Central Monitoring and Evaluation
Division (CMED);
National Planning Commission Secretariat
Singh Durbar, Kathamndu

Final Report
on
Effectiveness of Investment
in
Bhairahawa-Lumbini Ground Water Irrigation Project
(BLGWIP)

Submitted By :
Centre for Economic Development and Administration
(CEDA)
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ACRONYMS :

ADB	-	Asian Development Bank, Manila
ADB/N	-	Agriculture Development Bank, Nepal
ADO	-	Agriculture Development Office/Officer
AIC	-	Agriculture Inputs Corporation
APP	-	Agriculture Perspective Plan
BLGWIP	-	Bhairahawa-Lumbini Ground Water Irrigation Project
CEDA	-	Centre for Economic Development and Administration
CMED	-	Central Monitoring Evaluation Division
DDC	-	District Development Committee
DOA	-	Department of Agriculturer
DOI	-	Department of Irrigation
DTMP	-	District Transport Master Plan
DTW	-	Deep Tube Well
FAO	-	Food and Agricultural Organization of United Nations
FMIS	-	Farmers Managed Irrigation System
GDC	-	Ground Water Development Consultants
GDP	-	Gross Domestic Product
GW	-	Ground Water
GWRDP	-	Ground Water Resources Development Board
Ha.	-	Hectare
Helvetas	-	Engineering and Research (Non Profit) Unit of SDC
Hp.	-	Horsepower
ICIMOD	-	International Centre for Integrated Mountain Development
ILC	-	Irrigation Line of Credit
JADP	-	Janakpur Agriculture Development Project
KVA	-	Kolovolt-Ampere
LPS	-	Liter Per Second
MD	-	Man Days
MOA	-	Ministry of Agriculture
MTW	-	Medium Tube Well
NGO	-	Non Government Organization
NPCS	-	National Planning Commission Secretarial

NRB	-	Nepal Rastra Bank
O and M	-	Operation and Maintenance
PLRP	-	Pilot Labour Based District Roads. Rehabilitation and Maintenance Project
RRA	-	Rapid Rural Appraisal
SAARC	-	South Asian Association for Regional Cooperation
SDC	-	Swiss Development Cooperation
STW	-	Shallow Tube Well
UNDP	-	United Nations Development Program
USAID	-	United States Agency for International Development
VDC	-	Village Development Committee
WB	-	World Bank
WECS	-	Water Energy Commission Secretariat
WUA	-	Water User's Association
WUG	-	Water User's Group

ACKNOWLEDGEMENT

Investment effectiveness study of the Bhairahawa-Lumbini Ground Water Irrigation Project reveals that it is the output that matters in a long term investment strategy. Further, it also reveals that to develop and sustain ground water project like other social projects, it requires the strength of the local institutions and complementary support of public and private institutions and participatory involvement of the beneficiaries.

Many people benefited this study by their acumen and academic contribution. At the out set, I express my sincere gratitude to Mr. Baidya Nath Mallik, Joint Secretary (CMED), who provided both moral and administrative support as expected of his high office. Mr. Chitra Deo Bhatta (Advisor, CMED) was instrumental from day one and his contribution at all level of this study is gratefully acknowledged. To the research team, I am grateful to the Executive Director, CEDA, Prof. (Dr.) Pitamber Chettry, who worked as sociologist on the project and gave impetus to the study whenever it was required by the team mates. Similarly, my gratitude goes to Mr. Kamal Pandey, Irrigation Engineer, Dr. Subarna Lal Bajracharya, Financial Expert, Mr. Ram Bahadur Ghimire, Project Coordinator (NPCS/CMED), Mr. Dharma Prasad Devkota, Agricultural Economist and to associates, Mr. Deepak Aryal, Mr. Mahendra Raj Joshi, Mr. Suresh Narayan Manandhar and many others who worked day and night in the field and also during desk work to complete this modest endeavour.

I am grateful to Central Monitoring and Evaluation Division (CMED) of the NPCS for entrusting this responsibility and also financing this study. Mr. Ganesh Rai, Under Secretary on the Division was throughout helpful in supplying us required research materials. I express my sincere thanks to him.

This study would not have been completed without the active support of Mr. Narendra Khatri, Senior Project Staff, BLGWIP – Bhairahawa and many other officials leading the line agencies at the district level, I express my gratitude to all of them for their support to the study. People, sample households, WUA members, office bearers, VDC chairperson and all others related to this study (at the district level) are gratefully acknowledged for their contribution. Last but not least the logistic support provided by Messers Quality Computer Center– Putalisadak is greatly appreciated.

Vallabha Sharma
Team Leader
CEDA

EXCUTIVE SUMMARY

Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP) is located in the Rupandehi district of Western Terai, Nepal. The project area is interspersed by Kothi and Turia rivers in the east, west and centre. The physical dimension of the project area is longitudinal and entails some unevenness in surface towards the east. The same towards the south is drooping and long stretching.

The genesis for water in the systems is deep and flat aquifers, underground waterbeds and artisans, which have developed into a fountain underneath. The parsimonious cross section of the ground water, between middle and the lower crust, is enriched due to water retention capability, which is typical of the western Terai. However, the tectonic structure of the ground water bed, which leans towards south, indicates some typical unevenness in the ground water surface. The kind of unevenness has some effect on the water discharge condition in few places in the project area.

The physical area of the Rupandehi district is 1360sq. km. In land unit, it is 1,41,367 hectares. Out of it 85,122 hectares are cultivable land (60.21%). The forest (1.57%), pasture (6.28%) relief and terrains (0.29%) have occupied 39,700 hectares of the area. There has occurred a persistent growth (1.3% annum) in the residential set up due to urbanization and expansion in the township threshold. About 5,953 hectares of land is already covered by residential outfits and business complexes (4.21%). The land area under rivers and other type of wasteland account for 2,460 hectares (1.74%); while, some another type of public land is accounted at 8,052 hectares (5.70%).

Demographic situation in Rupandehi district is influenced by natural population increase (3.7% annum) and in-migration/vertical migration from the western hills. The influx of horizontal migrants from across the border from south is also experienced to have increased in recent years.

According to 1991 population census and other studies, it has been recognized that the difference between female to male population (sex ratio), in the age group between 0-5 and above have narrowed down. In other words, there is a natural influx in young age female population. Granted the fertility rate is high in females between age group 14-49 in Rupandehi; there is every likelihood that young age population growth rate would remain constant in immediate future. If this is coupled with in-migration, which is increasing, the

total growth in district population would be much higher in the coming years. This is expected to effect the interurban relation, encroachment in forest and pastureland, and above all, the production economy of the district.

More than 80% of economically active population of the district is dependent on agriculture. About 18% of total labour force of the district are dependent on non-farm employment. On same token, about 20% or more economically active populations are self-employed in various petty business and vendings; while around 20-22% economically active population work as casual labour in local consumer industries for livelihood.

More than 60% of land available in the district is cultivable. Because of the sandiloam character of the soil, the lands are predominantly porus and maintain moisture in the middle and lower level. The upper portion of the soil (top soil) generally remains dry in summer and winter. A similar characteristics is true for the Bhairahawa-Lumbin Ground Water Irrigation Project (BLGWIP) area.

More than 39% of the cultivable area falls under the irrigated category. Irrigated land area is higher in summer (monsoon) season and this decreases in the winter. Approximate increase in irrigated land is around 2-3% of the total irrigated area. The cause for such an increase in the irrigated land size is due to river inundation and easy access to water. About 70% of the total irrigated land are being served by shallow or deep tube wells, besides lift irrigation and the Farmer's Managed Irrigation Systems (FMIS). Bhairahawa-Lumbini Ground Water Irrigation Project accounts for irrigation facility at 29% of all irrigated area.

Land Ownership in the district is not skewed. About 4.6% of land owners own a land size between 5-10 hectares. Similarly, about 50-60% of land owners own a land size between 1-4 hectares, while, rest land owners own land between 1-0.05 hectare. The average size of the land parcel is estimated at 2.8 hectares in case of large farm and in case of small and marginal farms, it is estimated at 1.08 and 0.4 hectares respectively. There are 67,839 registered land owners in Rupandehi district. About 1,568 people in Rupandehi district are reported to be landless at present.

In 1998-1999, 72,900 hectares of land was deployed under the paddy crop. The wheat on the other hand was grown in 30,341 hectares and maize, pulses, oil seeds and potatoes were grown in 15,554 hectares. The vegetables were raised in 1,505 hectares. Sugarcane is one of the major cash crops of the district which was grown covering 19,880 hectares of land.

There was a surplus in relation to total production the order of 25,833 metric tons in paddy during 1999, while, the same in wheat was 30,133 metric tons. There was a production deficit recorded in maize at 1,285 metric tons. Similarly, there was a production deficit recorded at 5,671 metric tons in pulses, at 1,040 metric tons in oilseeds, at 10,416 metric tons in potatoes and at 1,101 metric tons in vegetables respectively.

Inputs comprise chemical fertilizers, pesticides and other chemicals, that have been used in the district. Average use of chemical fertilizers per hectare is recorded at 40 kg. The application of pesticides and other chemicals is not known.

The average productivity per unit of land use is as follows. For paddy it is 1.72 metric ton per hectare; in other cereal crops, such as, in wheat and maize, it is 0.78 and 1.73 metric ton per hectare respectively. In oilseeds, pulses and potatoes, it is 0.86, 0.69 and 11 metric tons per hectare. In sugarcane and vegetables, it is 32 and 7.99 metric tons per hectare respectively.

Cropping intensity between 1996-1999, for paddy, wheat and maize is estimated at 1.65, 105 and 100 respectively.

Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP) was started in the second half of 1970 and completed in May-June 1999. The BLGWIP has been completed in three stages.

In the first phase of BLGWIP, 64 deep tube wells were installed of this 4 DTWS' became inactive due to technical reasons. An irrigated command area of 7,200 hectares was covered during the first phase. 60 Deep Tube well Systems (DTWs) were turned over to the Water User Groups (WUGs) during the same period.

In the second phase, 38 deep tube wells were installed, of which, 7 DTWs' became inactive due to technical reasons. During the period, which was unusually long, due to backlogs of the first phase, 3,860 hectares of the project command area was covered under irrigation. 31 deep tube wells were turned over to the Water User Groups (WUGs).

In third and final phase of the project, 79 deep tube wells (DTWs) were installed, of which, one system became inactive. Irrigated command area of the order of 9,249 hectares was covered and all 78 DTWs were turned over to WUGs in the process.

The system's performance in the six samples VDCs' has been satisfactory in an overall terms. The water utilization efficiency on an average in the six VDCs' is around 3 hours per hectare per month (by head, middle and tail reach), and on the annual basis it is about 107 hours; which is quite low in South Asia. In India for instance, the average ground water utilization rate is over 2,000 hours per annum. The ground water utilization efficiency in India is around 766 lps in Pakistan it is 602 lps and in Bangladesh it is 558 lps. The same in the sample area in BLGWIP is 33.46 lps.

The cause for a low water utilization efficiency accounts for water leakage loop damage, non availability of power during water demand and relatively a low utilization of water in large land category in the sample area. Besides, the water utilization rate in project area is also affected by the structural defect in the systems. Four out of twelve systems surveyed were found to have structural and other kind of defects.

The operation and maintenance costs of the sample ground water systems is high. It is Rs. 23,684 at present per system per annum, which is very high in South Asia. In India for instance, the average ground water operation and maintenance costs are around Rs. 9,660 per annum, which is generally recovered within one crop.

The cost recovery rate is about 3.6% of the crop calendar, which is very low. This has partially affected the investment effectiveness of the project; although, the benefit cost ration (BCR) is found to be 1.346 which is quite acceptable under any circumstance. By the crop production standard, the economic internal rate of return is over 12% which indicates that the project may generate a higher rate of return, possibly in the region of 16-18% if the irrigation support programs and institutional strengthening could be fruitfully executed. Similarly, the financial rate of return and other benefits are also found to be quite acceptable at present except, the real recovery rate which needs an improvement in the up coming years. The cost recovery rate may also be improved by controlling input costs and subsidizing the power costs which are very high at present. It is reported that between 1998-2000 the input costs have increased by over 15% in the study area.

Power cost per unit in project area is around Rs. 3.25 to Rs. 4.00 which is non redeemable even if the water (for irrigation) is not used. By this, an hour use of power approximately costs Rs. 242 to Rs. 298. Since, the present cropping intensity in the sample area is low at

161-162, the high power cost may not be compensated. Therefore, the government is needed to take a decisive action as early as possible on this matter.

During household and also Rapid Rapid Rural Appraisal surveys, the farmers opined for fixising a minimum floor price for the cereals and cash crops.

The farmers also pointed out that due to geophysical situation of the Rupandehi district, which interfaces open border on the south has caused a considerable problem in agricultural pricing and supply of commodities. The easy influx of identical commodities from across the border at competitive price has adversely affected local demand of food grains produced in the project area. The Agriculture Development Office (ADO) has currently planned a vegetable development program for Khudabagar, Kerwani, Madwalia and Dayanagar VDCs'

Integration of agricultural programs on priority basis is important for sample VDCs'. This, at the out set requires a functional strategy which must take into account the systems performance vis a vis the economic needs of the households and markets. Similarly, there also need to be an initiation of the integrated agricultural program in each sample VDC under the aegis of VDC members and WUAs'. The VDC programs need to be developed in the form of a participatory pressure group, which could interact with line agencies such as ADO, ADB/N, AIC, and other related institutions for current and future agriculture development. Production in agriculture has improved in all sample VDCs'. However, the consumption of fertilizer and pesticides in the sample area has either slightly declined or has remained static.

Household consumption of food grain, vegetables and other cereals has increased by over 30% between 1998-2000. The H.H. consumption in tail reach farmers has increased by over 36% in last five years. The same in middle and head reach farmers has increased by over 32% and 34.32% respectively.

The crop diversification in the sample VDCs' is not very encouraging barring some exceptional cases. The farmers reiterated that cooperative system of farming was important in the sample VDCs' (RRA) to sustain the crop diversification program. Few other farmers reiterated about the sustained market promotion for creating the export outlets.

Women drudgery in the sample VDCs' has reduced due to availability of ground water. Few women folk in Kerwani, Khudabagar and Mainhiya VDCs' were found engaged in Kitchen garden development. Further, Women were also found selling vegetables at threshold markets in Kerwani and Madhwalia VDCs'. On inquiry with key informatns and women selling vegetables it was gathered that there has been a change in personal income at around

10-15% between 1998-2000. Income of households in all VDCs' due to sale of livestock products has also increased.

About 90% respondents have said that their income has increased at an average of 20-22% in the last five years. Due to which their living standard has improved. About line agency services in the sample VDCs', there was a mixed reaction. About 20% households reiterated that line agency services were good, while about 60% households complained about the services of the line agencies. They said that there was no fixed program of the line agencies in their area. Another 20% respondents were indifferent in answering the question.

On the environmental issue (Kerwani, Khudabagar, Mainhiy and Dayanagar VDCS'), the farmers showed great concern about the forest depletion rate and opined to integrate crop, livestock and community forestry with irrigation development to provide sustainability in water harvesting through preservation of the ground water.

TABLE OF CONTENTS

Text Tables

CHAPTER I

INTRODUCTION

1.1 Location :

Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP) is located in the Rupandehi district of Western Terai, Nepal. The project area is interspersed by Kothi and Turia rivers in the east, west and centre. The physical dimension of the project area is longitudinal and entails some uneveness in surface towards the east. The same towards the south is drooping and long strentching.

1.2 Physical Characteristics :

The genesis for water in the systems is deep and flat aquifers, underground waterbeds and artesians, which have developed into a fountain underneath. The parsimonius cross section of the ground water, between middle and the lower crust, is enriched due to water retention capability, which is typical of the western Terai. However, the tectonic structure of the ground water bed, which leans towards south, indicates some typical uneveness in the ground water surface. The kind of uneveness has some effect on the water discharge condition in few places in the project area.

The physical area of the Rupandehi district is 1360sq. km. In land unit, it is 1,41367 hectares. Out of it 85,122 hectares are cultivable land (60.21%). The forest (1.57%), pasture (6.28%) relief and terrains (0.29%) have occupied 39,700 hectares of the area. There has occurred a persistent growth (1.3% annum) in the residential set up due to urbanzation and expansion in the township threshold. About 5,953 hectares (4.21%) of land is already covered by residential outfits and business complexes. The land area under rivers and other type of waste land account for 2,460 hectares (1.74%); while, some another type of public land is accounted at 8,052 hectares (5.70%). These are presented in Table 1.1 as under.

Table 1.1

Physiography of Rupandehi District

S.N.	Item	In ha.	In %
1.	Cultivatable Land	85122	60.21
2.	Forest	30484	21.57
3.	Pasture	8882	6.28
4.	Relief and terrain	414	0.29
5.	Residential area	5953	4.21
6.	River and waste land	2460	1.74
7.	Others	8052	5.70
	Total	141367	100

Source : District Development Committee, Rupandehi District, 2000

1.3 Socio-economy :

1.3.1 Demography :

Demographic situation in Rupandehi district is influenced by natural population increase (3.7% annum) and in-migration/vertical migration from the western hills. Influx of horizental migrants from across the border from south is also experienced to have increased in recent years.

