is recommended to use p=0.05)

Morang District

$$n = N \div \left(\frac{E^2 \times (N-1)}{1.96^2 \times p \times (1-p)} + 1 \right) = 59{,}856 \div \left(\frac{0.05^2 \times (59{,}856-1)}{1.96^2 \times 0.5 \times (1-0.5)} + 1 \right) = 381.7$$

Where,
N= Population
E= Standard Error
p= population ratio

Sunsari District

$$n = N \div \left(\frac{E^2 \times (N-1)}{1.96^2 \times p \times (1-p)} + 1 \right) = 105{,}427 \div \left(\frac{0.05^2 \times (105{,}427-1)}{1.96^2 \times 0.5 \times (1-0.5)} + 1 \right) = 382.8$$

For t-test for dependent sample (one-group before-after comparison)
Morang and Sunsari respectively

<Ideal size>
Condition: d = 0.2 (Small effect); Alfa =0.05; Power = (1-Beta)=0.95

$$n \geq \frac{(Z_{1-\alpha/2} - Z_{\beta})^2}{d^2} = \frac{(1.960 - (-1.6449))^2}{0.2^2} = 324.9$$

<Minimum size>
Condition: d = 0.6 (Slightly more than medium); Alfa =0.05; Power = (1-Beta)=0.80

$$n \geq \frac{(Z_{1-\alpha/2} - Z_{\beta})^2}{d^2} = \frac{(1.960 - (-0.842))^2}{0.6^2} = 21.8$$

=> Use n=25 for each VDC

Sampling Methods

Multistage sampling method was applied in the selected cluster by simple random sampling. Under this sampling methods following steps werefollowed;

Step 1: Stratification of Four study areas of the project; Morang East, Morang West, Sunsari East, Sunsari West

Step 2 : Cluster sampling in each VDC based on the population and select the random number in VDCs

Step 3: Allocate overall sample size for each areas based on the ratio of total population of stratified four areas

Step 4; Decide the sample size of each VDC based on the ratio of population minimum of 25sample households in each VDC within each stratified area.

Sample Size

Based on the above statistical calculation, the total sample population was 765 HH only. However, 1000 HHs were taken as sample size for Case group and 200 HHs were taken for Control Group in the project area. The sample size of Case Group and Control group was 5:1 ratio (1000:200). Academically, the ratio of 3:1 is acceptable (Torgerson & Torgerson (2008). The sample size of Case ad Control Group was discussed and agreed which was representative sample size of the study area. The 5 VDCs were selected in Morang West Case and Control and 5 VDCs from Morang East were taken the HH survey on Case group. 5 VDCs from Sunsari East and 8 VDCs from Sunsari West were selected for HH survey on Case Group. 2 VDC from Sunsari and2 VDCs from Morangwere selected from each cluster(closer to Canal area) on Control Group. The calculation of the sample size of each VDCs according to the formula is given in Annex 8. Based on the above calculation the Sample size of the survey household in Sunsari and Morang district are as follows;

Table 1.2: Sample size on Case and Control Group

S.N.	District	Sample Area	Number of Sample HH	
			Case Group	Control Group
1	Morang	East	173	50
		West	210	50
	Sub-total		383	100
2	Sunsari	East	218	50
		West	399	50
	Sub-total		617	100
	Total		1000	200

Case Group
Case Group are the beneficiaries of the SMIP within the command area where people are getting the irrigation facilities.

Control Group
Control Group are the people out of the SMIP command area where people are not getting the irrigation facilites from SMIP.

Selection of Respondent

The respondents household is selected from sample size of the VDCs applying random/equal interval. The basic criteria of selecting of respondent are the availability of water for irrigation. The survey was conducted by local enumerators. The identification of HH and samplewas calculated as follows;

- Collected the number HH from Voter's list
- Considered the Canal length (starting to ending point)

- HH are selected randomly with the interval of as per table
- Interview of Selected HH of case and control group.

Piloting of Questionnaire

The survey questionnaire was pre-tested in the Madhesa and Khanar VDC. After the field test, the Consultant finalized the questionnaire incorporating the comments and field corrections.

1.4.3.5 Focused Group Discussion

The Focus Group Discussion (FGD) was carried out to the specific groups in the project study area comprising with the discussion to find out the qualitative information. The consultant organized the FGD with beneficiaries, WUA and mixed groups in three different areas. The FGD was conducted with the help of checklists.

Table 1.3: Focused Group Discussion in areas.

S.N.	FGD Groups	Number of Participants	Remarks
1	Beneficiaries(WUA)	20	Representatives of 20 WUAs
2	Project Staff	25	Senior and Field Staffs
3	Mixed Group	25	Civil societies personnel. Project staff, Beneficiaries, political parties, media

FGD was conducted in three places with the target beneficiaries, project staffs, mixed groups. The discussion was carried out with the group based on the checklist. The team members facilitated during the discussions in order to get their discussion effective and get valuable information. Beneficiary group discussion was held at tertiary to central level representatives. The discussion with project staffs was conducted at project office with senior level staff, engineers and field level staffs. Mixed groups discussion was carried out with the representatives of political parties, civil societies, intellectuals, media persons etc.

1.4.3.6 Key Informants Interview

The Consultant carried out Key InformantsInterview to the concerned stakeholders and project related people in order to collect the relevant information and triangulation of respondents information as well. The interview were conducted with

the following officials and people. The checklist was used for the key informants interview.

- Ministry of Irrigation
- Department of Irrigation
- District Agriculture Office
- Sunsari-Morang Project Office
- Water Users Association (central level)
- Political parties
- Local Communities
- Civil Societies

1.4.3.7 Data Analysis

Data analysis is the function to determine the impacts whether occured or not occurred by the project interventions and the degree to which extent of effects were occurred. The approach of data analysis was quantitative methods by comparison and qualitative methods of constructing information.

Quantitative methods

Quantitative methodswasapplied to analyse the data in order to compare with the previous data and current data, compare on Case and Control group before and after irrigation facilities and compare with case group (irrigated area) and control group (unirrigated area).

SPSS program is used for the data analysis. The statistical analysis method is used for the analysis of two values (i.e. before and after). Independent/dependent t-test and multiple comparison tests (ANOVA and post-hoc analysis) are applied.

Qualitative methods

A qualitative method is used to analyse the qualitative information collected from FGD, literature review, interview with key informants and consultant's observation. The analysis comprises with the facts of the project, relationship between the internal and external, issues, and future plan and policies implications. The qualitative analysis methods are given below;

- Situation of the Project
- Classify information according to issues
- Examine relationship among the information
    - Implementation process and input/output of project

- Logical relationship between project implementation and effects
- Relationship between project and beneficiaries.

Triangulation

Triangulation methods were applied to examine data from different perspectives and sources with the reality and cross check. It was combination of qualitative and quantitative data to achieve triangulation with minimum error. The triangulation was used for the verification and validation of analysis as;

- Methods Triangulation; checking the consistency of findings generated by different data collection methods (Quantitative and Qualitative)
- Triangulation of Sources: checking the consistency of different data sources (beneficiary, WUA, local people, key informants)
- Triangulation of Respondents ; Triangulation of the respondents were carried out with the piloting and interview with different respondents.

Consolidating Analyzed Data and Outcomes

Using the quantitative and qualitative analysis, the data is consolidated with the outcomes of the impact evaluation. Cross-tabulation of the data was drawn with basic indicators of the result. The result of the analysis interpretswith value judgment of the study.

1.4.3.8 Impact Evaluation

Based on the data analysis, the output tables are preparedfor the field data which indicates the different aspect of the project helped on fact findings. The basic indicators and parameters are considered for the impact evaluation of the project using five evaluation criteria. The impact evaluation was carried out time comparision of Before and After the SMIP. The time line of Before and After is assumed as in 1985 A.D.before the construction of Stage I and After the completion of Stage I in the command area of 9,750 ha. Similarly, the before and after was assumed in 2001 A.D. where the construction of Stage II and Stage III (first phase) was completed. The evaluation was carried out as follows;

1. Relevance

The government irrigation policy (2060) isanalyzed in respect to Sunsari-Morang Irrigation project. Project analysis is reviewed in terms of relevancy of the Run-off river system.

2. Effectiveness

Effectiveness of irrigation facilities in terms of production/productivity of agriculture in the command area was analyzed on Case and Control group. The direct effect of the irrigation system to farmers especially the marginalized group and change in the livelihood of the farmers was also studied. The statistical analysis was applied with the independent/dependent t-test; multiple comparison test (ANOVA and post-hoc

analysis) for the effectiveness of the project interventions of Sunsari-Morang Irrigation Project.

The descriptive statistics is calculated from the t-test of some relevant questions regarding the irrigation facilities, agri-culture production, effect of irrigation etc. The test is comparison of case and control groups. The case group is the beneficiary of the SMIP having irrigation facilities and control croup is out of SMIP command area.

3. Efficiency

Cost-benefit analysis of the project was evaluated based on the cost benefit ratio of Project Documents. Economic Rate of Return (ERR) was applied for the analysis of efficiency of the project in terms of investment, output and financial sustainability. A comparative analysis was carried out as per project documents and present scenario. 10 % Discounted ratewas taken for the calculation of ERR. ERR was calculated on phase I and phase II of the SMIP implementation.

4. Sustainability

Sustainability is major criteria of evaluation which consist the overall impact of the project. The sustainability is considered with the;

- Financial Sustainability; Government investment in the project, IDA loan, the irrigation tariff, income from farmers, repair and maintenance expenditure, short term financial shortcomings, long term financial requirement, Budget allocation etc.

- Technical Sustainability; discharge, water flow in canal section, life of the canal and existing structure, repair and maintenance of canal etc. Technical information was gathered from the project staff regarding the sustainability.

- Organizational arrangement/Management; Existing organizational structure, Staffing pattern, Staff movement, Job analysis, Field staff, supervision and monitoring, MIS on irrigation.

- Environmental Sustainability: Environmental degradation, soil erosion, flood, plantation and vegetation etc.

- Other general information; WUA's meeting observation and minutee, observation of repair and maintenance, decision making process of WUA's were analysed.

1.4.3.9 Dissemination of Impact Evaluation

The first draft report was submitted to the NPCS. The powerpoint presentation was carried out to the Task Force of SMES and discussed. Second Draft Report was prepared incorporating all the comments from the concerned line agencies, project, NPCS and SMES office. The second draft report was submitted to the NPCS and power point presentaton was also carried out. Final Draft Report waspresented at Harka Gurung Hall at NPCS on December 7, 2012. The Final Report is prepared after incorporating all the comments on final draft report.

1.5. Limitation of the Evaluation

The impact evaluation study of SMIP was carried out in the filed as per the provided ToR and instructions provided from the NPC, SMES. The limitations of the study are given below;

1.5.1 The study time was not favorable for field work due to the heavy rainy season which hampered the completion of Field Survey.

1.5.2 Due to busy and working season, most of the respondents were reluctant and aggressive to provide the information. There were number of surveys and interview conducted so many times by different organization in the area. Farmers were worried about fertilizer; seed and water for paddy plantation during our survey time and they were not interested for this study.

Chapter 2

Background of SMIP

2.1 Background of the SMIP

Nepal has abundant water resources, including major river systems with annual discharge totaling 150 billion m^3, and capable of irrigating 6 to 8 MT/ha. Irrigation sector has been developing from the First Five Year Plan in 1957. The emphasis has given in the Fifth Plan towards the completion of on-going schemes and new investment in projects with short gestation period and high returns.

Under the Koshi Project Agreement in 1954, as amended in 1966,Nepal has the right to withdraw any required quantity of water from the Koshi river and itstributaries, and India has the right to regulate the balance and to generate power at the Indian-built Koshi Barrageabout 30 km downstream of Chatara. In 1964, HMGN entered into an agreement with the Government of India (GOI) under which GOI undertook to construction of the Chatara Canal Project (CCP) as part of the overall aid made available by India to Nepal. Headworks for the withdrawal of water for the project were constructed at Chatara, immediately downstream of the gorge from which the Koshi debouches on to the Terai plain.

CMC runs along a contour 100m above sea level and commands the area limited by the Bakra River to the east, the boundary between Nepal and India to the south, and by a flood bund on the left bank of Koshi to the west. The irrigation scheme is about 45 km from east to west, and varies in width between 20 and 25 km from north to south. The irrigation system consists of the 50 km CMC, 17 km of branch canals, 210 km of secondary, and only 105 km of tertiaries. The system is designate to irrigate an area of 68,000 ha. of Sunsari and Morang district.

The existing condition of the CMC had some defects.Downstream of Chatara, the Koshi River flows across an alluvial fan, at the head of which is divided into two channels. The main steam flows on the right of the river, and a subsidiary channel supplies to the CMC into on the left bank. The main channel has recently been shifting further to the right, resulting in increased sediment disposition on the left, thus extending a large shoal which is progressively restricting flow in the subsidiary supply channel. As a result, the intake may be isolated from the river by the shoal

during the dry season within the next four years and suspended sediment content in the intake channel exceeds 3 grams/liter(the World Bank, 1978, pp7).

Below the intake, CMC passes through a 9 km long headreach in 10 m deep cutting. It is crossed by 6 large super passages (cross drainages structures) in the headreach for disposal of the flood flows from the foothills.Due to inadequate design of these structures, flood flows have occasionally spilled into the canal, causing considerable damage and interrupting irrigation supplies. Other frequent cause of canal closure is breaches which occurthrough weak embankments. This weakness is aggravated by the high water levels at which CMC has to be operated due to heavy sediment deposits. Removable of sediment requires canal closure for maintenance to be lengthened from one month to at least 4 months, thus limiting operation of CMC in dry season.

There was no flow regulating structures in the secondary and tertiary canals. The distribution system was therefore uncontrolled. Construction of distributary canals was terminated wherever each canal decreased in capacity to 0.14 m^3/sec and the system was therefore incomplete. As a result only about 35,000 ha command area receives some irrigation supplies (ibid).

Koshi River has a catchment are of 58,000 km^2 , of which almost a third lies in China. The river is notorious for its high sediment content which rises to about 20 gram/liter (2 % by weight) during monsoon floods (June-August) is reported to the fourth most sediment-laden river in the world.

SMIP Stage -I

Sunsari Morang Irrigation and Drainage Development Stage I Project was identified by 1975 IDA mission in line with HMG's objectives of upgrading and exploiting existing irrigation schemes as well as to develop the capacity of CMC and irrigation system. HMGN later engaged the consultant's service of Nippon Koei (Japan) to assist in the project feasibility study. During IDA appraisal in September 1977, a careful review of implementation capacity, project organization and farmers' participation was carried out, to determine an appropriate project design, including the construction schedule. SMIP-I was IDA financed to overcome these shortcomings by modification and rehabilitation of the system in planned manner with the development of 9,700 ha.

SMIP Stage-II

After completion of SMIP-I stage from 1978-1985 and completed with extension of three year in 1987. The SMIP –II was implemented to support for modification and rehabilitation of Sunsari Morang Irrigation System (SMIS). The total command area of SMIP was originally defined as 68,000 ha. The project aims at increasing agricultural production and farmer's incomes through the rehabilitation and improvement of existing irrigation and drainage system and the efficient utilization of available resources.

Sunsari Morang Headworks Project (SMHP)

The existing intake has less efficient and problems on water supply to CMC. The discharge of the CMC was reduced and not maintained as per the designed discharge. IDA team carried out the study for the new intake system with good efficiency and adequate discharge. The components of SMHP was not only the construction of intake but it has constructed the pre-settling basin, settling basin, regulating feeder tunnel canal, 3.2 MW hydro electricity.

SIMP-Stage III, Phase I

The stage III -Phase I project was carried out for the further development of the command area and rehabilitation of the CMC and improvement of the Budhi Aqueduct. This phase has continuation of the second phase for the development of the remaining command area of the SMIP. The stage was funded by the World Bank and GoN contribution.

2.2 Objectives of the SMIP

The major objective of SMIP-I is aimed to rehabilitate the largest existing irrigation schemes with the objectives of a) restoring the system to its original scope and capability; b) improving the reliability of water deliveries, and therefore to increase farmer's confidence in the system and c) accelerating agricultural development and thus increasing farmer's income and rural employment.

SMHP had provisioned for construction of new intake in the upstream of old intake for the reviving the discharge to CMC in order to full fill the objective of SMIP to enhance the capacity of CMC. The settling basin and operation of two dredgers are another important work to control the silt.

2.3 Description of SMIP

SMIP project was located in Sunsari and Morang districts in the Eastern Development Region of Nepal. The project was developed for the irrigation of the terai plain land which is highly potential for agriculture. There is some description of the project;

2.3.1 Topography

The topography of the project is flat land with subdued micro-relief features. The slopes from north to south with an average gradient of 1:700lackening to south. The elevation of the project area varies from 60m AMSL to 107 m AMSl at intake site. There are number of river and rivulets crossing the CMC.

2.3.2 Project components

The project was carried out in different construction works and implementation in periodic basis. The overall project was completed with different stage and phases are given below;

SMIP-I

Main Project Components:

a) River control and flood protection works on the Koshi river in the vicinity of the Chatara Main Canal (CMC) intake
b) Sediment control arrangement at the CMC intake and along CMC
c) Restoration and improvement of the canal system and provision of about 180 new structures throughout 66,000 ha.
d) Planning and design of complete minor distribution canals extending to outlets serving 10 ha groups of farms throughout an area of about 18000 ha. And within this area, construction of canals and drains serving 6,400 ha.
e) Drainage improvement covering 12000-15,000 ha.
f) Pilot schemes for tubewells, improved water management and canal micro-hydroelectric developments;
g) Strengthening agricultural extension, research and training activities throughout Sunsari and Morang districts
h) Equipment and vehicles for construction, survey and laboratory activities and project operation and maintenance
i) Building for engineering and agricultural activities and staff housing;
j) Technical Assistance

Benefits and Justification of SMIP-I

The overall impact of the project at full development can be summarized as follows:

- Increase in Net irrigated area (ha) 31,000
- Increase in crop area under irrigation (ha) 49,000
- Increase in net foreign exchange earnings (US$) 2M per year
- Farm Employment generated (jobs) 10,000
- Non-farm employment generated (jobs) 5,000-7,000
- Economic Rate of Return 17 %
- Discounted costs and benefits over 50 Years period
- Command Area Development of 9,700 ha

SMIP-II

Project Components

a) Improvement of Chatara Main Canal (CMC) including modification of head regulator, repair to main super passages, rehabilitation of drainage chutes on the headreach, replacement of gates and repair of head regulators of distributary canals, completion of bridges; repair and improvements to cross drainage works, siphons and access structures, replacement of cross aqueduct structures and other miscellaneous minor works including desilting of CMC
b) Improvement of desilting operations to provide a feasible desilting facility determined by the studies during the first two project years by evaluating further the viability of mechanical solutions (larger desilting basin provided with portable suction-cutter dredgers)against hydraulic flushing.
c) Rehabilitation and Improvement of irrigation distribution and drainage networks in Stage II area (16,700 ha)
d) Modification to the irrigation block headquarters
e) Procurement of equipment, vehicles and spares of O & M and installation of radio communication for the system operation and equipment necessary for desilting
f) Technical Support and Training through the provision of consultancy services for design and supervision of construction, training, monitoring and evaluation and studies and
g) Support for incremental project establishment and maintenance costs.

Technical Panel of Experts (POE) invited to review the sediment study in 1990 in order to find out the solution of sediment removable by mechanical desilting versus hydraulic flushing. The consultant and POE advised to make the intake site upstream to solve sediment problems in monsoon and acute water intake problem in dry season. The IDA agreed on Consultant's and POE's recommendations and decided to modify the SMIP-II by i) moving the intake site 1,300 m upstream of existing intake; ii) constructing a larger capacity desilting basin c) utilizing dredgers to remove deposited silt from the desilting basin; and iii) constructing a micro-hydro unit in headreach of the main canal to provide hydro-power for dredger operations. The amendment of the SMIP II did not cover full funding requirement for thee additional facilities. Then the ID credit is added in 1992 for implementation of a new Sunsari Morang Head Works Project (SMHP). There was a time gap of about four years in between the commencement of SMIP and SMHP.

Benefits and Justification of SMIP-II

The overall impact of the project at full development can be summarized as follows:

- Increase in irrigated area (ha) 16700
- Incremental food grain production (ton/yr) 31920
- Incremental oilseed production (ton/yr) 1870
- Farm Employment generated (man/year) 2,400
- Directly benefiting farm families (no) 8,560
- Economic Rate of Return 16 %
- Discounted costs and benefits over 30 Years period

- Command Area Development of 16,700 ha

SMHP

Project Components

a) Construction of new intake at upstream of Koshi river 1300 m from old intake at capacity of 60 cumex.
b) RCC culvert 1000 m of 3 barrel
c) 300 m Pre-settling basin
d) Regulator structure at old intake
e) Construction of Tunnel of 4.57 diameter 180 m on Regulating structure to Feeder Canal
f) Settling Basin of 900m length and 60 m width.
g) 3.2 MW hydro power
h) Two dredgers with 14 inch cutter
i) Transmission line of 33 KV to Dharan substation.

SMIP Stage III-Phase I

Project Components

a) Improvement works on CMC
b) Command area development of 13611ha. from Biratnagar branch to Harinagara Branch
c) Construction of 5.5. km. left Embankments on Koshi river
d) Improvement works on Budhi Aqueduct.

2.3.3 Socio-economic

The project has directly affected to 34 VDCs in Morang and 33 VDCs in Sunsari district. The socio-economic status of the project area comprises with the irrigated area of SMIP and control groups.

2.3.3.1 Demographic

The population of the project is the total population of the district directly or indirectly of Sunsari and Morang districts

Table 2.1 : Population of Sunsari and Morang district

S.N.	Description	Sunsari	Morang
1	Total Population	625633	843220
	Male	315530	422895
	Female	310103	420325
2	Humber of Households	120295	167875
3	Average Household Size	5.20	5.02
4	Area in Sq. Km.	1257	1855
5	Population Density	498	455

Source: Population Census, CBS, 2001.

The sample survey conducted during the impact evaluation study is considered with the cast distribution of the irrigated areas are as follows;

Table 2.2 : Cast/ethnicity of Sampled HH

S.N	Cast	Case Group		Control group	
		Number of HH	%	Number of HH	%
1	Bharman	88	8.8	33	16.5
2	Chettari	71	7.1	26	13.0
3	Newar	11	1.1	8	4.0
4	Tharu	57	5.7	7	3.5
5	Muslim	111	11.1	2	1.0
6	Chaudhari	109	10.9	37	18.5
7	Yadav	55	5.5	2	1.0
8	Gurung	11	1.1	4	2.0
9	Magar	5	0.5	2	1.0
11	Rai	16	1.6	22	11.0
12	Limbu	4	0.4	2	1.0
13	Kami	6	0.6	2	1.0
14	Sarki	2	0.2	1	0.5
15	Damai	5	0.5	2	1.0
16	Terai (Brahmin)	234	23.4	28	14.0
17	Terai (Dalits)	215	21.5	22	11.0
	Total	1000	100	200	100.0

Source: Field Survey, 2012

The above table shows that the cast/ethnic distribution of project areas of case and control group. The terai brahmin and terai dalit cast constitutes the highest percentage in case group. Chaudhari cast is highest percentage in control group.

Family Size

The family size of the sampled area was found with the number of family members in different levels. The family size of the study area is given below;

Table 2.3 : Family Size of Sampled HH

S.N.	Family size	Case Group		Control Group	
		Number of HH	%	Number of HH	%
1	1-3	64	6.4	20	10.0
2	4-6	595	59.5	123	61.0
3	7-10	265	26.5	47	24.0
4	More than 10	76	7.6	10	5.0
	Total	1000	100	200	100.0

Source: Field Survey, 2012

The family size of the project area revealed that 4-6 member family is highest of 59.5 percentage in case group. The family size of 4-6 members is found 61.0 % in control group. There is also 7.6 percentage of households having more than 10 members of the family in case group whereas 5 % members having more than 10 family size in control group.

Period of Living

The living status of the people comprises with the migration and permanent residing in the project. The living period is given with the certain ranges of the time period for their living status as follows;

Table 2.4 : Period of Living of Sampled HH

S.N	Period of living	Case Group		Control Group	
		Number of HH	%	Number of HH	%
1	From the beginning	502	50.2	72	36.0
2	2-5 Years	21	2.1	3	1.5
3	5-10 Years	25	2.5	7	3.5
4	10-15 Years	41	4.1	11	5.5
5	15-20 Years	153	15.3	12	6.0
6	> 20 Years	258	25.8	95	47.5
	Total	1000	100.0	200	100.0

Source: Field Survey, 2012

The above table shows that there is 50.2 percentage households are residing permanently from the beginning as ancient period in case group. Similarly, 36.0 % are living from the beginning in control group. There are 25.8 percent households living more than 25 years in case and 47.5 percentage in control group.

