

Irrigation

1.0 Introduction

Nepal is a developing country with over 86 per cent of its population living in the rural areas. Agriculture forms the backbone of the Nepalese economy, contributing about 40 per cent to the gross domestic production. Over 80 per cent of the population directly or indirectly derives their livelihood from agriculture, and about 80 per cent of them are classified as subsistence farmers.

No other sector can engage the large section of population presently involved in agriculture for many years to come. National goal of reducing poverty in the country can be achieved only through the development of agriculture. Development of agriculture can alone influence positively the big chunk of population and so automatically eliminate the problem of distribution also. Presently, population involved in agriculture is employed for half of the year only due to unavailability of irrigation in most of the cultivated area throughout the year. Reduction of poverty is possible only if efforts are made towards providing full employment to the people depending on agriculture.

Development of agriculture is an effect of many inputs. Most vital among the inputs is irrigation. To minimize the effects of climatic condition of the country, provision of irrigation is needed. But the available water resource is also greatly influenced by the climate. The seasonal variation in the discharge of the rivers is more than fifty times and so irrigation systems developed so far are able to irrigate only 30 to 40% of the command area in winter season. Practically, very less command area can get irrigation in the spring season through these systems.

Full utilization of the available human resources involved in agriculture can accelerate the development of the country. To maximize the agricultural production, year round irrigation in the whole irrigable area of the country is the needful of the present. On this perspective, **objectives** of the irrigation sector can be summarized as follows:

- ?? Management of existing irrigation systems
- ?? Expansion of irrigation area
- ?? Expansion of year round irrigation area

This working paper summarizes the present status, the existing plan and policies, the issues and challenges for the future development in irrigation sector.

2. Plan, Policies and Strategy

His Majesty's Government of Nepal has brought out several plans, policies and strategies for the development of irrigation and thereby irrigated agriculture in the country. Of them the Agriculture Perspective Plan (APP), National Water Resources Strategy (NWRS), 10th Five Year Plan, Irrigation Policy (IP) and Irrigation Regulation are note worthy. Following paragraphs describes features of these plans and policies.

2.1 National Water Resource Strategy (NWRS)

In Nepal, the freshwater system is undergoing continuous natural changes in terms of quality, quantity and morphology. These changes are further accelerated due to increasing human exploitation of water resources caused by increasing population pressure demanding more water for several uses such as irrigation, drinking water, hydropower, and others. Growing concern for environmental degradation has further increased pressure on water resources. To cope up with such phenomenon and to manage country's water resources in a holistic approach, Nepal brought out its National Water Resources strategy (NWRS) in 2002.

NWRS has set the following short, medium and long term targets in the development of irrigation sector.

By 2007 (short term)

- ?? year round irrigation to 60% of irrigated land
- ?? 40% increase in average cereal yield in irrigated area
- ?? establishment of WUAs that are capable of managing irrigation systems up to 500 ha
- ?? an average cropping intensity that exceeds 200% in year round areas

By 2017 (medium term)

- ?? year round irrigation in two-thirds of the command area.
- ?? provision of irrigation systems to 80% of all irrigable land
- ?? 125% increase in average cereal yields in irrigated areas
- ?? an increase in the effective use of command area to 80%
- ?? an irrigation service contribution (ISC) by farmers that exceeds 20% of O&M cost
- ?? establishment of WUAs that are capable of managing irrigation systems up to 5,000 ha

By 2027 (long term)

- ?? provision of irrigation services to 90% of irrigable lands
- ?? an average cropping intensity that exceeds 250%
- ?? an increase in irrigation efficiency to 60%
- ?? an increase in the effective use of command area to 100%

In order to meet the above objectives, NWRS aims to adapt following strategies in irrigation sector.