According to 1991 population sensus and other studies, it has been recognized that the difference between female to male popualtion (sex ratio), in the age group between 0-5 and above have narrowed down. In other words, there is a natural influx in young age female population. Granted the fertility rate is high in females between age group 14-49 in Rupandehi; there is every likelihood that young age population growth rate would remain constant in immediate future. If this is coupled with in-migration, which is increasing, the total growth in district population would be much higher in the coming years. This is expected to effect the interurban relation, encroachment in forest and pastureland, and above all, the production economy of the district.

1.3.2 Activity :

1.3.2.1 Agriculture :

More than 80% of economically active population of the district is dependent on agriculture. About 18% of total labour force of the district is dependent on non-farm employment. On same token, about 20% or more economically active populations are self employed in various petty business and vendings; while around 20-22% economically active population work as casual labour in local consumer industries for livelihood.

1.3.2.2 Landuse :

More than 60% of land available in the district is cultivable. Because of the sandiloam character of the soil, the lands are predominantly porus and maintain moisture only in the middle and the lower level. The upper portion of the soil (top soil) generally remains dry in summer and winter. A similar characteristics is true for the Bhairahawa-Lumbin Ground Water Irrigation Project (BLGWIP) area.

More than 39% of the cultivable area falls under the irrigated category. Irrigated land area is higher in summer (monsoon) season and this decreases in the winter. Approximate increase in irrigated land is around 2-3% of the total irrigated area. The cause for such an increase in the irrigated land size is due to river inundation and easy access to water. About 70% of the total irrigated land is being served by shallow or deep tube wells, besides lift irrigation and the Farmer's Managed Irrigation Systems. (FMIS).

1.3.2.3 Land Ownership :

Land Ownership in Rupandehi district is not skewed. About 4.6% of land owners own a land size between 5-10 hectares. Similarly, about 50-60% of land owners own a land size between 1-4 hectares, while, rest land owners own land between 0.05-1 hectare. The average size of the land parcel is estimated at 2.8 hectares in case of large farm and in case of small and marginal farms, it is estimated at 1.08 and 0.4 hectares respectively. There are 67,839 registered land owners in Rupandehi district (March, 2000). About 1568 people in Rupandehi district are reported to be landless at present (March, 2000).

1.3.2.4 Prodution :

In 1998-1999, 72,900 hectares of land was deployed under the paddy crop. The wheat on the other land was grown in 30,341 hectares and maize, pulses, oil seeds and potatoes were grown in 15,554 hectares. The vegetables were raised in 1,505 hectares. Sugarcane is one of the major cash crops of the district which was grown covering 19,880 hectares of land.

There was a surplus in the order of 25,833 metric tons in paddy during 1999, while, the same in wheat was 30,133 metric tons. There was a production deficit recorded in maize at 1,285 metric tons. Similarly, there was a production deficit recorded at 5,671 metric tons in pulses, at 1,040 metric tons in oilseeds, at 10,416 metric tons in potatoes and at 1,101 metric tons in vegetables respectively.

1.3.2.5 Inputs :

Inputs comprise chemical fertilizers, pesticides and other chemicals, that have been used in production process in the district. Average use of chemical fertilizers per hectare is recoreded at 40 kg. The application of pesticides and other chemicals is not known. The ADO, Rupandehi however told that farmers generally use pesticides to protect vegetables from insects.

1.3.2.6 Productivity :

The average productivity per unit of land use is as follows. For paddy it is 1.72 metric ton per hectare; in other cereal crops, such as, in wheat and maize, it is 0.78 and 1.73 metric ton per hectare respectively. In oilseeds, pulses and potatoes, it is 0.86, 0.69 and 11 metric tons per hectare. In sugarcane and vegetables, it is 32 and 7.99 metric tons per hectare respectively.

1.3.2.7 Cropping Intensity :

Cropping intensity between 1996-1999, for paddy, wheat and maize is estimated at 165, 105 and 100 respectively.

1.4 Indicators of Development :

In order to ascertain level of changes in the district-economy an attempt is made here under. As indicators, reflect development processes, we have taken into consideration following indices for our purpose. These are composite index of development, poverty and deprivation index, women empowerment index, socioeconomic and infrastructural development and allocativeness indices; which takes into account : irrigation, road density, women share in non agribusiness, cultivated area and percapita regular and development budget allocation etc. The reference data for computing indices have been prepared by International Centre for Integrated Mountain Development (ICIMOD) by using 10 years (or even more) time series information. The methodology for computing indices is given in District of Nepal-Indicators of Development; 1997. Table 1.2 given under, describes the rank score by item.

Table 1.2 :
Indicators of Development : Rupandehi District

Rank

S.N.	Item	Best	Intermediate	Worst
1.	Composite Development	-	50	-
2.	Poverty and Deprivation	-	30	-
3.	Women Empowerment		38	-
4.	Resource Endowment	70	-	-
5.	Socio-Economic Infrastructure Development	60	-	-

Contd...

6.	Gender Imbalance in Agriculture	41.04	--	
7.	Gender Imbalance in Non-agriculture	-	20.12	-
8.	Landlessness and Marginal Farms	26.97	-	-
9.	Per Capita Food Production	-	26.53	-
10.	Occupation	28.37	-	-
11.	Agriculture Credit	-	10.10	-
12.	Farm size	1.08	-	-
13.	Cropping Intensity	-	-	161.43
14.	Irrigated Area	18.94	-	-
15.	Cooperatives	0.38	-	-
16.	Per Capita Budgetary Allocation	-	-	294
17.	Per Capita Development Budget Allocation	588	-	-
18.	Women Share in Non-agri Business	-	15.54	-
19.	Percent of Cultivated Area	62.55	-	-
20.	Gender Discrimination	54	-	-

Source: District of Nepal - Indicators of Development, 1997.

As can be seen, out of 20 variables considered, the district development process is mediocre in 7 items, namely, composite development of the district, poverty and deprivation, women empowerment, degree of imbalance in gender related non agri-business, per capita food production, agriculture credit and women share in non-agri-business. It seems that the line agencies and non-government and community institutions are lacking in social and economic planning to complement the district and regional development perspectives.

In 9 other variables, namely, gender imbalance in agriculture, landlessness and marginal farms occupation, farm, size, irrigated area, cooperatives, per capita development budget allocation, cultivated area and gender discrimination, the district

has scored highest points. Gender imbalance in development has received a world wide attention in recent years. In Rupandehi district this appears to be a critical social problem. And this has prompted the economic problem as well. Hence, this aspect needs mitigation through education, awareness and sensitization programs. The women folk and communities and also related institutions need to amend this short coming as early as possible.

Aside above, the district has also secured a highest rank in macro development perspectives, namely in resource endowment and infrastructure development. Consumer industries and infrastructure such as roads, irrigation, electricity, warehousing, civil aviation and hotel industry are currently making head way towards sustainable growth in the district economy.

Contrary to above, however the Rupandehi district has lagged behind in cropping intensity and per capita budgetary allocation. These have turned out to be the problem areas to which the government needs to concentrate to sort out the problems.

2.0 Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP) :

In section 1.1 to 1.4. we dealt in BLGWIP with in the district back-drop. All statistics and information summarized are those that account for the project area as well. In this section however, we are concerned with the project and the project area alone.

2.1 Project Initiation :

Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP) was started in the second half of 1970 and completed in May-June 1999. The BLGWIP has been completed in three stages. The details are provided in table 1.3 as under.

Table 1.3

Project Implementation Schedule BLGWIP

Stage	Project/Start up Period	Project Completion Period
I	1977-1978	1982-1983
II (I-Phase)	1983-1984	1989-1990
II (II – Phase)	-	1994-1995
III	1990-1991	1998-1999

Source : Bhairahawa-Lumbini-Ground Water Irrigation Project, 1999.

As can be seen, the second phase of the BLGWIP was divided into two phases and was completed between 1989-1990 and 1994-1995. In between the second phase, the third and final phase of the project was started in 1990-1991. Upon inquiry (BLGWIP office) it was told that a part of work of the second phase was devoted to maintenance and rehabilitation of the first phase program.

2.2 Project Status :

In the first phase of the BLGWIP, 64 deep tube wells were installed. Of this, 4 DTWs' became inactive due to technical reasons. An irrigated command area of 7200 hectares was covered during the first phase and 60 Deep Tube well Systems (DTWs) were turned over to the Water User Groups (WUGs) during the same period.

In the second phase, 38 deep tube wells were installed, of which, 7 DTWs became inactive due to technical reasons. During the period, which was unusually long, due to backlogs of the first phase, 3860 hectares of the project command area was covered under irrigation. 31 deep tube wells were turned over to the Water User Groups (WUGs).

In third and final phase of the project, 79 deep tube wells (DTWs) were installed, of which, one system became inactive. Irrigated command area of the order of 9,249 hectares was covered and all 78 DTWs were turned over to WUGs in the process. This is shown in table 1.4 below.

1.4 Table : Project Status : BLGWIP

Stage	Deep Tube Well			Command/ Irrigated Area/ Ha.	Turnnover Status
	Installed No.	Closed No.	DTW in Operation/ No.		
I	64	4	60	7200	60
II	38	7	31	3860	31
III	79	1	78	9249	78
Total	181	12	169	20309	169

Source: Bhairahawa-Lumbini Ground Water Irrigation Project, 1999

2.3 Command Area Irrigation :

The survey result and discussion with sample farmers and other key informants have made it clear that irrigation in the sample VDCs' have low capacity in area coverage. There is a decline in the command area irrigation. In table 1.5, this is presented as under :

Table 1.5
Command Area Irrigation in sample VDCs'

S.N.	VDC Stage	Ward No.	Place	Tube well No.	Actual command Area/ha.	Irrigated Command Area/ha.	%
1.	Anandban [I]	3	Bihana	W.4E.	102	90.	88%
		8	Pahuni	WISE.	114	102	89%
2.	Madhwalia [I]	7	Bihuli	W. 28	121	113	93%
		8	Chankipur	W. 65	145	97	67%
3.	Dayanagar [I]	6	Ramgunj	W. 48	129	114	88%
		8	Dayanagar	W. 51	105	94	90%
4.	Khudabagar [II]	2	Ahirauli	T.W.7.N	126	119	94%
		5	Bhagatpur	T.W.10.N	124	104	84%
5.	Kerwani [III]	3	Dhekawar	E.W.01	143	140	98%
		4	Pethaniya	E.W.02	125	119	95%
6.	Mainhiya [III]	1	Gadsari	CWW.15	84	69	82%
		4	Sublisemra	CWW.22	118	102	86%
	Total :				1436/ha	1263/ha.	88%[2]

Source : 1) Field Survey, May 2000

2) % shown refers to May 1999-2000

3. Objectives of study :

This study is concerned to social and economic benefits generated by Bhairahawa-Lumbini Ground Water Project to the people of the sample area in increasing agricultural production, area augmentation through irrigation, crop diversification and increase in productivity and above all, increase in household consumption, disposable income and factor endowment in the agricultural sector as a whole. This incidentally is the overall objective of the task in question. However, the specific objectives of research are to :

- examine issues concerning the a) efficiency, b) effectiveness and c) impact of the ground water irrigation to improve future performance.

- assess the appropriateness and relevance of the ground water design, inputs and implementation arrangements (of the system) with respect to sustainability and benefits for understanding the project's utility.

- assess the impact of the project and identify potentialities, which the ground water project might have generated overtime to help increase are new projects.

- assess the strength and the weakness of the ground water project by studying the targeted and actual facilities developed thus far.

- assess the actual number of households benefited, participation rate of beneficiaries, besides involvement of women, poor families and underprivileged (caste groups), community participation and those of common people in the ground water project activities. Also consider the attitude of the people towards the ground water project and the perspectives which may generate out of it.

- Recommend the future course of action to be adopted by the NPC keeping in view the factors such as sustainability, operation and maintenance cost, long-term and short-term national needs etc.

4. METHODOLOGY :

4.1 Approach : Household Survey :

4.2 Identification of VDCs ' :

VDC identification in Rupandehi sample universe was first stage work, completed prior to ward stratification. Rupandehi district, which was the project area has 69 VDCs' distributed into 17 ilakas. Out of 69 VDCs', only 36 VDCs' are at present being served by ground water system, while rest others are only casually benefited. Taking the situation as an yard stick and to segregate the study universe, the research team identified the VDCs' on a purposive sample basis. Six VDCs' were identified altogether.

4.2.1 Stratification of the Universe :

4.2.1.1.1 Ward Identification :

The ward identification was based on stratas. Wards at the out set were classified into strata by head, middle and tail population unit. Further to this, a weight was given to head, middle and tail influence area to denote adequate coverage of the sample space. The weights this assigned had a direct correspondence with activities, i.e., water demand and availability of water, crop diversification and agriculture extension (linkage) and exogenous factors like market, prices and products etc.

4.2.1.1.2 Household Units :

Household units from each strata (Ward) by head, middle and tail was obtained by systematic sampling process. The sample size was uniform throughout and a size of 240 households were subjected to questionnaire survey. Population chosen for household survey by VDC by Ward (head, middle and tail) is described in table 1.6 in the nest page.

1.6 Table

Distribution of H.H. By VDC By Ward (Head, Middle and Tail)

Item	I-Stage						II-stage		III-stage				Total
VDC	Anandban		Dayanagar		Madhwalia		Khudabagar		Kerwqani		Mainhiya		
	W	W	W	W	W	W	W	W	W	W	W	W	
Ward No.	3	8	6	9	7	8	2	5	3	4	4	1	12
Farmer type													
Head	5	7	7	6	7	6	8	5	5	8	6	3	73
Middle	8	7	6	6	7	7	8	6	8	5	5	8	81
Tail	7	6	7	8	6	7	4	9	7	7	9	9	86
Total	20	20	20	20	20	20	20	20	20	20	20	20	240

Source : Field Survey, May 2000

4.2.2 Sociological Survey :

This is covered by focus group meeting of sample farmers, knowledgeable people of the sample area and Ilaka members. For this checklist was developed. The focused information were as under :

a) Initial objective of ground water system development.
b) People's participation, employment generation and poverty alleviation.
c) Women, impoverished and landless participation in ground water project.
d) Production, marketing and ground water system management.
e) Water distribution and sharing of ground water including conflict and conflict resolution.
f) Cost recovery and it's mechanism, and
g) Alternate use of ground water and role of private sector.

The sociologist extensively used diary to prepare a descriptive note on sociological issues. The sociological information and analysis has covered sample VDCs' and also the overall project.

4.2.4 Technical Information :

Under it three aspects have been covered: namely, the design aspect of the BLGWIP, the operational aspects of pumping stations and water delivery aspects of the system as a whole. This is explained as under :

4.2.4.1 Design Aspect :

This refers to the design of the BLGWIP and the capacity of the system by installation. This is appropriately covered in this report.

4.2.4.2 Operational Aspect :

This refers to operation and maintenance of the system. Who operates, how long does the system is operated (by season); operational period per week and year, idle time, leakage, routing maintenance and recurring maintenance, time and water delivery capacity of the system, horse power of the machine, operation and maintenance cost per annual operation and other costs etc.

4.2.4.3 Water Delivery Aspect :

Water delivery constitutes technical, economic and social phenomenon of sample systems. Ability to pump water and to usher requisite amount (Volume) during need is a technical aspect of a water system. Similarly, ushering requisite amount of water as per the demand of a farmer or group of farmers is an economic aspect since it is attached with the irrigation land percentage and net-cropped area to be brought under the production activity. On the contrary, however, the social aspect accounts for the general welfare and participatory management and up keep of the system. However to understand the ground water scenario from the technical point of view, the ground water engineer working on the project has evaluated the system performance from the mechanical point of view such as, intake capacity and discharge, water, priming and delivery and energy and mechanical rounding of pump. The other two aspects have been broadly covered under economic and sociological study of the system respectively.

4.2.4.4 Efficiency, Effectiveness and Impact as Perceived in BLGWIP Study :

Efficiency	Effectiveness	Impact
1. Investment efficiency	1. Cost effective project completion	1. 100% coverage of the command area
	1.1 100% achievement of the target. 1.2 Potential project development.	1.2 Increase in crop productivity, total production, marketed surplus and household income.
	1.3 Effective participation of the private sector.	1.3 Increased employment, women participation and alleviation of poverty.
2. Management efficiency	2.1. System wise good management.	2.1. Adequate water delivery on demand by head, middle and tail.
	2.2. Increased participation of the user groups.	2.2. Confidence building in users due to irrigation benefits.
	2.3. Low or no conflict and quick conflict resolution.	2.3. Increase in collective responsibility and also awareness.
	2.4 Appropriate and timely maintenance of the system.	2.4. Increased sense of collective ownership of the system for optimum benefit through available resource.
3. Cost recovery	3.0. No need for public expenditure.	3.0. Self sustaining growth in irrigation management.

4.2.4.5 EIRR and Project Worth :

This is calculated on the basis of field and secondary information.