2.3.3.2 Economic status

The economic status of the project area is taken into consideration from the field survey of the SMIP which generally discussed with the major occupation and food sufficiencyof the households.

Occupation

The major occupation of the study area comprises with the agriculture, business, government/private services, industry, labour and other income. The income distribution of households is categorically given below;

Table 2.5 : Major Occupation of Sampled HH

S.N.	Main Occupation	Case Group		Control Group	
		Number of HH	%	Number of HH	%
1	Agriculture	707	70.7	118	59.0
2	Business	72	7.2	20	10.0
3	Government or Private Service	42	4.2	17	8.5
4	Industry	24	2.4	0	0.0
5	Labour	130	13	33	16.5
6	Others	25	2.5	12	6.0
	Total	1000	100	200	100.0

Source: Field Survey, 2012

The above table indicates that the income of household is dominated by agriculture with 70.7 percent in case group and 59.0 percentage in control group. The wage labour are 13 percent in case group and 16.5 percent in control group.

Food Sufficiency

Food sufficiency of the study area is taken with sufficiency period of the households which indicates the well being of the house and agricultural production.

Table 2.6 : Food Sufficiency of Sampled HH

S.N.	Food Sufficiency	Case Group		Control Group	
		Number of HH	%	Number of HH	%
1	< 3 months	124	12.4	41	20.5
2	3-6 Months	241	24.1	40	20.0
3	6-9 months	253	25.3	26	13.0
4	9-12 months	382	38.2	93	46.5
	Total	1000	100	200	100.0

Source: Field Survey, 2012

The food sufficiencyindicates that there are 38.2 percentage households are sufficient 9-12 months in case groupand 46.5 % in control group having the surplus of the food. The sufficiency of less than 3 moths is 12.4 percent households in case group and 20.5 % in control group which has hardship for food.

2.4 Cost Invested of SMIP

The cost of the project is calculated in different stages and phases on the funding of the GOI, World bank, EEC, GoN. The investment of the SMIP project designing, construction, implementation, operation and maintenance works and post construction regular budget is given below;

Table 2.7 : Cost Invested in SMIP

S.N.	Cost components	Period	US $	NRs.
1	Indian Government Support Cost of CMC	1964-1975	16,000,000.00	200,000,000.00
2	Stage I-	1978-85	37,500,000.00	579,130,587.00
3	Stage II	1986-1997	49,900,000.00	1,926,076,161.00
4	SMHP	1992-1997	29,600,000.00	1,441,073,293.00
5	Stage III-Phase I	1997-2001	39,200,000.00	2,234,400,000.00
	Total		**172,200,000.00**	**6,380,680,041.00**
	Regular Government Budget			
	Budget	Amount		
	F.Y. 2061/62	98370000		
	F.Y. 2062/63	104000000		
	F.Y. 2063/64	59985000		
	F.Y. 2064/65	143402000		
	F.Y. 2065/66	237656000		
	F.Y. 2066/67	156660000		
	F.Y. 2067/68	219177000		
	F.Y. 2068/69	297921000		
	Total	**1317171000**		

Source: Project Office and DOI, 2012.

The total investment cost of the project was US $ 172,200,000.00 USD and NRs.6,380,680,041.00 and the regular budget of NRs. 1,317,171,000.00

2.5 Plan and Achievement of Project

The project was constructed stage wise in different period for the development of command area. The plan and achievements of the project is given below;

Table 2.8: Plan and Achievement of Project

Stage	Period	Command Area Development
Stage I-	1978-85	9,750 ha
Stage II	1986-1997	16,600 ha
Stage III-Phase I	1997-2001	13,611 ha
Total		39.961 ha

The total target of the SMIP is 68,000 ha. year round irrigation in the Sunsari and Morang districts. The presentdeveloped areas is only 39,961 ha. which is 58.7 % of the total target.

2.6 Comparative Investment of SMIP and Mahakali Irrigation Project (MIP)

The comparative investment of the SMIP with MIP was carried out on the basis of following reasons;

- Both the project were financed by the World Bank.
- Both the projects are large scale irrigation systems.
- Both the projects are similar nature of surface irrigation.

SMIP and MIP was compared on cost investment , ISF collection and command area development.

Table 2.9: Comparative Investment of SMIP and MIP

Particular	SMIP	MIP
Total Command Area* (ha)	39931	11674
ISF Collection Rate	Rs 300.00/ha/year	Rs 300.00/ha/year
Project Cost**	Rs. 6380.68 million	Rs. 9798.5 million
Cost per hectare	Rs. 159,792.00	Rs. 224,355.00

Source: DOI and project office, 2012.

* For the case of MIP, the future development of 32,000ha. command area of stage III is considered. In case of SMIP, the total command area is considered 39,931 ha as CAD is carried out only for 39931 ha.

** For MIP, the estimated cost (Rs. 8000 million) for the development of Mahakali stage III is added whereas for SMIP project cost is considered from initital stage to stage III (Phase I).

The allocation of budget for the last 4 years of SMIP and MIP is presented below;

Table 2.10: Comparative Budget of SMIP and MIP

(Rs. in million)

Description	SMIP				MIP			
	F.Y. 065/066	F.Y. 066/067	F.Y. 067/068	F.Y. 068/069	F.Y. 065/066	F.Y. 066/067	F.Y. 067/068	F.Y. 068/069
Operation Cost	18.28	21.76	27.87	25.82	5.43	6.57	12.59	10.23
Capital Cost	75.00	77.90	191.30	272.10	35.50	37.70	78.42	171.51

Source: DOI and project office, 2012.

The following are the findings of comparative study of SMIP and MIP.

- Per hectare development cost of SMIP is much less than MIP. The development cost per hectare for MIP will be even higher when stage III is completed.

- The allocation of yearly operation and capital cost of MIP with the development of 11,674 ha. CA is relatively higher than the budget allocation for the SMIP.

- The above comparative investment cost of two projects justifies that SMIP should be continued and additional investment should be arranged to develope remaining command area.

Chapter 3

Evaluation Results

3.1 Relevance (Consistency with governmental policy, logic of the project and need of people/farmers)

When the project was formulated, there was no such irrigation policy developed. Before First Five Year Development Plan in 1957, Nepal had few irrigation works undertaken by HMGN. During the Second Five Year Development Plan (1962-65), HMGN's irrigation programs were concentrated on the building of large system in Kathmandu Valley, Eastern and Mid-Western Terai regions. Third Plan emphasized a program was launched for construction of minor irrigation projects, to encourage greater farmer participation and to expand irrigated areas rapidly. Fourth Plan has prioritized to a policy of constructing medium-sized irrigation projects,mainly in Terai. Fifth Plan had given emphasis towards the completion of on-going schemes and new investment in projects with short gestation periods and high returns.

Tenth Plan period was achievement of development irrigation infrastructures was in 87,485 ha. and rehabilitation and improvement of FMISs in 14,298 ha. that include surface (25,504 ha) and groundwater (47,683 ha) respectively. The Interim Plan (2007-2010) has priorities for the irrigation sector comprising the development of the additional irrigation facilities in the country. The target of the interim plan is given below;

Table 3.1: Target of the Interim Plan (Irrigation Sector)

S.N.	Program/Projects	Physical Target (ha)
1	Infrastructure Development for Expansion of Irrigation in New areas a) Surface Irrigation Schemes - 58,900 ha b) Groundwater Irrigation Schemes-37,400 ha c) Non-conventional Irrigation Program 1,600 ha	95,900
2	Rehabilitation and Expansion of FMIS	23,700
3	(A) Sustainable Management of Existing Irrigation Schemes (3,29,720 ha) (B) Irrigation Management Transfer of Irrigation Schemesin Operation (24,000 ha) (C) Rehabilitation and Improvement of Large Irrigation Schemes (27,000 ha) (D)Rehabilitation of Flood/Landslide Damaged IrrigationInfrastructures (50,000 ha)	
	Total	119,600

The strategy of the Interim Plan for irrigation development was to implement large and medium scale irrigation schemes, besides groundwater schemes, in the Terai and

small and medium scale irrigation schemes in the Hills. The interim plan hadpolicy and working policy in irrigation sector which included;

• Implementation of medium and large-scale irrigation schemes shallbe continued.

• Conjunctive use of surface and groundwater shall be promoted inorder to provide sustainable and dependable irrigation services.

• Integrated Crop and Water Management Program will be continuedand new irrigation schemes shall be selected in coordination with theDepartment of Agriculture and related organizations.

• Management transfer of public sector irrigation schemes toorganized groups of waterusers shall be continued through neededrehabilitation and improvement of schemes and the capacity buildingof water users.

The plan has given the priority to new projects as;

Irrigation and Water Resources Management Project (IWRMP)
The targeted achievements of the project within the Interim Plan period included:

• Construction of 51 surface and 7 groundwater irrigation schemes in a total of 40 Districts in the western, mid-western and far-western development regions.

• Management transfer in a total of 24,000 ha in the irrigated command under Kankai, Sunsari-Morang (Sitagunj Branch) and Narayani Irrigation Project, Parsa (Block 2 &8).

The outcomes expected during the Interim Plan period are as under:

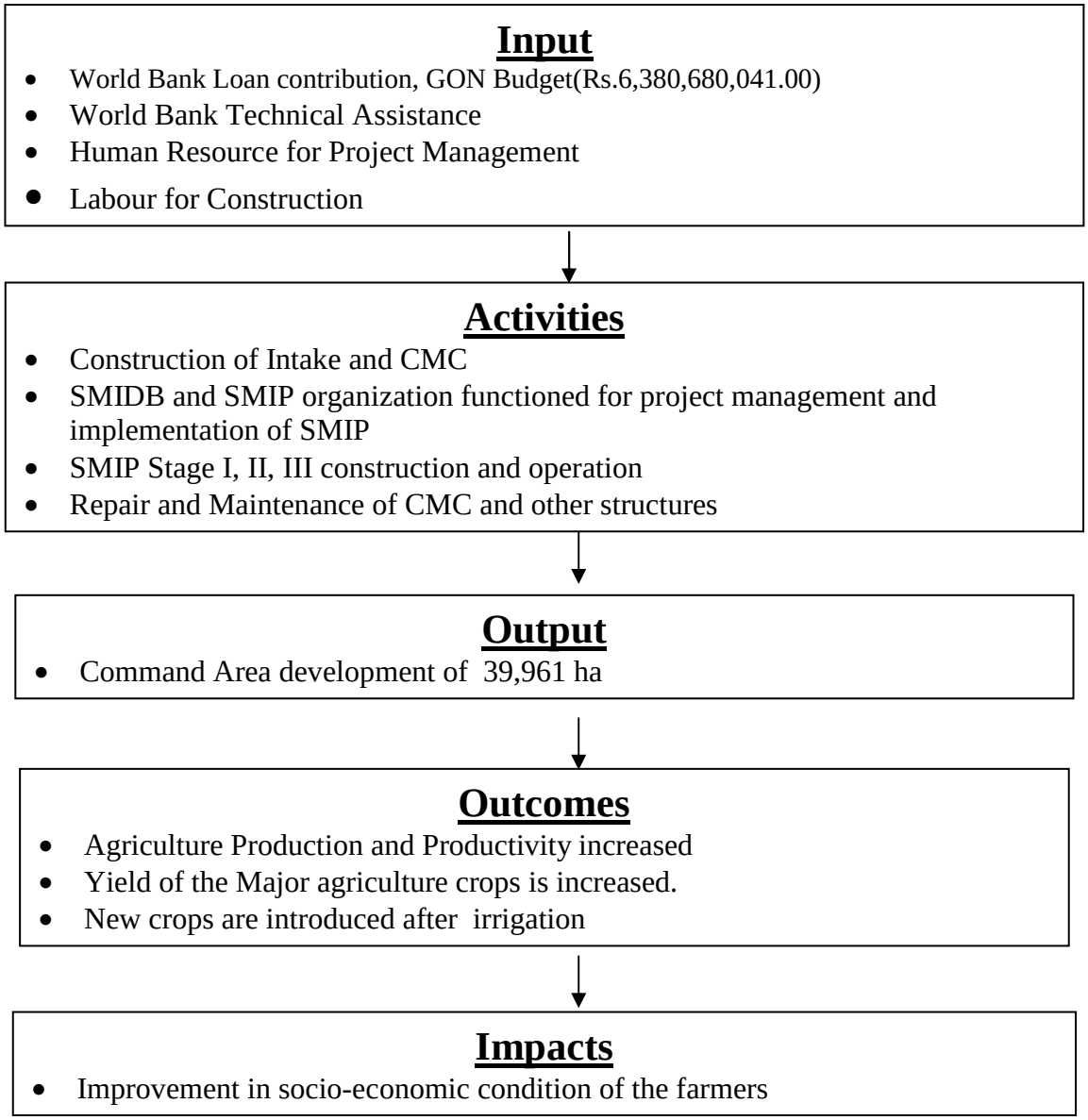
• Development of irrigation infrastructure in an additional 95,900 ha of arable land, management improvement and management transfer in irrigation schemes covering atotal of 24,000 ha, have been expected to be completed during the Interim Plan period. In addition,rehabilitation and improvement and expansion of FMISs covering 23,700 ha. are also expected.

• Improvement in the state inclusive irrigation governance through capacity development of water users and users' organization, expected.

The evaluation finding of the relevancy of the irrigation plan and policy regarding to SMIP is relevant as its objective to increase the agriculture production and productivity in the Sunsari and Morang district. The interim plan has policy and working policy to renovation and rehabilitation of larger irrigation projects including Sunsari-Morang Irrigation Project.

The Project Design model of the SMIP Impact Study is given below;

Chart 1: Logical Model of SMIP



3.1.1 This project was been started in 2032 B.S. and the Irrigation Policies has been formulated after the implementation of the project. These policies has stated for the development of irrigation projects in terai and hill areas. The Draft Irrigation Policy 2069 has provision "for the development of large and multipurpose irrigation projects in Terai and inner Terai".

3.1.2 The policy has stated that the irrigation projects have to be implemented in close coordination and cooperation with Government and non-government institutions. SMIP project had worked in coordination and effective implementation with government institutions (District Agriculture Development Office, Regional Agriculture Development Directorate) and private organization during the implementation of different stages of the World Bank funding. SMIP at present is not been effectively implemented with coordination and cooperation with government and private institutions.

3.1.3 The policy clause 1.5.7 has stated that large project having direct effect on national economy should arrange the required resources by Department of Irrigation in line with other concerned ministries. According to this policy regime, SMIP is one of the large irrigation projects which are running with limited resources at present. Department of Irrigation is not in position to arrange the resources for the rehabilitation, operation and maintenance of SMIP and developing the under developed command areas.

3.1.4 The policy also provisioned of investment of the government or private as well as joint investment shall be made effective for the irrigation project developmentand implementation. In case of SMIP, this has not been materialized for the investment of command area development.

3.1.5 Irrigation Policy 2060 has provisioned on transfer of irrigation system based on the action plan of Water Users Associations (WUAs) and ownership of infrastructure of irrigation system. SMIP has just handover Sitagunj Branch Canal irrigation system to Water Users Coordination Committee under the Irrigation and Water Resources Management Project.

3.1.6 Similarly, Draft Irrigation Policy 2069 has also emphasized for the effective involvement of local bodies and Water Users Associations.WUA are involved after completion of CMC and branch canal for water management as per the provision of Irrigation Regulation 2056.Furthermore, the policy stated that the Water Users Association shall contribute 5 % on improvement/rehabilitation of Water Course Level. SMIP has various water courses which needs to rehabilitation and improvement. The draft policy 2069, state that there should be skill development and human resources development training in irrigationprojects. Human Resources Development and Research Center is proposed to establish in central level.

3.1.7 The policy 2060 has stated that WUA should be organized and effectively managed and implemented from water course level to main canal level. There are WUAs formed and organized in Water Course level to CMC level and working on their areas. But, the management and effectiveness of the WUA is lacking in all levels in SMIP.

3.1.8 The policy 2060 has provisioned for Irrigation Service Fee (ISF) to be collected from farmers by WUAs. ISF collections by WUAs are not encouraging at present.

3.2 Effectiveness (Short-term/Direct effect)

Irrigation has the direct effect for the agriculture production and cultivation of the crops in the command area. It has short term effect and long term effect. The short term and direct effect of the SMIP is assessed from the FGD, Key informants Interview and primary data. The direct and short term effectiveness of SMIP is discussed below;

The effectiveness of the SMIP consisted is directly related with the agriculture production productivity in the project area. The effectiveness of the SMIP is based on the Case and Control Group. Case Group is taken for irrigation facilities of the Command Area of SMIP and Control Group is out of the SMIP Command Area.

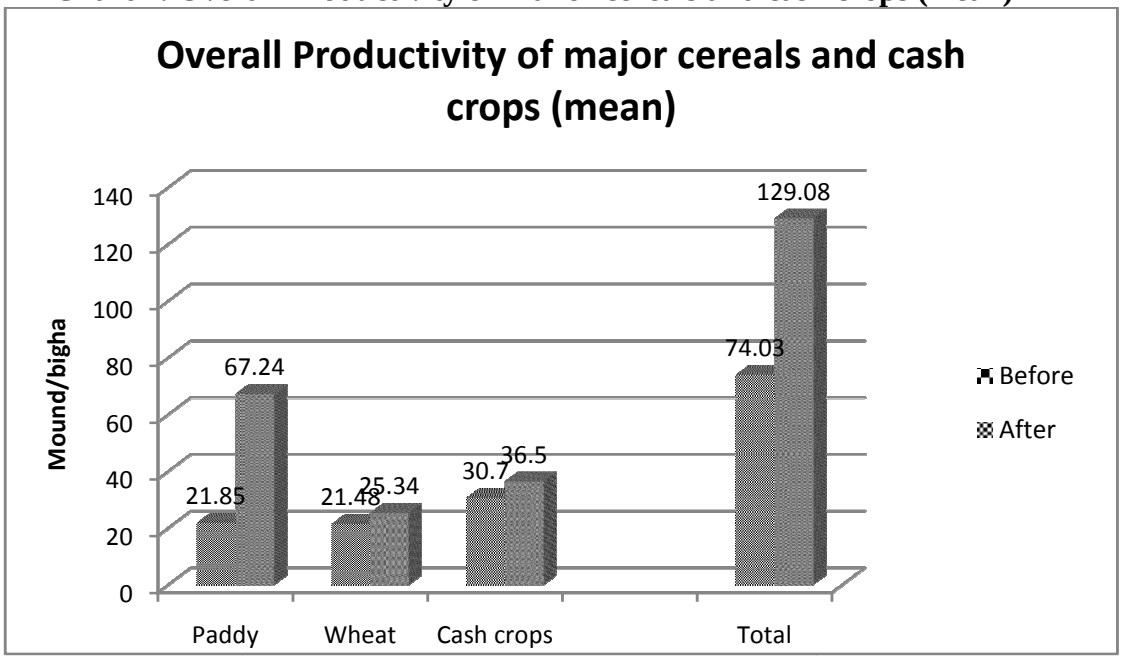
3.2.1 Agriculture Production

As mentioned in methodology the impact of SMIP on the production and productivity of major crops diversification, cropping intensities and patterns and introduction of new crop species and varieties were worked out and in both the case and control groups before and after the irrigation.

3.2.1.1 Overall Agriculture Productivity

The overall agriculture productivitywas calculated for the production of the major agriculture crops (paddy and wheat) and cash crops (pulses, mustard, vegetables, banana etc.). The productivity was calculated on average annual production in the study area of major crops. The less water discharge in tail end was also taken into account of average production. The overall production was taken as mean production of each crops and total of the mean production at before and after the intervention (Chart 2).

Chart 2: Overall Productivity of Mahor cereals and cash crops (mean)



The mean yield of paddy was found to be increased significantly after irrigation as against no irrigation. However, a meager increments of wheat and cash crops were also recorded in the CA. Significantly higher total yield was observed after the interventions (Chart 2 and Table 3.2)

Table 3.2:Mean Productivity of Paddy, wheat and cash crops in CA (mounds/bigha)

Crops	**Before**	**After**
Paddy	21.85	67.24
Wheat	21.48	25.34
Cash crops	30.70	36.50
Total	74.03	129.08

Source:Field Study of SMIP, 2012.

The above table shows that there is increment of total production by 129.08 mound/ bigha after interventions. The increment of mean production of wheat is lower than paddy and cash crops. The reason for the less production is that farmers are less preferance to cultivate the wheat in one hand and there is change in cropping pattern with new crops mainly on cash crops having high value on the other.

3.2.1.2 Paddy Productivity (Overall)

Yield increment due to intervention was significantly higher under case and lower under control groups. Since the contribution of water on crop's productivity is about 30 % and the other factors (fertilizer, veriety of seeds, technical skills, crop management practices) are also contribute the production. Comparision between cases and control was made under the similar management. Thus, If we substract the differences in production of Control group between before and after from the differences in production of Treatment Groups between before and after, we can get the pure differences as impact of irrigation.

Pure amount of increase = [(Amount of Case $_{after}$)- (Amount of Case $_{before}$)]-

[(Amount of Control $_{after}$)- (Amount of Control $_{before}$)]

Production of Paddy (Overall)
Pure amount of increase = [(75.4-23.01)]-[(26.42-16.04)]
= 52.30-10.38
= **41.92 (Mound/bigha)**

Similarly the effect of irrigation seemed to be evident in both case and control conditions (chart 3 and Table 3.3 and 3.4).

Chart 3: Paddy Productivity (Overall)

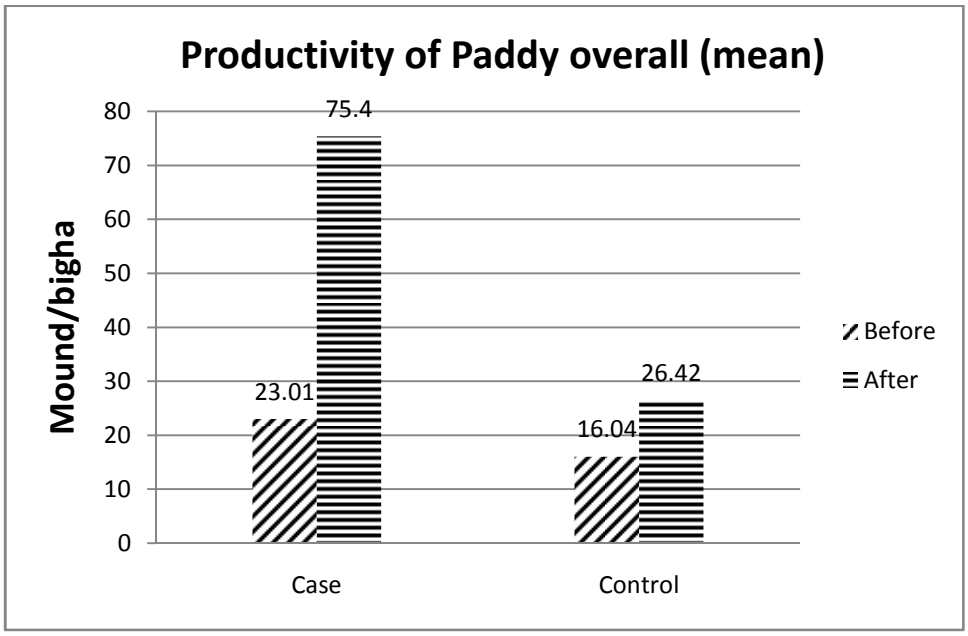


Table 3.3:Mean Productivity of paddy before and after (Overall)

Particular	**Before**	**After**	**Difference (mean)**
Cases	23.01 (n= 1000)	75.40 (n==1000)	52.39***
Control	16.04 (n==200)	26.42 (n==200)	10.38***

*** Significant at 1% level of significance

Table 3.4:Mean Productivity of Paddy cases vs. control(Mound/bigha)

Production	**Cases(mean)**	**Control (mean)**	**Mean difference**
Before	23.01 (n= 1000)	16.04 (n==200)	6.97***
After	75.40 (n==1000)	26.42 (n==200)	48.98***

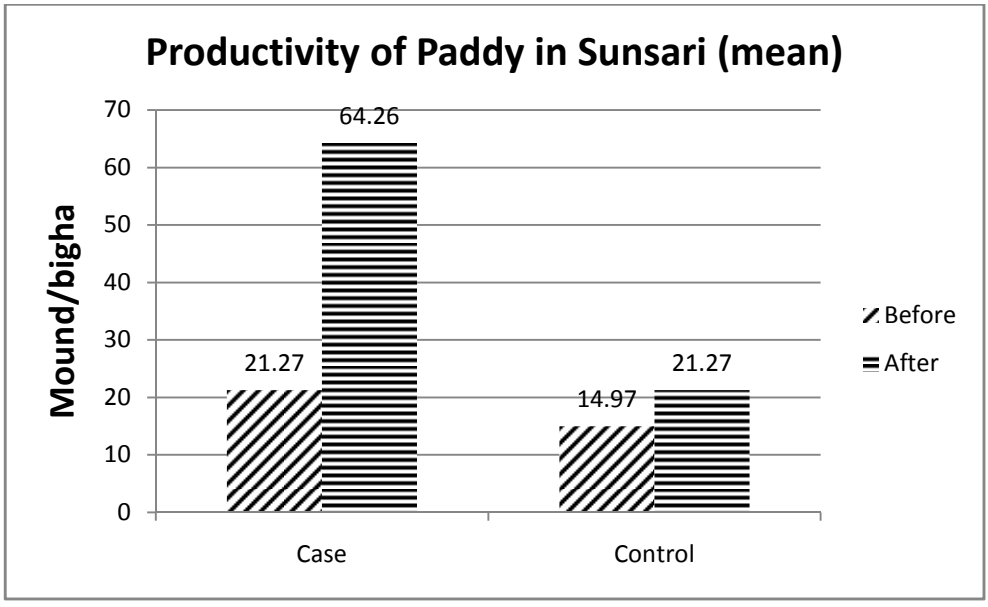
*** Significant at 1% level of significance

Differences were statistically significant for grain yield of paddy due to irrigation intervention on Case and Control groups. The crop yield of paddy after irrigation is 75.40 mound/bigha (4.2 MT/ha) in Case group which is higher than the national average of 3.0 MT/ha.The overall productivity of the paddy is presented in (chart 3 and Table 3.3 and 3.4).