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

2.2 Agriculture Perspective Plan (APP)

In 1995, the government unveiled a 20-year Agriculture Perspective Plan (APP). The main expectation of this APP is to accelerate Nepal's agricultural growth rate from 3 to 5 percent per annum. It considers irrigation as one of the prime inputs for agricultural development. Other priority inputs include agricultural road, power, technology, and fertilizer. For irrigation, APP emphasizes on the development of year round irrigation by improving the existing Farmer Managed Irrigation Systems (FMISs) and by expanding the installation of shallow tube wells, especially in the Terai.

The Agricultural Perspective Plan (1995) has proposed to irrigate 612,000 ha of Terai land by groundwater by the year 2015 AD, mainly through Shallow Tube Wells (STWs). The Plan envisages installing 176,000 new STWs, to bring a total of 223,300 STWs in operation; each irrigating 2.5 ha command area, at the end of the Plan period. The water balance study has shown that the available groundwater resource is adequate to support the proposed scale of groundwater irrigation development in the Terai.

Even today, the fundamental basis of the APP and its strategy for irrigation (emphasis on use of groundwater) has been reconfirmed, but some of the implementation actions (like market promotion, other support services and installation of shallow tube-wells) need revision. Although intensification of agricultural production using ground water appears to be financially viable, greater commercialization of agriculture products is needed to enhance farmer's investment on tube-wells. This requires an integrated approach to agriculture.

2.3 Tenth Five-Year Plan

As more than 80 percent of the country's population is engaged in agriculture, the Tenth Plan through its poverty reduction strategy targets to increase agricultural growth by about 4 to 5 percent. To achieve this target, the strategy focuses on: (i) increased investment from both the private and public sectors; (ii) streamlining the public expenditure in line with the APP investment plan; and (iii) improving the modality of implementation by emphasizing polycentric institutional arrangement¹. In order to achieve successful implementation of the APP, strong emphasis need to be laid on package program of fertilizer, irrigation, technology, rural agricultural roads, electricity and market access. The strategy and programs outlined in the tenth five-year development plan are as follows:

- ? Develop deep and shallow tube-wells with appropriate subsidy support in poverty-stricken areas and bring additional areas under irrigation through other irrigation schemes
- ? Increase water use efficiency in the irrigation system
- ? Emphasize the use of local manpower and inputs in the construction of medium and large irrigation systems
- ? Intensify water management activities

¹ Improved modality of implementation also means involvement of private sector and NGOs in the existing programs being implemented by the government.

Table 2.1: Physical Targets of Tenth Five Year Plan

Description	Targets (in ha)
A. Expansion of irrigation area	1,77,600
1. Department of Irrigation	1,29,600
?? Surface irrigation	(42,600)
?? Ground water (shallow tube wells 66,000 ha and deep tube wells 11,000 ha)	(77,000)
?? Non conventional irrigation systems	(10,000)
2. Agriculture Development Bank	38,000
3. Ministry of Agriculture	10,000
B. Rehabilitation of FMISs	64,000
C. Management of Existing Irrigation Systems	
?? O & M of AMISs	2,80,710
?? Joint irrigation management/handover	37,000
?? Rehabilitation of AMISs	33,780

2.4 Medium Term Expenditure Framework (MTEF)

The first MTEF prepared by the National Planning Commission and introduced in January 2003 covers the initial three years (FY 2002/03-2004/05) of the Tenth Plan. The second MTEF has now been prepared to cover FY 2003/04-2005/06. It has come as a complementary tool to operationalize the Tenth Plan. It aims at correcting the persisting problems by:

- ?? Linking the annual programs and budgets with the periodic plan;
- ?? Prioritizing programs and expenditures in relation to the periodic plan's goals and objectives;
- ?? Adjusting the expenditure programs envisaged in the Tenth Plan's each year to a level consistent with resource availability;
- ?? Maintaining macro-economic stability;
- ?? Providing funding guarantee to those activities on the basis of priority rankings.