4.2.4.6 Command versus Actual Irrigated Area is calculated on the basis of secondary sample information.

4.2.4.7 Strength and Weakness of the Ground Water System :

The strength of BLGWIP is water delivery and multitude of other activities such as access roads made by the system, the power transmission by the residents and sample farmers. The weakness of the BLGWIP, an the other hand, is an inefficient use of water by the user's groups, and low cost recovery due to poor management practice etc. This is appropriately taken care of in the study.

4.2.4.8 Appropriateness and Relevance of the Ground Water Project :

Investment effectiveness assessment under above calls for a concretization of technoeconomic, social, managerial and behavioural aspects of the system as a whole. In summary form, the topic relates the past with the present. How much changes have occurred and in which dimension with what effect ? This is addressed variously in this study.

4.2.4.9 Sustainability, Operation and Maintenance and Energy Requirement :

Sustainability, operation and maintenance and energy requirement perspectives have been studied from secondary sources. For this the field project office as well as Ministry of Water Resources and WECS were visited for discussion and information collection.

CHAPTER II

GROUND WATER IRRIGATION SYSTEM DEVELOPMENT IN NEPAL

2.1 Historical Background :

Land irrigation to raise agricultural crops is not a new subject matter in Nepal. Review of ancient literature on culture and living condition of the farmers denote that irrigation as production culture dates back to history. In this respect, the current Farmers Managed Irrigation System (FMIS) is the off shoot of the ancient participatory irrigation management, although, the then philosophy of participation was more of a self-help type than purely materialistic. The former was the product of a barter system, while the latter the off shoot of the modern exchange economy.

Following change in the irrigation management, and also realizing the benefits of the small projects in irrigation, the government in support of the donor agencies started off with sector development projects. It was named the irrigation sector project (ISP) and was started in the late sixty and early seventies. The objective of the ISP was to develop crop to water integration by attracting production development package (inputs) and best utilize the available water resource to help augment land capability. Almost during same period, it was realized that to cut down upon the public sector investment costs in the infrastructure sector, the promotion in the people's participation was necessary. Based on this line of thinking the Irrigation Line of Credit (ILC) was launched in the hills and Terai of Nepal.

Under the ILC program, about 37,000 ha. of land area in Terai was benefited. Many ILC projects are now under the FMIS. Apart from ILC, the USAID evolved the Food for Work Program (FWP) to assist marginal and subsistent farmers to take part in small scale irrigation development and management. In the FWP, Ministry of Agriculture Ministry of Local Development and Agriculture Development Bank/Nepal were involved. The MOA, MLD and ADB/N combination was to develop a package deal for FWP to augment this program on a sustainable and long-term basis.

In early seventies FAO and UNDP also joined hands in small scale irrigation development with farmer's cooperation. The FAO and UNDP provided greater

emphasis to intensive crop to water development program in the central, eastern and western Nepal.

Between 1972 –1973, the World Bank (WB) and the Asian Development Bank (ADB) joined hands with Nepal on irrigation development and system management. The local point of irrigation development was participatory development of the systems, while, management of the system was made to become obligation on the local institutions and private organizations. By 1999, the donors involvement in irrigation sectors has increased by over three time growth.

Review of sixth, seventh and eighth plan documents indicate that the planners provided a great emphasis to irrigated area under the assumption that the availability of water would increase total production in agriculture. However, this had not been true in all cases. For instance, in BLGWIP, the initial expectation was that the land use under irrigation would increase by over 125% between 1988-1997. It actually increased by only 38%. On the contrary in FMIS during the same period, the net area increase was 102% under irrigation.

2.2. Ground Water Development :

According to Water and Energy Commission Secretarial (WECS), there exists an abundance of ground and surface water resource in the country. The average of ground water resource availability is estimated at over 265 billion cubic meters; while that of surface water it is estimated at 230 billion cubic meters. At present about 1.82 million hectares of land is under irrigation. The Agriculture Perspective Plan (APP-1995) has recognized that Nepal currently uses only about 8% of its water resource potential(Mentor, 1997).

The ground water resource of Nepal has been studied variously over the years. One of such studies was on shallow aquifers. In 1986-1987, the World Bank made an investigation on deep and shallow tube wells to formulate the ground water development strategy. The ground water consultants (Cambridge/UK) made the study for World Bank. Another study on ground water potential was convered in 1987 and was financed by UNDP. In this study, a large amount of technical information were collected on chemical properties, it's occurance and it's impact on the water delivery at the source. In addition, the UNDP study also brought out a computerized Ground Water Information System (GWIS) for immediate and future use.

About 62% (1.1 million/ha.) of Nepal's total irrigable area has been so for studied by various national and international agencies under infrastructure, socioeconomic, diagnostic and technical fact findings. As pointed out elsewhere as well, the net total irrigated land in the country is about less than 40% of the total irrigable (potential) area studied. In other words, the irrigation potential is grossly underutilized. However in the ground water sector, only about 14% of irrigation potential is fully utilized on the year round basis. In ground water, the shallow tube well proportion for water use is 80% (more) over deep tube wells. This is mainly because of cost and operation and maintenance easigness in the former.

By potential irrigation area account, more than two third irrigation potential area lies in the Terai which is adjacent to the gangtic plain land. A little over a quarter of the irrigation potential area lies in the hills, while less than 5% potential irrigable area lies in the mountains. The Indo gangetic basin which contains large sediments and alluvium deposits due to river trespass and left overs, are the major characteristics for holding rechargable water. A similar character is found in the Nepal's Terai; because of proximity to the gangetic plain, uniformity in elevation and similarity in the water table underneath. In Nepal's Terai, the fertile alluvial deposits are found generally at 500 meters, while, the new alluvum is found above the alluvial at about 150 to 200 meters. The natural interaction between the alluvum and the alluvial deposits ends up by forming complex aquifers (FAO, 1989). These aquifers become either aquitard or aquiclude at certain distance. The distance thus formed are natural and provide on outlet to the ground water (FAO. 1994). The chemical combination of soil attacthed with aquitard produces sand stone, corze and finally turns intoclay, which is porous in character and long holding by technical nature (FAO, 1969).

2.3 Ground Water Source :

Rainfall and geology are the major resources of ground water. The western Terai has an average rainfall of 1500-1800 m.m. per annum for the last 10 years (BLGWIP-1999). The Siwalik and the foot hills which are not very far from the Terai plain has more precipitation, which results into high humidity. The humidity percolates water and protects against mass evaporation. The transevaporation in Rupandehi and surrounding are during June, July and August is comparatively low compared to other Terai regions of Nepal.

The water retention in the Rupandehi district is about 8-10%. In addition, the intermittance of the rivers such as Rohini, Dano and Tinau, has recharged the water table to a great extent. A similar situation may be found in other Terai regions of the country.

2.4 Ground Water Study :

The Ground Water Resource Development Board (GWRDB) and the Agriculture Development Bank-Nepal (ADB/N) in the last 10 years have performed extensive resource assessment study in many parts of the Nepal's Terai in connection with shallow and deep tube wells installation. It is however recommended that water table less than seven meters may be served by shallow tube wells, while, a height of above seven meters is needed to be served by deep tube well category. In Bhairawaha-Lumbini Ground Water Project area, the average water table depth is between 118 to 200 feet (TAHAL, 1999). In some other parts of the Terai region, the GWRDB and ADB/N have also recommended for the injection pumps. These pumps are a limited alternative for deep tube wells. In what follows the number and area covered under different ground water systems by district is provided in table 2.1 as under :

Table 2.1
Number and Area Covered Under Different GW Systems by District

DISTRICT	STW		DUGWELL		ARTESIAN		MTW		DTW		TOTAL	
	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area
Jhapa	3254	12980	426	1704	0	0	0	0	10	188	3690	14872
Morang	3702	14692	49	186	0	0	0	0	4	200	3755	15078
Sunsari	4242	16988	8	32	0	0	0	0	1	50	4251	17070
Saptari	972	2406	52	206	1	2	0	0	3	82	1028	2696
Siraha	1455	5238	86	337	0	0	0	0	30	889	1571	6464
Dhanusha	2377	3510	155	579	269	364	0	0	108	2950	2909	7403
Mahottari	1218	4683	76	286	347	672	26	793	21	840	1688	7274
Sarlahi	2627	10261	528	2074	2	4	0	0	32	1200	3189	13539
Rautahat	2652	6807	55	213	0	0	0	0	0	0	2707	7020
Bara	4517	19088	73	276	7	4	0	0	26	181	4623	19549
Parsa	673	2145	0	0	0	0	0	0	5	75	678	2220
Chitwan	450	1226	1470	5097	0	0	0	0	24	1400	1944	7723
Nawalparasi	1248	4445	329	1071	17	34	14	209	10	334	1618	6093
Rupendehi	3777	13686	115	418	72	114	0	0	176	12285	4140	26503
Kapilvastu	599	2402	32	125	4	5	26	380	20	518	681	3429
Dang	484	2010	660	1029	0	0	0	0	19	240	1163	3279
Banke	2387	7301	52	205	23	46	0	0	14	280	2476	7832
Bardia	1953	6577	10	40	1	2	0	0	12	400	1976	7019
Kailali	4850	17252	3	12	25	22	0	0	55	1400	4933	18686
Kanchanpur	2461	8128	1	4	0	0	0	0	3	60	2465	8192
Total	45898	161825	4180	13894	768	12689	66	1382	573	23572	51485	201941

Source: Ground Water Development Board; 1999.

2.5 Ground Water Development Performance :

DOI, ADBN and DOA are the major players in GW development in Nepal. Groundwater Resources Development Board (GWRDB) under DOI was established for exploring the potentials of GW, GWRBD mainly concentrated in the installation of DTWs in its early days. GW development efforts of DOI is also supported by the World Bank through Irrigation Line of Credit (ILC) Project to install deep, medium and shallow tube wells in Nawalparasi, Kapilbastu, Dang, Banke, Bardia, Kailali and Kanchanpur. Similarly, International Fund For Agricultural Development (IFAD), since 1995, has been supporting GW activities in Sunsari, Saptari, Siraha, Sarlahi and Rautahat districts through providing technical and financial assistance for the installation of community STWs.

ADBN is the only institution in the country having many years involvement (since 1970) in promoting STWs in Nepal and has the largest network of field offices. ADBN was involved in installing 41000 STWs, 4500 Dugwells, 9000 rower and treadle pumps and 800 artesian wells providing irrigation facilities in approximately 165000 ha. area through government supported subsidy programs. Since 1980, ADBN has emerged as a prominent institution working in the creation of irrigation facilities. The STWs dugwells, rower pumps, and treadle pumps being propagated by ADBN in the Terai region have already created irrigation means for about 165000 ha. ADBN has also provided credit for the development of more than 41000 STWs.

ADBN has played a pioneering role in the promotion and development of STWs in Nepal since 1970, financing (together with the subsidy provided by HMGN) more than 30000 STWs (including hand pumps and rower pumps), of which around 20% are community wells.

DOA's role in promoting GW development was confined to JICA supported Janakpur Agricultural Development Project area in Dhanusha district. It has recently extended its activities in Chitwan and Banke districts.

Most wells financed by ADBN were drilled manually using indigenous methods by local Nepali or Indian drilling contractors hired by ADBN. Typical well diameters range from 38 to 150 mm and utilize bamboo or mild steel casing and screen pipes. All wells exceeding 100 mm diameter are operated by diesel driven centrifugal pumps whereas smaller size STWs are operated by Hand pumps or rower pumps. Water distribution systems comprise temporary earthen canals constructed by the farmers. With the use of such low cost technology, STWs under the ADBN programme have been constructed for around Rs 30000. While the ADBN has been active in arranging drilling manpower for quality assurance, this has contributed to underutilization of wells which were constructed under the programme.

Beside, the above there are other agencies; both local and international, who supporting the GW development in minor scale. International Development Enterprises (IDE) currently is supporting Treadle pumps in coordination with ADBN, Grameen Bank and other non-government organizations (NGOs). The involvement of different agencies in GW development is summarized in table 2.2 below.

Table 2.2
Ground Water Development Performance

Agencies	Area of Specialization	Total Number of Tube wells	Total Area Covered (ha)	Average Area/Tube well	Duration of Involvement since
DOI					
GWRDB	DTW	278	9798	35.2	1970's
	MTW	26	793	30.5	
	STW				
SIRDP	DTW	15	473	31.7	1981
ILC	STW	117	930.5	7.9	1966
	MTW	36	588	16.3	
	DTW	65	2392	36.8	
IFAD	STW	111	932	8.4	1995
ADBN	STW	41085	145095	3.5	1970
	DW	4511	14726	3.2	
	ARTESIAN	763	1246	1.6	
	ROWER	8637	4179	0.5	
	TREADLE				
DOA					
JADP	DTW	220	7700	35.0	1970'S
	STW	3743	22558	6.0	

Source: Compiled from ADBN, DOI (GWRDB), DOA (JADP) reports.

Several studies of the operational wells have indicated that although the expected command area required is at least 4 ha, the average command area available is around 2.5 ha. Further the pumping hours are also low (100-200 hours per year) in case of the ADBN tube wells. This underutilization of the ADBN tube wells is partly due to technical situation which entails the non availability of the technical guidelines during construction of the system.

It has been reported that the existing tube wells have not been effectively utilized. Hours of operation of tube well and pumps is important to find out their effective utilization. Operation hours of both DTWs and STWs developed by the government agencies as well as by the farmers are discussed below.

A study of STW installed by JADP found that farmers have not utilized pump and tube well sets more than 300 hours in a year.

The trend of STWs installed by the farmers themselves is also not encouraging. Most shallow tube wells were utilized only for irrigating wheat and partial irrigation of early paddy and main paddy. It is noted that farmers utilized a maximum of 250 hours/per year/per pump, which is very low in comparison to average of 2000 hours of pump used per year in adjoining areas in India.

The installation of STW or DTW alone does not contribute to the increase in production unless it is tied with an integrated package that includes extension, credit and marketing aspects.

2.6 Eighth Plan Policies for Groundwater Development :

The basic objectives of irrigation development as set out in the Eighth Plan were to: i) increase agricultural production using approprivate irrigation technologies to diverse climate and soil conditions and with the minimum negative impact to the environment; ii) enhance the credibility of irrigation systems through improvement in the management of existing irrigation systems and iii) provide irrigation facilities in maximum land area by implementing finamcially, technically and environmentally sustainable and cost effective projects with the participation of farmers.

To achieve the above objectives, a new Irrigation Policy was promulgated by the Ministry of Water Resources in 1992. This declares that the role of the government shall focus in the areas of wider national importance such as review and development of sectoral policy on irrigation, resource mobilization, economic analysis and technological development etc. The policy emphasises for sustainable and environmentally friendly utilization of irrigation water and a demand driven

approach to irrigation development whereby farmers would : i) individually or collectively submit a request for tube well facilities ii) form a Water Users Groups and Farmers Irrigation Association (representing a number of WUGs) iii) be involved in all stages of irrigation development iv) contribute a minimum of 155 of STW construction costs and v) accept responsibility for tube well O & M upon completion of construction works. The users would also have to provide all land required for the construction free of cost. Present government policy supports investment in irrigation infrastructure through capital subsidies which (for groundwater development) range from 40% from an individual private shallow tube well to 85% for community shallow tube well (BLGWP. 1994).

Other significant provisions of the new Irrigation Policy are i) a 20% representation of women in all executive position of the farmer's organizations : and ii) responsibility for delivering agri-inputs as per the damned of farmers with DOA and other relevant agencies.

In the Eighth Plan period, the physical target was set to provide irrigation facility to an additional 2,93,895 ha. of land through various new and under construction irrigation projects. Of that target, the following achievement was made during the Eighth Plan period by developing infrastructures in additional irrigation land.

Table: 2.3
Physical Target and Achievement of the Eighth Plan

(in ha.)

	Description	Target	Achievement	Percentage
A	Department of Irrigation	1,61,132	1,38,245	85.5
	1. Surface irrigation	(1,44,042)	(1,30,484)	90.8
	2. Ground irrigation	17.090	(7,761)	63.6
B	ADB/N	1,19,700	76,098	63.6
	1. Surface irrigation	(49,000)	(15,694)	74.2
	2. Ground irrigation	(70,700)	(52,462)	74.2
	3. Other various	-	7,942	-
	4. Life Pump	-	22,727	-
C	Non government sector	13,063	-	-
	Grand total	2,93,895	2,06,401	72.9

Source : The Ninth Plan (1997-2002)

The situation of irrigation development up to the Eighth plan is shown in table number 2.3 below.

Table : 2.4
Situation up to the Eighth Plan

(in ha.)

S.N.	Programme/Project	Up to the Seventh plan	Achievement of the Eighth Plan	up to the Eighth Plan
1	Department of Irrigation	3,95,857	1,38,245	5,34,102
	a. surfarce irrigation	(3,46,444)	(1,30,484)	(4,76,928)
	b. ground irrigation	(49,413)	(7,761)	57174)
2	ADB/N	71,545	68,156	1,39,701
	a. surface irrigation	(11,860)	(15,694)	(27,554)
	b. ground irrigation	(59,685)	(52,462)	(1,12,147)
	c.other(various programmes)	19,289	7,942	27,231
	d. life pump programme	5,777	22,727	28,504
	Total	4,67,402	2,06,401	6,73,803
3	Irrigated land developed by farmers	3,81,814	-	3,81,814
	a. surface	(3,57,0989	-	(3,57,098)
	b. ground	(24,716)	-	(24,716)
	Grand total	8,49,216	2,06,401	10,55,617

Source : The Ninth Plan (1997-2002)

2.7 Ground Water Development in the Ninth Five Plan :

Importance of Ground Water Irrigation has been realized from the very beginning of periodic plans in Nepal. The Ninth Plan (1997-2002) has also given high priority to this component. Even in the Agriculture Prospective Plan (APP), irrigation has been identified as one of major inputs for agriculture development. Irrigation plays a vital role in crop diversification and crop intensification which ultimately will help increase productivity.