(i) P**addy Yield in Sunsari**

A separate analysis of variance was worked out for mean productivity of paddy in Sunsari (Chart 4 and table 3.5 and 3.6).

Chart 4: Productivity of Paddy (Sunsari)



The statistical analysis revealed that the effect of irrigation on the grain yield of paddy was highly significant under both case and control groups in Sunsari (Table 3.5 and 3.6)

Table 3.5: Mean Productivity of paddy in Sunsari District (mound/bigha)

Particular	**Before intervention**	**After intervention**	**Difference**
Cases	21.27 (n= 609)	64.26 (n==609)	42.99***
Control	14.97 (n==100)	21.27 (n==100)	6.30***

*** Significant at 1% level of significance

Table 3.6: Mean Productivity of Paddy (Mound/bigha) cases vs. control Sunsari)

Particular	**Cases**	**Control**	**Mean difference**
Before	21.27 (n= 609)	14.97 (n==100)	6.30***
After	64.26 (n==609)	21.27 (n==100)	42.99***

*** Significant at 1% level of significance

(ii) **Paddy Productivity in Morang**

Like in Sunsari, statistical analysis was done for the grain yield of paddy in Morang with or without interventions.

Chart 5: Mean Paddy Productivity (Morang)

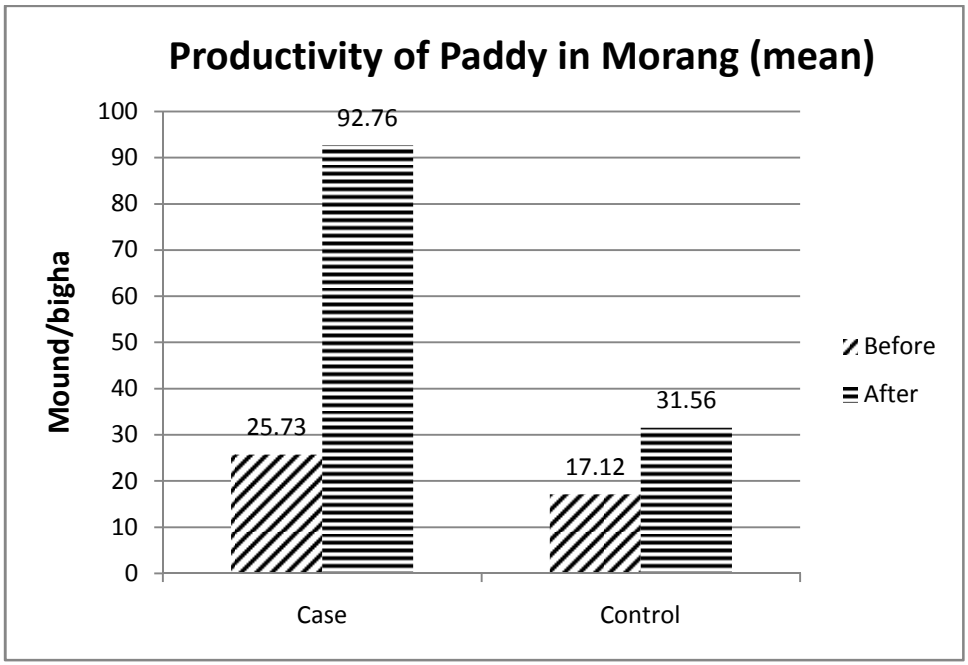


Table3.7: Productivity of paddy (mean) before and after in Morang (mound/bigha)

Particular	**Before intervention**	**After intervention**	**Difference**
Cases	25.73 (n= 391)	92.76 (n==391)	67.03***
Control	17.12 (n==100)	31.56 (n==100)	14.44***

*** Significant at 1% level of significance

Irrespective of cases and control, the effect of irrigation on grain yield of paddy was significant in Morang. Similarly, the variation was evident due to the cases. The yield increment of 67.03 mound/bigha was observed (Table 3.7 and 3.8) due to irrigation in cases and 14.44 mounds/bigha in control. Effect of water on grain yield of rice was found to be significiant since rice crop needs more water to produce the grain as compared to other crops.

Table 3.8: Productivity of Paddy (mean) Cases vs. Control in Morang (mound/bigha)

Particular	**Cases**	**Control**	**Difference**
Before	25.73 (n= 391)	17.12 (n==100)	8.61***
After	92.76 (n==391)	31.56 (n==100)	61.20***

*** Significant at 1% level of significance

3.2.1.3 Wheat Productivity

Chart 6: Overall Wheat Productivity (mean)

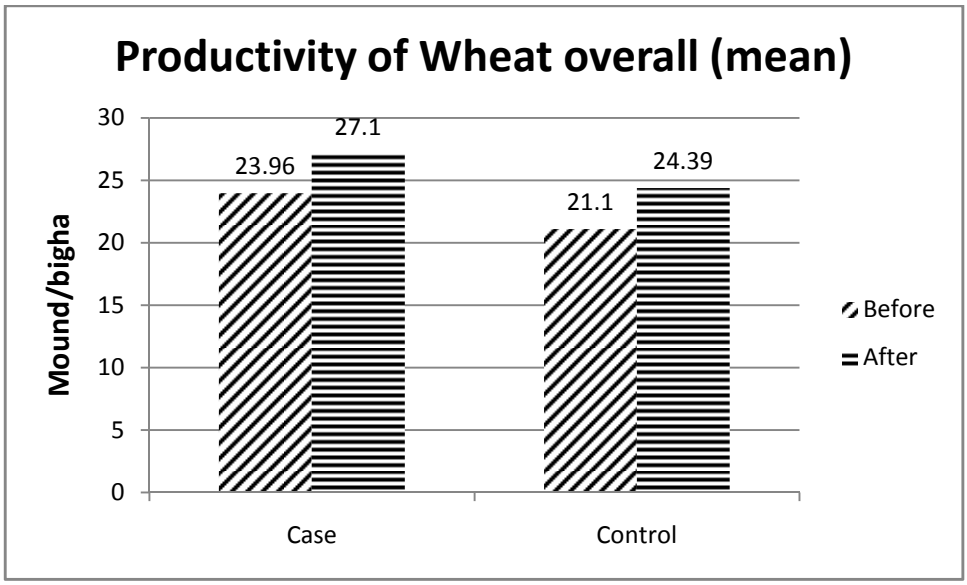


Table3.9:Mean Wheat Productivity before and after mound/bigha (overall)

Particular	**Before intervention**	**After intervention**	**Difference**
Cases	23.96 (n=561)	27.10 (n==561)	3.14**
Control	21.10 (n==105)	24.39 (n==105)	3.29**

** Significant at 5% level of significance

Variation in grain yield of Wheat was observed on cases and control. Yield increment was 3.14 and 3.29 mounds/bigha after irrigation in cases and control conditions. Similarly, yield grain of 5.86 mounds/bigha was found during no irrigation in cases and control conditions.

However, the effect of irrigation on grain yield of Wheat was found to be non-significant in both the districts (chart 6, 7 and 8; Table 3.9, 3.10,3.11, 3.12, 3.13 and 3,14). It might be due to less preference towards wheat during winter season due to preference shifted to commercial crops like; vegetables. Static yield in wheat was due to poor yielding wheat varieties in the cases. But the yield increment of the Wheat (0.4 MT/ha.) due to irrigation in CA was found higher as documented by DADOs from Sunsari and Morang (Table 3.28).

Table 3.10. Mean Wheat Productivity (Mound/bigha) cases vs. control (Overall)

Particular	**Cases**	**Control**	**Difference**
Before	22.52 (n=700)	16.65 (n=150)	5.86***
After	25.50 (n=628)	24.39 (n=105)	1.11 $^{n.s}$

*** Significant at 1% level of significance

$^{n.s}$ Non Significant

(i) Productivity ofWheat in Sunsari

Chart 7: Wheat Productivity in Sunsari

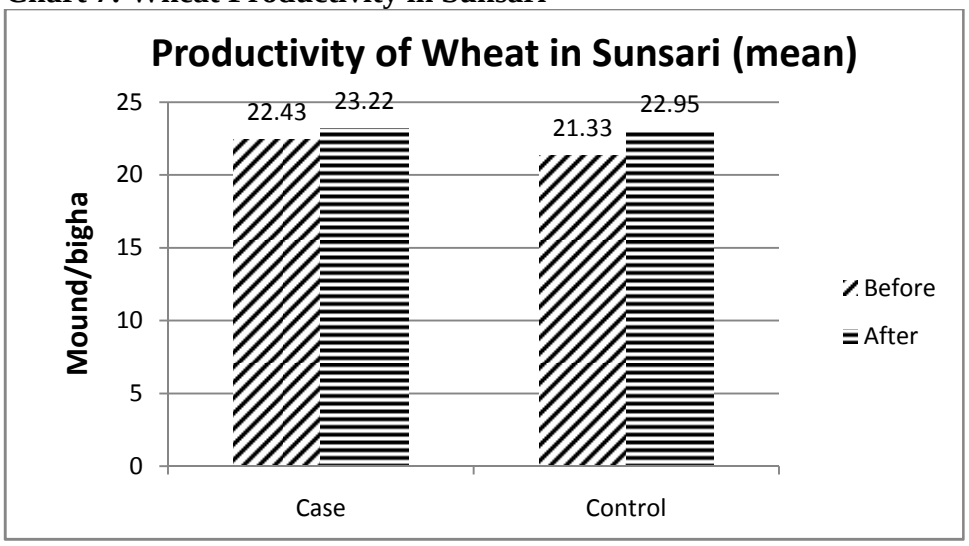


Table 3.11: Productivity of wheat (mean) before and after in Sunsari (mound/bigha)

Particular	Before intervention	After intervention	Difference (mean)
Cases	22.43 (n=312)	23.33 (n==312)	0.90 n.s
Control	21.33 (n==46)	22.95 (n==46)	1.62 n.s

n.s Non Significant

Table 3.12: Productivity of wheat (mean) cases vs. control in Sunsari (mound/bigha)

Production	Cases	Control	Difference (mean)
Before	20.99 (n=412)	15.30 (n=74)	5.69**
After	22.06 (n=350)	22.95 (n=46)	-0.89 n.s

** Significant at 5% level of significance

n.s Non Significant

(ii) Productivity of Wheat in Morang

Chart 8: Mean Wheat Productivity in Morang

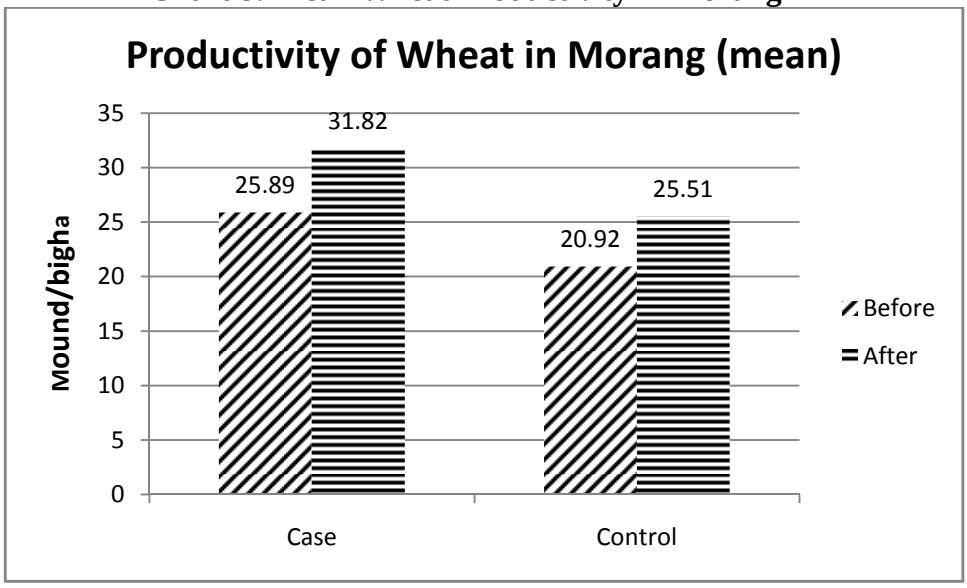


Table3.13:Productivity of wheat (mean) before and after in Morang District (mound/bigha)

Particular	Before intervention	After intervention	Difference
Cases	25.89 (n=249)	31.82 (n==249)	5.93***
Control	25.50 (n==59)	25.92 (n==59)	O.42 n.s
Mean Difference	6.7**	4.33 n.s	

*** Significant at 1% level of significance

n.s Non Significant

The production of wheat in Morang in case is significant increase before and after the intervention. The production in control group is not significant.

Table 3.14: Wheat Productivity (mean) under cases vs. control in Morang (mound/bigha)

Particular	**Cases**	**Control**	**Difference (mean)**
Before	24.70 (n=288)	17.97 (n=76)	6.73**
After	24.70 (n=350)	25.50 (n=46)	-0.80 $^{n.s}$

** Significant at 5% level of significance

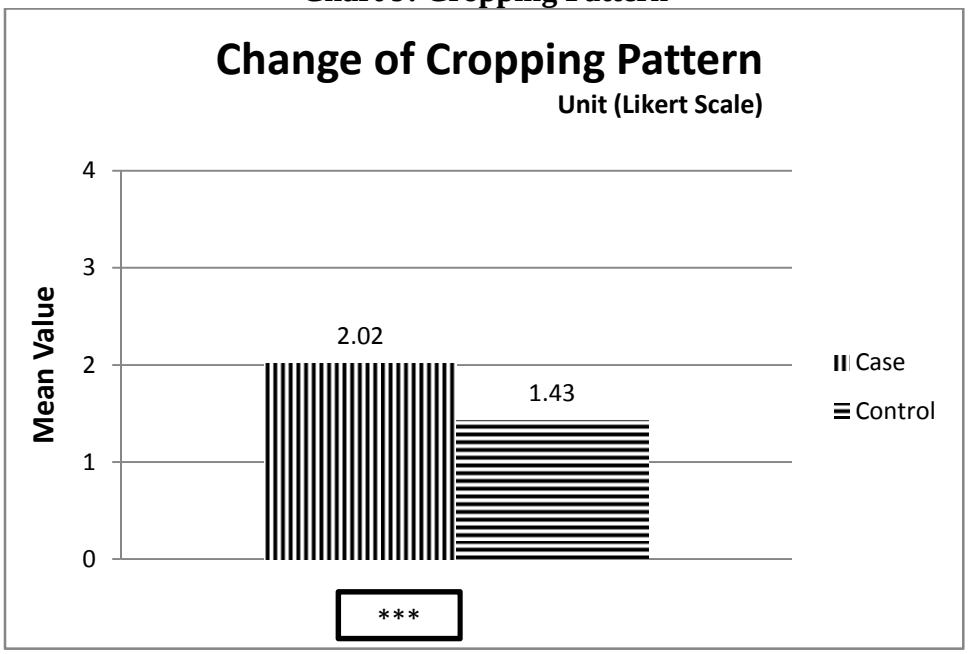
$^{n.s}$ Not Significant

3.2.3 Change in Cropping Pattern (Multiple crops)

The cropping pattern has been changed in Morang and Sunsari district with the introduction of new crops. The cropping pattern of the district comprises with the cultivation of high value cash crops in the area. The existing single crops havereplaced with multiple crops (double crops, triple crops) in a year.

Wheat, cole crops (cabbage, cauliflower, broccoli etc.), radish and beans in winter, maize, early rice and sugarcane in spring season are the major crops introduced after the access of irrigation in CA. Hence, instead of a monocropping system of rainy season paddy, the other crops have been introduced in sequence. The change in cropping pattern is based on the Five Point Likert Scale[1] applying the t-test.

Chart 9: Cropping Pattern



[1] Although, it is an academic discussion on whether Likert scale can be used as interval scale, it is widely practiced in many research studies. In addition, Winder and Dodou (2012) indicated that, in conclusion, the t-test (paremetric test)and MWW test (nonparametric test) generally have similar power, and researchers do not have to worry about findings a differences
Source: Joost C.F. de Winter and Dimitra Dodou. (2012). Five Point Likert.

Table3.15: Effect of Irrigation on Cropping Pattern under Case vs. Control

Cropping Pattern	Cases (Mean)	Control(mean)	Difference (mean)
Cropping Pattern	2.02	1.43	0.59***

*** Significant at 1% level of significance

Effect of irrigation on the change in cropping pattern was found to be highly significant. Meaning, the shift from mono-cropping to multiple cropping is observed. On and average two crops a year were grown in cases than 1.43 in control (Chart 9 and Table 3.15). Before irrigation only one crop during normal rainy season had been grown, but one or two additional winter crops have been grown after the access of irrigation.

3.2.4 Cropping Intensity (CI)

Change in cropping pattern also affected the cropping intensity across the CA. The effect of irrigation on CI was highlysignificant in the CA (Chart 10 and Table 3.16)

The cropping intensities were changed from 184 % to 216 % in Morang and 184 % to 205 % in Sunsari district as reported by the respective DADOs.

Chart 10: Change in Cropping Intensity of agriculture crops

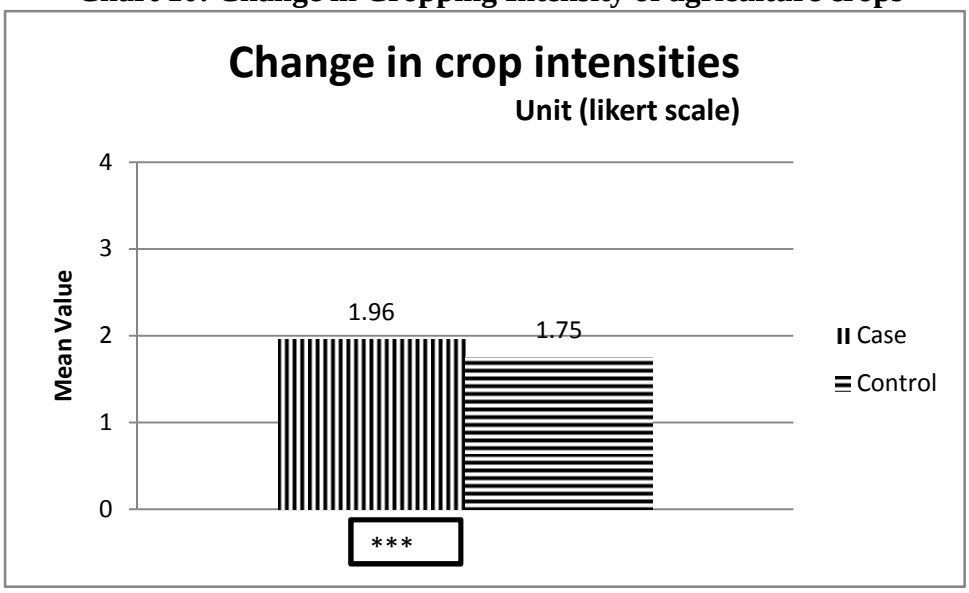


Table 3.16 : Change in Cropping Intensity case vs. control

Crop Intensity	Cases (mean)	Control (mean)	Difference (mean)
Crop Intensity	1.96	1.75	0.21***

*** Significant at 1% level of significance

3.2.5 Irrigation facilities

Farmers are taking irrigation facilities from different ways and comparative analysis of the effect of the irrigation facilities to production is carried out. The irrigation facilities in the CA are SMIP, small irrigation schemes, ground water irrigation schemes, traditional methods of irrigation. ANOVA test was carried out with above irrigation system and effect on overall productivity..

Table 3.17: Comparative Analysis of SMIP and other irrigation schemes

Production in mound (after)	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sunsari Morang Irrigation project	519	106.00	102.93	4.51	97.32	115.07	5	780
Small Irrigation	62	45.53	43.51	5.52	34.48	56.58	5	278
Ground water	112	56.24	78.36	7.40	41.56	70.91	3	600
Traditional method	150	39.57	60.40	4.93	29.83	49.32	6	630
No irrigation	157	32.27	19.97	1.59	29.12	35.42	3	150
Total	1000	75.24	89.28	2.82	69.70	80.78	3	780

ANOVA revealed that the access of irrigation significantly affected the crop production and productivity. Comparisons were made among SMIP, small irrigation schemes, groundwater schemes, traditional irrigation schemes and without irrigation. The highest production efficiency was recorded in SMIP followed by groundwater schemes, and small irrigation schemes.

3.3 Impact (Long term/Indirect effect)

The long term impact of SMIP was assessed through the increase in crop production and productivity and thereby increased in farm income as well as livelihood of farming communities across of CA.

Indicator of the increase in income simultaneously impacted at the level of expenditure on health services, construction and maintenance of houses and purchasing of durable goods. Irrigation facilities in CA also impacted on reduction of women's drudgery in household works.

3.3.1 Income from Agriculture Production

Farmer’s income depends upon the agriculture production of different crops. The impact of the irrigation interventions has increased the income from agriculture. The study used Likert Scale to assess the level of income as follows;

Chart 11: Increase in income from agriculture production

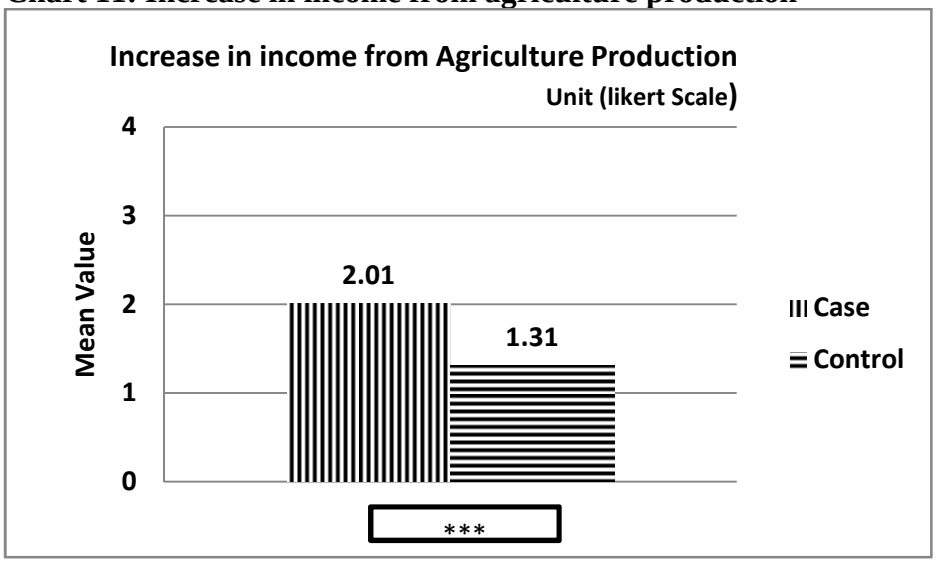


Table 3.18: Income from agriculture Production under case vs, control

Income from agriculture	Cases (mean)	Control(mean)	Difference mean)
Income from agriculture	2.01	1.31	0.70***

*** Significant at 1% level of significance

There is significant increase on income from agriculture on case vs. control of the study area. The mean difference of case and control is 0.70.