Budget layout for the irrigation sector in the second MTEF has been shown in the Table below:

Expenditure	Rs Million			
	FY 2003/04	2004/05	2005/06	Total
Regular	236	244	254	734
Development	2,182	2,365	3,056	7,603
Total	2,418	2,609	3,310	8,337

More than 70 percent of the development expenditure is expected from foreign loans and grants.

2.5 Irrigation Policy

Adaptation of the National Water Resources Strategy (NWRS) by the Government in 2002, launching of 10th five-year plan in 2002, and reaching the completion stages of many important irrigation development projects like NISP, SISP, IDP and IMTP necessitated promulgation of new irrigation policy. As a result, recently, the government brought out the new Irrigation Policy-2003. Following are the objectives set out by Irrigation Policy-2003.

1. Provide year round irrigation service to the irrigable land by effective utilization of the country's water resources.
2. Develop institutional capability of water users association for the sustainable management of existing system.

3. Enhance the knowledge, skill and institutional working capability of irrigation professionals, water users and non-governmental association / organization relating to irrigation development sector.

Important features such as participatory approach of irrigation management, focus on ground water development (mainly STWs) for year round irrigation, river basin based approaches of irrigation development, capability building of local users and so on are also retained in the new policy. Following are some of the new provisions made by the Irrigation Policy-2003:

- ?? It aims to empower WUAs with required legal authority for administrating system operation and even collection of irrigation service fee (ISF), especially in AMISs.
- ?? It aims to raise the rate of ISF based on the incremental production due to irrigation.
- ?? It aims to create a maintenance support fund under DOI.
- ?? *It aims to involve private sector in managing public irrigation system. It also aims to involve private sector in irrigation development through the concept of BOOT (Built, Own, Operate and Transfer).*
- ?? It aims to demarcate the land having irrigation facility and declare the same as *irrigated area*.
- ?? It aims to transfer possession and ownership of the irrigation infrastructure and the land where such infrastructure are built for the concerned users.
- ?? It plans to initiate non-conventional irrigation development program in marginal lands through adaptation of several technologies like water harvesting, cycle pump, treadle pump, drip and sprinkler irrigation with especial focus to poverty alleviation. The policy intends to implement this program through partnership with NGOs and private sector.
- ?? For the development of year round irrigation, it intends to develop reservoir schemes for irrigation purpose. The policy encourages the potential production of electricity through such systems.
- ?? It aims at strengthening the capabilities of water professionals, local bodies and users for their effective participation in planning, construction and management of irrigation systems.
- ?? It aims to involve local bodies (VDCs and DDCs) in the development and management of small and medium irrigation systems.
- ?? It aims to adapt quantitative monitoring system for delivery of irrigation services to users through quantity of water delivery for crops, irrigated area, and incremental agricultural production.

3. Status of Irrigation Development

To arrive at the present level of irrigation, the efforts of the farmers throughout the country has played a vital role. By the efforts of government, several large and medium projects which are beyond the capability of the farmers have been developed with donor assistance after the start of the first five-year plan in 1957. In addition, Agricultural Development Bank (ADB), Nepal has also played a significant role in this regard.

Depending upon the agro-ecological conditions and social organization of an area, farmers all over the country have developed indigenous irrigation systems since time immemorial, referred to here as farmer managed irrigation systems (FMISs). Traditions of self-governing systems and strong community participation are important and common features throughout the development and the management of these FMISs. Local ingenuity and skills have been applied over the ages to develop these systems.

3.1 Status of Infrastructure

Irrigation infrastructures developed so far is able to cover about 1.121 million hectare out of 2.65 million hectare of cultivated land and 1.76 million hectare of irrigable land. The developed infrastructure covers around 64 percent of potential irrigable area of the country. Thus, a large portion of cultivated area still depends on rain for crop production. Table 3.1 and Table 3.2 gives an idea of irrigation development in the country.