The Plan has envisaged to place high priority to those projects which could be managed and maintained by the farmers themselves. As a result special focus has

been put forward to private and community shallow tube well development in the Terai region.

2.7.1 Objectives of the Ninth Plan :

- to assist in raising agricultural production by improving the rainfall-based agricultural system by providing irrigation facility as per the need of crops.
- to raise water utilization efficiency of surface and ground projects.
- To reduce the government liability in repair, maintenance and operation of irrigation projects by encouraging the user farmers participatioon in those works and transferring responsibility of the management of organisations.

2.7.1.1 Policy and Implementation Strategy of the Ninth Plan for Ground Area Irrigation Development :

- According to the APP, tube-well irrigation programmes will be mobilised by utilising the existing ground water resource of Terai, which can be constructed in short period of time, with minimum expenses and under the control of farmers themselves. And agricultural road and rural electrification will be integrated with cluster on which tube well programmes depend and cash crops will be developed along with paddy crops in these areas.

- Subsidies of HMG/N for the operation of shallow tube well, dug well, sprinkler, drip and tanker pond will be gradually reduced. Farmers group will be formed in shallow tube well construction and other incentives along with loan will be provided to them. For this both NGOs and COs will be mobilised.

- The DOI will identify the proper drilling technique and arrange training for drilling and formers in technical aspect about tube well construction. The DOI and Agriculture and concerned bank will monitor the programme in a co-ordinated manner.

- Tube wells will be constructed in the existing and proposed irrigation projects of Terai where surface irrigation source is inadequate. The Plan has put target of achieving area coverage of a total of 2,49,400 ha. of land comprising 90,500 ha. under GW systems, 1,48,900 ha. under surface irrigation systems and 10,000 ha.under NGO irrigation systems from both additional new land and improvement of farmers field channels.

CHAPTER III

PERFORMANCE OF THE DEEP TUBEWELLS IN THE SAMPLE VDCs'

3.1 Setting :

In this chapter, we wish to evaluate the performance of the ground water systems of the six sample VDCs' on the basis of emprical data relevant information.

3.1.1. Deep Tube Wells in the Sample VDCs' :

Altogether, 12 systems were visited. The details on the systems by VDC, ward, beneficiary, command area and turnover period is summarized in table 3.1 given as under.

Table 3.1.:
Deep Tube Wells In Sample VDCs By Ward

VDC	Stage	Ward No.	Place	Tube Well No.	Beneficiary H.H.	Command Area in ha.	Turn over to WUGs' Period
1. Anandban	[I]	3	Bihana	W.4.E	106	102	1998
		8	Pahauni	W.15.E	114	144	1998
2. Madhwalia	[I]	7	Behuli	W.28	155	121	1997
		8	Chankipur	W.65	155	145	1997
3. Dayanagar	[I]	6	Ramgunj	W.48	200	129	1995
		8	Dayanagar	W.51	159	105	1995
4. Khudabagar	[II]	2	Ahirauli	T.W.7.N	130	126	1995
		5	Bhagatpur	T.W.10.N	125	124	1995
5. Kerwani	[III]	3	Dhekwar	E.W.01	275	143	1995
		4	Pethwaniya	E.W.02	135	125	1995
6. Mainhiya	[III]	1	Gadsari	CWW.15	86	84	1999
		4	Subhsermra	CWW.22	82	118	1999
					1722	1466	

Source : Field Survey, May, 2000.

3.1.2. Installation of Deep Tube Wells :

This is shown in table 3.2 here under. Broadly, the time taken to instal the system in each VDC and manpower involved for installation the systems are approximately similar in 4 out of 6 VDCs'. In 2 VDCs', the system installation has involved slightly more man power and also few more days of time.

Table 3.2
Installation Details of the Ground Water System by Sample VDC

VDC	Duration/Operation	Time Taken to Instal the System/days	Manpower used
1. Anandban	1996	30	45
2. Madhwalia	1995	30	56
3. Dayanagar	1992	40	41
4. Khudabagar	1993	35	58
5. Kerwani	1984	25	30
6. Mainhiya	1996	30	30

Source : Bhairahawa-Lumbini Ground Water Project, May, 2000.

3.1.3 System's Specification :

This is presented in table 3.3 below. This contains the size of the wells, depth, water level, length of the casing, length of screen and the thickness of the aquifers. The water table in the sample VDCs' is found to be uniform; although, a minor deviation in Khudabagar can be observed. The depth of the well is highest in Madhwalia and Kerwani VDCs', it is approximately same. The static water level is reported to be stable (at the median) in Madhwalia and Kerwani VDCs' (26.06 and 26.20 m.). In Dayanagar and Khudabagar VDCs', the static water level is reported at some upper level from the bottom (20.82 m.). In Anandban and Mainhiya VDCs', the difference in static water level is fairly marginal (24.62 and 23.10 m.).

On the other hand, the water discharge (lps capacity) is found highest in Kerwani VDC (26.60 m.) and it is lowest in Dayanagar and Khudabagar VDCs' (23 m.). In rest other VDCs', it is almost identical. Rest others given in the table are self explanatory. The table follows.

Table 3.3 :
Well-Specification

VDC	Size of Well (inch)	Depth (m)	Static Expected Water Level by Well (m)	Discharage (lps)	Estimated Casing Length (m)	Screen Length (m)	Aquifer Thickness
1. Anandban	8.6-11	108	24.62	25.02	86.07	29	30
2. Madhwalia	8.6-12	124	26.06	26.0	86.07	28	32
3. Dayanagar	8.2-11	120	20.82	23.0	80.07	26	32
4. Khudabagar	6-8-14	118	20.82	23.0	72.0	24	26
5.Kerwani	6-12	124	26.20	26.60	92.50	31.50	32
6. Mainhiya	6-12	119	23.10	23.60	90.50	29.50	30

Source : Discussion with DOI Engineer, Personal Investigation during Field visit, May, 2000

3.1.4 Physical Condition of the Systems :

In table 3.4, physical condition of the system is presented. 4 of the 2 systems studied are partially operative. These systems are located in Anandban Ward No. 8, Madhwalia Ward, no. 8, Khudabagar ward no 2 and ward no. 5. In rest other VDCs' and Wards, the systems are fully operative at present. The major problems in partially operating systems have been a) low fittings, b) unclear and smudgy screen, c) leakage in the surface at the pump site d) defect in loop and e) inadequate channel length due to which, the waste of water is pronounced. The table follows :

Table 3.4

Physical Condition of the Ground Water System by Sample VDC

VDC	Ward No.	Condition		Identification of Defect		
		Fully Operative	Partially Operative	Pipe Damage	Loop Damage	Others
1. Anandban (I)	3	Yes	-	-	-	-
	8	-	Yes	Low fittings	4th loop	Inadequate channel length
2. Madhwalia (I)	7	Yes	-	-	-	-
	8	-	yes	Screen not clear	3 rd loop	Surface defect
3. Dayanagar (I)	6	Yes	-	-	-	-
	8	Yes	-	-	-	-
4. Khudabagar (II)	2	-	Yes	Surface Leakage	The opening of any one loop operates full discharge, of water, generally, not required at that point of time.	Waste of water which may be controlled
	5	-	Yes	Surface Leakage		
5. Kerwani (III)	3	Yes	-	-	-	-
	4	yes	-	-	-	-
6. Mainhiya (III)	1	Yes	-	-	-	-
	4	yes	-	-	-	-

Source : Field Survey, May, 2000

3.1.5 Water Conveyance :

Water conveyance in and around the system is yet to be fully piped from the main system to the end point of delivery in head, middle and tail. This is perceived in the 5 of the six VDCs' visited. Only in Kerwani VDC, the conveyance channel is fully piped; although it is bruised in few places in between. Due to the problem arising out of the water conveyance, the water loss in the surveyed VDCs' is observable. It is between 5 to 8 percent in Anandban VDC to 10 percent in Khudabagar VDC, which is highest of all VDCs'. In Mainhiya VDC, it is estimated at 5 percent. In Kerwani, where the conveyance system is fully piped has water loss in the order of 2-3 percent during the full-discharge from the system. In Dayanagar VDC, the water loss during the recharge is estimated at 2 percent. These are presented in table 3.5 as under.

Table 3.5
Water Conveyance System in the Sample VDCS'

VDC	Conveyance System		Length of the System		
	Lined (%)	Piped (%)	Lined (%)	Piped (%)	Water Loss (%)
1. Anandban	42	58	20	80	5-8
2. Madhwalia	-	100	-	100	5-
3. Dayanagar	15	85	5	95	2-
4. Khudabagar	10	90	5	95	10-
5. Kerwani	-	100	-	100	2-3
6. Mainhiya	40	60	10	90	5-

Source : Field Survey, May, 2000

3.1.6 Ground Water Utilization :

Ground water utilization is highest in Kerwani VDC, while it is lowest in the Anandban VDC. In other VDCs', it is approximaterly same. Review of the SAARC Irrigation Developinent Report (Vol. IV, no. 16, New Delhi, 1999) shows that per hectare water utilization in ground water in India is 687 hours at 69% efficiency level, that in Pakistan it is 592 hours at 63% efficiency level and in Bangladesh it is 492 hours at 59.46% efficiency level. In Morang-Sunsari-Ground Water Irrigation, it is estimated at 4.8 hours per

hectare at 8.2% efficiency level (WECs, 1996). Rest of the table 3.6 is self explanatory and follows as under.

Table 3.6
Ground Water Utilization Efficiency by Sample VDC

VDC	Irrigated Area			Net Operation		Tube well Hour/ha
	Own Land (ha)	Rent out land (ha)	Total (ha)	Own Land (ha)	Rent out Land (ha)	
1. Anandban	41	-	41	107	-	2.7
2. Madhwalia	39	-	39	121	-	3.1
3. Dayanagar	36	-	36	102	-	2.8
4. Khudabagar	32	-	32	99	-	3.0
5. Kerwani	47	-	47	195	-	4.1
6. Mainhiya	37	-	31	107	-	2.9

Source : Field Survey, May, 2000

3.1.7 Operation and Maintenance :

Total repair and maintenance cost in the six sample VDCs' is Rs. 10,971, while the operating cost stands out at Rs. 1,61,637. The total operation and maintenance cost for of all systems for the year 1999 is Rs. 1,42,108. The average operation and maintenance cost 1999 is 23,684. This is shown in table 3.7 below.

Table 3.7
Operation and Maintenance Cost

VDC	R and M' Cost/Rs.	Operating Cost/Rs.	Remuneration to operator/Rs.	Total "O & M" Cost/Rs.	Average "O & M" cost Rs.
1. Anandban	1,927	19,920	2,500	24,347	
2. Madhwalia	2,029	20,701	2,600	25,330	
3. Dayanager	1998	20,008	2,200	24,206	
4. Khudabagar	1479	18,030	2000	21,509	
5. Kerwani	2160	19,989	3000	25,149	
6. Mainhiya	1378	17,989	2200	21,567	
Total :	10971	1,16,637	14500	1,42,108	23884

Source : Field Survey, May 2000

3.1.8 Discharge Situation :

Water discharge deviation of the systems in six VDCs' is significant with respect to area coverage. A higher deviation in discharge is integral to irregular water use, non availability of power on demand and low cropping intensity. In India, water discharge deviation under large acrerage is 2.1%. In medium acerage it is 2.3% and is small acerage it is 2.4% during 1999. The same in Pakistan and Bangladesh it is 2.6% and 2.7% respectively. In Rupandehi BLGWIP, it is high compared to other countries.

On the other hand, the water sufficiency level by VDC is highest in Kerwani (38.89%), Anandban (37.10%), Madhwalia (34.40%), Mainhiya (33.87%), Khudabagar (30.31) and Dayanagar (26.24%) respectively. This is given in table 3.8 as under.

Table 3.8
Discharge Situation of The Deep Tube Wells in Sample VDCs'

VDC	Rated Discharge (lps)	Actual Discharge			Sufficiency Level
		In Winter (lps)	In Summer (lps)	Deviation (%)	
1. Anandban	44.2	28.02	26.02	7.11	37.10
2. Madhwalia	46.0	26.02	23.01	11.56	34.40
3. Dayanagar	41.0	27.1	23.1	14.76	26.24
4. Khudabagar	39.0	23.0	21.0	8.69	30.31
5. Kerwani	46.0	28.1	26.1	7.11	38.89
6. Mainhiya	39.0	23.0	21.0	5.13	33.87
			Average		33.46%

Source : Field Survey, May, 2000

3.1.9 Area Coverage of Deep Tube Wells :

In table 3.9, the area coverage by deep tube wells is shown. There is an average deviation of over 40% over the designed area coverage capacity which confirms that at present the systems installed in the sample VDCS' are not working at 100% capacity. The table follows here under.

Table 3.9:
Area Coverage of Deep Tube Wells by Sample VDC

VDC	Designed (ha)	Actual (ha)	Deviation (%)	Average Deviation (%)
1. Anandban	52	33	-36.53	
2. Madhwalia	54	30	-44.44	
3. Dayanagar	54	29	-46.30	
4. Khudabagan	52	30	-42.30	
5. Kerwani	58	39	-32.75	
6. Mainhiya	50	31	-38.0	
		Average		40.06%

Source : Field Survey, May, 2000

3.1.10 Pumpset Information :

This is summarized in table 3.10 given as under. The information was collected during field survey. The table follows as under.

Table 3.10:
Pumpset Information by Sample VDC

VDC	Ward No.	Type	Ownership	Intalled Capacity	Rated Actual Capacity
1. Anandban	3	DTW	WUA	Prime Mover/ 12.5hp.	
	8	DTW	WUA	150 hp.	120 ha
2. Madhwalia	7	DTW	WUA	100 hp.	85 ha. in an hour
	8	DTW	WUA	100 hp.	85 ha. in an hour
3. Dayanagar	6	DTW	WUA	80 hp	65-70 ha. in an hour
	8	DTW	WUA	100 hp.	80 ha. in an hour
4.Khudabagar	2	DTW	WUA	100 hp.	80 ha in an hour
5. Kerwani	3	DTW	WUA	55.hp.	30 ha. in an hour
	4	DTW	WUA	55 hp.	30 ha. in an hour
6. Mainhiya	1	DTW	WUA	12.5hp.	7.50 ha in an hour
	4	DTW	WUA	55 hp.	30 ha. in an hour

Source : Field Survey, May, 2000

3.1.11 Household Perception on Deep Tube Wells :

This is provided in tables 3.11 and 3.12 respectively. The tables are self explanatory which follow as under.

Table 3.11:
Household Perception on Deep Tube Wells of Sample VDCS'

VDC	Good H.H.(%)	Fair H.H. (%)	Poor H.H. (%)
1. Anandban	30	45	25
2. Madhwalia	20	67	13
3. Dayanagar	15	69	16
4. Khudabagan	11	81	8
5. Kerwani	33	58	9
6. Mainhiya	11	66	23

Soruce : Field Survey, May, 2000

Table 3.12
Household Perception on Deep Tube Wells by Category

Item	Good H.H (no)	Fair H.H.(no)	Poor
Head	29	32	17
Middle	59	61	48
Tail	12	7	35

Source : Field Survey, May, 2000

3.2 Project Investment Cost :

The project investment cost is worked out at Rs.3,68,948 and 3,80,979 for year one to ten. The interest on capital is worked out at 8% and `O and M' costs at Rs.23,884. The O and M costs is calculated at per annum basis.

3.3 Crop Budget :

The objective of crop budget is to understand farm level investment pattern as found in the sample VDCs'. This is presented below :

		One Hectare Farm Case		
		I Stage	**II Stage**	**III Stage**
1.	Net Farm Incomes	Rs. 47,400	Rs47,400	Rs47,400
2.	Incremental (%)	-	3.9	4.1
3.	Estimated Consumption	11,400	11,400	11,400
Note : 115 kg. Percapita / annum	-		-	-
At 6 persons per household	-		-	-
4.	Net cash Incomes	Rs. 47,400	Rs47,400	Rs47,400
5.	Estimated Water charge	Rs. 860	Rs. 860	Rs. 860
6.	Other cost (electricity etc)	Rs. 3740	Rs. 3740	Rs. 3740
	a) Net Rs. =	Rs. 28280	Rs. 30140	Rs. 30162
	b) Average =	Rs. 47,400		

3.4 Project Life Span :

The project life span depends upon the materials used in the systems, the design of the well, the rigs used and the operation and maintenance applied overtime> Considering the situation as observed in the field it is estimated that an economic life of the system would be about 12 years from the date of functioning.