3.3.2 Expenditure on Education

Chart 12: Expenditure on education

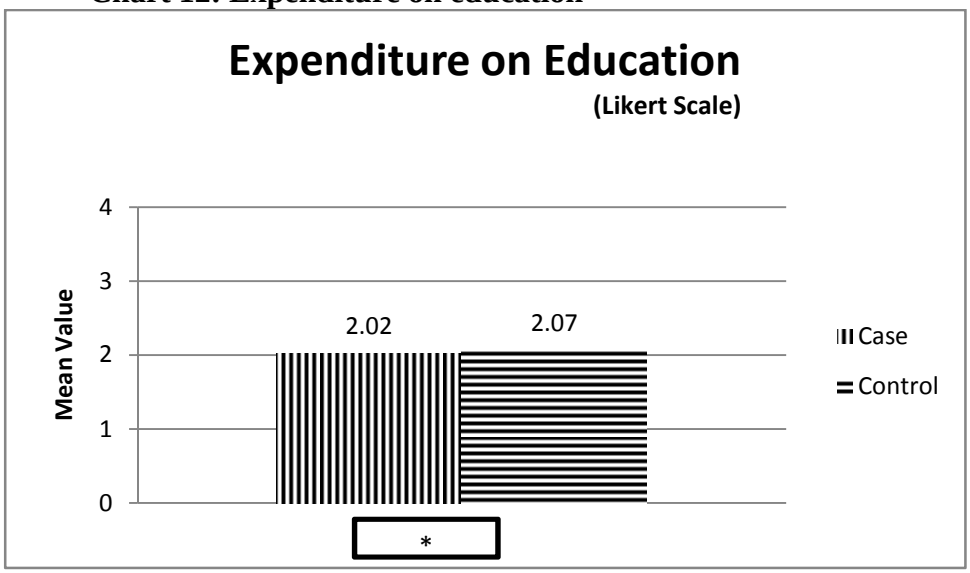


Table 3.19: Expenditure on Education case vs, control

Income from agriculture	Cases(Mean)	Control(mean)	Mean difference
Income from agriculture	2.02	2.07	0.05*

* Significant at 10% level of significance

No significant difference of expenditures on education of children was observed in study area. The basic education of the children is provided by the state and higher education is expensive. Most of the children from case and control group completed the secondary level education. People are concious and aware on child education which in turn enrollment at school is a general practice. Although, the income from agriculture is higer or lower, the expenditure on child education in Case and Control Group was found almost on equal basis.

3.3.3 Expenditure on health services

Health services are provided by the government both in cases and control. However, the expenditure on health services varied significantly in case over control group. Increase in agricultural production due to irrigation created the level of expenditure on health services of farmers (Chart 13 and Table 3.20).

Chart 13: Expenditure on Health SErvices

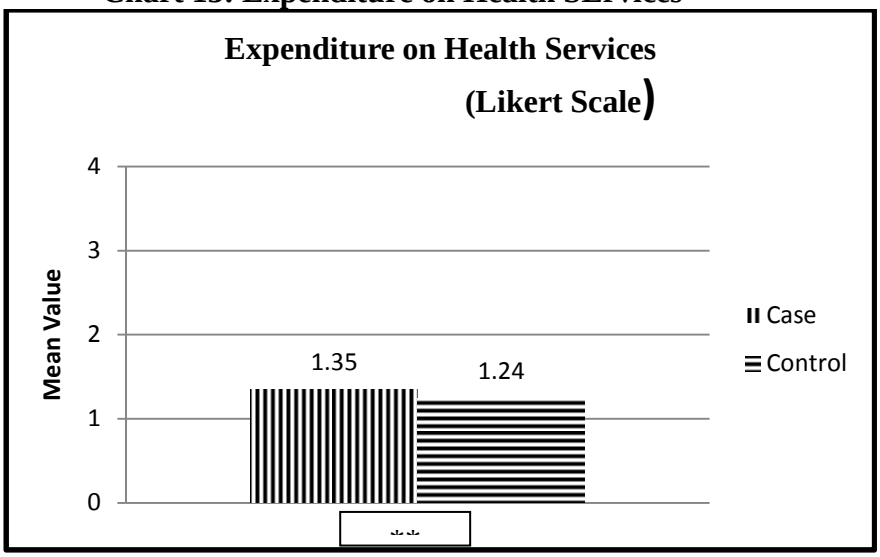


Table 3.20: Expenditure on Health Services case vs, control

Income from agriculture	Cases (Mean)	Control (mean)	Mean difference
Income from agriculture	1.35	1.24	0.11**

** Significant at 5% level of significance

3.3.4 Expenditure on durable goods

The durable household goodslike (kitchenware, refrigerator, television etc.) are considered as basic necessary items of the farmers and have to purchase the durable goods both in case and control groups. Therefore, the expenditure on durable goods did not vary due to case and control in study area Chart 14 and Table 3.21).

Chart 14: Expenditure on durable household goods

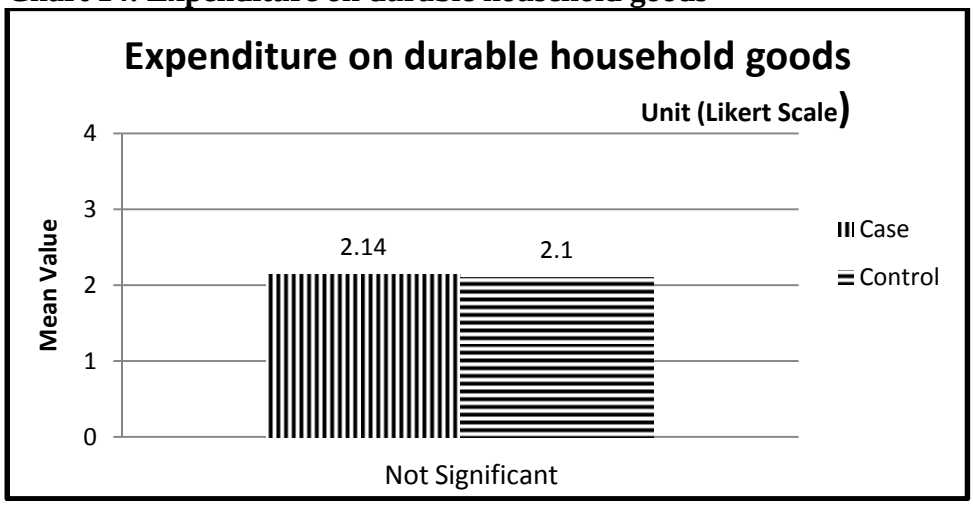


Table 3.21: Expenditure on Durable Household Goods case vs, control

Expenditure on HH Goods	Cases(mean)	Control(mean0	Difference (mean)
Expenditure on HH Goods	2.14	2.10	0.04 [n.s]

[n.s] Non Significant

3.3.5 Construction and maintenance of houses

Construction and maintenance of houses is another aspect to analyse the impact of irrigation on farmers in the study area.

Chart 15: Expenditure on construction/maintenance of Building

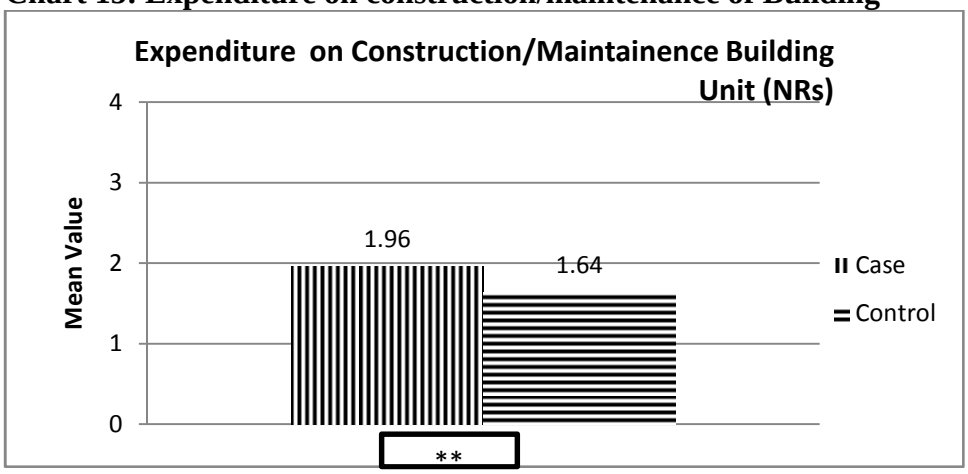


Table 3.22: Expenditure on construction/maintenance buildings case vs, control

Income from agriculture	Cases (Mean)	Control (mean)	Mean difference
Income from agriculture	1.96	1.64	0.32**

** Significant at 5 % level of significance

Significant effect of irrigation on grain yield thereby farm income and consequently in construction and maintenance of houses was observed in study area (Chart 15 and Table 3.22). Higher number of respondents reported that construction and maintenance of their houses was only possible due to increase in farm income.

3.3.6 Investment of farm Income

The investment of farm income is analysed in case and control groups (education, family social work, livestock, business etc.,).

Chart 16: Investment of farm income

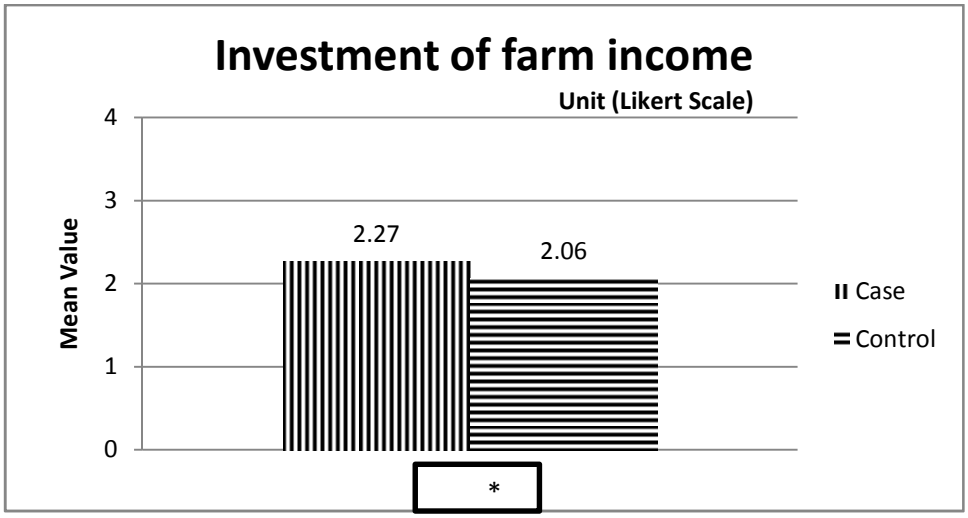


Table 3.23: Investment from farm income case vs, control

Income from agriculture	Cases (Mean)	Control (mean)	Mean difference
Income from agriculture	2.27	2.06	0.21*

* Significant at 5 % level of significance

Variation in the level of investment from farm income per household was found to be significant across the study area. It might be due to the increased farm income as a result of increased production and productivity of major cereals and cash crops in the SMIP.

3.3.7 Women's drudgery on HH works

Women's household works are relatively associated with water which is used in different purposes. Irrigation has impact on women's drudgery on household work.

Chart 17: Impact of Irrigation on women's drudgery on HH works

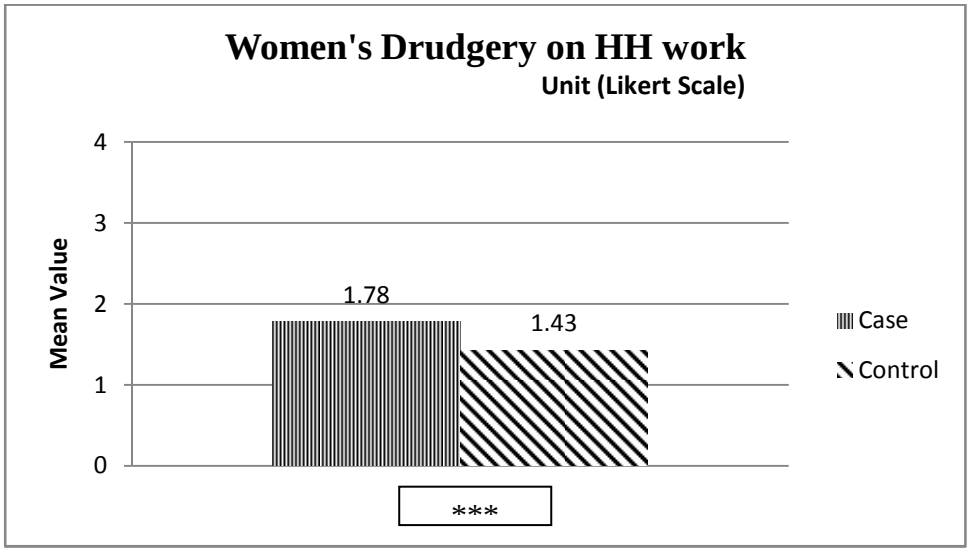


Table 3.24: Effect of Irrigation on women's drudgery on HH Works case vs, control

Income from agriculture	Cases(mean)	Control(mean)	Difference (mean)
Income from agriculture	1.78	1.43	0.35***

***Significant at 1 % level of significance

It is an established fact that workloads of women are higher than men in each HH. Due to the access of irrigation, workloads of women have been reduced significantly. Irrigation helped to plant the crops in time, reduced the weed infestations especially in the paddy thereby reduced the labor requirement. It is known that 30 % of labour is spent for weeding. Fetching water for their livestocks used to consume most of the women's time before irrigation.

3.3.8 Cropping Intensities and Crop Budgeting in SMIP

Cropped area increased from 30728 ha in 1998/99 to 34508 ha in 2011/12, indicating the area under vegetables increased significantly. Overall cropping intensities increased from 184% to 210% in the same period (Table 3.25).

Table 3.25: Comparative studies of cropping intensities of various crops during 1998/99 and 2011/12 across the command area.

At full development (1998/99)					**2011/2012**		
Crop	Cropped area Stage I	Cropped area Stage II	% Cropped area 1998/99 stage-II	Cropping intensity (%)	Area	Cropped area (%)	Cropping intensity (%)
Rainy season							
Paddy main	8190	14028	45.56	84	15324	44.4	80.0
Vegetables	98	167	0.5	4	521	1.5	15.0
Sub-total	8288	14195	46.06	88	15845	45.9	95.0
Winter season							
Wheat	3900	6680	21.9	40	6986	20.2	43
Oilseed	1170	2004	6.5	12	2035	5.9	10
Pulses	1170	2004	6.5	12	2041	5.9	10
Potato	390	501	1.6	3	717	2.1	5
Vegetables	292	334	1.1	2	418	1.2	9
Sub-total	6922	11523	37.6	69	13345	35.3	77
Summer season							
Early paddy	1560	2672	8.7	16	3012	8.7	17
Maize	390	668	2.2	4	819	2.4	4
Jute	292	501	1.6	3	607	1.8	5
Mungbean	195	334	1.1	2	419	1.2	4
Vegetables	295	334	1.1	2	713	2.1	8
Sub-total	2732	4509	14.7	27	5570	16.2	38
Perennial							
Sugarcane	0	501	1.6	3	602	1.7	5
Sub-total	0	501	1.6	3	602	1.7	5
Total	17942	30728	100	184*	34508		210*

CCA: 16700 ha. * CI excluding sugarcane

Source: ICR, the World Bank 1997 and DADO Reports, 2012

The crop budget of the crop grown in the command area is calculated based on the secondary and primary information. The comparative crop budget and crop grown in the command area is presented in Table 3.26 and 3.27;

Table 3.26: Comparative crop budgeting of the crops grown in the command area during 2011/2012.

Parameters	Rice (Normal)	Paddy (early)	Maize (Spring)	Wheat	Pulses
1. Gross return (NRs/ha)	42000	44000	96250	36250	5000
A. Main product(Grain Mt/ha)	3	3.5	5.5	2.5	1
Price(NRs/Mt)	11500	11000	17000	14000	5000
Value (NRs)	34500	38500	93500	35000	5000
B. By-product (Mt/ha)	2.5	2.75	5.5	2.5	
Price(NRs/Mt)	3000	2000	500	500	
Value (NRs)	7500	5500	2750	1250	0
2. Production cost(NRs/ha)	27200	27520	49000	23720	16450
A. Input cost	12200	12520	25000	14720	7350
i. seed cost	1800	1620	7500	4320	3000
Seed rate (Kg/ha)	50	45	25	120	30
Price(NRs/kg)	36	36	300	36	100
Value (NRs)	1800	1620	7500	4320	3000
ii.. Fertilizer cost	9400	9400	15000	9400	3600
N kg/ha (Urea)	90	90	120	90	40
Rate/Kg N	30	30	30	30	30
Value (NRs)	2700	2700	3600	2700	1200
P kg/ha (DAP)	60	60	90	60	40
Rate/Kg P	45	45	45	45	45
Value (NRs)	2700	2700	4050	2700	1800
K kg/ha (MoP)			45		20
Rate /kg K			30		30
Value (NRs)	0	0	1350	0	600
iii. FYM (Mt/ha)	4	4	6	4	
Rate/Mt	1000	1000	1000	1000	
Value (NRs)	4000	4000	6000	4000	0
iv. Chemicals (NRs/ha)	1000	1500	2500	1000	750
v. Labour cost	12000	12000	18000	6000	7000
Human labour mandays	60	60	90	30	35
Rate/manday	200	200	200	200	200
Value (NRs)	12000	12000	18000	6000	7000
vi. Draught cost	3000	3000	6000	3000	2100
pair day/ha	10	10	20	10	7
Rate/pair/day	300	300	300	300	300
Value (NRs)	3000	3000	6000	3000	2100
NER= Gross return-Total cost	14800	16480	47250	12530	-11450

Source: ICR, the World Bank 1997 and DADO Reports

Table 3.27: Comparative crop budgeting of the crops grown in the command area during 2011/2012.

Parameters	Jute	Potato	Sugarcane	Tomato	Brinjal	Cabbage	Cauliflower
1. Gross return (NRs/ha)	42500	220000	246000	350000	256000	280000	300000
A. Main product(Grain mt/ha)	2.5	22	60	35	32	35	30
Price(NRs/Mt)	17000	10000	4100	10000	8000	8000	10000
Value (NRs)	42500	220000	246000	350000	256000	280000	300000
B. By-product (Mt/ha)							
Price(NRs/Mt)							
Value (NRs)	0	0	0	0	0	0	0
2. Production cost(NRs/ha)	32850	108100	113750	208250	140750	177600	185600
A. Input cost	11850	78100	83250	76250	51750	55600	53600
i. seed cost	2450	40000	20250	22500	5400	8000	6000
Seed rate (Kg/ha)	7	2000	4500	0.15	0.9	0.4	0.3
Price(NRs/kg)	350	20	4.5	150000	6000	20000	20000
Value (NRs)	2450	40000	20250	22500	5400	8000	6000
ii. Fertilizer cost	8400	23100	61000	34750	31350	32600	32600
N kg/ha (Urea)	90	150	600	60	150	90	90
Rate/Kg N	30	30	30	30	30	30	30
Value (NRs)	2700	4500	18000	1800	4500	2700	2700
P kg/ha (DAP)	60	240	600	150	210	180	180
Rate/Kg P	45	45	45	45	45	45	45
Value (NRs)	2700	10800	27000	6750	9450	8100	8100
K kg/ha (MoP)		60	200	40	80	60	60
Rate /kg K		30	30	30	30	30	30
Value (NRs)	0	1800	6000	1200	2400	1800	1800
iii. FYM (Mt/ha)	3	6	10	25	15	20	20
Rate/Mt	1000	1000	1000	1000	1000	1000	1000
Value (NRs)	3000	6000	10000	25000	15000	20000	20000
iv. Chemicals (NRs/ha)	1000	15000	2000	19000	15000	15000	15000
B. Labour cost	18000	21000	20000	120000	80000	110000	120000
Human labour mandays	90	105	100	600	400	550	600
Rate/manday	200	200	200	200	200	200	200
Value (NRs)	18000	21000	20000	120000	80000	110000	120000
i. Draught cost	3000	9000	10500	12000	9000	12000	12000
pairday/ha	10	30	35	40	30	40	40
Rate/pair/day	300	300	300	300	300	300	300
Value (NRs)	3000	9000	10500	12000	9000	12000	12000
NER= Gross return-Total cost	9650	111900	132250	141750	115250	102400	114400

Source: ICR, the World Bank 1997 and DADO Reports 2012.

Crop budgeting for rice, paddy, maize, wheat, pulses, jute, potato, sugarcane, tomato, brinjal, cabbage and cauliflower were worked out. Net Economic Return (NER) was calculated for each crop to assess the profitability.

The lowest but negative NER was found in pulses and it was due to poor yields of pulses in the area. The highest NER was recorded in vegetables like tomato, followed by sugarcane, potato and brinjal (Table 3.26 and 3.27).

Despite the higher NER in the above mentioned crops, farmers are growing cereals extensively due to their importance in food security of the area.

3.3.9 Productivity of Major cereals, pulses, vegetables and other crops

Economic yields of major cereals and vegetables werefound to be increased except in early rice from the base year of 1998/99 to 2011/12 (Table 3.28). It was due to lower use of input mainly inorganic fertilizers, heavyweed infestation and poor quality seeds of local varieties of early paddy in the command area. Significant economic yield gain was also recorded in sugarcane and vegetables. It was due to increase in productivity of both the crops coupled with ever increasing demand with increased market prices.

Table 3.28: Change in major crops productivity from 1998/99 to 2011/12 in the command area

Crop	Productivity (Mt/ha)		
	1998/99	2011/12	Change
Paddy (normal)	3.5	3.6	+0.1
Paddy (early)	3.9	3.5	-0.4
Wheat	3.0	3.4	+0.4
Maize	3.0	5.5	2.5
Sugarcane	45	60	+15
Oil seeds	0.8	1.3	+0.5
Pulses	1	1.0	+0
Jute	1.5	2.5	+1.0
Vegetables (Tomato)	24	35	+11
Vegetables (Brinjal)	25	32	+7
Vegetables (Cabbage)	19	35	+16

Source: ICR, the World Bank 1997 and DADO Reports

Table 3.29: Seasonal crop productivity (mound/bigha) Sunsari/Morang

Winter Season			Summer/rainy Season		
S,N.	**Crop**	**Productivity**	**S,N.**	**Crop**	**Productivity**
1	Wheat	29.12	1	Rice	34.25
2	Lintels	13.36	2	Maize	64.07
3	Potato	232.60	3	Sugarcane	698.34
4	Mustard	8.49	4	Tomato	407.71
5	Cabbage	582.46	5	Brinjal	372.76
6	Cauliflower	230.42	6	Jute	29.12
7	Radish	326.65			

Source: Annual Report of DADOs, 2011/2012.

During winter majority of farmers were growing cash crops like; lintels, potatoes, mustard, cabbage, cauliflower and radish and in summer sugarcane, tomato, brinjal and jute were commonly grown cash crops (Table 3.28 (b)).

3.3.10 Water Users Associations (WUAs)

The beneficiaries are organized under Water Users Associations(WUAs) in different levels of irrigation system in order to manage water in the areas.

Table 3.30: Level of satisfaction on the performance of WUAs in CA

S.N.	Satisfaction on WUAs	Number of HH	Percent of response
1	Don't Know	223	22.3
2	Unsatisfied	460	46
3	Okay	209	20.9
4	Satisfactory	78	7.8
5	Greater than satisfactory	30	3
	Total	1000	100

Source: Field Survey, 2012.

Surprisingly, 46 percent of HH were found unsatisfied with the WUAs performance . The satisfactory level is very low (7.8 %). Very few were satisfied with and some were unknown with the performances of WUAs, the reasons were not being transparent and cooperative (Table 3.29).

3.3.11 Access Road

Access road helps to increase transportation of agriculture production in the market and agriculture inputs in the farmland. The impact of access road to the farmers is given in following table.

Table 3.31: Use of Service Road

S.N	Use of Service Road	Number of HH	Percent
1	No road	223	22.3
2	No support	120	12.0
3	Difficult in rainy season	168	16.8
4	Only seasonal	205	20.5
5	Fully benefited	284	28.4
	Total	1000	100

Source: Field Survey, 2012.