Table 3.1: Irrigation development up to the end of ninth five-year plan (2002)

Agency	Progress up to eighth plan	Progress in ninth plan	Progress up to ninth plan
1. Department of irrigation	5,34,102	1,26,628	6,60,730
?? Surface irrigation	(4,76,928)	(1,04,523)	(5,81,451)
?? Ground water	(57,174)	(22,105)	(79,279)
2. Agriculture development Bank	1,39,701	20,075	1,59,776
?? Surface irrigation	(27,554)	(5,942)	(33,496)
?? Ground water	(1,12,147)	(14,133)	(1,26,280)
3. Miscellaneous	27,231		27,231
4. Lift pump	28,504		28,504
Total	6,73,803	1,46,939	8,20,506
5. Farmer managed irrigation system	3,81,814	(-80,879)	3,00,935
?? Surface	(3,57,098)		(2,76,219)?
?? Ground water	(24,716)		(24,716)
Grand total	10,55,617	1,46,939	11,21,441

? 3,57,098 – rehabilitation from DOI (74,937 ha)- rehabilitation form ADBN 4,645 ha

Table 3.2 : Irrigation development status (1999/2000)

Geographic Region	Overall cultivated area '000 ha	Total Irrigable Area '000 ha	Total Irrigated Area '000 ha	Year Round Irrigated Area '000 ha
Terai	1360	1338	889	368
Hills	1054	369	167	66
Mountains	227	60	48	18
Totals	2642	1766	1104	452

3.2 Status of Irrigated Agriculture Production

Irrigation as an input has made significant impact on agricultural productivity as well as in increasing cropping intensity in irrigated area. Annex-1 is the collection of data which gives an idea of agricultural productivity and cropping intensity achieved through the implementation of different irrigation projects in the country.

3.3 Undergoing Programs and Projects

In fulfilling the target set by the 10th five-year plan, key programs and activities carried out by the Department of Irrigation (DOI) are summarized below. The activities are focused towards achieving the objectives stated above. The activities can be divided broadly into the following categories:

Operation and Maintenance of AMISs

Agency Managed Irrigation Systems (AMISs) covering total area of about 280,710 hectare are maintained and operated annually to deliver irrigation water to users or group of users . This activity is carried out through users' participation and includes support for the institutional development of water users associations.

Maintenance of Major Hydraulic Structures

Major hydraulic structures such as intakes, weirs, barrages and pumping stations located throughout the country are planned for maintenance. As this work requires specialized technical skill, a central project office will manage this activity in close coordination with field offices. This activity will also focus on the intakes; weirs and barrages constructed on FMISs, as maintenance of such structures are beyond the technical capacity of users.

Rehabilitation of AMISs

Several important infrastructure of most of the large and the medium irrigation systems, which were originally developed during 1970s, are already deteriorating. They have almost lived up their life. Thus, rehabilitation/replacement of such irrigation infrastructure has become essential, without which the system may become defunct in near future.

Management Transfer of AMIS

Irrigation infrastructure whose management is to be transferred to users is first rehabilitated to match the user focused operational objective. In the mean time, institutional capability of all stakeholders benefiting from the schemes is enhanced to assume management responsibility of the system. This helps in creating an environment for equitable water distribution and higher irrigation water utilization efficiency. Presently, the Department of Irrigation is implementing Irrigation Management Transfer Project with the assistance of the Asian Development Bank. This project is due to be completed by 2004.

Rehabilitation of FMISs

This program focuses on those FMISs, which need external help to enhance the present level of irrigation service by constructing or improving the essential structures and by upgrading the management capability of users. Such projects need to be linked with the APP package program in the district. This program is implemented in participatory approach based on users genuine demands. Presently following projects are under implementation:

- ?? The World Bank assisted Nepal Irrigation Sector Project (NISP) which is to be completed by June 2004
- ?? The European Commission assisted Irrigation Development Project which is to be completed by August 2004.
- ?? Recently Second Irrigation Sector Project funded by the Asian Development Bank is completed. A follow up project named Community Managed Irrigated Agriculture Sector Project is expected to start by 2005.
- ?? Praganna Irrigation Project funded by Kuwait Fund is expected to be completed by 2005.