3.4.1 System Management :

System management in the sample VDCs' has been average. This is because of the lack of training imported to the WUAs' and villagers and sometime because of the early breakdown of some critical parts, whose repair takes unusually a longer time.

3.4.2 Repair and Maintenance Facilities :

As mentioned variously in this study, the repair and maintenance of the systems in the sample VDCS' is much desired to be stream lined and systematized. Repair and maintenance must take care of :

1. Field geometry (length and width)
2. Water supply situation
3. Slope and level to which the system is addressed to
4. Infiltration rate to and of the system
5. Surface roughness, materials used and assessment of the critical parts.
6. Channel management and regular monitoring of the electrical parts and those of machine which includes the pump set.

These facilities and expertise are non existent in the sample VDCs'.

3.4.3 Comparative Advantage of the System :

Ground water system has biggest advantage in water delivery on demand. It can be operated or closed as per the need of the users. In other words, the water for irrigation can be used on year round basis representing the crop calendar.

3.5 Socio-economic Impacts :

The objective of socio-economic impacts is to look into the possible changes which might have occurred to the users and the beneficiary farmers overtime as a result of the water availability to irrigate their farm lands.

3.5.1 Beneficiary Households :

Altogether, 240 households in 12 sample systems (by ward) by head, middle and tail were interviewed by way of structured questionnaire and RRA schedule. The results have been variously reported in this study at appropriate place.

3.5.2 Land Ownership :

VDC		Sample No.	Irrigation Situation		% change/ha.
			Before the Project/ha.	After the project/ha.	
1.	Anandban	40	1.2	2.01	67.5
2.	Madhwalia	40	0.8	2.1	61.90
3.	Dayanagar	40	1.0	2.52	72.38
4.	Khudabagar	40	0.6	2.02	70.29
5.	Kerwarni	40	1.6	3.02	88.75
6.	Mainhiya	40	1.02	1.75	71.56

During the filed survey and also in discussion with the farmers at each sample VDC and wards, it was understood that percentage of large farmers involved in irrigated agriculture were low due to some unexplained reasons. On the contrary, the irrigation percentage in medium and small farmers were more. By head, middle and tail, the middle and tail reach farmers were found to be working hard in agriculture. The household net employed days by summer and winter had increased by 43% and 29% respectively in the case of middle reach farmers. The same in the tail reach had increased by 52% and 41.25% respectively.

3.5.3 Agricultural Performance :

The overall performance in crop production has increased under stage I, II and III in the sample VDCs' by ward. However, this could have increased even more if the support services and complementary services of the line agencies could have been sufficiently developed and WUAs' could have been more strengthened by way of training, material support and extension and knowledge transfer.

3.5.3.1 Cropping Pattern :

The installation of the ground water system has made a perceptible change in the cropping pattern in the study VDCS'. This is shown as under.

Table 3.13
Cropping Pattern in the Sample VDCs'

VDC		Cropping Pattern		Cropping Index	
		Before Project	After Project	Before Project	After Project
1.	Anandban	Paddy, lentils wheat, maize	Paddy, Lentils Vegetables, Wheat Maize	129	162
2.	Madhwalia	Paddy, lentils, wheat, maize	Paddy, lentil, wheat, maize	121	147
3.	Dayanagar	Paddy, Wheat, Maize, Minor crops	Paddy, Wheat, Maize, Raazma, Sunflower	126	152
4.	Khudabagar	Paddy, Wheat, Maize	Paddy, Wheat, Maize, Banana Vegetables	120	166
5.	Kerwani	Paddy, Wheat, Maize, Potato, Lentils	Paddy, Wheat, Maize, Vegetables, lentils Banana, Potato, Sugar cane	162	190
6.	Mainhiya	Paddy, Wheat, Maize, lentils	Paddy, Wheat, Maize, lentils potato, minor crops	114	161
			Average		163

Source : Field Survey, May 2000

Table : 3.14

Household Perception On the Role of Line Agencies in the Sample Area .

VDC	Sample H.H. No.	ADB/N	ADO	BLGWIP	Others
1. Anandbn [I]	40	Non Existent	No Extension Support	Heavy Repair Support Required	-
2. Madhwalia [II]	40	Group Credit Support Required in Raazma and Sunflower Production	Soil test in the Tail end is required	Loop maintenance and panel board replacement is necessary.	-
3. Dayanagar [I]	40	ADB/N and WUAS' need to Develop Longterm Credit and agricultural program in vegetable pocket Development in Ward No. 6 and 8.	The Agriculture Pocket Program of the ADO Rupandehi does not cover Dayanagar VDC.	BLGWIP and DOI are needed to consult the WUA for Repair and Maintenance Program in the VDC.	-
4. Khudabagar [II]	40	ADB/N has no activily. ADB/N is needed to start Input supply and Distribution Program in Ward no. 5 in Bhagatpur.	ADO had Proposed a limited Agri-Pocket Program in Ward number 2, in Ahirauli for 2056/57 which is not materialized.	The Existing WUA Members are Limited to Water Delivery, where as the Major Problem lies in Adequate Delivery of Water and Management of the System. The Physical Aspect of the System is	-

				not Taken care by the BLGWIP till Todate.	
5. Kerwani [III]	40	In Dhekwar In ward no. 3, the ADB/N in support of ADO had Formulated a Seed Replication and Distribution Program for 2056/57. This did not Materialize	Extension Support Program in Dhekwar, Pethwania, Manigram and Sisuwai- has slacked considerably in last Two years.	BLGWIP and DOI should Develop an Integrated System Management Program with WUA and Farmers Participation. This need be based on a Role-Model Pattern for other VDCS' to follow.	-
6. Mainbiya [III])	40	In Gadsari ward no. 1, The ADB/N In Assistance of ADO need to promote vegetable growing pocket. Even service centre may play a lead role in this.	The ADO office has no program for Gadsari ward no. 1 and Subhsemra, ward no. 4.	BLGWIP did not visit the VDC since ages the tail end water users have great deal of water discharge problem since, 2055/56 which is not mitigated.	The cooperative development in Agriculture Development is necessary.

Source : Based on HouseHold Survey and RRA Information, May, 2000

3.5.3.2 Food Sufficiency :

Food sufficiency in the BLGWIP area and also in six sample VDCs' indicates a good progress; and it is increasing satisfactorily. By Category (head, middle and tail), farmers of the middle and tail reaches seem to have been better off than farmers of the head reach; though in few places, even the head reach farmers have also gained in production and

thus in food self sufficiency. A detail on food sufficiency by sample VDC by ward and category is shown in table below.

Table : 3.15
Food Sufficiency Status in Sample VDCS'

VDC	Reporting H.H. No.	Ward No.	Category	Before Project		After Project	
				Lowest (%)	Highest (%)	Lowest (%)	Highest (%)
1. Anandban [I]	20	3	Head	10	47	33	39
			Middle	38	29	29	48
			Tail	52	24	38	13
	20	8	Head	19	41	34	40
			Middle	31	33	31	52
			Tail	50	26	35	8
2. Madhwalia [I]	20	7	Head	9	37	29	26
			Middle	37	37	38	37
			Tail	54	26	33	37
	20	8	Head	14	27	34	19
			Middle	42	36	36	41
			Tail	44	37	37	40
3. Dayanagar [4]	20	6	Head	24	29	21	38
			Middle	34	40	40	49
			Tail	52	31	39	13
	20	8	Head	27	33	27	19
			Middle	36	42	32	44
			Tail	37	25	41	37
4. Khudabagar [II]	20	2	Head	29	34	24	21
			Middle	38	37	30	44
			Tail	33	29	46	35

	20	5	Head	32	29	28	35
			Middle	40	42	32	31
			Tail	28	29	40	34
5. Kerwani [III]	20	3	Head	14	29	11	44
			Middle	39	44	39	39
			Tail	47	27	50	17
	20	4	Head	25	39	31	34
			Middle	42	33	34	34
			Tail	33	28	35	32
6. Mainhiya [III]	20	1	Head	34	40	40	41
			Middle	30	34	29	22
			Tail	36	26	31	37
	20	4	Head	36	41	34	30
			Middle	40	35	45	40
			Tail	24	24	21	50
Total :	240						
Highest	55.08%						
Lowest	48.03%						

Source : Field Survey, May,2000

By food sufficiency index, Kerwani and Dayanagar VDCs' are found to be more better off than others in absolute terms. On relative comparison there appears to be a overall better off situation in the sample VDCs'. The table given below indicates this.

3.5.3.3 Cropping Intensity :

The cropping intensity in the sample VDCs' have been increasing at a slow pace of 161-162%, which is close to the district average of 161.43% (ICIMOD 1997). By sample VDCs it is higher in Kerwani (164%) and lower in Mainhiya (149.6%). In other VDCs it is almost equal (160-161%).

3.5.3.4 Crop Yields :

The average crop yields in the sample VDCs' are shown in table 3.16 as under.

VDC	Yield in Ton/ha						Varieties Used	
	Before Project			After Project			Local	Improved
	Paddy	Wheat	Maize	Paddy	Wheat	Maize		
1. Anandban	1.1	0.8	1	2.0	1.1	1.6	20	80
2. Madhwalia	1.4	0.6	1.2	2.6	1.4	2.0	30	70
3. Dayanagar	1.0	1.0	0.86	2.9	1.8	2.0	40	60
4. Khudabagar	0.9	0.8	1.4	2.0	1.8	1.9	40	60
5. Kerwani	2.1	1.8	1.6	3.02	2.6	2.4	70	30
6. Mainhiya	0.86	0.8	1.0	1.9	1.8	2.8	50	50

Source: Field Survey, May 2000

3.5.3.5 Family Income and Expenditure :

The average farm family income in sample VDCs before the ground water project was about Rs. 13000, which incresed to about 19000 and over in last 8 to 10 years. In other words there is a growth in the per capita H.H. income by over 46.0% which is quite significant in over all terms. In table 3.14 average family income and expenditure is presented here under.

Table 3.17

Average Family Income and expenditure of the Sample Households

(Rs.in 000')

VDC	Before Project				After Project			
	On Farm Income (Rs)	Off Farm Income (Rs)	Total Income (Rs)	Total Expen diture (Rs)	On Farm Income (Rs)	Off Farm Income (Rs)	Total Income	Total Expen diture
1. Anandban	14	11	25	18	21	12	33	21
2. Madhwalia	11	9	20	13	18	9	27	19
3. Dayanagar	15	9	24	13	20	9	29	19
4. Khudabagar	9	5	14	9.5	15	6	21	12
5. Kerwani	23	9	32	19	29	11	40	22
6. Mainhiya	6	3	12	6	10	3	13	9

Source : Field Survey, May 2000

3.6 Financial Analyasis :

Framework :

In the process of analysis of the Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP), we collected various data and information from the sample VDCS' on ward and head, middle and tail basis. In order for financial and econonic analyses, the data sets have been converted into ratios such as the financial ratio, the efficiency ratio, the income ratio to denote the return on investment equity, net worth and assets. This is summarized as under :

		Financial Performance	
1.	Year	1-5	5-10
	Capital costs	3,68943	3,80979
2.	Movement of gross cost factors including rate of interest at 8% and O and M costs	96,774 =3.81	94,760 =4.02

We recall here that between year one to year 5, the installation of machine and other capital costs had rather a slow movement due to stepwise cash out flow made by the management for system development. Because of this, the project investment effectiveness ratio between year one to year five was in the order of 3.81, while, the same between year six to year ten in creased at 4.02. The main reason for increase is due to a change in externalities which involves prices, transfer payments and imputed values. In other words, there seem to have a change in the economy of the sample VDCs' on account of irrigation availability but it has priced, change and decision making delay effects. Therefore, this has to be corrected.

Next, we wish to take on income, which denotes a change in production due to water availability. This is done on the basis of cash flow, operation and maintenance and other costs and a cost recovery rate per annum is worked out. this is shown as under:

		Before project	After project
Income ratio on Output Valuation	Income / Cost	25,300 / 42,250 x 100 = 59.88%	47,400 / 77,297 x 100 = 61.33%
Cost Recovery	2.44% after project		

3.6.1 Economic Analysis :

We have at the out taken the average cash out flow in the sample VDCS', the value of production vide field survey and cash inflow that might have been realized. Besides, we have taken the operation and maintenance costs and also the production cash as incurred in the farming. This follows as under :

	Item	Investment/Output
A.	The Cash in flow	Rs. 47,400
i)	Total value of crops	Rs. 47,400
Ii)	Salvage for (15 yrs)	0
Iii)	Other direct/indirect costs	0
B.	Cash Out flow	Rs. 35,204
i)	Initial investment in survey period	0
ii)	Operation and Maintennace Cost	Rs. 23,884
iii)	Production Cost	Rs. 11,320
C.	Net cash flow	Rs. 12,196

∴ The Benefit Cost Ratio (BCR)

$$BCR = \frac{\text{BCR = Pv of Cash in flow}}{\text{Initial Cash inflows}} \quad \frac{47400}{35204} = 1.346$$

Theoritically and also from application point of view the Benefit cost Ratio of 1 or over (1.346) suggests that the project is bankable and feasible. Therefore, the effectiveness of investment in DTWS in the sample project area is economically cceptable and also socially viable.

In the next step we wish to calculate internal rate of return (IRR) which is a discounting measure to look at the net present value (NPV) of the project's net investment costs over time. This is shown as under

IRR = Cash inflow		Discount Factor/DF.	P.V.
= 47,400	at 12%	0.893/12%	42328
Out lay = - 35,204	0.893		35,204
		NPV = 7,124	

$\therefore$ IRR = 12% + $\frac{7,124}{65+7124}$ x 12

= 11.891 say 12%

$\therefore$ EIRR = 12% + $\frac{1\,7,124}{65+7124}$ x 12

= 12.89 say 13%

$\therefore$ Project Worth (=) (0.26 + 0.17) + 12.89 = 13.32%

Thus (=) the irrigation projects in the sample VDCs' are economically feasible

Table : 3.18

Food Sufficiency Index of the Sample VDCs'

VDC	Category	Before Project	After Project
1. Anandban	Head	119	133
	Middle	126	141
	Tail	121	137
2. Mandhwalia	Head	118	124
	Middle	127	141
	Tail	119	139
3. Dayanagar	Head	116	126
	Middle	121	139
	Tail	117	139
4. Khudabagar	Head	111	117
	Middle	116	132
	Tail	115	133
5. Kerwarni	Head	123	147
	Middle	125	163
	Tail	117	139
6. Mainhiya	Head	111	126
	Middle	113	129
	Tail	114	124

Source : Field Survey, May 2000

CHAPTER IV

WATER USER ASSOCIATIONS

4.1 Background :

Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP) have had a long tradition in forming water user groups and its associations. The idea to constitute an WUA and WUG is to strengthen the grass-root unit of the irrigation users to facilitate local level and community participation in irrigation management. An WUA is a representative of a system and works at 3 levels in the VDC, viz, 1) organizes villagers in planning the system's operation, 2) performes the duty of a system implementor and 3) safeguards the interest of the system through capacity utilization measures.

The decentralization policy of HMG has vide its' by laws provided a special scope to grass-root organizations in infrastructure development. In this regard, the District Development Committee (DDC) is also empowered. There generally exists a close rapport between the DDC and user association members in the general body meeting of the DDC. The DDC however is not a directly responsible party in irrigation development and management of the system, but as an appex political body, representing the people of the district, it has some in built responsibility to listen to the people's grievances and represent those to the DOI, Ministry of Water Resources (MOWR) or even further. On the other hand, the WUA in each VDC is the stakeholder. The WUA as a unit or organization undertakes discussion on system's prospect in

a) Technical capacity building,
b) Management arrangement of the system,
c) Membership fee collection,
d) Deposit collection,
e) Formation of committee to undertake private channel (sluice) building and
f) Maintenance and management of electrical equipments including transformer (minor) maintenance, maintenance of the panel board, water delivery junctions and loops and other minor repairs around the system complex. Channel maintenance outside the purview of the system complex is the responsibility of the beneficiaries. The head, middle and tail reaches (nodal point) are

maintained by beneficiary farmers. The channel maintenance is a mandatory activity of the land owners. The WUA only supervises the channel maintainence.

4.1.1 Technical Capacity Building :

The WUA in consultation with it's members decide to undertake the technical maintenance of the system. This includes electrical maintenance, the maintenance of the minor mechanical parts, supervision of the outer design structure and operational data collection and information sharing on system's performance. Discussion during field survey at Kerwani, Khudabazar and Mainhiya VDCs' reflected that the WUAs' which are not very old, have provided emphasis to the capacity building training.

4.1.2 Management Arrangement :

This includes overall management of the system of a concerned VDC. The WUA by virtue of it's own authority, can assign specific management related work to any one or all members at a point of time.

4.1.3 Membership Fee Collection :

Membership fee per member is Rs. 10 per months. This is not refundable. Membership holders are facilitated by WUA in electricity tariff. For instance, a non member is required to pay power tariff at Rs. 10 per unit while a member would pay Rs. 3.25 for using a unit of electrict power. The tariff rate state above is in relation to system's use. This is separate from the household-electric use.