3.4 Efficiency (Cost-benefit comparison or narrative cost-efficiency)

The efficiency of the SMIP comprises with the cost-benefit of the project, the cost investment and rate of return on investment. The project has huge investment for the construction, operation and maintenance of the project. Economic Rate of Return (ERR) is for the assessment of the efficiency of the project. ERR is calculated as compared with the World Bank ICR from the year 1987/88 to 2012/13. The cost is derived from SMIP stage II and SMHP cost and the benefit was calculated with the net saving on agriculture production. The ERR calculation in details is presented in Annex 7. The ERR of the SMIP on stage I and Stage II with planned and present is presented below;

Stage I

Command Area Development (ha)	9,700
Planned ERR	17 %
Present ERR	26 %

Stage II

Command Area Development (ha)	16,600
PlannedERR	16 %
Present ERR	19 %

3.5 Sustainability

In order to measure the sustainability of SMIP financial, technical, environmental and organizational aspects were the key indicators taken into accounts.

3.5.1 Financial Aspect

Financial sustainability is one of the major component of the SMIP which affect on the implementation, operation and maintenance of the project as well as continuation of the project in long run.SMIP has to depend on external funding from multilateral and bilateral sources. The financial overview of SMIP has shown that there are funding from the Government of India (GoI) for first intake and CMC construction, the World Bank and EEC fro the Stage I, Stage II and Stage III- Phase I implementation and government contribution. The total investment and funding is given below;

Table 3.32 : Financial Investment of SMIP

S.N.	Cost components	Period	US $	NRs.
1	Indian Government Support Cost of CMC	1964-1975	16,000,000.00	200,000,000.00
2	Stage I-	1978-85	37,500,000.00	579,130,587.00
3	Stage II	1986-1997	49,900,000.00	1,926,076,161.00
4	SMHP	1992-1997	29,600,000.00	1,441,073,293.00
5	Stage III-Phase I	1997-2001	39,200,000.00	2,234,400,000.00
	Total		172,200,000.00	6,380,680,041.00

Source: Project Office and DOI, 2012.

SMIP is facing the financial crises for the development of Stage III-Phase II. Substantial funds are required for the rehabilitation of old structures and regular O

&M. The regular budget allocated is not sufficient to carry out all the rehabilitation and maintenance works.

The internal ISF collection is the main sources internal resource which is not collected effectively.The scenario of ISF collection is not encouraging. The payment status of ISF in the area is given below;

Table 3.33 : ISF Payment Status

S.N.	ISF Payment	Number of HH	Percent
1	ISF paid	117	11.7
2	ISF Not paid	883	88.3
	Total	1000	100

Source: Field Survey, 2012.

Primary datas from HH survey shows that 88 % of the farmers have not paid the ISF. As per discussion with WUCCC it was mentioned that 80 % of the farmers have not paid the ISF.

Both the information indicate that it is difficult to collect ISF at present. This is due to inactiveness of the WUCCC to motivate the farmers for the collection of ISF. Also proper awareness campaign in this aspect is lacking.

3.5.2 Technical Aspect

3.5.2.1 Efficiency and performance of Canal Systems

The technical team had carried out the efficiency and performance assessment of the sample canals (best performed and worst performed) as previously agreed. The household survey had also considered on the water distribution and availability of the water in the canals. The present water distribution situation in SIMP is as follows:

Table 3.34: Water Distribution in SMIP

S.N.	Water Distribution simplicity	Number of HH	Percent
1	Water not provided	189	18.9
2	Personal influence	91	9.1
3	Difficult to get	301	30.1
4	Takes time	326	32.6
5	Easily available	93	9.3
	Total	1000	100

Source: Field Survey 2012.

The above table shows that 10 percent HH are getting irrigation water easily, 32.6 percent households are taking times, 30.1 percent HH has difficult to get, 9 percent has personnel influence to get water and 19 percent are unable to get water.

The water sufficiency condition of the SMIPduring the cropping seasons is given below;

Table 3.35: Water quantity availability

S.N	Water Quantity Availability	Number of HH	Percent

1	Insufficient	218	21.8
2	Little quantity	307	30.7
3	Satisfactory	363	36.3
4	Sufficient	88	8.8
5	More than sufficient	24	2.4
	Total	1000	100

Source: Field Survey 2012

The table indicates that there is satisfactory level of water availability is 36.3 percent, the sufficient level is 8.8 percent, more than sufficient level is 2.4 percent. the availability of water in little quantity is 30.7 percent andinsufficient water quantity is 21.8 percent.

Table 3.36: Water Measurement and Productivity at various chainages

Chainage	**Discharge (approx.) m^3/sec**	**Productivity of Paddy(mound/bigha)**
Sitagunj Branch Canal		
ch 0+030	5.90	73.5
ch 3+300	3.60	68.6
ch 7+100	1.40	62.8
Manikchauri Sub Distributor		
ch 0+060	1.10	70.1
ch 3+000	0.45	65.4
ch 4+900	0.25	57.4

Source: Field Survey and DADOs of Sunsari and Morang

52 % beneficiaries receiving insufficient quantity of water are located in the lower part of the canal whereas 37 % of beneficiaries receiving satisfactory quantity of water are from middle part of the canal. The reamining 11 % of the farmers receiving sufficient quantity of water are from the upper reach of the canal (Table 3.34 and 3.35).

The field study reveal that the discharge of the upper reach is higher and gradually declining at the lower ends. The productivity of the paddy is comparatively higher on upper reach and reducing in lower part of the canal (Table 3.35).

The following are some major observation of the study team regarding efficiency and performances of the canal systems of SMIP. The observations are based upon transect walk, discharge measurement and discussion with officials of SMIP and WUAs.

- The discharge of CMC in the monsoon and dry season is not sufficient to run all the branch canals with the designed discharge at a time. Rotation system is practiced.

- All the branch/secondary canals are run with higher discharges than the designed discharge. The measured discharge at head reaches of Sitagunj and Manikchuri canals are 5.9 m^3/sec. and 1.10m^3/sec. respectively whereas the designed discharge of those canals is 5.59 m^3/sec and 0.91 m^3/sec respectively. Even higher discharge of branch/secondary canal is also not sufficient for the operation of all levels of canals under the branch canal/secondary canal. In this situation also rotation system is carried out.

- The discharge at Ch 3 +300 of Sitagunj canal was found to be 3.6 m^3/sec which is nearer to the discharge after deducting the discharges of SS9A, SS9C, SS9B, SS9D and losses. This canal can be considered as efficient canal.

- The discharge at Ch 4+900 of Manikchuri Canal was measured to be 0.25 m^3/sec which is much less discharge after deducting the discharges of four water courses and losses. The efficiency of this canal is low.

The following are the major aspects regarding technical sustainability of SMIP

3.5.2.1 At the beginning of Stage-I, to reduce investment costs use of sediment ejectors (vortex tubes) was tried to overcome the sediment issue. But this solution was not effective. To overcome shortcomings some modifications to Stage-II works were recommended by the Consultants and reviewed by an independent Panel of Experts. The major recommendations were (i) moving the present intake site to 1,300 m upstream (ii) construction of a larger capacity de-silting basin to utilize dredgers for the removal of silt and (iii) construction of a micro-hydro unit in the head reach of CMC to provide 3.2 Megawatt hydro-power for the operation of the dredgers.

3.5.2.2The durability of the structures at both of the intakes can be rated good. Also the functional aspects of the structures at the intakes are satisfactory. The maintenance and cleaning of the intake sites is done frequently. The gates and others mechanical structures installed at the intakes are maintained satisfactorily.

3.5.2.3 Initially the silt is trapped in the Pre-settling Basin through sedimentation process, which is cleared through the Escape. The major portion of the silt (60-70%) is collected in the Settling Basin (950m x 60m) downstream. Two French made Dredgers are operating from last 17 years for the removal of the collected silt.

During the field visit it was observed that only one of the Dredger was in operation. SMIP officials claim that at present both the Dredgers need huge maintenance cost and with the maintenance cost allocated by GoN it was only possible to operate and maintain only one of the Dredgers. They also are of the opinion to replace the old Dredgers with new ones. The Consultants also think that one of the Dredgers must be replaced by a new one immediately and the another could be replaced in one or two years time.

3.5.2.4 The mini hydro-electric plant (3.2 MW) with 15 km long 33 KV transmission line up to Dharan Sub- Station is already handed over to Nepal Electricity Authority. The surplus energy is supplied to the National Grid. NEA is now responsible for the O & M of the plant. The plant at present is working satisfactorily.

3.5.2.5 The Consultants are also of the opinion that 'Barrage' type diversion system would have solved the problem of low flow of water from Koshi to CMC during the dry season. This solution also controls the flow of water into the Canal in the monsoon season.

3.5.2.6 The beneficiaries must be involved in planning, survey, design, cost estimation and construction phases of a Project for its smooth operation and timely maintenance. In the case of SMIP the participation of the communities for the planning and implementation of SMHP and other intake structure works is considered as poor.

3.5.2.7

Due to the lowering of the bed level (retrogression) at the downstream of the rivers/ rivulets and drains crossing the Main Canal, the structures in the Main Canal are endangered. Recent flood of 2067 and previous floods have

caused considerable damages in Jwala Khola Headwork, Gayal Khola/ Chisang Khola, Chisang Minor, Bhote Kholsi, Naya Patti and in many structures. Most of the structures of CMC were built with Brick Masonry works. Some RCC structures were also built. During the Stage-I and Stage-II works many old structures needing major rehabilitation works were replaced by RCC structures. In some cases B/M structures were replaced by RCC structures due to the change in design of the distribution system. On the basis of present field observation the degree of durability of the structures of CMC can be rated satisfactory but unexpected flood and other unavoidable factors may cause the breakdown of some old structures.

3.5.2.8 The Project is preparing the 'Feasibility Reports' for the temporary and permanent rehabilitation works of the damaged and endangered structures located in the Main Canal and other Branch/ Secondary Canals. SMIP officials are of the opinion that allocation of sufficient maintenance fund is necessary to carry out major and minor rehabilitation works in the Main Canal to extend its service period to another 15-20 years.

3.5.2.9 Major rehabilitation works were already carried out by SMIP at 12.9RD on Patmali River, on Thalaha River, and at 106 RD on Budhi River. In all these cases the reasons behind the damages were the lowering of the downstream bed level of the rivers crossed by Main Canal.

3.5.2.10 It was observed that the supply level of the Main Canal at many places crossed the freeboard level. But in reality the supply is around 40-45 m3/sec instead of 60 m3/sec, which is the required discharge. The discharge in the Main Canal is low due to the heavy siltation and leakages at several points. The tail portion of SMIP is badly affected due to the low flow of water in the Main Canal. At several places along the Canals the side slope is not maintained which causes leakages of water due to the disturbance in the seepage line. The tail- enders is compelled to adopt the 'Rotation' system for the cultivation of all types of crops.The detail findings and recommendations regarding the technical sustainability aspects of SMIP is given in Annex: III

3.5.3 Organizational Aspect

3.5.3.1 The organization of the Sunsari Morang Irrigation Project (SMIP) was initially formed as Chatara Canal Project (CCP) under the agreement between Government of Nepal and Government of India in 1964. Sunsari Morang Irrigation and Drainage Development Board was a governing board created for executing the project under the Development Board Act of 1956. Project Manager (PM) was deputed by the government for overall responsibility of the project. Under the PM,three wings were established as; a)planning and control wing b) Engineering Wing c) Agricultural Wing.

Sunsari Morang Irrigation Development Board (SMIDB) was formed in 1979 to execute Sunsari Morang Irrigation Project chaired by the Secretary, Ministry of Irrigation and has nine members as follows:

Secretary, Ministry of Irrigation	Chairman
Representative, Ministry of Finance	Member
Representative, Ministry of Irrigation	Member
Representative, National Planning Commission Secretariat	Member
Director General, Department of Irrigation	Member
Director General, Department of Agriculture	Member
Director, Eastern Region Irrigation Directorate	Member
Director, Eastern Region Agriculture Directorate	Member
Chairperson, Water Users Central Coordination Committee	Member
Project Manager, Sunsari Morang Irrigation Project	Member Secretary

SMIDB was functioned well in policy decision making, approval of annual program and budget and necessary policy level decisions during the construction period in Stage I, Stage II and Stage III-Phase I. The board has played significant role in project implementation, organization management, project management etc. At present the board has been functioning with regular meetings and regular procedural administrative works. The context of Development Board Act 1956 is over ruled by Procurement Act, which affect on function of the board to some extent.

For the sustainable organizational management, SMIDB should be made effective for timely decision making relating to project management and policy guidance.

3.5.3.2 The present organization structure of SMIP is headed by Project Manager (PM) with four Divisions headed by SDEs and one mechanical unit headed by a Mechanical Engineer. The mechanical division at present is under Regional Irrigation Directorate. The divisions consisted of two operation and Maintenance Divisions (O & M) , one for Sunsari and one for Morang district, one Water Management Division and one Construction Division of the construction, operation and management of Stage I and II (PCR, August 1998 pp. 1.5).There was frequent turnover of key management staff (Project Manager and Senior Divisional Engineers) and some delays in establishing a Monitoring and Evaluation Division has affected on project management.

The organization of SMIP consist of PM, under 4 Divisions, 10 sub-division, 6 branch offices are working with 95 staff out of 13 approved position at present. For the next Fiscal Year, according to workload of the project 100 positions are approved whereas

63 position are filled up and 37 are vacant. There is a Sunsari Morang Irrigation Management Division no 1, Biratnagar which is also supporting to SMIP. It is required to fulfill the vacant positions for the smooth operation and management of SMIP in order to make sustainable organization management. There is lack of human resource development and training to senior and sub-ordinate staff. The presrnt approved post chart is given in Annex VI.

There is large number of daily wage labour working in different assignment. As per discussion with WUAs, this daily wage staffs are big in number and has less work load. The project has already started lay-off daily wage labour. The project management should review the number of required staff and finalized with the consent of WUAs.

3.5.3.3 For the sustainable organization management, the organization structure shall be reviewed with job description, job analysis, accountability and responsibility as well as reward and punishment provision for staffs. The Management Information System (MIS) should be developed for effective communication, information dissemination, decision making process on water management, repair and maintenance, CMC management, WUA coordination etc. The existing facilities and equipment as well as vehicles should be properly maintained in order to enhance the efficiency of staff movement and prompt management of SMIP. The frequent turnover of Senior staff also should be minimized.

3.5.3.4 Water Users Associations

Water Users Associations (WUAs) is institutionalized for the water management and representation of the beneficiaries. The objective of water management is i) to deliver water in a timely and equitable manner to all farmers in the area of SMIP, ii) to deliver water to form a flow rate that ensures efficient on-farm irrigation and iii) as far as possible, adopt delivery schedules to crop water requirements.

Further, the structured irrigation adopted in the project is based on the principal that CMC would runcontinuously during irrigation season, supplying full water to secondary canal, sub-secondary canal and tertiary canals commanding 1000 ha. and less would run either at full capacity or be closed by turn. At the time or running full capacity, water would automatically be distributed into water course proportionately to the areas served; water delivered to water course would be distributed in rotation to field outlets serving about 4 ha. each. WUA is responsible for water management and repair and maintenance at water course level.

Table 3.37:Water Users Associations

S.N.	WUAs	Level	Number
1	Water Users Group (Toli)	Water Course Level	1675
2	Water Users Committee (WUC)	Tertiary Level	86
3	Water Users Coordination Committee (WUCC)	Secondary (Branch canal) Level	20
4	Water Users Central Coordination Committee (WUCCC)	CMC Level	1
	Total		1782

The WUAs are registered and functioning as per the rules and regulation prevailing to the act, Irrigation Regulation 2056, Irrigation Policy 2060. The formation of Water Users Groups has taken long timelap which was started in 2049 B.S and completed in 2065 B.S. The institutionalization and collective representation of Water Users Associations were not on time within certain period which affected the water management of command areas.

The elections of WUAs were not held as per scheduled time which affected the efficient management and representation of beneficiaries. Some WUCC are working efficiently and some are less efficient in water management, ISF collection, coordination with farmers as well as project, repair and maintenance work etc.

For the Sustainability of WUAs, there should be consideration on management aspect as follows;

1) Timely election of WUCC and WUCCC. The WUA should be updated and renewed on stipulated time. There should be coordination and involvement on planning, implementation and supervision and water management.Empowerment of WUAs by providing different kinds of training (organizational development, account management, technical skill etc.)Make effective and efficient on ISF collection with responsibility and authority to WUA.There should be transparency on management aspect of project and WUA in order to minimize the gap and misunderstanding.
2) One of the function of WUA is repair and maintenance of water system. There is high siltation in canal. There is shortage of labour for the silt removal and other works in the area which creates the problem for WUA to use the required labour on time to complete the works. According to procurement Act, WUA is not able to use heavy machines. As per the discussion with WUAs, there should be provision to use heavy machines to carry out the repair and maintenance work effectively and timely.
3) To transfer the ownership of canal to WUA, management handover of the system is necessary. The management of Sitagunj Branch Canal is handed over to WUCC under Irrigation and Water Resource Management Project. The handover process shall be continued to other canal system on SMIP.There should be joint project meetings with Project and WUCCC. The meetings of WUAs in all levels should be in timely and decision should be materialized.ISF collection should be made effective by creating the awareness and empowerment to farmers to encourage the use of ISF. WUA should be transparent on ISF collection and expenditure.

3.5.4 Environmental Aspect

The environmental aspect of the sustainability of the SMIP is presented below;

3.5.4.1 Environmental degradation plays vital role for the sustainability of the big project like SMIP. In many causes it is out of control. SMIP diverts water from one of largest rivers of the World. The intake site is located in a geologically fragile zone. The risk of change in river flow pattern due to sudden unexpected landslides or glacier outbursts upstream always exists. Koshi River is considered as the fourth highest

silting River in the World. The sediment content rises to about 20 gm./liter (2 % by weight) during monsoon. One of the causes of sediment is soil erosion in China and in Nepal (Appraisal Report May 12, 1978). The Koshi River has a catchment area of 58,000 Km^2 of which almost one third lies in China.

3.5.4.2 The new intake site was selected by Panel of Experts after detailed search for a most stable point in the area. Aerial photographs of last 30 years were also studied. At present it can be assumed that the intake site is stable. During monsoon the flow is sufficient enough for the SMIP but the problem of heavy silt deposition exists. With the construction of pre- settling basin and settling basin and the provision of two dredgers, about 70% of the silt is removed. The dredgers must be in operation during the monsoon otherwise the more silt will enter to the Main Canal.

3.5.4.3The flood in June 1980 and Tamu landslide has caused the change in river flow pattern of Koshi River. The flow has shifted westwards and it is continuing. At present, the level of the Koshi is down by 1 m than the usual dry period level. SMIP officials agree that the dry season flow of silt free water in the Main Canal is only around $10m^3$/sec. This has caused enormous problems at the tail end. The construction of a Diversion Weir has been discussed at various labels

3.5.4.4 The natural drainage pattern of the CA has changed due to massive deforestation, increase in human settlements and more land cultivation at the head reach and also in most of parts of the CA. The Project has developed sufficient drainage network systems.

But due to environmental degradation, untimely floods and other reasons the problem of water logging at the tail is also noticed. Also the downstream bed level of the drains, rivers etc. at the crossing points of the water conveyance systems is going down day by day due to retrogression. This is causing breakdown of bridges, water conveyance systems and other structures situated nearby.

3.5.5 Others-Aspects

SMIP has some of the other aspect of sustainability as given belows;

3.5.5.1 Urbanization

The irrigation canal passes through the urban areas of Sunsari (Inaruwa Municipality, Khanar and Duhabi) and Morang (Biratnagar Municipality). These areas are used for theresidential purpose.

3.5.5.2 Conflict

The quality of work was affected to quality check up and supply of qualitative materials in the construction site. Irrigation system management and water management was not effectively carried out. ISF Collection was difficult to carry out.

3.5.5.3 Encroachment

People have occupied lands on the banks of CMC and access road side and constructed the temporary houses and business shops in the areas. This is causing leakages and breakdown of structures. The local government, project and WUCCC were not able to control such activities.

3.5.5.4 Open Border

Open border with Indian cities has also effect on sustainability of the SMIP. The price of agriculture products in the command area is higher than the price in the border. The Nepalese agriculture products has higher production cost, so that it can not compete with Indian agriculture products.

3.5.5.5 Industrialization

The Industrial corridor of Sunsari-Morang area was located in the command area of SMIP. The land occupancy is higher in industrial establishment areas is observed.

3.5.5.6 Indian government has given priority to maintain the east and west bank of Koshi river in order to protect the area from flood. It is a major sustainable factor for the protection of Koshi river and continuation of SMIP.

3.6 Overall Conclusions

The overall conclusion of the impact evaluation findings comprises with the relevancy, effectiveness, impact, efficiency, sustainability of the SMIP. The overall evaluationconclusions are given below;

Table 3:38 Overall Evaluation Results of SMIP Study

Evaluation criteria	Evaluation Result[2]	Main findings (Major fact identified)
1. Relevance	Highly Relevant (A)	Relevance according the national policy and plans for irrigation. Also the logic of intervention for improvement of agricultural production/productivity and socio-economic situation is rational.
2. Effectiveness (Short-term/Direct effect)	Effective (B)	Significant improvement has been realized on production, productivity, crop intensity, crop pattern from agriculture by irrigation facilities. Paddy Production increment on control (without irrigation) 10.38 (mound/bigha), case (with irrigation) 52.39 (mound/bigha). Wheat production increment on control 3.29 (mound/bigha) and Case 3.14 (mound/bigha). New agriculture products are introduced like; banana, vegetables and sunflower etc.
3. Impact (Long-term/Indirect effect)	Moderately Impacted (C)	Socio-economic situation of farmers has been moderately impacted and improved. Responses of farmers are as follows (using Likert scale questions). (+ Positively Impacted; Δ Not Significant; - Negatively impacted) + Household income is higher (Case 2.01 and Control 1.31). + Expenditure on family health is better (Case 1.35 and Control 1.24). + Construction and maintenance of house is higher (Case 1.96 and Control 1.64). + Women's drudgery is significant (Case 1.78 and Control1.43). Δ Purchase of household goods is not significant (Case 2.14 and Control 2.10). Δ Family Education is not significant (Case 2.02 and Control 2.07). Δ Major investment is not significant (Case 2.27 and Control 2.06).
4. Efficiency (Cost-benefit comparison etc.)	Highly efficient (A)	ERR at present is 26 % (planned 17 %) for Stage I ERR at present is 19% (planned 16 % on base case) for Stage II.
5. Sustainability	Sustainable(B)	New intake and silt removable system is sustainable for project. Some structures on CMC need repair and maintenance which could operate for 20-25 years. WUAs are organized and active needs to be coordinated with project and farmers.
Overall conclusion	Satisfactory(B)	SMIP provides irrigation facilities to Sunsari and Morang district which increase the agriculture production and productivity with highly efficiency, and it moderately improved the socio-economic condition of farmers.

Source: SMIP Study, 2012

Note: Rating criteria:
Relevancy: Highly relevant (A), Relevant(B), Moderately relevant(C), Not relevant(D)
Effectiveness: Highly effective(A), Effective(B), Moderately effective(C), Not effective(D)
Impact: High impact(A), Impacted(B), Moderately impacted(C), Not impacted/Negative impact(D)
Efficiency: Highly efficient(A), Efficient(B), Moderately efficient(C), Not efficient(D)
Sustainability: Highly sustainable(A),Ssustainable(B), Moderately sustainable(C), Not sustainable(D)
Overall conclusion: Highly satisfactory(A), Satisfactory(B), Moderately satisfactory(C), Unsatisfactory(D)

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3.6.1 After IDA/World Bank support, the project was carried out the development in different stages from 1978 to 2002. It concludes that the project construction has taken long time and still the target of command area development is not achieved.

3.6.2 There was not sufficient participation of beneficiaries on planning, implementation, monitoring and supervision from the beginning which has affected on development of ownership feeling.

3.6.3 The project management aspect is not efficient as desired at present which also affect on operation of irrigation system. Clear cut job description of the staffs is not prepared. The staffs are not made accountable for their performances. Also frequent transfer of the senior staffs is practiced.The coordination and cooperation with agricultural credit agency are not effective.

3.6.4 Discharge in the CMC is lowered to $10m^3$/sec. in the dry period due to the lack of the diversion system at the upstream of the present intake site.

3.6.5 The two dredgers working in the settling basin are very old and need huge investment for maintenance.

3.6.6 Massive defforestation, increase in human settlement and other environmental factors as well as effect of Climate Change have caused lowering of the bed level of the river/rivulets and drains (retrogression) in the CA. The slide slopes of the canal banks are not maintained at many places which cause leakages and breakdown in the system

3.6.7 The mechanical equipment at the HR and other structures are not well maintained. This is causing improper distribution of water at the tail ends and especially at water courses.