Ongoing and New Irrigation Development

This program includes development of both ground water and surface irrigation projects which are listed in Annex-2. Of these projects, some will be completed in the 10th plan period, while others will be continued further.

4. Future of Irrigation Development

Irrigation network developed so far is able to cover about 1.121 million hectare out of which the area getting year round irrigation is very small and is equal to 0.452 million hectare. So, a lot of work is yet to be done to bring the irrigable area of the country under year round irrigation network. The development in irrigation so far was technically easier and less costly. Future development, in the perspective of changed demand of year round irrigation, involves technical complexity as well as huge investment. Future works in irrigation development can be grouped into the followings:

- ?? Regular operation and maintenance of existing systems
- ?? Rehabilitation/modernization of existing systems

?? Expansion of year round irrigation area

Regular Operation and Maintenance of Existing Systems

General operation and maintenance of existing irrigation systems covering 1.121 million hectare is the vital for proper utilization of the investment done so far in this sector. Mostly, FMISs are managed by the farmers themselves. Management of AMISs is the responsibility of the Government. Every year a significant amount of money is needed to run these systems at designed level. Government with the help of water users is able to operate these systems.

Rehabilitation/Modernization of Existing Systems

The existing irrigation systems (AMISs and FMISs) which have already lived up their life are to be rehabilitated. These systems are scattered throughout the country. Restructuring of all the AMISs developed during 1970s is needed to cope with the present demand of year round irrigation. Conjunctive use of surface and ground water is considered to be effective in this regard. Government alone could not carry out these types of works and so donor's assistance is needed.

Expansion of Year Round Irrigation Area

The run-of-river type of systems developed so far are unable to meet the demand of year round irrigation in the command area. The seasonal variation in the nature of the water resources available in the country necessitates the big engineering intervention requiring huge investment as well as technical competency to cope with the demand in time and space. Realization of such projects will be a landmark in irrigation development and be effective in reducing the poverty of the country. Without the assistance of donors, Government is unable to carry out such type of projects. Future development is to be focused on materializing the following types of projects.

- ?? Storage types of projects. Kankai and West Rapti projects are already identified for this purpose. Power generation is to be taken as secondary outputs through these projects. Study is to be carried out to find out other more such type of projects.
- ?? Inter basin transfer projects. Development of Sun Kosi-Kamala diversion and Bheri-Babai diversion projects will be a milestone in meeting the objectives.
- ?? Large river projects. The available discharge in the large rivers like Kosi, Gandaki, Karnali and Mahakali is sufficient even in the lean period to meet the demand in the respective basin. Irrigation in Saptari and Siraha districts and extension of command area of Sunsari Morang Irrigation Project through Kosi river has to be initiated as an example of this type of projects.
- ?? Ground water projects. Development of deep tube wells as well as shallow tube wells (as envisioned by APP) will give immediate return in materializing the objectives.

5. Challenges and Issues

The development of irrigation is a complex socio-technical phenomenon. Achieving benefits from irrigation system involves collective action by a number of stakeholders and includes multiple activities - maintenance of irrigation infrastructure, organizing local community, delivering water to users to meeting crop water requirements, timely supply of seeds, fertilizers and pesticides, support to capacity building of the farmers, market support for the farm produces etc. Varying demand and supply of irrigation water over time has further increased the complexity in managing irrigation systems and achieving the desired benefits.

Present issues of irrigation development are broadly categorized as below.