4.1.4 Deposit Collection :

The WUA collects a sum of Rs. 1040 (in other VDCs' it is found at Rs. 1078 and Rs. 1086) as a deposit money. The objective of this deposit fund is to raise the local resource for any emergency related to the system. The WUA, however do not pay any interest on this deposit.

4.1.5 Building Private Channels :

This is also known as farm bed channel. The responsibility for constructing the farm bed channels lies in owner operator. The WUA supervises the modality followed by the owner operator in constructing such channels.

4.1.6 Maintenance and Management :

This includes all kind of minor repairs and management works related to the system. Panel board repair, loop repair, decongestation of line channel, minor electricity repair and other similar works are provisioned to be undertaken by the WUA by managing appropriate labour force.

Table 4.1
Problems Identified in Irrigation By Sample VDC

VDC	Problem	Suggested Measure
1. Anandban	1.1 Power supply is irregular	1.1 Needs immediate attention
	1.2 Power tariff of Rs. 3.25 per unit is very high.	1.2 Needs government subsidy
	1.3 Loop no. 4 does not work. It has leakage of late.	1.3 Needs immediate replacement.
	1.4 The water operator needs training.	1.4 This has to be organized by WUA as early as possible with the support of DOI.

Contd...

	1.5 Usually, the tail end of the farm does not receive water either due to power failure or due to defect in the system structure.	1.5 Both the problems need urgent attention from the BLGWIP and DOI.
2. Madhwalia	2.1 Pump station no. W.28 does not work properly. It is greatly disturbed by power failure, which is quite frequent in summer.	2.1 BLGWIP and DOI needs urgent attention
	2.2 The input price is high and it is not available on demand. There is about 15% upward change in the prices of fertilizers between 1998-2000.	2.2 Line agency like AIC and ADB/N need to intervene to solve this problem. Further, the ADO and service centre should also come in the fore to help Madhwalia farmers.
	2.3 The line canal which is relatively new has defect in the floor. Due to which water delivery between middle to tail is problemetic.	2.3 The WUA along with BLGWIP and DOI should trashout the problem by inviting responsible contractor. There need to have a renovation in the canal immediately

Contd...

3. Dayanagar	3.1Power shortage in the Ramgunj locality is acute. The system W.48 works for only about 30 hours in a month.	3.1 BLGWIP and DOI need to take needful action.
	3.2 In pump station no. W.51 the second and third loop do not work and there occurs a leak in the pipe.	3.2 Since, this cannot be repaired by local farmers< the DOI should find out the way to replace or repair the loop. The leak in the water pipe be repaired as well.
	3.3 The extension service under agriculture is weak. New programs have been recommended but not it's know-how.	3.3 The ADO to take note of this. Even the agriculture section of the project needs special attention to this end.
4. Khudabagar	4.1 Power tariff needs a down ward revision. In India, in the Eastern UP, the irrigation power cost per unit is only 0.55 paisa. In our case, we pay Rs> 4 per unit which is too much.	4.1 BLGWIP to take note of this.

Contd...

	4.2 Cost subsidy on inputs is required to make the farming attractive to some degree.	4.2 The ADO, AIC and ADB/N need to take up this matter to DOI and BLGWIP to find out certain ways.
5. Kerwani	5.1 There is a problem in the outlet. It is greatly affected by the construction technique. The distance between the outlet is unequal. At least, 4 more outlets are required.	5.1 BLGWIP to take note.
	5.2 Power tariff of Rs. 4 per unit is very high.	5.2 BLGWIP to take note.
	5.3 Those who are not member of the users committee, they pay Rs. 10 per unit as tariff which is sheerly very high charge by any standard.	5.3 BLGWIP to take note.
	5.4 At present, a person is allowed to consume 10 units of power at a time. This has affected small farmers very much.	5.4 WUA to take this matter to BLGWIP and DDC

Contd...

	5.5 The canal is old and the repair would be costly hence, the DOI should finance the repair work. At present there is a leakage in the canal.	5.5 DOI to take note.
	5.6 Due to canal problem the water delivery at the tail end is about 50% only	5.6 DOI to take note
	5.7 Power failure is a continued problem in Kerwani VDC.	5.7 BLGWIP to take note.
	5.8 The side filling around the canal is weak.	5.8 DOI to take note
	5.9 Due to high cost and low profit many farmers have abandoned the vegetable farming as a result there is a decline in the command area.	5.9 ADO to take note.

Contd...

6. Mainhiya	6.1 In Gadsari-pump station no. CWW 15, the main water discharge sluice is not evenly laid. This has caused problem to middle and tail end farmers in obtaining water for irrigation.	6.1 Since, WUA is not fully functioning in the VDC, the BLGWIP and DOI are needed to intervene and set right the problem encountered by the farmers.
	6.2 The electricity charge of Rs. 4 per unit as levid is too much. This should be around Rs. 1 for the irrigation purpose.	6.2 The BLGWIP to take note.
	6.3 In pump station no. CWW. 22 in Subhsemra, there is a structural defect in setting the pump station. Water supply in summer and winter is problemetic.	6.3 The BLGWIP to act along with DOI.

Source: Field Survey, May 2000.

4.2 Water User Associations in the Sample VDCs:

Water user associations in the sample VDCs are still very young and they lack in capacity to address technical, behavioural and managerial problem solving; which is an essential requirement to deal with the ground water systems and people in the Rupandehi district. The inherent character of a water delivery system is to facilitate land with water whenever it is required. This is generic to production and the production encompasses the circular flow of the social and economic activity. Hence,

there exists a direct relation between technology and activity. From the system's point of view, it entails a technical relation between the man and the machine.

In this context, the role of the user associations is two fold: viz,

(1) to make people accountable to irrigation water and

(2) to supervise the productive use of water. Said differently, the first case is to bring people to an activity, viz, agriculture by making available the ground water on demand and in the second case, supervise people, whether or not the water is adequately and productively used to which it is made available for.

By above explanation the role of an user association is quite vast and perpetuating. For instance, under the above statement the role of the user association is not only to deal as an institution but it is also the duty of WUA to bring closer the farmer (beneficiary) the land and water for complementary development in the production system. This entails the behavioural aspect of crop and water relationship. The research team perceived the above framework to make inquries about the condition, function and utility of WUAs in the sample VDCs'. The observation follows as under.

4.2.1 Condition of the WUA's :

As said earlier, the WUA's in the six VDC's are young and that they have not developed as an institution. Their relation with beneficiary farmers and line agencies (AIC, ADB/N, BLGWIP, ADO and others) are only polemic. There does not exist an information sharing between farmers and WUA's.

4.2.2 Function of the WUA's:

On inquire we found that the function of the WUA's was to collect membership fee (Rs. 10 per member), Collect electricity tariff (Rs. 4 per unit for member and Rs. 10 for non per month member), supervise the system in most subjective manner and conduct meeting twice or thrice in a year. The WUA's were not concerned to cost recovery of the system by taking into consideration:

(a) Accountability/ownership

(b) Transparency /functional clarity

(c) Consumptive of water, and

(d) Commercialization in production

4.2.2.1 Accountablility/ownership :

By accountability, we mean ownership of the system. We did not find a collective ownership feeling in the WUA members during our discussion. They had a growing concern about water delivery and water availability but they could not discuss any "objective action plan" regarding water management and water distribution system by head, middle and tail.

If we are allowed, we may add here to say that the WUAs' to whom we came across had very little devotion toward the system. To this we may as well reason out that the large land holders of the sample VDCs' were found to be indifferent about the system and it's performance. They were not bothered to agriculture production in their land. Most of them were either living else where in Nepal or in India and agriculture was not their main business. In other words, the strength of WUAs' as a grass-rool pressure groups was found to be weak in the absence of an influencing support to them from within the VDCs'.

4.2.2.2 Transparency/Functional Clarity

Transparency does not mean only financial transparency, public audit or accounting; it does also mean a transparency in role that is defined and clarity in discharging the role. We did not witness a similar role of WUAs' during our visit to the sample VDCs'. Many WUAs, complained about the delay in registration at the CDO office. Similarly, the role of DOI was said to be mediocre in the transfer of the system. Few members opined that the BLGWIP management was indifferent in the system's turning over process.

4.2.2.3 Consumptive Use of Water:

Consumptive use of water represents the net effective demand principle, which is the off shoot of the marginal productivity thesis. The net effective demand for water is positively correlated with the net cropped area irrigated. There exists a difference between total land irrigated and net irrigated cropped land. On this basis, the consumptive use of water is the function of net cropped land and actual amount of water needed to irrigate the crop (s). Any extra dose of water provided to crop other than the required dose, would result into a diminishing marginal productivity (E.O.

Heady 1969). That is with the succeeding increase in the water quantity applied by the farmer, there is every likelihood that the production of crop would declining ?

The objective of stating this thesis here is to stress on the importance of water management in the BLGWIP irrigated area in general and in sample VDCs' in particular. The WUAS' need to take into account this thesis to optimize the water utility. By following the thesis, the VDCs' may be able to cut down the power tariff in the short run. Similarly, the misuse of the system may also be curtailed. Hence the WUAs' should treat the entire discussion in terms of a possibility for the rational use of water. The agriculture extension and package program and the BLGWIP agriculture section are needed to play a greater role (in cooperation of WUAs') in establishing the consumptive water use as a defined program in the VDCs' in the up coming years.

4.2.2.4 Commercialization in Production :

One of the critical aspects of cost recovery and income redistribution in the BLGWIP is commercial production development in agriculture. This has a strong possibility provided a comprehensive homework is done in advance. The following aspects need a priori consideration stated as under.

(1) study of various crops possibilities
(2) study of the road net-work linkage
(3) study of the markets
(4) study of the geophysical situation of the district
(5) study of complementarity within the sectoral development programs
(6) assessment of the VDCs contribution in crops commercialization process
(7) assessment of the support programs

These have been elucidated within the back-drop of WUAS' expected role. It is also expected that if the WUAs' could emulate above activities their strength and popularity in the VDCs would increase vis a vis the socioeconomy of the district.

4.2.2.4.1 Study of Various Crops Possibilities :

The WUAs' are not only the system's protector and water facilitator, but they are also the motivators at the VDC level. Although, this role of their is not specified in their charter, it needs to be included from the long –term (system's development) integration objective. The WUAs' in cooperation of ADO and BLGWP- agriculture section, can undertake a crop possibility study need to be categorized by cereal and cash crops which includes vegetables, sugarcane, raazma and sunflower production. Vegetables and sunflower have tremendous market possibility in recent years. Similarly, the raazma has a great prospect in immediate future. This need to be tapped by the growers to which the cooperation between WUAs' and agriculture extension can play a lead role. This study must be completed by the year 2000 and programs be developed for 2001 and later years.

4.2.2.4.2 Study of the Road Net-Work Linkage :

Road net-work study at the district level is suggested in the Agriculture Perspective Plan (APP/1995). Between 1992-1997 (8^{th} plan period) the Plot-Lobour-based District Road has District Road Rehabilitation and Maintenance Project (PLRP) has between 1992-1997 (8^{th} plan period) extensively studied 4 districts rural roads under the financial support of the UNDP, Helvetas and the World Bank. In December 1997, the PLRP { has brought out a District Transport Master Plan (DIMP) of 4 districts, including Rupandehi district. In this study however, the PLRP has not considered those roads (272km.) constructed by BLGWIP in the last 10 years. At present, the Rural Infrastructure project (RIP) is started in 7 districts of the western region which includes the Rupandehi district.

The WUAs' are needed to contact the DDC-Rupandehi to obtain a roadnet work map along with extensive plan prepared. This would give them an overview on the prospect of their VDCs. Based on the road linkage the future programs of the VDC's may be decided.

4.2.2.4.3 Study of the Markets :

Study of the markets is important for two reasons : number one, it provides an idea about the type of commodities being sold and purchase;

number two, it provides a benchmark to the growers for the futurer development prospect. The WUAs' should have a first hand knowledge about it for the benefit of the farmers. We have during our field survey collected following information which may be expanded and updated by the WUAs' and other concerned for future use. Such information always require an updating from time to time. We summarize our information as follows:

Table 4.2
Threshold Markets of the Sample VDCs'

VDC	Ward No.	Place	Tube Well No.	Name of the Market	Distance in km.
1. Anandban	3	Bihana	W.4.E	Suryapura	2
	8	Pahuni	W.15.E	Kathuwa	1
2. Madhwalia	7	Behuli	W.28	Kusum	1.5
	8	Chamkipur	W.65	Chamkipur	½
3. Dayanagar	6	Ramgunj	W.48	Ramgunj Bazar	1
	8	Dayanagar	W.51	Devisthan	1.5
4. Khudabagar	2	Ahirauli	J.W.10 N	Paroha	2
	5	Bhagatpur	J.W.10 N	Guniya	2
5. Kerwari	3	Dhekawar	E.W.01	Birtabazar	½
	4	Petbaniya	E.W.02	Manigram	½
6. Mainhiya	1	Gadsari	CWW.15	Mainhiya	1
	4	Subhsemra	CWW.22	Khudipur	2

Source: Field Survey, May 2000.

4.2.2.4.4 Study of the Geo-Physical Situation of the District :

The WUAs' need to have a complete information about the opennes of the southern border and the competitiveness of the identical products (prices) which might have distorted the district market in last few years. Actually, this study is needed to be tied with the market study. To understand the situation the WUAs' require a grater support from DDC, ADO and Bhairhawa custom office located in Sunauli.

Similarly, support service on situation analysis may be obtained from Nepal Rastra Bank (NRB), Bhairahawa. Their role would be supply whole sale and retail prices of various agricultural commodities on monthly basis and a simple forecast on commodity demand and likely change in prices overtime. These information would gratly help the BLGWIP farmers and also sample VDCs'. The WUAs' are needed to maintain a record to brief each and every VDC on demand.

Since, geophysical condition and the openness of the border cannot be altered, the sample VDCs' would require a consistent guidelines to maintain farm to market supply framework. At this point the service centre is needed to play its role by holding inputs prices as stable as possible. For this, the intersectoral support of all concerned line agencies are important. The BLGWP and DDC should have an extensive homework to implement this program and the WUAs' need to be made an important party in this.

4.2.3.4.5 Study of Complementarity Within the Sectoral Development Programs :

The major objective of complementarity under the irrigation program is producer's surplus. This is integral to the margin of profit per household and social welfare. There are other aspects as well, which are outside the purview of the present study.

The WUAs however cannot make a broad survey to study complementarity but they can atleast visualize as to how far has the timely availability of irrigation water could change the household status in a given time. On the other hand, they can as well underscore the benefits due to other programs financed by different government ministries, departments and projects in the Rupandehi district and more specifically, in the project (BLGWIP) influence area.)

This collection of information is important for the sample VDCs. Additionally, these information would lead the WUAs for the systematic policy development in future. Aside the role of the WUAs, there exists a greater role of the DDC and also Nepal Rastra Bank, who generally prepares the development indicators and provides explanation for the policy guidelines.

4.2.3.4.6. Assessment of the VDCs' Contribution in Crop Commercialization Process :

This can be executed by the WUAs' by comparing past and current information. This is a kind of performance evaluation which will benefit the sample VDCs for the future development. For this, assistance may be drawn from BLGWIP, ADB/N and Nepal Rastra Bank office. The ADO/office is needed to be involved as well.

4.2.3.4.7. Assessment of the Support Programs :

Under the above, the WUAs' are required to assess their own performance and those of others in the wake of irrigation development, are coverage under irrigated crops, production difference and inputs use pattern. ADOs' support and that of ADB/N is greatly required to assess the agricultural development programs.

On the road network side, assessment is needed to be made on average traffic by the roads connected to the sample VDCs'. Similarly, an assessment of the other sectoral programs need to be made to see their impact on the VDCs' and vice versa . The support of DDC in this respect is greatly required.

4.3 Current Status of WUAs' in the Sample VDCs' :

In the proceeding section under various subheads, we discussed a detailed framework which may be replicated by WUAs' in association of the line agencies to address systems and water delivery vis a vis the agricultural development in sample VDCs' in immediate future. In what follows here under,we wish to present the current scenario as witnessed during the field visit.

4.3.1 Users Committees and Organizations :

We had during the field visit met 9 users committee members and many local villagers. During detailed discussion with user committee members and the villagers following findings emerged :

4.3.1.1 Legal Status:

The users committees have problem in exercising their power on water delivery and maintenance of the system. This is because they do not have legal status and necessary empowerment. While according to the decentralization policy (1992), they are the legal body at the village level but they do not own up any legal- power. This has curtailed their activities. Many irrigation related works are being executed on the basis of mutual understanding.

Next, their domain of work is not clear. At times they are as much responsible for DOI as they would be for BLGWIP. But they are not in a position to thrust on them any genuine demand on behalf of the VDCs'. From this point of view they are only liaison without any real authority.

4.3.1.2 Charter :

The charter of the users committee is open in character and it does not specify duties and modalities specifically. The major duties involve are member fees, power tariff and advance collection from beneficiary farmers.

4.3.1.3 Strength :

The users committee is an elected body. This is their greatest strength. Being popularly elected by the VDCs, the members of the users committee maintain a very rapport with different polities at the local level and they usually have access to financial, accounting and audit related decisions.