3.6.8 Emergency rehabilitation works could not be carried out at needed places due to shortage of funds and other facilities. As for example huge investment was needed afterwards for the rehabilitation works at Thalaha and Budhi Khola.

3.6.9 The alignments of water courses are deficient. Beneficiaries are not well persuaded to construct field channel for irrigation.

3.6.10 Augmentation of the flow at the tail ends is necessary.

3.6.11 Productivity of major crops productivities are slightly increasing. However the yield potentials have not been attained yet. It might be due to poor adoption of high yielding genotypes and better crop management technologies. Planting of early paddy and growing of hybrid seeds of maize and vegetables are introduced in the area.Cropped area increased by 30728 ha in 1998/99 II stage to 34508 ha in 2011/12, cropping intensities (from 184 to 216% in Morang and from 184 to 205% in Sunsari's SMIP command area) along with crop diversities (mono to multiple cropping) also increased. Net economic return from normal paddy, early paddy, wheat and sugarcane were NRs. 14800, 16480, 12530 and 132250 per hectare.

3.6.12 Mission oriented targeted crop-livestock integrated program need to be implemented in the SMIP's command area with the strong commitments and collaboration of all the stakeholders like SMIP, DADO, DLSO, I/NGOs, DDC, VDCs and so on.

Chapter IV

Recommendations

4.1 Recommendation for future policy-planning

4.1.1 SMIP should be continued. There should be people's participation from initial stage of project identification, planning to implementation, operation and maintenance of project. There should be involvement of Project Affected Persons (PAFs) of the project area in future projects.

4.1.2 Formation and mobilization of WUAs should be carried out as per the demand driven approach. It will enhance the ownership feelings and also increases the capacity of the beneficiaries for running the project successfully.

4.1.3 The decision making process of the policy related matters and regulatory system should be authorized to a special project management body (Board/Project). The timely decision on project implementation issues should be decided in order to minimize the project risk and cost increment.

4.1.4 WUAs should be made responsible for the repair and maintenance works to tertiary level. The capabilities of WUA in this respect must be improved.

4.1.5 The irrigation projects should be planned and designed on less urbanized area. Rapid urbanization causes increase in human settlements and industries which reduces the CA.

4.1.6 The management of the irrigation schemes should be handover to beneficiaries with specific action plan.

4.1.7 An adequate amount of budget for the development and promotion of agriculture need to be allocated. Adequate supports by GoN to develop the post harvest storage structures and marketing incentives should be rendered to the farmers from command area in order to streamlining the markets.

4.1.8 The policy and national plan should consider an integrated approach on irrigation development and agriculture development.

4.1.9 The financial resources must be generated for the full construction, operation and maintenance as well as post construction activities of the irrigation projects.

4.2 Recommendations for the Project Target

4.2.1 Provision of 'Diversion' system at the upstream of the present new intake site is needed. NPC, MoI and other stakeholders should act promptly in this regard.

4,2,2 Strong collaboration and cooperation between and among the SMIP, DADOs at community level should be developed.

4.2.3 For the implementation of Maintenance Plan (as prepared by SMIP), the resources should be made available to the project by exploring internal and external source of funding.

4.2.4 The operation of two dredgers must be continued for overall sustainability of the whole system. The deposited silt in the Main Canal, Branch Canals, Secondary Canals, Tertiary Canals, Water Courses etc. must be cleared as far as practicable. Flow of water above the free board level must not be allowed at any case.

4.3. Recommendation for Technical Aspect

4.3.1 Proper drainage development works are to be carried out to minimize water logging and to reduce the retrogression of the rivers/rivulets and developed drains in the CA. Soil conservation works along with the afforestation programs need to be carried out in the CA.

4.3.2 Utmost care should be given to the durability of the old physical structures. Temporary rehabilitation works is also necessary to prevent further damages that may need heavy investments afterwards as it has happened in the past.

4.3.3 The farmers must be persuaded to construct field channels to irrigate their lands as this will improve the efficiency of water delivery. Conjunctive use of surface and groundwater at the tail ends can be improved by developing the shallow tube wells. More inlets should be made in order to augment flow at the tail end.

4.3.4 The present condition of the service roads must be improved and the movement of heavy vehicles must be stopped.

4.4 Recommendations for Management Aspect

4.4.1 In order to increase the agronomic efficiency of SMIP, technological interventions in terms of high yielding and improved varieties of major crops and their crop management technologies are to be developed and promoted through farmers participatory research approach. Larger plot demonstrations of the best-bet technologies, seed-kit distribution and farmers training and visits are the key approaches to upscale the farmers' technical know-how.

4.4.2 Agricultural officers and veterinarians from SMIP should be deployed and trained frequently to up-scale and update their technical know-how on improved agro-techniques.

4.4.3 The organization structure of the SMIP must be output oriented and for each and every staffs must be developed and enacted. Based on the performance of the staffs rewards and punishments should be enforced.

4.4.4 WUAs in different levels should be accountable and functional ontheir duties, responsibility and authorities. The project should provide the trainings, awareness campaign, InformationCommunication and Services (ICS) materials to WUA and beneficiaries. The project (social unit) should facilitate and monitor the WUAs

management and election process. The project should provide the technical guidance and facilitating role in operationalizing the system.

4.4.5 There should be coordination committee for irrigation management and agriculture development as mission program. The committee shall be formed as follows:

Director, Regional Irrigation Directorate	Coordinator
Director, Regional Agriculture Directorate	Member
District Agriculture Development Office	Member
Agriculture Inputs Corporation	Member
Irrigation Division Office	Member
Agriculture Development Bank	Member
WUCCC	Member
District Livestock Development Office	Member
Project Manager (SMIP)	Member Secretary

4.4.6 Heavy equipment needed for O & M must be repaired and maintained timely and must be made available for O & M works. Better co-ordination and co-operation between Regional Irrigation Directorate and SMIP is needed for the timely use of the heavy equipments.

4.5 Recommendation for Financial Aspect

4.5.1 Timely release of the budget and delegation of necessary authority including the financial authority from top to the bottom should be made with corresponding emphasis on accountability.

4.5.2 ISF collection rate is in decreasing trend. The responsibility need to be given to WUAs for ISF collection. Act related to ISF collection and management should be formulated and enacted.The act should made provision to collect ISF with the land revenue. The government should provide the matching funds to the WUAs as equivalent to the collected ISF to increase its collection.

Bibliography

1. Three Years Interim Plan, NPC 2010.
2. Present Status Report. SMIP, 2012
3. Project Completion Report of SMHO, NEPECO, 1998.
4. Follow up Review Mission of SMHP, 1996
5. Main Canal and Cropping Potential of SMIP, SG Naryamurty, 1991.
6. Study of Agronomic Effect of SMIP, Nippon Koei, J.V. 1990.
7. Progress Report on Water Management Activity, SMIDB, 1992.
8. Irrigation Policy DOI, 2003.
9. Irrigation Regulation 2056 (Amend 2060), DOI.
10. Inception Report Headworks Improvement Desilting Facilities, NEDECO, Silt J.V. 1991.
11. Project Completion Report of SMIP Stage II, Nippon Koei co. ltd. 1994.
12. ICR on Irrigation Sector Project, WB (South Asia Regional Office, 2005.
13. Socio-economic Bench Mark Study of SMIP , APROSC, 1987
14. Report & Recommendation to President for IDA Credit, WB, 1978.
15. Staff Appraisal Report SMIDD Stage I, WB, 1978
16. ICR of SMIP Stage III, NEDECO, 2003.
17. Staff Appraisal Report of SMIP II, Project WB, 1987.
18. ICR of SMIP II Project , WB, 1996.
19. District Agriculture Profile, DADO, Biratnagar
20. District Agriculture Profile, DADO, Sunsari
21. Population Census, 2001, CBS
22. Annual Report, DOI
23. Voter's List of Morang and Sunsari district

Annex-I
Sample Questionnaire of Household Survey

Questionnaire Code No:

Impact Evaluation of Sunsari –Morang Irrigation Project

HOUSEHOLD SURVEY QUESTIONNAIRE

1. GENERAL INFORMATION

1.1 District..... 1.2 Municipality/VDC ..... 1.3 Ward No.....

1.4 Name of the Settlement/Tole ..... 1.5 House No .....

1.6 Name of Enumerator ..... 1.7 Date.....

1.8 Name of Supervisor.....

1.9 Distance of Interview HH from Canal (km) .....

2. Household INFORMATION

2.1 Name of Household .....

2.2 Ethnicity: 1. Brahmin ☐ Chettri 3. ☐r 4. Th☐ ☐

5. Muslim 6. Chaudhary 7. ☐v 8. Gurun☐ ☐ ☐

9. Magar 10. Rai 11.L☐ 12. Kami ☐ ☐ ☐

13. Sarki 14 Damai 1☐ers specify).....☐

2.3 Sex Male ☐ Female ☐

2.4 Is the respondent head of this household Yes ☐ No ☐

2.5 Land ownership/rental of the household for farming

Own land=4, Fully Rented=3 Partly Rented=2, Not Rented=1, Dont' Know=0 [.....]

Own Land	HH is the owner of the land
Fully Rented	Fully Rented for farming
Partly Rented	Part of the land is rented and part of own land
No Rented	Not rented but ownership is others
Don't' know	null (not much aware)

2.6. Household family number:

2.7 Since how long have you been in this village ?

1. From generation to now, ☐
2. 0-2 Years, ☐
3. 2-5 years, ☐
4. 5-10 years ☐
5. 10-15 years ☐
6. 15-20 years ☐
7. more than 20 years ☐

If migrated from which district or village? .....

2.8 What is your family's major occupation? (multiple answers)

1. Agriculture ☐
2. Trade/Business ☐
3. Govt./Private Service ☐
4. Industries ☐
5. Wage/Labour ☐
6. Others..... ☐

2.9 Major sources of family income?

i) Agriculture ☐
ii) Business ☐
iii) Services ☐
iv) Remittances ☐
v) Others ☐

2.10 Land holding of household

S.N.	Land	Total land (Bigha)	Irrigated Land	Un irrigated
1	Khet			
2	Bari			
	Total			

2.11 Food Sufficiency from own agriculture production

S.N.	Months	Sufficiency (Tick)
1	None	
2	Less than 3 month	
3	3-6 months	
4	6-9 month	
5	9-12 month	
6	Surplus	

2.12 Copping strategy below 6 months of food sufficiency

S.N.	Income source	(Tick)
1	Wage Labour work in near town	
2	Remittance	
3	Services in private sector	
4	Others	

Effectiveness

3.1 Production of major crops (at present)

S.N.	Crops	Total land area (Bigha)	Production (Quintal/Bigha)		Increase of Production due to irrigation
			Quintal	Quintal/Bigh	
1					
2					
3					
4					
5					

6					
7					
8					
9					
	Total				

3.1.1 Production of major crpos (before irrigation facilities)

S.N.	Crops	Total land area (Bigha)	Production (Quintal/Bigha)		Increase of Production due to irrigation
			Quintal	Quintal/Bigh	
1					
2					
3					
4					
5					
6					
7					
8					
9					
	Total				

3.1.2 Agriculture Inputs for Production

S.N.	Agriculture Inputs	Quantity (per year) kg	Unit cost/kg (NRs)	Cost (per year) NRs.	Availability in cropping season
1	Urea				
2	Compost Fertilizer				
3	Complex Fertilizer				
4	Compost Fertilizer				
5	Seed				
6	Pesticide				
7	Insecticide				
8	Labour				
9	Others.....				
	Total				

3.2 Daily food consumption habit of household

S.N.	Food	Food Habit Before Irrigation	Food Habit at Present	Remarks
1	Rice			
2	Bread			
3	Pulses			
4	Vegetables			
5	Fruits			
6	Milk			
7	Ghee			
8	Corn			
9	Others.....			
	Total			

3.3 When do you use the irrigation scheme from? Year :

3.3.1 Do you use water provided by Irrigation scheme ?

a) Yes, by the project, ☐ b)Yes, by traditional scheme ☐ c) Yes, by both ☐
d) Only rain fed ☐ e)others ☐

3.3.2 What type of irrigation facilities are you using to irrigate land?

a)Sunsari Morang Irrigation b) Small Irrigation c) Ground Water d) Traditional irrigation e) No-irrigation

3.4 Are you satisfied with the irrigation facilities?
Highly Satisfied=4, Satisfied=3 Moderately satisfied=2, Dissatisfied=1, Dont' Know=0

Highly Satisfied	Regular and almost always sufficient water supply
Satisfied	Regular supply with sufficient water
Moderately Satisfied	Supply of water in low volume
Dissatisfied	No supply of water
Don't' know	null (not much aware)

3.5 If you do not have irrigation service, What type of facilities would you prefer ?

a) Canal ☐ b) Ground water ☐ c) Lift system ☐ d) Other ☐

3.6.1 Ease of irrigation water supply during cropping season

Easy to get water=4, Time consuming=3 Hard to get=2, Influence by person=1, Impossible=0
[.....]

Easy to get water	Easy to get sufficient water supply
Time consuming	Un timely and low volume of supply
Hard to get water	Hard to get the water for irrigation on plantation
Influence by person	Not systematic (influence person get easily)
Impossible	Almost impossible to get water

3.7.1 Level of irrigation water supply during the cropping season
Excess=4, V. Adequate=3, Adequate=2, Fairly Adequate=1, Inadequate=0, [.....]

Excess	Excess water, Much more than needed
V. Adequate	More than Adequate
Adequate	Just Adequate
Fairly Adequate	Just Below Adequate
Inadequate	Water is inadequate

3.8 Are you a member of Water User Association ?

i) Yes ☐ ii) No. ☐

3.9 If Yes, what is your present responsibility under irrigation committee?
1. Position..... 2. No of Meetings attended.....

3.10 Interval of meetings being held ?
i) Once in a month ii) Twice in a month iii) Bimonthly iv) as required

3.11 Are you satisfied with the mobilization of User's Community in maintaining and improvement of irrigation facilities?

Highly Satisfied=4, Satisfied=3 Moderately satisfied=2, Dissatisfied=1,
Dont' Know=0 [.....]

Highly Satisfied	Well maintained canal/regular water in farm by WUA
Satisfied	WUA members working as per demand
Moderately Satisfied	Mobilized members in minimum level
Dissatisfied	No mobilization and no work for improvement of irrigation facilities
Don't' know	null (not much aware)

3.12 How much do you pay for Irrigation Charges ?
NRs.

3.13 Are you satisfied with the Charges ?

Highly Satisfied=4, Satisfied=3 Moderately satisfied=2, Dissatisfied=1,
Dont' Know=0 [.....]

Highly Satisfied	The irrigation charges are appropriate for sufficient water
Satisfied	The charges is satisfied for existing services
Moderately Satisfied	The charges is little bit high for low volume of water
Dissatisfied	Charges is high and burden for farmers having no sufficient irrigation
Don't' know	null (not much aware)

Impact

4.1 Has the cropping intensity changed in your land after irrigation?

Totally Change=4, Changed=3 Moderately changed=2, No change=1,
Dont' Know=0 [.....]

Totally Change	The cropping intensity has changed totally after irrigation
Changed	Cropping intensity is changed
Moderately Changed	Cropping intensity is changed in some extent
No Change	No change on cropping intensity after irrigation
Don't' know	null (not much aware)

4. 2 If yes, how much is your cropping intensity?

i) One crop in year (100%) ii) Two crops in a year (200%) iii) Three crops in a year (300 %)
iv) More than 3 crops in a year (----%)

More than three crops=4, Three Crops=3 Two crops=2, One crops=1,
No change=0 [.....]

More than 3 crops	More than 3 corps in a year with cash crops
Three Crops	Three crops in a year
Two crops	Two crops in a year
One Crop	Only one crop in a year
No change in cropping	No change in cropping

4.3 Has the cropping pattern change after irrigation?

Totally Change=4, Changed=3 Moderately changed=2, No change=1,
Dont' Know=0 [.....]

Totally Change	The cropping pattern has changed totally after irrigation
Changed	Cropping pattern is changed
Moderately Changed	Cropping pattern is changed in some extent
No Change	No change on cropping pattern after irrigation
Don't' know	null (not much aware)

4.4 If yes, name the new patterns?

4.5 Has the household income increased after irrigation by sale of agriculture products?

Totally Increased=4, Increased=3 Satisfactory=2, No Increment=1, Don't Know=0 [....]

Totally Increased	HH Income is increased fully from agriculture products
Increased	HH Income increased
Satisfactory	Satisfactory increased of HH income
No Increment	No increment of HH Income
Don't Know	Do not know whether increased or decreased

4.5.1 Do you spent to your children's education level?

Higher Education=4, Campus level=3 Secondary=2, Primary=1, Not schooling=0 .....]

Higher Education	Degree and higher level of education in country/abroad
Campus level	Studies in Campus level
Secondary	Higher secondary and secondary level of education
Primary	Primary education only
No Schooling	Not enroll in school

4.5.2 Do you able to spent for the treatment to your family health aspect?

Major Health sickness=4, Regular checkup=3 Occasional checkup=2, As and when necessary=1, Not visit health institutions=0 [.....]

Major Health Sickness	Treatment of major operations and sickness in hospital/nursing home
Regular checkup	Regular visit the hospital/clinics for checkup
Occasional Checkup	Occasional visit on checkup in hospital/clinics
As and When	Visit hospital/clinics as and when sick
No visit to health institutions	Not visit to health institutions

4.5.3 Do you able to purchase/install durable goods (HH essentials) in house?

Fully Purchased=4, Partly purchased=3 Some items=2, No purchase=1, Don't know=0 [.....]

Fully Purchased	Purchased (TV, Freeze, Motorcycle, generators, kitchenware, mobile)
Partly	Purchased partly items
Some times	Only kitchenware
No Purchased	Not able to purchased new items
Don't know	Not aware or not considered

4.5.4 Do you able to build/maintain the house?

Build New house=4, Extension of old house=3 Old house repair=2, As it was=1, Old house=0 [.....]

Build New house	Able to build new house and living there
Extension of old house	Extension of rooms in old house
Old House Repair	Old house is repaired and maintained
As it was	No repair and maintenance of old house
Old house	Old house which is going to breakdown.

4.6 What are the major investment of your household;

- Education ☐
- Purchase of land ☐
- Purchase of Livestock ☐
- Social Function ☐
- Others; ☐

50

4.8 Has the women's drudgery been reduced after irrigation ?
i) yes ☐ ii) No

4.9 Accessibility of transportation to go to farm and market center?

Accessible=4, Accessible only on dry season=3 In accessible in rainy season=2, Inaccessible all season=1, No road service=0 [.....]

Accessible	Accessible to go to farm and market in all season
Accessible only on	Accessible only on dry season to farm and market

Dry Season	
Inaccessible in Rainy season	In accessible in rainy season due to flood and/or crossing
Inaccessible in all season	In accessible in all season to farm and market
No Road service	Not road services to go to market

4.10 What are the major problems of your irrigation system ?

.....
.....

4.11 What are your opinions to improve the irrigation system ?

.

Interviewer Name ..... Signature and Date.....

Supervisor Name ..... Signature and Date

Respondent's Contact Phone:

Annex-II
Sample Checklist of FGD and Technical study

CHECKLIST FOR -Beneficiaries (Water Users Associations)

1. GENERAL INFORMATION

1.1 Name of Participating WUAs
   a.
   b;
   c;
   d;
   e;
   f
1.2 General Objective of WUAs
   a.
   b.
   c.
   d.
   e.

1.3 Major Activities of Irrigation facilities
   a.
   b.
   c.
   d.
   e

---

2. Water User's Association Management

2.1 WUA Members : Total farmers

2.2 Formation of Executive Committee

- Election of process EC
- Women Participation
- Social Inclusion

S.N.	Name	Position
1		
2		
3		
4		
5		
6		

7		
8		
9		
10		
11		
12		
13		

2.2 Number of Meetings held in last year:

2.2 Major Topics of Discussion on Irrigation and Farming (minutes of the meetings)

2.2 Major income source of the WUA (Last year 2067/68)

S.N.	Income Source	Amount
1		
2		
3		
4		
5		
	Total	

2.3 Main Expenditure of WUA

S.N.	Main Expenditure	Amount
1		
2		
3		
4		
5		
	Total	

2.4 Irrigation Charges per month : Rs.....

2.5 Is the charge sufficient to operate WUA ?

Sufficient=4, Moderately Sufficient=3 Low Charge to operate=2, Insufficient=1, Has to be revised=0

[.....]

Sufficient	The existing charges are sufficient to operate and manage WUAs
Moderately Sufficient	Manage and operate hardly
Low charge	The charges is low to operate WUAs
Insufficient	Insufficient to manage and operate WUAs
Revision	It has to be revised and increased

2.6 Is there any provision of late fee if the monthly charge payment is delayed ?

Late Fees: NRs

2.7 Irrigation management system of the User's Committee in village

3.1 Irrigation Canal water flow in seasonal basis:

Name of Canal:
Command Area VDC

S.N.	Name of Water Users Associations	Water Flow in Rainy Season			Water Flow in Dry season		
		Months	Quantity	Adequacy	Months	Quantity	Adequacy

3.1.1 Production of major crops in the area

S.N.	Crops	Total land area (Bigha)	Production (Quintal/Bigha)		Increase in production after irrigation
			Quintal	Quintal/bigha	
1					

2					
3					
4					
5					
6					
7					
8					
9					
	Total				

3.2 Has the cropping pattern changed after irrigation facilities?

Totally Change=4, Chnged=3 Moderately changed=2, No change=1, Traditional=0 [.....]

Totally Change	The cropping intensity has changed totally after irrigation
Changed	Cropping intensity is changed
Moderately Changed	Cropping intensity is changed in some extent
No Change	No change on cropping pattern after irrigation
Traditional	Cropping are in traditional way

3.3 Condition of Irrigation Canal

Fully Operational=4, Operational=3 Partly Operational=2, Not operational=1, Need Rehabilitation=0
[.....]

Fully Operational	The canal is operating fully with adequate water flow
Operational	Operational in all season
Partly Opertional	Operational partly, some section is not working and leakage of water
No operational	No operational and damage structures
Rehabilitation	Need Rehabilitation of canal

3.4 How frequently do you repair and maintain the canal?

Almost Always=4, Frequently=3, Sometimes=2, Rarely=1, Never=05 [.....]

Almost Always	Maintenance and repair conducted almost always
Frequently	Maintenance and repair done frequently
Sometimes	Only sometimes repair and maintain
Rarely	Maintenance and Repairing conducted rarely
Never	No Maintenance and repair

3.5 Please enlist the major problems of your irrigation system.

What are your suggestions for improvements of irrigation facilities in your area, please enlist according to priority?