4.3.1.4 Weakness :

Despite an elected body, the users committee is not empowered by the decentralization act in local level decision making. The committee cannot thrust upon local level institutions such as DOI, BLGWIP, ADB/N, AIC, NRB etc, to mandatory help in irrigation management and development. However, they may obtain a moral support on few occasions only; but this is not guranteed.

4.3.1.5 Composition :

The composition of the users commitees in six sample VDCs is presented below in table number.

Table 4.3
Composition of the Users Committeess

VDC	Tube well No.	No. of office Bearers	No. of Members From the Beneficiaries	Remarks
1. Anandban	W.4.E	7	12	Registration
	W.15 E.	5	9	In process
2. Madhwalia	W.28	9	24	Registration
	W.65	8	17	In process
3. Dayanagar	W.48	9	19	Registration
	W.51	6	8	In process
4. Khudabagar	T.W.7.N.	7	9	Registration
	T.W.10.N.	7	11	Materialized
5 Kerwani	E.W.01	11	46	Registered
	E.W.02	11	37	In 1995
6 Mainhiya	CWW.15	5	4	Not registered
	CWW.22	3	7	

Source : Field Survey, May, 2000

CHAPTER V

ISSUES, STRENGTHS AND WEAKNESSES

5.1 Issues :

On the basis of field discussion, household survey, RRA and key in formats outlook, we have broadly classified issues identified at the sample VDCs in relation to BLGWIP-irrigation development. These are summarized as follows.

1. Technical
2. Managerial
3. Behavioral
4. Institutional, and

4.1.1 Technical Issues :

The technical issues in the BLGWIP Comprise :

1) Installation and lay-out defects in the systems
2) Lack of technical (system's operation) follow up
3) Lack of training and transfer of knowledge
4) Lack of major maintenance provisions
5) Lack of availability of the spare parts
6) Lack of equipment support
7) Lack of information sharing between VDCs and BLGWIP, and
8) Lack of collective responsibility.

The issues are elucidated as under:

1) Installation and Lay out Defects in the Systems :

There was an absorbing discussion at the sample VDCs with households, and key informants. In addition, there was a rapid rural appraisal survey conducted in 3 of the six VDCs to finding out the key issues.

It has been unanimously said by the farmers (sample H.H.), key informants and those covered under the Rapid Rural Appraisal (RRA) that installation of irrigation systems have been problematic in 4 of the 12 systems visited by the research team. The problematic systems are:

1) Dayanagar, System, No. W. 51
2) Khudabagar, System, No. T.W. 10. N
3) Khudabagar, System, No. T.W. 7.N., and,
4) Mainhiya, System, No. CWW22

In system no W.51 in Dayanagar VDC the machine platform is oval rather than flat. Additionally, it is being placed on height has unduly affected loop no. 3 and 4. The water discharge in loop no. 3 is very low while in loop no. 4, the leakage of water is observable.

In Khudabagar VDC, both systems, Viz, T.W.10. N and T.W.7.N., the rig has leakage during pump operation. Due to this the water discharge per second is low around 20% per operation. The low discharge has affected mostly the tail farmers during summer.

In Mainhiya VDC, the system no. CWW.22 is placed on height and that the loop no. 4 is defective. Water discharge from loop no. 4 is low due to unevenness of the pipe attached to the system and the loop 4 self, which is very low at the end surface. This actually needs animmediate repair along with other systems to which is mentioned is above.

2) Lack of Technical Follow up of the Systems :

In almost all sample VDCs', there is a common complaint that the responsible party (BGWIP) did not contact the WUAs as part of a follow up; which is their implicit duty. After the system's installation, the BLGWIP experts as well as the contractors hardly had visits to the VDCS' and the complaints made by the users were overlooked.

3) **Lack of Training and Transfer of Knowledge :**

Apart from one training (of 6 days) during the middle of 1998 in Kerwani VDC (Manigram); training in other VDCs was never conducted. In Kerwani VDC, the pump operator was overly trained which was said to be insufficient.

4) **Lack of Major Maintenance Provisions :**

Defect in transformer, grid connection, panel board, switch gear, input and output valbs, loops and rig joints are generally considered as major maintenance problems in power driven irrigation system. To set right such defects, the trained mechanics in Rupandehi district is not easily available. Even the replacement parts are not available. The farmers of the sample VDCs feel that the DOI and BLGWIP should provide these services to the sample VDCs and also to the project area on demand.

5) **Lack of Availability of the Spare Parts :**

Many important spare parts of the motor and pump of irrigation system are not locally available. Some time one has to go to Calcutta in India to purchase the replaceable part, which is a costly affair for the VDCs.

6) **Lack of Equipment Support:**

The sample VDCs have not received any equipment support from the BLGWIP during turning over of the system.

7) **Lack of Information Sharing Between VDCs and BLGWIP:**

The sample farmers and those covered under the RRA said that there had been a lack in information sharing between the sample VDCs and the BLGWIP.

8) Lack of Collective Responsibility :

The sample farmers and RRA respondents were of the opinion that BLGWIP did not feel, it obligatory to help farmers by bringing them closer to a joint venture in operation and maintenance, in providing exposure through training or by any other appropriate means.

5.1.2 Managerial Issues :

Managerial issue entails cost effective operation of the system which is greatly affected by the high cost per unit of power (Rs. 4), non availability of support services and disintegration of the institutional program.

5.1.3 Behavioural Issues :

It is recognized during the social investigation that many farmers have been modest due to their nature and they generally do not feel important to place their demand or interact with others to secure their legitimate right. Their confidence level is low. Women do not generally participate in the vi-llage level meetings.

5.1.4 Institutional Issues:

We have in this study talked at length about the institutional problems elsewhere. We have also touched upon this issue while taking about the development complementarities. Actually, this issue is not as easy as it appears to be. To solve the institutional problems related to deep tube well irrigation in the sample VDCs, all related line agencies, NGOs' and others have to widely discuss on the sustainability of the irrigation system as a whole. The HMG needs to evolve a policy-framework to subsist with agricultural development program in a wider perspective.

5.2 Strenthes :

Irrigation sector of Nepal is highly equipped with technically qualified manpower, requisite equipments and adequate logistic support. The shallow tube wells have also provided enough experience in the ground water development.

5.3 Weaknesses :

Weakness in the irrigation development involves a) lack of inter sectoral complemntarity, b) Lack of improved market arrangements c) inadequate support programs and d) lack of reinvestible capacity.

To overcome the above shortcomings, the irrigation sector in general and ground water sector in particular shall have to be properly addressed by the government through workable/complementary plans and programs in immediate future.

5.4 What Need to Be Done :

The most important in this connection is to develop an irrigation culture in the sample VDCs. This can not be promoted independently by the VDCs' alone. The responsible institutions and local NGOs' working at the district level must cooperate as an inter disciplinary team to work together with local farmers and WUAs'.

Secondly, we must also understand that an irrigation system (DTW) is a dynamic object located in an area and its' development and sustainability are closely linked with only productive activities. This immediately calls for to develop both short and long term operational (implementable) programs with the conformity of the system. At this point, the concerned party (BLGWIP/WUAs' and other institutions) is needed to bring out a phase wise agricultural plan to subsist with district and regional complementarities. We must remind ourselves that unless the commplementarities are interlinked and sustained within a group effort (of the responsible parties), the true benefit of the system cannot be obtained, no matter what level of investment is plughed in to the system.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

5.2 Conclusions :

Bhairahawa-Lumbini Ground Water Irrigation Project (BLGWIP), located in the Rupandehi district of western Terai, Nepal is a largest irrigation project of it's kind in Nepal. In its 3 stages of development and implementation, spanning a time frame of almost 20 years, the BLGWIP has covered 36 VDCs' out of 69 VDCs' of the

Rupandehi district. During the process it has covered command area of 20,309 hectares. The name of the benefited VDCs' is summarized in table 6.1 below.

Table 6.1

VDCs Benefited by Bhairahawa-Lumbini Ground Water Irrigation Project :

Stage	Name of the VDC	Total
I	Makrahar, Karahiya, Gangolia, Anand Ban, Motipur, Pharsatikar, Madwaliya, Amuwa, Tikuligarh, Man Pokadi, Manmateria, Dayanagar	12
II	Sakron Pakadi, Khudabagar, Kamahriya, Bishnupura, Akala, Bargadwa, Sauraha, Pharsatikar, Madhubani, Jogada, Sameri Ghonha, Sipwa	12
III	Sadi, Jogda, Mainhiya, Harniya, Haatibangai, Pharsatikar, Dhakdhai, Patkhauli, Sikthan, Chipagarh, Chotki Ramnagar, Kerwani.	12
Total		36

Source : Bhairahawa-Lumbini Ground Water Irrigation Project, 1999.

6.1.1 Low Capacity Utilization :

In sample VDCs' some problems related to low capacity utilization is also witnessed. This is summarized as under in table 6.2.

Table 6.2
Low Capacity Utilization Identified in the Sample VDCs'

Problem Area	Anand ban	Madh walia	Daya Nagar	Khuda bagar	Kerwani	Mainhiya
Tube	W4-E	W-28	W-48	T.W.7.N	E.W.01	CWW.15
Well No.	W.15E	W.65	W.51	T.W.10.N	E.W.02	CWW.22
1. Technical	1.1 Voltage fluctuation	1.5 Loop defect	1.8 Loop defect	1.11 Power shortage	1.14 High tarrif	1.18 Theft of transformer
	1.2 Load sheding	1.6 Load sheding	1.9 30% Power	1.12 Defective transformer	1.15 BLGWIP not capable	1.19Defect in structure
	1.3 Low discharge	1.7 Defect in structure	1.10 Maintenance problem	1.13 Machine breakdown	1.16High tarrif 1.17 BLGWIP not capable	1.20Theft of Transformer 1.21 Defect in structure
	1.4 Low discharge					
2.Economic	2.1 No price incentive 2.2. High prod cost 2.3. Limited market	2.4 Land Productivity is low (149) 2.5. Cost of prod is high 2.6. Inputs are costly (15% more than 1998)	2.7.Agri Package Program is ineffective 2.8. Service Centre dies not benefit farmers	2.9 Large Farmers do not utilize land to its capacity 2.10. water Avail ability in tail regions is assured	2.10 Conventional agriculture is not profitable and vegetable farming produced loss due to open border.	2.11 VDC expects extension support which is non existent
3. Institutional	3.3 The WUGs' in the VDC are less effective in the wake of technical problems faced by VDC in water delivery	3.4 WUGs' have a very less say in water utilization. The BLGWIP predominate seven to date.	3.5 The turnover of the system was atrandum. There were no trainings offered hence WUG'S face number of problems.	3.6 WUG's are effective but there is no coordination from the govt. agencies.	3.7 Presently WUG's are not effective	

6.1.2 Operational and Technical Problems :

The operational and technical problems faced by the sample VDCs' are summariged in table 6.3 below.

Table 6.3
System Based Problem in
Bhairahawa-Lumbini Ground Water Irrigation Project

VDC	System Based	Operational	Technical	Others
1. Anandban	1) Command area declined	1) Maintenance problem is ever continued	1) Acute power fluctuation during irrigation period is recognized	1) 46 members and 35 users
	2) System maintained by WUGs	2) The canal is damaged at several places at present	2) The power charge is high	2) Membership fee Rs. 10 per month per person. Electricity cost for members is Rs. 4 and for others it is Rs. 10 per unit.
		3) There is a natural compaction of the surface causing problem in water delivery	3) Like people's participation at the VDC level, the government is also required to contribute to support O' and M' of the system.	3) A person can use 10 units of power at a time.

		4) The tail search of the system experienced a low water availability during summer.		
2. Madhwalia	1) Demand charge of Rs. 1078 per month is very high, hence the DOI and BLGWIP should subsidize such cost to a minimum.	1) Improved seeds and other agricultural inputs are not timely available. At times, there occurs a significant up ward change in their prices. Such a change in price is generally illogical, hence, price monitoring and distribution of inputs need to be assured.	1) Repair of transformers and other mechanical units are generally very costly, hence these have to be maintained by the government and not by farmers	
	2) The system design is defective. The placement of the machine has been done on the ebb of the low land. Actually,	2) During the "turn over" of the system in 1996, the machine operator was trained for only 6 days, while the	2) The technical sustainability of the system depends on technical management efficiency. At present, this aspect is very weak in the	

	this should have been on the high land area. The wrong placement of the machine has affected the water discharge in the summer and promoted water logging in rainy season.	users were not trained at all. This caused a considerable problem in system's operational management.	VDC.	
			3) The ADO has not conveived any "Crop to Water" management program at the VDC level.	
1) Dayanagar	1) The additional machine is needed to be installed to cover remaining command/ irigable area in immediate future.		1) If the power is not used in that case the "demand cost" charged as advance need be returned to the users.	
2) Khudabagar	1) The contractors have not laid the underground water discharge and channel delivery pipe from the point	1) The power system managemen t is poor. 2) The operational demand charge need	1) The current machine used to draw water out of ground is of 63 KVA, while, the actual power machine	1) Theft is a problem not sorted out. The farmers usually have a power cut problem during water

	of origin of the system to the field channel of the farmers. This has not only retarded the water delivery but also has evolved water logging and enundation problems in and around the system's influence area. For syphoning off the Water logging and to resume the water delivery the farmers of Tikaligorh have been incurring unnecessary expenditures. 2)The design of the system is defective. It is actually installed in oval shap conthe low land, which has a negative impact on the water discharge. 3) The average cost of irrigation water is high	to be reduced. 3) Power fluctuation is a problem. 4. The system was operational in 1982 and was turned over to Ugs' in 1996. 5) Out of 200 ha. of cultivated land, the irrigation facility is available in only 129 hectares at present. 6.The system was turned over in most inappropriate way. 7.The demand costly. This actually needs be subsidized. 8. System operation training is not provided to the system operator. 9. There needs to "Joint Operation " in system management.	required is of 100 KVA or of higher capacity. This has caused a considerable technical problem in system operation at present. 2) There is a technical defect in the discharge loop of the machine which is not corrected till this day. And also, there does not exist uniformity in water discharge from all four loops existing. 3) Responsibility in electrical maintenance, such as of transformer etc, has yet to be identitied The command area is not appropriately demarketed,	demand forirrigation. The system was turned over to the WUGs' in 1999 without appropriate procedures being fulfilled. 2) The panel board of the system is being locked and controlled by BLGWIP despite its' turning over. 3) Water gate management is inappropriate

	due to which the farmers are not attracted very much to winter cropping	The government is needed to take part with users in all 'O and M' efforts.		

Other Common/Problems :

VDC-Kerwani

(1) That in India per unit ground water irrigation (power) cost is only 0.55, where as in sample VDCs, the unit cost (power) is RS. 4.00. Further, after 100 unit power use an additional unit would cost a 3% increase in total cost, which is quite discouraging to the participating farmers.

(2) Rs.200 per Bigha an advance is charged.

2.1 One loop is washed away during flood and is not repaired

2.2 The unit cost need to be reduced from Rs. 4.00/ to Rs. 1.00 only.

2.3 Water discharge to all field channel is unequal.

2.4 The D loop is placed on a height which has resulted in to a low discharge of water from the system

2.5 Cost per hour of one loop is Rs.35/ it is recognized during field survey that even if only one loop is used the farmers are required to pay for other three loops also which is not justified.

2.6 The farmers reiterated that there does not exist a separate water discharge mechanism for each individual loop. For instance, if one loop is opened the water out flow takes place in other three loops also, whose water may not be used at that time. That caused the waste of water. The farmers however suggested that such a waste of water may be controlled by placing a large diameter structure to collect water for later use. For making such structure the farmers are ready to bear the cost.

6.2. Recommendations :

6.2.1. The Irrigation Status in the BLGWIP and Sample VDCs :

There are at least four aspects to which the ground water project attempts to touch upon. These are :

- Agricultural development through production increase by increased irrigated land coverge.
- Gradual change in production structure through technology and knowledge transfer to generate a competitive scale of economy to withstand sustainable development in agriculture sector, overtime, and generate subsidiary means of development in other sectors of the regional economy.
- Social and economic change by availing livelihood to landless and marginal land holders by creating production conditions to help eliminate rural and urban poverty.
- Reduce gender disparity by availing productive circumstance to promote employment, income, consumption and reinvestment in agricultural and industrial sectors. In addition, the motive of BLGWIP has also been to promote private sector management in irrigation through group initiatives and participatory mangement for the up coming future. The groundwater project, in order to attain a full-benefit requires a complementary agricultural development program, which is lacking at present. While, the ADO has some package out fits these are not integrated both socially and also activity wise. These packages are conventional and do not address the crop diversification needs of the BLGWIP and the sample VDCs.
- The ground water project actually needs to evolve a self priming sustainability by integrating production and inputs through government policy, regulations and participatory support. This needs a comprehensive exercise from wi-thin, which is lacking at present.
- The DDC and VDCs' need to have a corroborative action to support user groups, impoverished people, women and those living below poverty line by providing access in groundwater support services, such as, in maintenance, up keep of the systems and awareness programs to crate a mass in irrigation development. Only if the attitude could be changed that a pressure groups could be formed to address the sustainability of the

groundwater systems. Presently it is lacking in the BLGWIP and also in the sample VDCs.