Checklist For Project Staff

Relevancy

- Policy and Plan implementation of Sunsari Morang Irrigation Project
    - Irrigation policy (2060) and project strategies
    - Annual plan for irrigation facilities

Effectiveness

- Command Area in each project phases
    - Phasewise construction and command area development
- Completion and operation of irrigation schemes(canals)
    - Timely completion and operation of irrigation canal
    - Supply of water to the canal
- Production of Agriculture Products
    - Production and productivity of agriculture products
    - Target of command area and production
- Beneficiaries and their social status
    - Total number of HH benefitted
    - Command area VDCs
    - Social groups (Dalit, Janjati, etc.)
- Economic and livelihood of farmers
    - Improvement of Livelihood of farmers

Impact

- Increment in agriculture production yield
    - Major agriculture yeild in comman area
- Improve the access to transport agriculture product and inputs by using Access Road
    - Access road on main canal and branch canal
    - Maintenance of access road

Efficiency

- Cost-benefit of the project in terms of investment in different phases
    - Project investment and annual budget
    - Benefit of the project
- Timely Completion of project and additional cost (if any)
    - Timely construction of project
    - Additional cost or cost verification

Sustainability

- Financial Sustainability;
    - Government investment in the project, IDA loan
    - Irrigation tariff, income from farmers
    - Rrepair and maintenance expenditure
    - Short term financial shortcomings, long term financial requirement, Budget allocation etc.
- Technical Sustainability;
    - Discharge, water flow in canal section, life of the canal, existing structure,
    - Repair and maintenance of canal etc.
- Organizational arrangement/Management;
    - Existing organizational structure,
    - Staffing pattern, Staff movement,
    - Job analysis, Field staff,
    - Supervision and monitoring, MIS on irrigation.
- Environmentally Sustainability:
    - Environmental degradation, soil erosion, flood, plantation and vegetation etc.
    - Mitigation Measures

Checklist for Mixed Group

Relevancy

- Policy and Plan implementation of Sunsari Morang Irrigation Project
    - Irrigation policy (2060) and Sunssari –Morang Irrigation Project
    - Implementation of Planned irrigation shcemes

Effectiveness

- Command Area in each project phases
    - Phasewise construction and command area development
- Completion and operation of irrigation schemes(canals)
    - Timely completion and operation of irrigation canal
    - Supply of water to the canal
- Production of Agriculture Products
    - Production and productivity of agriculture products (increase)
    - Target of command area and production
- Beneficiaries and their social status
    - Total number of HH benefitted of Sunsari and Morang
    - Command area VDCs coverage
    - Social inclusion (Dalit, Janjati, etc.)
- Economic and livelihood of farmers
    - Improvement of Livelihood of farmers
    - Improvement on health, education, well being of household

Impact

- Increment in agriculture production yield
    - Major agriculture yeild in comman area with change in cropping pattern

- Improve the access to transport agriculture product and inputs by using Access Road
    - Access of transport by access road to go farm and market centers
    - Maintenance of access road

Efficiency

- Cost-benefit of the project in terms of investment in different phases
    - Project investment, IDA credit and Government Investment
    - Benefit of the project as per investment
- Timely Completion of project and additional cost (if any)
    - Timely construction of project
    - Timely supply of Water for irrigation

Sustainability

- Financial Sustainability;
    - Government investment in the project, IDA loan
    - Irrigation tariff, income from farmers
    - Rrepair and maintenance expenditure
- Technical Sustainability;
    - Discharge, water flow in canal section, life of the canal, existing structure,
    - Repair and maintenance of canal etc.
- Organizational arrangement/Management;
    - Existing Project organizational structure,
    - Staffing pattern, Staff movement,
    - Supervision and monitoring,
    - Coordination with WUA and other stakeholders.
- Environmentally Sustainability:
    - Environmental degradation, soil erosion, flood, plantation and vegetation etc.
    - Mitigation Measures

Technical Checklist

Checklist for Technical Evaluation

Name of the Scheme	
District:	
VDC:	
Name of the Consulting form	
Completed By:	
Completed Date:	
Field Visit Date:	From To

A) INTAKE WORKS (Method: Discussions with SMIP Officials, Transect Walk and Observations)

1. Degree of the durability of the Intake Structure:

Excellent = 4, Good =3, Satisfactory = 2, Fair =1, Poor = 0 [.....]

Excellent	Perfect Quality and Workmanship, Well functioning
Good	Good Quality and Workmanship, Good Functioning
Satisfactory	Satisfactory Quality and Workmanship, Functioning
Fair	Quality and Workmanship to be improved, Bad Functioning
Poor	Low Quality and Workmanship, Non-Functional

If fair and poor, please provide remarks

2. Degree of the protection works of the Intake:

Excellent = 4, Good =3, Satisfacory = 2, Fair =1, Poor = 0 [.....]

Excellent	Perfect protection works
Good	Enough Protection Works
Satisfactory	Satisfactory Protection Works
Fair	Improvement of Protection Works needed
Poor	Poor Protection Works, Chances of Washout

If fair and poor, please provide remarks

3. Frequency of cleaning and maintenance of Intake:

Almost Always=4, Frequently=3, Sometimes=2, Rarely=1,Never=0 [.....]

Almost Always	Maintenance and Cleaning conducted almost always
Frequently	Maintenance and cleaning done frequently
Sometimes	Only sometimes clean and maintain
Rarely	Maintenance and Cleaning conducted rarely
Never	No Maintenance and Cleaning

If rarely and never, please provide remarks

4. Degree of Community Participation in O & M works:

Excellent = 4, Good =3, Satisfactory = 2, Fair =1, Poor = 0 [.....]

Excellent	Full Participation in Decision Making and Implementation of O&M works
Good	Good Participation in all aspects of O & M
Satisfactory	Satisfactory Participation in O &M Works
Fair	Less Participation in O&M Works as desired
Poor	Almost No Participation in O & M Works

If fair and poor, please provide remarks

B) MAIN/BRANCH CANAL SECTION (Method: Transect Walk, Observation, Discussion with Official of SMIP)

Chainage No: ..... to Chainage No.....

1. Adequacy of water demand:

Excess=4, Adequate=3, Satisfactory=2, Fairly Adequate=1, Inadequate=0, .]

Excess	Excess water, Much more than needed
Adequate	Adequate of water
Satisfactory	Satisfactory of water flow
Fairly Adequate	Just Below Adequate
Inadequate	Water is inadequate

If inadequate, please provide remarks

2. Adequacy of Service level:

Very High=4, High=3, Adequate= 2, Fairly Adequate=1, Inadequate=0 [ ]

Very High	Service level to full and utmost satisfaction
High	Service level to satisfaction
Adequate	Adequate service level
Fairly Adequate	Service level fairly adequate
Inadequate	Inadequate Service Level

If inadequate, please provide remarks

3.

Good	Good functioning as required
Satisfactory	Satisfactory functioning with minor problems
Fair	Unsatisfactory functioning
Poor	Leakages, breakdowns and damaged section

If fair and poor, please provide remarks

4. Frequency of Silt removal on the studied section:

Almost Always=4, Frequently=3, Sometimes=2, Rarely=1, Never=05 [.....]

Almost Always	Removable of Silt almost always
Frequently	Frequently removable of silt
Sometimes	Silt remove sometimes
Rarely	Silt remove rarely
Never	No silt removable

If rarely and never, please provide remarks

5. Frequency of maintenance of the studied section:

Almost Always=4, Frequently=3, Sometimes=2, Rarely=1, Never=05 [....]

Almost Always	Maintenance conducted almost always
Frequently	Maintenance done frequently
Sometimes	Only sometimes maintained
Rarely	Maintenance conducted rarely
Never	No Maintenance

If rarely and never, please provide remarks

6.Degree of the condition and durability of the Structure on Main/Branch Canal Section:

Excellent = 4, V. Good =3, Good = 2, Fair =1, Poor = 0 [.....]

Excellent	Perfect Quality and Workmanship, Well functioning

Good	Good Quality and Workmanship, Good Functioning
Satisfactory	Satisfactory Quality and Workmanship, Functioning
Fair	Quality and Workmanship to be improved, Bad Functioning
Poor	Low Quality and Workmanship, Non-Functional

If fair and poor, please provide remarks

7. Degree of the functional matter of the Structures on Main/Branch Canal Section (damaged, ,malfunctioned, leakage etc.) :

   Excellent = 4, Very Good =3, Good = 2, Fair =1, Poor =0 [.....]

Excellent	No leakage, no breakdown, and no damaged section
Good	Good functioning as required
Satisfactory	Satisfactory functioning with minor problems
Fair	Unsatisfactory functioning
Poor	Leakages, breakdowns and damaged section

Annex-III
Technical Study of SMIP

Annex III- Technical Study: Findings

The new intake, pre-settling basin, old intake, settling basin, mini hydro plant, transmission lines and main canal up to 106RD of SMIP was visited by the technical team together with the concerned project officials. The following are the main findings and recommendations:

- The new intake is built about 1300 m upstream of the old intake to increase the discharge of CMC from 45 m^3/sec to 60 m^3/sec.
- In between the new intake and old intake a 300 m long pre-settling basin is constructed where the velocity of flow is low in order to collect as much silt as possible through sedimentation process. The collected silt is removed through the escape built on the right side of the old intake.
- The durability of structures at both of the intakes can be rated good.
- The maintenance and cleaning of the intake sites is done frequently.
- More protection worked are needed upstream of the new intake.
- Beneficiaries and the project official pointed out that the flow of Kosi River is shifting westwards year by year. This has caused the low flow of water in CMC during the dry season. Some kind of diversion system is needed to divert enough flow from Kosi River to CMC during dry season.
- A bridge on Kosi River just upstream of the new intake is being built by The Road Department. It is strongly recommended that the officials of National Planning Commission and concerned Ministries take up the matter seriously to construct the bridge with the diversion system for SMIP.
- So far as community participation for O & M works of the intake sites is concerned it can be said that it is poor. The WUACC & the Project must discuss themselves for more and more involvement of the beneficiaries in O & M works of the intakes. Also the beneficiaries are advice to follow up the construction. aspects of the diversion system.
- The gates and other mechanical structures installed at the intakes are maintained satisfactorily.
- A de-silting basin (length 990 m and bed with 60m) is constructed to collect the silt of the second highest silting river (Kosi) of the World. The silt is removed with the help of French made two- cutter suction dredgers of 14.0m^3/hr capacity. Both the

dredgers are in operation from last 17 years and at present they need heavy maintenance works for their operation.

- During the field visit it was found that only one dredger was working and the another was out of order. It is strongly suggested that the Ministry allocate sufficient funds to SMIP for the procurement of new dredgers.
- 3.2 Megawatt of power is also generated downstream of the de-silting basin with the head available due to the construction of the new intake. The power generated is used to operate the dredgers and the surplus energy is connected with the National Grid. The mini hydro-power plant was under maintenance works during the field visit.
- At 12. 9 RD of the Main Canal the bed level of Patmali River has lowered beyond expectations. This was caused by flood on the river and progressive lowering of the downstream levels. The bridge over the Patmali River and the water conveyance works were effected. The project carried out protection works with enough energy dissipation system, cut offs and side protections works. Now all the structures are safe. The project officials are of the opinion that if the rehabilitation works were carried out earlier, the cost of the repairing works would have been much less.
- The supply of water in the Main Canal section can be considered satisfactory. It was observed that the silt deposit is not cleared for a long duration of time. This means that the present supply level is below the required supply level. As discussed with SMIP officials the present supply is around 45 m^3/sec instead of 60 m^3/sec, which is the required discharge. The discharge in the Main Canal is lowered not only by the deposition of silt nut also due to leakages in several points. The tail portion of SMIP is badly effected due to the low flow of water in the main canal. The irrigation water is inadequate which causes several problems at the tail. It was known that there is a problem of closing the Main Canal for a long period for maintenance works. It is recommended that the SMIP with the help of WUACC take prompt action for the clearance of deposited silt and repair of the leakages. The Main Canal must be closed for repairing works in such a way that it did not disturb the cropping practices of the beneficiaries. WUACC has a big role to play in this aspect. It must be carried out in a planned way with the acceptance of all stakeholders.
- Another problem in the Main Canal is the encroachment of banks in several places specially in Jhumka and Khanar areas. Houses are built on the top of the banks. Toilets are built on the inner slope of the banks. Kitchen gardening and animal

husbandry development works are carried out in both the side slopes. The houses built on the top of the banks have electricity connections. How it is possible on the government land ? The slopes are cut in several places and the initial designed slope is not maintained. The seepage line is disturbed causing leakages at several places. The operation and maintenance of the Main Canal is also effected. The houses must be immediately removed and the damaged portions repaired to avoid leakages. The side slopes of the banks must be maintained as per the design. Plantation of tree is recommended.

- The condition of the service roads is fair. In some sections immediate maintenance is needed. The roads are built for O & M works of SMIP. But at present most of the roads, especially from Jhumka to Chatara is used for regular traffic. Heavy loaded trucks and buses filled with passengers are using the service roads. Accident can take place at any time. In past a bus plunged into the canal causing several deaths. Also recently a tractor fell down the canal which also caused some casualties of human being. This type of activities must be controlled.
- The Aqueduct at 48 RD of the Main Canal is functioning satisfactory. But due to the lowering of the bed level of the river, the bridge and the Aqueduct is effected. At present a new bridge is being constructed to replace the old bridge. Sufficient energy dissipation works & protection works on the bed of the river is recommended to protect further lowering of the bed level due to retrogression. Also the movement of heavy vehicles through the old bridge is to be stopped immediately.
- The Escape built at 52RD is closed now to prevent further damages downstream and the nearby settlement. The side drain is also not functioning. The guide wall is also damaged. Necessary protection works downstream, rehabilitation of the guide wall and the repair of the drain is to be carried out as soon as possible. The Escape can not be closed for ever as the possibility of opening the Escape always exists in case of emergency.
- The Cross Drainage works at 52 RD needs minor repairing works like plastering etc.
- Also at 56 RD the bridge is damaged due to the lowering of the bed level downstream. Protection works to prevent further damages is needed.
- The Head Regulator at 64 RD is functioning satisfactorily.
- At 70 RD there is a small Escape which functions well. The floor downstream of the bridge is damaged. Protection works are recommended.

- The bridge at 80 RD is totally collapsed and a new bridge is under construction. The reasons for the collapse of the bridge is the same as in the previous cases. The floor downstream of the bridge completely collapsed about 4 years ago. Now the floor of the new bridge is concreted with piling works. It will take one more year to complete all the rehabilitation works including the construction of the new bridge.
- At present a major rehabilitation works is being done in Budhi Khola at 106 RD. The present structures are functioning satisfactory but due to the lowering of the bed level of Budhi Khola, the protections works downstream and the side walls are collapsing. The water conveyance works and the bridge above the river were endangered. The SMIP took prompt action to repair the floor with extra gabion works, sheet piling new cut offs etc. At the time of the visit the works were in good progress and it is expected that the major part of rehabilitation work will be completed before the coming monsoon. Now the whole structure on the main canal at 106 RD can be considered safe. Now the supply to the Morang District is possible as Bhdhi Khola is on the border of Sunsari and Morang districts. SMIP's efforts in this regard is appreciated.

- Almost all the structures of the Main Canal are built more than 50 years ago. Besides the structures discussed above, it can be said that the durability of most of the other structures can be rated fair. Some of them need minor but immediate repairing works. The quality and workmanship of some of the structures is to be improved. The degree of functional matter of the structures looks satisfactory.
- The maintenance of mechanical gates and other parts like greasing etc are done from time to time.
- SMIP is advice for the close monitoring of the structures of the Main Canal. The reasons for damages are flood, lowering of the bed level of the rivers/ rivulets due to retrogression and side drains which are in bigger size now due to deforestation practice. If some minor damages are noticed, prompt action must be taken for immediate repair works. As the structures are old., complete breakdown may happens are old, complete breakdown may happen if not repaired in time. Also late rehabilitation works will cause heavy investments afterwards as it has happened in the past.
- The Shankapur Branch Canal is functioning well. The supply of irrigation water looks good. The silt deposit was cleared not so long ago. Enough bank lining works is carried out at the head portion. But the tail part of T-4 is damaged and all the supply is

diverted towards the near by drain. It must be repaired immediately otherwise the supply of water in field channels and village courses downwards the damaged portion is not possible. Project must seek community participation for the timely repair works.

- The inlet, to augment water from nearby Jwala River to the tail portion of T-3 at Shankarjora VDC is damaged completely. The bed level of Jwala River has lowered beyond expectations and the whole inlet system is damaged. Now the supply of T-3 is diverted to the Jwala River causing more damages. In this case a major rehabilitation work with the involvement of the beneficiaries is urgently needed.
- The Canal section of Holiya Minor was well maintained. The silt was removed about 1 year ago with departmental work using excavator. The removed silt was immediately taken away by outsiders. It would have been better that the removed silt is deposited at the damaged bank portion to maintain the necessary slope. Some leakages were observed in the Aqueduct. Community interventions and participation is urgently needed in such cases. The outsiders must be prevented from taking away the removed silt. Also the beneficiaries can repair the leakage of water in the Aqueduct. This will prevent the wastage of water.
- In the Sukhsaina Branch near Inerwa a tertiary channel is damaged which causes wastage of water. The users have closed the supply at the upstream of the damaged tertiary channel to avoid the wastage of water. But this is not the proper solution. The beneficiaries downstream are deprived of the irrigation water which is at present badly needed for the paddy plantations. The concerned beneficiaries and the SMIP must work hand to hand for the immediate repairing works.
- During the field observations it was noticed that the Sitagunj Branch, Ramgunj Branch and Jhumka Minor are all functioning satisfactorily. The clearance of silt and minor maintenance works were carried out from time to time.
- In some field channels and village courses it was observed that the required bank slope is not maintained which is causing leakages.
- It was noted that the head and middle reach of the Sitagunj Branch, Ramgunj Branch and Jhumka minor are all functioning satisfactorily. The durability of the structures can be rated good and the degree of functional matter is also satisfactory. The silt deposited and some minor maintenance works were carried out from time to time.

Annex-IV
Focused Group Discussion

FGD with SMIP Staff(S..D.E. Chief Accountant, Engineers, Field Staffs, PRENA)

Presentation

1.	Mr. Surya Naraya Thakur	Engineer
2.	Suk Dev Thakur	Engineer
3.	Mr. Dharma raj Adhikari	Overseer
4.	Prem Chandra Jha	Engineer
5.	Naumidin Hok	Overseer
6.	Suk Dev Sharma	engineer
7.	Durga Pl Pokhrel	
8.	Balaram Yadav	Asst. engineer
9.	Sujin K. Chaudhari	Supervisor
10.	Nar B. Basnet	Engineer
11	Mahesh K. Pokhrel	Engineer
12.	Ramesh L. Karna	Engineer
13.	Pramod K. Das	Overseer
14.	Ajaya K. Mandal	Asst. Engineer
15.	Kali Pl Dev	engineer
16.	Shailendra Sigh	engineer
] 17.	Purnendra K. Kayastha	engineer
18.	Sambhu Pl Ojha	Account Officer
19.	Udin P. Dev	Engineer
20	Girija P. Karna	Secition Officer
21.	Shyam Nadin Yadav	SDE
22.	Hiranya P. Sharma	Agri Officer
23.	Mohan P. Shrestha	Supervisor
24.	Harikrishan Acharya	Engineer

Major discussions and observations are as follows:

- The works not completed in the First Stage of SMIP are revised and carried over to the later Stages. The revision is need on types of work also.
- The fund allocated for the 2nd phase of the Third Stage is not sufficient. GoN is not fulfilling its commitments. SMIP is like a 'White Elephant'.
- Due to siltation the flow of water in the Main Canal is less than the designed discharge. If the flow is increased from 50 m^3/sec, the level crosses the free broad level. The reduced flow of water causes problem at the tail end.
- The water management is also poor. The water is not sufficient in the dry season. The beneficiaries at the head reach do not follow the water delivery schedule in the paddy season.

- Diversion with protection works and de-silting of the Main Canal is urgently needed to increase the discharge. If the normal level of Kosi River goes 1m down, the flow in CMC will be around 40-45 m^3/sec.
- Also the whole Command Area is not developed.
- Encroachment of River Bank is increasing. This must be stopped and all the illegally built infrastructure should be removed.
- Boys & girls are swimming in the canal. Sometimes accident occurs and the canal must be closed. This effects the supply of water in the system for more than 5 days.
- All the structures of CMC are old. The brick masonry work in several places is damaged and exposed. The conditions of the bridges are also poor. Heavy loaded buses and trucks are using the service roads. This effects the old structures. Also the banks get weak. The bed level of most of the rivers and drains is lowering day by day effecting the bridges and the structures.
- Due to environmental degradation now the drains developed are of bigger sizes which cause the lowering of bed level of rivers nearby Also the flood water from time to time effects the whole system.
- There is a need of developing 'Maintenance Master Plan' for SMIP. The involvement and participation of the beneficiaries for O & M works must be made compulsory.
- At present the beneficiaries are taking the responsibilities of repairing works in some cases with Project support. But much improvements are needed for this type of works. If properly conducted this system is good.
- During the discussion it was agreed that the agricultural activities has increased. Different types of crops are cultivated and the production is higher than before the Project.
- In 2 to 3 canal systems the water tax is collected. Also money is raised among the beneficiaries to clean the water courses. It seems the present water tax collection procedures needs rectifications. The formulation of Act in this regard is a welcome step.
- The present organizational structure is good and the manpower is sufficient for all sorts of works including supervision and monitoring.

- Previously field staffs like engineers and sub- engineers also used to stay at site offices for better operation of the canals and supervision of the ongoing constructions.
- At present most of the field staffs stay at the Center. Due to the present development of mobile telephone network , the Site -in charges get immediate information about problems of their respective sites and prompt action is taken. As the vehicles allocated to the field offices are not in moving conditions, The Site-in charges can uses the vehicle from Center for supervision works.
- It seems that proper 'Job Description' and 'Job Evaluation' of the staffs is not practiced.
- Some times administrative staffs are sent for technical trainings.
- Frequent transfer of key staffs is also practiced. This hampers the overall progress of the Project.
- In some cases the deputed staffs are not well qualified and not so much experienced.

F.G.D. at Ramgunj

Present

S.N.	\Name	Address	Position
1	Tek Chandra Biswas		Chairperson, Ramgunj Branch Canal
2	Bijendra K. Paswan		Secretary, Ramgunj Branch Canal
3	Khadga B. Kattel		Chairperson, SS11
4	Ashok Kumar Majhi		Chairperson, SS10A
5	Narayan Sardar		Member, SS10-2
6	Shiva P.Dahal		Chairperson SS T1
7	Ram Krishna		Member
8	Ram SewakYadav		Farmer
9	Namun Lal Shah		Farmer
10	Mauli Sardar		Farmer

The following are the findings of F.G.D with the farmers, NPC, MOI, JICA, SMIP official and PRENA.

- New Ramguni WUA was formed about 3 months ago. The officials were selected through 'Election Process'.
- In some canals the water level is above the free board and in some cases there is an overflow of water but the field is dry.
- Paddy was the major cultivation before the Project with rain fed conditions.

- Due to heavy siltation the land of the farmers is effected. Also some of the water courses are blocked with the deposition of silt.
- The farmers are ready for cash contribution for the removal of silt but due to the shortage of labour at present the works can not be carried out.
- The farmers are aware that unmanaged way of irrigation effects the whole system.
- Proper training are needed for the farmers. They want to know the quantity of water needed for different crops. So far only the Chairman of the users committees have received the trainings.
- The previous committee did not work properly. Even some of the members did not know each other as the 'Meetings' of the WUA was not held as required. The WUA was inactive. The water tax collection was not done in proper transparent way.
- A new WUA is formed thorough 'Election' process. Although there was political interventions during election, the new WUA formed represents most of the of the beneficiaries. Regular meetings are held and all decision are noted in the Minute Book.
- Removal of silt once a year is necessary. Also the timely repair of the service road is needed.
- The beneficiaries are of the opinion that the canals with the designed flow must operate. This will provide adequate supply at the tail.
- Technicians like Engineers or Sub-Engineers must be in site for the proper O & M of the canals.
- Houses are built on the land of water course. The houses must be removed. The tail end farmers must be aware of their problems and they should co-operate with WUA & Project to solve the problems in time.
- Management transfer to the beneficiaries is possible. The canals and structures must be rehabilitated as necessary. Necessary agricultural training must be conducted to the farmers. Then only the management of transfer will bring positive results.
- Silt is not cleared in the Ramgunj Branch from many year but the irrigation through this Branch is going on.

FGD with WUCCC

The FGD was held at WUCCCs office at Biratnagar and the following participants were present.

1.	Mr. Ram Prasad Meheta	Chairman	WUCCC
2	Mr. Mohan Lal Sardar	Chairman	Harinagara
3.	Mr. Bhesh Raj Niraula	Chairman	Sundargundar
4.	Mr. Chatra B. Limbu	chairman	Sukhsena
5.	Mr. Gorakh B. Karki	Chairman	Manikchauri
6.	Mr. Jaya B. Khanal	Chairman	Ramdhuni
7.	Mr. Ram Nath choudhary	Chairman	Singhya Minor
8.	Mr. Du N. Choudhary	Chairman	SSJ
9.	Mr. Jaya N. Chaudhary	Chairman	Bishrampur

10.	Mr. Tapan K. Das	Chairman	Sitagunj
11.	Mr. Tek Chandra Bishwas	Chairman	Ramgunj
12.	Mrl Hem N. Bishwas	Chairman	Duhabi
13.	Mr. Birendra K. Bishwas	Chairman	Biratnagar
14.	Mr. Deb N. Gachhadar	Chairman	Hurhuriay
15.	Mr. Mohan Shrestha	Chairman	Bariyati
16.	Mr. Shibu Thapa	chairman	Nayapatti
17.	Mr. Tharka Basnet	Chairman	Amjhora
18.	Mr. Uma Nath Karki	Chairman	Ranjani Minor
19.	Mr. Bhakta Thapa	Chairman	Chisang Minor
20	Mr. Khanga lal Shah	Chairman	Jhamanpur Branch

The following are the major observation of the meeting;

- WUCCC chairperson were not involved for the preparation of annual CMC maintenance plan.
- The local administration must be involved to resolve the 'Encroachment Issues'.
- The number of daily wages workers in SMIP is about 400. This number is very high. Only the workers actually needed must be employed and paid with the recommendations of WUAs.
- For the smooth operation and maintenance of SMIP, more transparency is needed in the works carried by the Project Office as well as by WUAs.
- Agriculture inputs, extension service and new technology are not provided in time and in quantity to the farmers which reflected for the decrease in agricultural production and productivity.
- At present there is shortage of labour in the CA as many unskilled labour have gone abroad for better earning.
- If the WUAs can used the heavy equipments of SMIP, for the maintenance works, the labour shortage problems will be solved and more work will also be carried out.
- The 'Dhalpas' working with SMIP should be trained for better water management.
- The ISF must be collected all the canals and the present rate of ISF must be increased. For this, irrigation rules and regulations should be revised.
- The process of awarding direct maintenance work contracts to the individual must be systemized with the involvement of WUAs.
- Some of the HR in the head reach of SMIP are not functioning well which causes shortage of water at the tail end.
- The role of the beneficiaries for the smooth O &M and water management of SMIP is not clear due to the inadequate efforts form the project and WUAs side.
- The maintenance budget must be allocated as per the need of the rehabilitation of the canal.

FGD with Mixed Group

Presented

1. Dr. Bhesh P. Dhamal	Neruke , Biratnagar
2. Mr. Madan Kumar regmi	Mahendra Morang Campus
3. Mr. Gopan Kumar Karki	Nepali Congress, Morang
4. Mr. Bhola P. Prasai	UCPN -Maoist,
5. Mr. Dwarika lala Choudhary	CPN-UML
6. Mr. Ram B. Shah	Engineer
7.Mr. Bimala Dhakal	Nepali congress
8. Mr. Santosh Shah	Beneficiary
9. Mr. Jibeshwor Lakhe	Press Club
10 Mr. Baburam Subedi	Press-Blast Daily

The discussion was held with facilitation by the consultant team.

1. Overall impact is seen with the contribution on GDP as per the production and productivity increases in the area. But has some problems on irrigation management by the project.
2. No regular water low which affect on the production
3. Siltation is the main problem
4. The filed is covered with silt and decreased cultivation.
5. This project shall be operated with Multi purpose rather than single purpose.
6. There is high potentiality of agriculture and command area development but we can not utilized at all.
7. Repair and Maintenance work should be on timely and effectively.
8. Lack of coordination between agriculture and irrigation.
9. Irrigated land 3 % shall export the agri products by Isreal.
10. WUAs should be operated by good people.
11. small land must be maximum utilized for poverty alleviation.
12. Transparency should be maintained by project and WUAs.
13. Previously irrigated by Khola, but now SMIP has given opportunity of system irrigation but, no water availability on time.
14. Farmers are not able to get reasonable price of their products while producing more crops.
15. Not availability of Fertilizers as per requirement at time of plantation.
16. High breed seeds should be introduced and provide to farmers
17. CMC should be maintained
18. Labour problem on agriculture in most of the VDCs
19. 2 to 3 crops are planted in a year depending upon the irrigation facilties.
20. Urban people does not care on canal.
21. There is low flow of water in dry season.
22. Intake should be upper than the existing location
23. Dredgers should timely repaired and operated throughout the year.
24. Structures are older and older which can be breakdown in any time should be maintained on time.
25. Encroachment (building construction at Canal) is main problem of the canal repair.

Annex-V
Key Informants Interviews

K.I.I. With Mr. Mehta (NPC, MOI, JICA, PRENA)

The general comments and observations are as follows:

- The Gov can not always look after O & M of SMIP.
- WUACC's role for O & M of SMIP is very vital.
- Before the Project the supply of irrigation water was disorganized. The major crop was Paddy.
- Now after the Project the production has increased. Agricultural advices for proper farming was given Farmer started cultivating wheat and others cash crops.
- The new intake should have been built more upstream of the present site. The perfect location was upstream of the Khahare River. Now the Khahare River has deposited big boulders in front of the new intake.
- Provision of diversion works was also necessary. With the Barrage system irrigation services to other districts was also possible.
- Lot of benefits from multipurpose scheme like lift irrigation to the mountain areas, power generation etc. is achieved with low costs.
- The structures of CMC are more than 40 years old. Several of them are damaged . Also the structures of Branch & Tertiary Canals need repairing works.
- The bed level of most of the rivers, drains etc of the Project area is lowering day by day. This must be controlled with proper technical solutions.
- Encroachment of Canal land by building houses, toilets etc must be stopped and the land must be cleared by removing the built infrastructures. Department of Road can demolish the houses built on the unauthorized land but Department of Irrigation is not taking any actions. Electrical connections to the houses are provided. How it is possible without 'LalPurja'?
- With the rehabilitation of major damages the handover of the irrigation system to the respective beneficiaries must be practiced step by step. The maintenance fund from IWRMP must be used for repairing works. Proper trainings on agricultural aspects should be conducted to the farmers for their capacity building. In case of necessity the farmers can under take major rehabilitation works with Project help and the provision of mechanical equipments.
- Some sort of maintenance fund is to be established. The draft of the Rules on water tax collection is submitted by WUACC to the Ministry of Irrigation. The 'Bill' regarding this must be passed by the Concerned Agencies.

- With the collection of water tax the beneficiaries are capable of O & M of their canals.
- Improvement on the procedures of water users committee's involvement for the construction works is necessary.

K.I.I with PM, S.D.E, NPC, CONSULTANTS, JICA

The major findings & observations are as follows:

- While travelling to Biratnagar the monitoring team from NPC flew over the C.A. of SMIP & observed that there is no flow of water in most of the canals and the paddy cultivation is delayed.
- The project officials claim that much efforts are made with the provision of extra labours to supply water to the farmers for paddy cultivation and the farmers are satisfied. It could be at the tail end and in some areas where the canal is closed due to unavoidable reasons, the supply of irrigation water is disturbed.
- The flow of water in the canals of SMIP depends upon the level of water in the Kosi River. The Kosi River is flowing westwards day by day.
- There is a shortage of Manpower capable of working with the procurement guidelines of the Donor Agency and our own procurement Act. On the other hand the contractors are bidding well below the estimated amount. It is difficult to get desired quality of works from such contractors. There is also the problem of contract management. All these factors effects the completion of works in time.
- The Commend Area Development works are not carried out at many places. Especially Morang Districts lacks C.A.D. works.
- All the structures of CMC are more than 50 years old. Major maintenance works are needed.
- Due to silt (sand) deposit throughout the whole CMC, the cross sectional area of the canal is about half of the designed section. The fund available for the removal of the silt is not sufficient. The efficiency of the two dredging equipments is at present 50% less. The dredgers are working form last 17 years.
- Community only take care of the Water Courses. With the rehabilitation of the major structures and necessary repairing works the CMC can operate 15-20 years more. For this a comprehensive 'Maintenance Plan' with the participation of the Community is necessary.
- There is the encroachment problem. The houses built on the bank tops can not be removed. Service roads are being used by heavy trucks and buses causing further deterioration of the road surface. There is no provision of Royalty payment for the use of such roads by public vehicles.
- The maintenance fund allocated by the GoN is not sufficient for major works. The Project is compelled to spread the available budgets on several maintenance works. Outsiders give much present to carry out the repairing works in their respective areas. The rehabilitation works at Thalaha which cost around 4 million rupees in the previous years could not be started due to shortage of funds. At present Rs. 80 million

is spent for the rehabilitation works of the Thalaha. Similar is the case of Budhi Khola rehabilitation works.

- The Project is of the opinion that SMIP is providing round the year irrigation as per NPC's Norms. The cropping intensity is around 250 % and various types of crops are cultivated. The overall production has also increased.
- During winter time SMIP is supplying irrigation facilitates to 25000-30000 Ha. The supply is adequate although the quality of services may not be up to standards.
- There are direct and indirect benefits from irrigation. The network of service roads have raised the living standard of the farmers. Also the price of the lands has gone up with the construction of the service roads.
- Although there is the shortage of manpower, agricultural inputs etc the farmers have tried their best to increase the production.
- Due to the open border there is no competition in agriculture. The products grown across the border are cheaper. Nepalese farmers are deprived of the advantages from agricultures which is their right.

K. I. I. With Mr. Regmi (MoI)

The following are the findings and observations of the meeting held by PRENA with Mr. Kamal Regmi who is the Joint Secretary at MoI looking after Monitoring and Evaluation Division. Mr Nir Shakya, the Division Chief was also present.

- The cropping pattern of the C.A is now changed. The cropping pattern is around 200%. At present paddy, wheat, banana etc are cultivated.
- The maintenance of SMIP is not satisfactory.
- The CAD program of the Project is not completed. There is conflict between the developed and under developed areas. The whole CA must be developed.
- Most of the Water User Groups are inactive. Elections for new WUG are not held for a long time. The formation of the Groups is not practical . Lack of transparency is observed in the works performed by them.
- At present the problem of the labour is also one of the factor effecting the O & M works.
- Involvement of the beneficiaries in planning and implementation works of the Project is not done in a proper way 'Ownership' building is effected by such activities. At present only the O & M of the water courses is the responsibility of the WUG.
- The power generation works is creating back flow of water at the intake site.
- All the structures of the Main Canal are old and need rehabilitation works. The silt deposited in the Canal is not cleared for a long time. The decrease in flow of the water in CMC is causing lot of problems at the tail end portions. So the supply of water is done by 'Rotation.'
- Also the rehabilitation of the whole CMC is needed.
- With all these existing constraints the agricultural production of Sunsari and Morang districts has increased. So far about Rs. 15000 Million is spent for SMIP but the return (benefit) is also very high. This is an encouraging factor.

- There are lot of managerial problems like the encroachment of canal land and the presence of unlimited daily wage workers.
- Construction of the Barrage System at the intake site is very essential. This has been discussed at various levels. Everybody accepts that this type of solution is badly needed in the dry season when the flow of water is very low. The matter is pending as it could not be highlighted at the higher level.
- Sunsari Morang Irrigation and Drainage Development Board is not functioning as anticipated. Some of the Board Members are not aware about the problems and ground realities about SMIP. Sufficient resources for the CAD of undeveloped areas could not be allocated due to the less priority at the policy level.

K.I. I. With Mr. Sushil Tiwari (MoI)

The following are the major findings and observations of PRENA during the discussions with Joint Secretary Mr. Sushil Tiwari, Chief of Planning (MoI) regarding SMIP.

- The undeveloped CA of SMIP must be developed GoN funding for this purpose is also possible Usually GoN is hesitant for such funding due to budgetary constraints.
- The users committees must have members as per the land holding size. All the procedural guidelines must be followed for the formation of water user groups.
- Much efforts are needed for the timely collection of water charges. Some sort of matching fund in addition to the collected water fee can be considered to be deposited on WUC's account. Also the beneficiaries can contribute for the maintenance works as per the land holding size. With all these resources the WUC must be made responsible for the O & M their canals.
- Involvement of the beneficiaries form the Project planning phase to the O & M phase must be practiced to develop the 'Ownership' feelings which will certainly help and improve the O & M aspects of the completed schemes.
- At present construction works not exceeding Rs. 6 million can be awarded to the WUC. Use of heavy machinery for such works is not allowed. The beneficiaries are of the opinion that they are at present capable of handling works with the use of heavy machines. This will cause in some savings of the resources which can be used for other works.
- The encroachment problems can be solved by the Project, WUACC and local Administration.
- The present status of Co-ordination and Co-operation between the Agencies involved for the development of agriculture must be improved. The role of social mobilizer in

these areas is very important. The social mobilizer also play vital role to pursue the farmers for the increase in agricultural production.

K.I. I. With Mr. Khom Raj Dahal, DG (DoI)

The general comments and observatios are as follows;

- The use of dredgers is very successful for the removal of the deposited silt in the settling basin, which has helped for the required flow of water in CMC.
- The responsibility of the project and WUA for the smooth O & M of SMIP must be clearly defined. This should be done with the consultation and interactions of the WUA and SMIP the capabilities of WUA in this respect must be considered.
- Collection of ISF must be one of the main resource for meeting the O & M cost. In addition to this GoN may consider to provide some sort of matching grant amount to meet the O &M cost to the WUA if the service fees is collected satisfactory.
- Department of Irrigation is aware of the importance of Diversion Weir' at the new intake site of the SMIP. In this regard, several discussions with the concerned authorities are being held.
- New technology must be considered for the distribution of water where the discharge is low compared to its requirement. New technology will support for the effective water management of the CA.
- All sectoral agencies for the development of agriculture must be responsible for the completion of their respective works as outlined in National plan and policies.
- SMIP has indirect impact on the fertility of land of Sunsari and Morang districts due to the recharge of ground and surface water. In comparison of land of Siraha and Saptari (adjoining districts) are dry and most of the farmers are depended on rain water for irrigation.

Annex-VI
Approved Post Chart of SMIP

Annex-VII
ERR Calculations

ERR Calculation of Stage I

Year	Cost	O & Mcost	Benefit	Employment Benefit	Incremental benefit
1978/79	-579,130.50				-579,131
1979/80		-5791			-584,922
1980/81		-6081			-591,002
1981/82		-6385			-597,387
1982/83		-6704			-604,090
1983/84		-7039			-611,129
1984/85		-7391			-618,520
1985/86		-7760			-626,281
1986/87		-8149	883282	21318	262,022
1987/88		-8556	971610	22384	1,238,904
1988/89		-8984	1068771	23503	2,313,211
1989/90		-9433	1175648	24678	3,494,672
1990/91		-9905	1293213	25912	4,793,988
1991/92		-10400	1422534	27208	6,222,931
1992/93		-10920	1564788	28568	7,794,447
1993/94		-11466	1721267	29997	9,522,779
1994/95		-12039	1893393	31496	11,423,591
1995/96		-12641	2082733	33071	13,514,113
IRR	26%				

ERR Calculation of Stage II

Year	Cost Stage II	SMHP	O & M	Benefits	Incremental
1987/88	-1,926,076,161.00	0	0	0	-1926076161.00
1988/89			-96303808	474431750	-1547948219.00
1989/90			-101118998	498153337.5	-1150913879.90
1990/91			-106174948	523061004.4	-734027823.85
1991/92			-111483696	549214054.6	-296297464.99
1992/93		-1,441,073,293	-117057881	576674757.3	-981456416.20
1993/94			-122910775	605508495.2	-498858695.56
1994/95			-129056313	635783919.9	7868911.11
1995/96			-135509129	667573115.9	539932898.12
1996/97			-142284585	700951771.7	1098600084.48
1997/98			-149398815	735999360.3	1685200630.15
1998/99			-156868755	772799328.3	2301131203.11
1999/2000			-164712193	811439294.8	2947858304.72
2000/2001			-172947803	852011259.5	3626921761.40
2001/2002			-181595193	894611822.5	4339938390.92
2002/2003			-190674953	939342413.6	5088605851.92
2003/2004			-200208700	986309534.3	5874706685.97
2004/2005			-210219135	1035625011	6700112561.72
2005/2006			-220730092	1087406262	7566788731.25
2006/2007			-231766597	1141776575	8476798709.27
2007/2008			-243354926	1198865403	9432309186.18
2008/2009			-255522673	1258808674	10435595186.94
2009/2010			-268298806	1321749107	11489045487.74
2010/2011			-281713747	1387836563	12595168303.57
2011/2012			-295799434	1457228391	13756597260.20
2012/2013			-310589406	1530089810	14976097664.66
IRR	0.19	19%			

Annex-VIII

Sample Size for HH Survey

ID#	District	East/ West	VDC# in list	VDC Name	HH	HH /100	Ratio in Total HH	Ratio in District HH	Allocation of Sample size	# allocation for Cluster sampling		Result of Cluster sampling	Calculation of sample size			
													HH	Ratio	**# sample**	Interval
1	M	E	1	Amahibariyati	811	8	0.9%	2.2%		1	8					
2	M	E	4	BabiyaBirta	1,605	16	1.7%	4.4%		9	25	*	1,605	27.1%	**52**	31
3	M	W	7	Banigama	1,013	10	1.1%	2.8%		26	36	*	1,213	20.4%	**39**	31
4	M	E	15	Dadarbairiya	1,182	12	1.3%	3.3%		37	49	*	1,182	19.9%	**38**	31
5	M	E	19	Drabesh	2,069	21	2.2%	5.7%		50	71					
6	M	E	25	Hoklabari	768	8	0.8%	2.1%		72	79	*	768	12.9%	**25**	31
7	M	E	31	Kaseni	1,302	13	1.4%	3.6%		80	94					
8	M	E	33	Kathamaha	1,164	12	1.2%	3.2%		95	106	*	1,164	19.6%	**37**	31
9	M	E	35	Keroun	1,287	13	1.4%	3.6%		107	120					
10	M	E	42	Motipur	825	8	0.9%	2.3%		121	129					
11	M	E	50	Rangeli	2,243	22	2.4%	6.2%		130	153					
12	M	E	52	Sidharaha	675	7	0.7%	1.9%		154	160					
13	M	E	57	Sorabhag	1,898	19	2.0%	5.2%		161	180					
14	M	E	63	Thalaha	1,107	11	1.2%	3.1%		181	192					
Subtotal	M	E			17,949		19.1%	49.6%	191	#VDC	14	5	5,932	100.0%	**191**	
15	M	W	6	Baijanathpur	841	8	0.9%	2.3%		193	202	*	841	12.2%	**24**	36
16	M	W	11	Bhaudaha	1,033	10	1.1%	2.9%		203	213					
17	M	W	14	Budhanagar	1,357	14	1.4%	3.7%		214	228					
18	M	W	18	Dangraha	863	9	0.9%	2.4%		229	237					
19	M	W	24	Hathimudha	1,335	13	1.4%	3.7%		238	252	*	1,335	19.4%	**38**	36
20	M	W	29	Jhorahat	854	9	0.9%	2.4%		253	261					
21	M	W	32	Katahari	1,927	19	2.0%	5.3%		262	282	*	1,927	28.0%	**54**	36
22	M	W	36	Lakhanataha	630	6	0.7%	1.7%		283	289					
23	M	W	40	Majhare	1,156	12	1.2%	3.2%		290	301	*	1,156	16.8%	**33**	36

ID#	District	East/ West	VDC# in list	VDC Name	HH	HH /100	Ratio in Total HH	Ratio in District HH	Allocation of Sample size	# allocation for Cluster sampling		Result of Cluster sampling	Calculation of sample size			
													HH	Ratio	**# sample**	Interval
24	M	W	41	Matigachha	1,423	14	1.5%	3.9%		302	317					
25	M	W	44	Necha	490	5	0.5%	1.4%		318	323					
26	M	W	47	Pokhariya	390	4	0.4%	1.1%		324	327					
27	M	W	55	Sisabanibadahara	1,210	12	1.3%	3.3%		328	341					
28	M	W	56	Sisawanijahada	1,630	16	1.7%	4.5%		342	358	*	1,630	23.7%	**46**	36
29	M	W	61	Ttankisinuwari	2,169	22	2.3%	6.0%		359	381					
30	M	W	62	tetariya	931	9	1.0%	2.6%		382	391					
Subtotal	M	W			18,239		19.4%	50.4%	194	#VDC	16	5	6,889	100.0%	**194**	
Morang Total					36,188		38.5%	100.0%	**385**						**385**	
31	S	E	1	Ackamba	1,294	13	1.4%	2.2%		392	405					
32	S	E	2	Amaduwa	1,419	14	1.5%	2.4%		406	420	*	1,419	20.6%	**48**	30
33	S	E	3	Amahibelaha	1,020	10	1.1%	1.8%		421	431					
34	S	E	4	Aurabarni	1,116	11	1.2%	1.9%		432	443					
35	S	E	9	BhadgauSinawari	2,452	25	2.6%	4.2%		444	469					
36	S	E	10	Bhaluwa	652	7	0.7%	1.1%		470	476					
37	S	E	15	Chhitaha	1,364	14	1.4%	2.4%		477	491	*	1,364	19.8%	**46**	30
38	S	E	16	Chimdi	1,022	10	1.1%	1.8%		492	502					
39	S	E	20	Duhabi	2,526	25	2.7%	4.4%		503	529					
40	S	E	30	Khanar	1,948	19	2.1%	3.4%		530	549	*	1,948	28.3%	**66**	30
41	S	E	32	Madhelee	966	10	1.0%	1.7%		550	560					
42	S	E	42	Purbakushaha	2,053	21	2.2%	3.5%		561	581					
43	S	E	43	RamganjBelgachhi	1,136	11	1.2%	2.0%		582	594	*	1,136	16.5%	**38**	30
44	S	E	48	Simariya	855	9	0.9%	1.5%		595	603					

ID#	District	East/ West	VDC# in list	VDC Name	HH	HH /100	Ratio in Total HH	Ratio in District HH	Allocation of Sample size	# allocation for Cluster sampling		Result of Cluster sampling	Calculation of sample size			
													HH	Ratio	**# sample**	Interval
45	S	E	50	Sonapur	1,011	10	1.1%	1.7%		604	614	*	1,011	14.7%	**34**	30
46	S	E	52	Tanamuna	1,031	10	1.1%	1.8%		615	626					
Subtotal	S	E			21,865		23.2%	37.8%	232	#VDC	16	5	6,878	1	**232**	
47	S	W	5	Babiya	1,121	11	1.2%	1.9%		627	638	*	1,121	7.4%	**28**	40
48	S	W	8	basantapur	864	9	0.9%	1.5%		639	647					
49	S	W	14	Chadwela	938	9	1.0%	1.6%		648	658					
50	S	W	17	Dewanganj	787	8	0.8%	1.4%		659	667					
51	S	W	19	Dhuskee	1,445	14	1.5%	2.5%		668	682	*	1,445	9.5%	**36**	40
52	S	W	21	Dumaraha	2,577	26	2.7%	4.4%		683	709					
53	S	W	22	Gautampur	627	6	0.7%	1.1%		710	716					
54	S	W	24	Harnagar	873	9	0.9%	1.5%		717	726					
55	S	W	25	Haripur	1,191	12	1.3%	2.1%		727	739	*	1,191	7.8%	**30**	40
56	S	W	28	Jalpapur	659	7	0.7%	1.1%		740	746					
57	S	W	29	Kaptanganj	962	10	1.0%	1.7%		747	757					
58	S	W	31	Laukahi	1,053	11	1.1%	1.8%		758	769					
59	S	W	33	Madhesa	1,058	11	1.1%	1.8%		770	780	*	1,058	7.0%	**27**	40
60	S	W	34	Madhuwan	1,554	16	1.7%	2.7%		781	797					
61	S	W	35	Madhueharsahi	1,316	13	1.4%	2.3%		798	811					
62	S	W	36	Mahendranagar	4,446	44	4.7%	7.7%		812	856	*	4,446	29.3%	**112**	40
63	S	W	37	Narshinhatappu	2,671	27	2.8%	4.6%		857	884	*	2,671	17.6%	**67**	40
64	S	W	40	PaschimKasuha	1,479	15	1.6%	2.6%		885	900					
65	S	W	41	Prakashpur	2,116	21	2.2%	3.7%		901	922					
66	S	W	44	RamganjSenuwari	954	10	1.0%	1.6%		923	932	*	954	6.3%	**24**	40
67	S	W	45	RamnagarBhutaha	1,060	11	1.1%	1.8%		933	944					

ID#	District	East/ West	VDC# in list	VDC Name	HH	HH /100	Ratio in Total HH	Ratio in District HH	Allocation of Sample size	# allocation for Cluster sampling		Result of Cluster sampling	Calculation of sample size			
													HH	Ratio	**# sample**	Interval
68	S	W	46	Sahebganj	522	5	0.6%	0.9%		945	950					
69	S	W	47	Santerjhora	1,467	15	1.6%	2.5%		951	966					
70	S	W	49	Singiya	2,004	20	2.1%	3.5%		967	987					
71	S	W	51	Sripurjabdi	2,311	23	2.5%	4.0%		988	1011	*	2,311	15.2%	**58**	40
Subtotal	S	W			36,055		38.3%	62.2%	383	#VDC	25	8	15,197	43.5%	**383**	
Sunsari Total					57,920		61.5%	100.0%	**615**						**615**	
Grandtotal					94,108		100.0%		1000				34,896	100.0%	**1000**	

Control Group

72	M	E	19	Dangihat	4,759							4,759		**50**	95	
73	M	W	25	Indrapur	4,300							4,300		**50**	86	
Morang Total					9,059							9,059		**100**		
74	S	E	8	Hanshpsha	3,463							3,463		**50**	69	
75	S	W	14	Bakalauri	2,398							2,398		**50**	48	
Sunsari Total					5,861							5,861		**100**		
Grandtotal					14,920							14,920		**200**		