6.2.2. Support Service Development :

In chapter three, four and five we have provided special emphasis to irrigation support services required by the sample VDCs' by strengthening WUAs' and through institutional participation from other sectors. We have as well placed on record the importance of the DOI and BLGWIP in the process of irrigation development and maintenance of the systems. We wish that government provides a due attention to it in immediate future.

6.2.3. Complementarity, Integration and Resource use :

6.2.3.1 Complementarity :

By comprementarity, we wish to express a comprehensive program leading to crop, land and irrigation (combination) development. This needs to be a dynamic process to be monitored by season by an interdisciplinary team of experts from NPCS. How to develop such a complementarity in the project area is the responsibility of the DOI, MOA, BLGWIP in support of other related agencies like ADB/N, AIC and even private sector financial institutions including the Grameen Bank. The complementarity in production be broken down into (a) land production , (b) land utilization, (c) productivity (d) cropping intensity and (e) irrigation potentiality in the command area. Actually this needs a master plan approach for the BLGWIP.

On the other hand, the resource use pattern is needed to be assessed on the periodic basis by considering operation and maintenance, revenue generation and revenue utilization pattern.

6.2.3.2. Infrastructure Development in BLGWIP and Sample VDCS :

This should include access development like gravel road made by the BLGWIP, the district road development as conceived by the DDC under the DTMP and other rural roads, which may directly facilitate the irrigation programs. The objective of this approach is to restrengthen the " farm to market " concept as amplified by the DPP in its study, no tangible

work has so far been done in this regard in the Rupandehi district as well as in the sample VDCs'.

Apart from roads and access development the power generation and power supply situation needs a great deal of effort from HMG. The pricing policy of power supply has to be revised in the BLGWIP in the wake of people's demand in immediate future.

6.2.3.3. Market Development :

Product market development is highly desirable in the district as well asoutside the district. Similarly, a product transfer mechanism need be promoted through the private sector involvement, where participatory approach can play a very important role.

6.2.3.4 Project Potentiality :

BLGWIP has in sample project area generated a favourable atmosphere. As already pointed out, if the existing favourable conditions could be tapped there exists a bright future for the BLGWIP in the sample area.

6.2.3.5 Status of Road and Infra Structural Services :

272 km. road made by BLGWIP needs maintenance. The DDC has not taken over this road from the BLGWIP as yet.

6.2.3.6 NGO Activity :

NGO activity in the sample VDCs' is very limited. The local NGOs' are in search of operating budget from other sources. These NGOs' are not integrated and have not developed any action plan for cooperation at the VDC level.

ANNEX

Annex-1

[A]

Bhairahawa Lumbini Ground Water Project

Household Survey Questionnaire

I. [I] Household Information :

1.1 Name of the Repondent : .....

1.2 Rupandehi District .....

1.3 Ward No. .....

1.4 Family Size .....

2. **Land Wonership/**Land use :

		Before Project	After Project
2.1	Total owned Land/Bigha	.....	.....
2.2	Irrigated Land	.....	.....
2.3	Unirrigated Land	.....	.....

3. Household Employment Status :	Before Project/ in Days	After Project/ in Days
3.1 Number of days worked in own Farm/Land		
3.2 Off-farm working days		
3.3 Average Worked days (annum)		
Total :		

[II] BLGWP – System Information :

3.7 Type of Ground Water System : Tube well

yes [ ] No [ ]

3.7.1 If no then describe the type .....

3.7.2 Tube-well ownership pattern (if 3.7.1 applies) .....

3.8 Deep tube-well capacity in L.P.S. .....

3.8.1 Prime Over Capacity in H.P. .....

3.8.2 When Installed ? (Year) .....

3.9 Total Project Cost (Rs.) .....

3.9.1 How is cost sharing executed ?

3.9.1.1 Type of cost sharing :

a) Water tax (Rs.) Per Season/Rs. Per crop/Rs.

b) Any other type (Rs.) Describe : .....

3.9.1.2 Who collects the tax ?

a) User group Yes [ ] No [ ]

b) Any other mechanism Describe .....

3.10 Existing Condition Tube-well

Operational/Semi operational/Non operational

[ ] [ ] [ ]

3.10.1 Pump Operation in Tours/Annum :

Month	Crops/Tours					Others
	Paddy	Wheat	Sugar cane	Vegetables	Lentila	
Ashad						
Shrawan						
Bhadra						
Ashwin						
Kartik						
Marga						
Paush						
Magh						
Falgun						
Chaitra						
Baisakh						
Jestha						

3.10.2 Do you sell water ? Yes [ ] No [ ] Income/Rs.

3.10.2 Cost of Pump operation :

a) fuel/Rs/hrs.

b) repail and maintenance/Rs.

c) salary of the operator/Rs./month

4.1 Benefits Received :

S.N.	Food Sufficiency	Before Project/kg.	After Project/kg.
1.	Marked Surplus		
2.	Enough for H.H. Consumption		
3.	Available for 9 month		
4.	Available for 6 month		
5.	Available for 3 months		
6.	Not enough for H.H.		

4.1.2 Do you produce more vegetables than before ? Yes [ ] No [ ] %

4.1.3 Do your food consumption at H.H. changed than before Yes [ ] No [ ] %

4.1.4 Do your food consumption at H.H. changed than before Yes [ ] No [ ] %

4.1.5 Do your income increased than before Yes [ ] No [ ] %

4.1.6 Do you have more gainful employment in agriculture Yes [ ] No [ ] %

4.2 Change in H.H. Income :

S.N	Source	Before Project/Rs.	After Project/Rs	% / Rs.
1.	Farm based			
2.	Off farm			
	Total			

4.2.1 Change in H.H. Expenditure Pattern :

S.N.	Exp. Item	Before Project/Rs.	After Project/Rs.	%/Rs.
1.	Clothes			
2.	Festivals			
3.	Schooling			
4.	Health Care			
5.	Others			
	Total :			

5. IV Institutional and Social Aspects :

5.1 Are you a member of Water User Association (WUA) ?

5.2 List out the function of this association

-

-

5.3 Is there any conflict in using ground water ? Yes/No

5.4 What is the basis for using this community GW system ?

5.5 Are you satisfied with the performances of the WUA ? Yes/No

5.6 Do you use the water of this system for other Household purposes ?

If yes, what are the direct effects to women in work allocation and time saving ?

-

-

5.7 What are the Environmental effects of this GW Scheme ?

Positive

Negative

5.8 Have you received any training in the following aspects ?

O & M	Yes/No
Agriculture Production	Yes/No
Others (specify)	

5.9 In what ways are the training useful to you ?

6. V Overall Perception of Respondent

6.1	Level of family Income	Increased/Decreased/Same
6.2	Level of Living Condition	Increased/Decreased/Same
6.3	Quality of the GW System	Excellent/Good/Bad
6.4	Services of the Financial Institutions	Excellent/Good/Poor
6.5	Support from the DOI	Excellent/Good/Poor
6.6	Quality of Agriculture Extension Services	Excellent/Good/Poor
6.7	Repair and Maintenance Facility	Excellent/Good/Bad
6.8	Level of Water Discharge Over Year	Increased/Decreased Same

Annex-2

[B]

Bhairahawa – Lumbini Ground Water Project Study

QUESTIONNAIRE ON TECHINICAL ASPECTS OF BLGWP

1. Respondent

Name:	District	VDC	Ward No.
Project site	Rupandehi		

2. Installation

2.1	Year of Installation	
2.2.	Drilling Technology:	Rig Machine/Manual Rotary/Bogi/Thokuwa/Sludge
2.3	Time taken for Installation	Days
2.4	Number of Manpower used	Person per day
	Total cost of Installation :	Rs.:

3. Design

3.1	Casing Pipe	Type :	Length (m)
3.2	Screen	Type:	Length (m)
3.3	Gravel Packing	Yes/No	
3.4	Water Lifting Device Used		Type : Diesel/Electric/Gasoline
			HP/kW:
3.5	Conveyance System	Canal : Lined/Earthen	
		Piped :	

4. Well Specification

4.1	Depth (m)		
4.2	Static water level (m)		
4.3	Aquifer	Type:	Thickness (m)

4.4 Discharge (LPS)

Winter/LPS

Summer/LPS

4.5 Have you ever noticed shortage of water in your system ? Yes/No

4.6 Which Season ? Summer/Winter

4.7 How many months ?

4.8 For how many hours, does the pump can work in full capacity ?

5. Operation and Maintenance

5.1 Ownership type Individual/Community

5.2 Who operates the tubewell ? Owner/himself/Operator

5.3 Technical Know-how to the Operator Enough/Insufficient

5.4 Operating Hours (Hours/year) Own

Rented out

5.5 Repair & Maintenance Facilities Available/Not available

5.6 Repair and Maintenance Cost

(RS/annum) .....

5.7 Servicing Once a year/Twice a year/None

5.8 Total Cost of Operation

5.8.1 Fuel Consumption (LPH)

5.8.2 Cost per Liter or per unit (RS)

5.8.3 Remuneration to Operator if hired (RS/year)

5.8.4 Problems of Repair Maintenance : Describe

1.

2.

3.

4.

6. Tubewell Utilization

6.1 Area Covered (bigha) Owned area: Bigha Service (rent) area Total area

6.2 Income per hour from rent out (RS)

6.3 Utilization Rate : (hour required to irrigate one Bigha)

7. Replacement/Rehabilitation

7.1 Have you replaced the Tube well or the pump of the Tubewell ?

Pumpset [ ] Both [ ] None [ ]

7.2 If yes. Year of replacement

7.3 Cost of Replacement (RS)

7.4 Have you rehabilitated the tubewell ? Yes/No

7.5 If yes, type of rehabilitation Flushing/Chemical treatment/Surging/Others

7.6 Frequency of rehabilitation (times) .....

7.7 Cost of rehabilitation (RS)

8. Efficiency of Irrigation Structures (by observation/discussion)

8.1 Condition of Structure:

Tubewell/Machine

8.2 Canal

8.3 Ditches

8.4 Water Loss during delivery : Very high/high/Negligiable

9. Designed and Actual Discharge and Command Area

	Designed	Actual
9.1 Discharge		
9.2 Command Area		

10. Reasons of Low Utilization of this GW scheme ?

10.1

10.2

10.3

11. General Comment and Remarks of the Enumerator about the GW Scheme.

Annex-3

|C|

CHECKLISTS FOR KEY INFORMANTS

(to be administered to DOI/ADBN and other related agencies)

VI. General Information

6.1 Name and Designation of the Respondent

6.2 Organization

6.3 Years of Involvement in the program in the study area

VII GW System Related Information

6.4 Total Agricultural Area of the district : Bigha/Hectare

6.5 Total area covered by different Irrigation systems in the district

Irrigation System	Agencies Involved											
	No.of Schemes	Area Covered (bigha)	Beneficiary HHs	No.of Schemes	Area Covered (bigha)	Beneficiary HHs	No.of Schemes	Area Covered (bigha)	Beneficiary HHs	No.of Schemes	Area Covered (bigha)	Beneficiary HHs
STW												
MTW												
DTW												
DUGWELL												
ARTESIAN												
ROWER												
TREADLE												
OTHERS												
TOTAL												

6.5.1 Total GW potential in the district

Total potential

Used

Unused

6.6 GW Recharge areas and amount of recharge per year/unit area

6.7 Average depth of well (m)

6.8 Popular pump brands

6.9 Type and capacity of pumps commonly used :

Type : Kerosene/Petrol/Diesel/Electrical

Capacity : 7 HP/SHP/3HP/2HP/Rower/Treadle

6.10 Common Drilling Technology Used in the area

6.11 Common Aquifer Type and thickness

6.12 Availability of spare parts and quality of Repair and Maintenance Facilities in the area.

6.13 Effectiveness of WUA in water sharing and management

6.14 List problems of institutionalizing WUA

6.15 List the strengths and weaknesses of various of implementation of various GW schemes by various agencies.

Agencies	Strengths	Weakness
ADBN		
GWRDB		
SIRDP		
ILC		
IFAD		
JADP		
INGO/NGO		
OTHERS		

6.16 How do you implement irrigation programs in your area ?

6.17 Who are the players and their role ?

6.18 What are the reasons for Low Utilization rate of the GW Schemes ?

6.19 Are you satisfied with existing Coordination situation ? Yes/No

6.20 What should be done to improve it ?

6.21 List Major problems associated with program implementation.

6.22 What should be done to exploit GW potential in Rupandehi District.

Annex-4

[D]

Rapid Rural Appraisal (RRA)

Checklist

Bhairahawa – Lumbini Ground Water Irrigation Project

(BLGWIP)

1. Description of the System :

1.1 Physical System

1.2 Hydrology

1.3 Irrigated Area ha.

2. Operation and Maintenance :

2.1 Activity

2.2 Problem

2.3 Water Distribution Frequency

2.4 Routine Maintenance Time

2.5 Emergency Maintenance When

3. Institutions :

3.1 Who operates/maintains the ground water system ? WUA Yes [ ] No [ ]

Others Yes [ ] No [ ]

3.2 Organizational setup

Name

Membership

4 Conflict and Conflict Resolution

4.1	Conflicts. How is this resolved ?	Description	
4.2	Do you have water right problem by head, middle and tail ?	Yes ☐	No ☐
4.3	Type of Problem	Describe	
4.4	How is water allocation done ?	Describe	
4.5	How is the costs managed ?	Describe	
4.6	Resource Mobilization Pattern	Household/ Membership	Yes ☐ No ☐
		VDC	Yes ☐ No ☐
		Other source/ Describe	

REFERENCES :

1. Study of Effectiveness of Investment In Ground Water Development, July, 1997.

2. Effectiveness of Investment in Baghmati Watershed Project, February, 1999

3. Monitoring and Evaluation of Community based Irrigation Development; Nepal SPWP, Report M.10.

4. Pilot-Labour-based District Roads Rehabilitation and Maintenance Project, UNDP, Helvetas and the World Bank; 1997.

5. Statistical Information on Nepalese Agriculture, HMG, Ministry of Agri-culture, ASD, Singh Durbar, Katmandu, 1998-1999.

6. Diagnostic Analysis of Irrigation Systems, Vol. I, Concepts and Methodology, Water Management Synthesis Project, University Service Centre, Colorado State University, Fort Collins, Colorado, December, 1983.

7. District of Nepal, Indicators of Development, International Centre for Integrated Mountain Development, Katmandu, Nepal, 1997.

8. Compounding and Discounting Tables for Project Analysis. Series in Economic Development, EDI the World Bank, 1992.

9. Report on the Nepal – Labour Force Survey CBS, NPC; Katmandu, 1998-1999.

10. Bhairahawa-Lumbini Ground Water Irrigation Project, credit – 2144-NEP, Project Completion Report (PCR), TAHAL CONSULTING Engineers. Ltd; June, 1999.

11. Institutional Development Support Component, Bhairahawa-Lumbini Ground Water III-Project, IDA-Credit, No., 2144-NEP, Data Base for Irrigation Development, HMG, June, 1997.

12. Assistance in the Establishment of Design Cri-teria and Manuals for Irrigation Projects in Nepal (Sociology and Farmer Participation) Draft; Siz M. Macdonald and Partners Ltd. In association of Macdonald Agricultural Services Ltd. And East Consult (P.) Ltd, December 1988.

13. Bhairahawas-Lumbini-Ground Water Irrigation Project_III, Credit no. 2144 NEP, ICR, Report No. 19985, Rural Development Unit, Sourth Asia Regional Office, IDA-the World Bank; December 27, 1999.

14. Economic Analysis of Agricultural Projects EDI-Series in Economic Development, The Johns Hopkins University Press, Baltimore and London; 1987.

15. Participation, People Behind the Projects< IFAD, December 1999.

16. Emerging Issues in Asia and Social Cost Benefit Analysis, ADB, Report No. 41 Minala; 1998.

17. Nepal-Maintaining Structure Reforms and Managing Public Resources, Report No. 8352-NEP, 30 March 1990.

18. Analysis of Complementarities Amongst Irrigation and Fertilizer Projects Investment CEDA, 1982, Kirtipur, Katmandu.

19. Measuring the Indirect Effects of an Agricultural Investment Project, World Bank series no. 154, USA.

20. Policy Analysis for Agricultural Resource Management in Nepal; HMG, Winrock Int., Katmandu, July 1996.

21. Principles of Agricultural Economics, the IOWA Study Series/EO. Heady eds. 1969, IOWA, USA.

22. District Profile (Nepali) Rupandehi, Western Neopal, 2056.

23. Ground Water Development Committee, BKLGWIP, Sankshipt Bibaran (Nepali) 2056, Falgun.

24. Jilla Krishi Bikash Karyakram (Nepali); ADO, Rupandehi, 2056.

25. Jilla Krishi Bikash Karyakram (Nepali); ADO, Rupandehi, 2056.

26. District Irrigation Profile (Nepali), 2053, District Irrigation Office, Rupandehi.

27. Krishi Bulletin, Anka 3, 4, Paush/Magh, Magh/Falgun, 2056, Rupandehi-Western Nepal (Nepali-bulletin).

Mountain Districts
Hill Districts
Terai Districts