- ?? Sustainable management of existing irrigation systems which includes both the management of AMISs and modernization of FMISs
- ?? Sustainable development of year round irrigation through the development of both surface and ground water irrigation

Sustainable Management of Existing Irrigation Systems

1. Studies have suggested that in case of Agency Managed Irrigation systems (AMIs) crop yields have increased by two folds with over 60 per cent increase in cropping intensity which shows the positive impact of these systems from the point of national food and water security. However, sustainability of these systems has been questioned because of the following reasons.
 - a) Low water use efficiency.
 - b) Poor linkage between irrigation and agriculture.
 - c) Low level of collection of irrigation service fees.
 - d) Insufficient budget allocation for O & M.
2. Several important infrastructure of many large and medium irrigation systems developed during 1970s, are already deteriorating. Maintenance of such irrigation infrastructure has become essential, without which the system may become defunct in near future.
3. Most of the agency managed irrigation systems were developed during 1970s. These systems are basically designed to supplement the rain for monsoon paddy. Such systems are, therefore, not effective enough in fulfilling the present demand of year round irrigation. So modernization of these systems is the needful.
4. People's participation has remained one of the key policy tools in modernizing FMISs for its sustainable management. Other than participation in planning and design, participation is also required in sharing capital cost for infrastructure development. However, past experiences suggest that people's participation in sharing capital cost of infrastructure has not been encouraging.

Sustainable Development of Year Round Irrigation

5. The expansion of irrigation area done up to now through the exploitation of medium and small rivers was technically easy as well as requiring less capital costs. Covering the remaining irrigable area requires high technical competence and huge capital investment.
6. Most of the surface irrigation systems in Nepal are fed by medium or small rivers, with limited water resources available during the lean season, making them insufficient for year round irrigation. Development of year round irrigation through these systems is not possible unless storage reservoirs are developed.
7. Although Nepal has ample opportunities in developing year round irrigation by utilizing water either from the major river systems or through inter basin transfer, actualization of such projects has remained a dream so far. Many of these river systems need to be developed as multipurpose projects.
8. APP emphasizes development of groundwater for year round irrigation, especially in Terai. Despite great effort in this line, the groundwater development has not been very satisfactory. The reasons are: (1) removal of subsidy on development of shallow tube wells, and (2) the high operating cost of tube well mainly due to the price hike of diesel and electricity.

As HMGN has already removed subsidy on the development of shallow tube well, other support services (like promotion of agricultural market, improvement of farm roads, provision of agricultural inputs and rural electrification) need to be provided as an indirect subsidy for commercialization of the agriculture sector.

9. Irrigation development so far was concentrated only on the *terai*, river valleys, and on *tars* (almost flat terraces located much higher from the major or medium rivers in the mountains),

where people are slightly better off compared to those who depend on the marginal lands. As poverty alleviation is the main focus of the Tenth Five-year plan, there is a need to develop appropriate technology and irrigation development program to address such lands by adopting non-conventional irrigation such as drip, sprinklers, and pond irrigation system.

10. Lack of sufficient funds, stringent criteria attached with loan agreements with donors, subsistence farming, and skewed land distribution with very small land holdings are also identified as constraints for irrigation development.

6. Major on-Going Actions to meet the Challenges

National Water Resources Strategy 2002 provides clear vision for irrigation development in the country. The Government is committed to implement the Irrigation Policy 2003.

Building upon the experience of management transfer of surface and deep tube well systems, emphasis has been given to raise the capacity of water users organizations in managing the irrigation systems.

Based on the demand of the user farmers, rehabilitation and modernization of farmers managed irrigation systems have been given high priority.

Efforts are underway for foreign assistance for projects such as Sikta irrigation project. High priority has been given to implement projects such as Sunkoshi Kamala diversion, Bheri Babai diversion, Mahakali -III which can provide year round irrigation to significant area.

Poverty is widespread in small marginal areas situated in isolation on the foothills of mountains and degraded land in the Terai where conventional irrigation is costly and often not possible. Realizing this fact, non-conventional irrigation programs such as drip, sprinkler, pond etc has been initiated. Landholding size, which is an indicator of poverty as well, has been adopted in project selection, implementation and cost-sharing.

On implementation of groundwater projects, priority has been given to areas having possibility of conjunctive uses.

Annex-1

Crop Production and Cropping Intensity in Different AMISs

Name of Project	Crop Yield (mt/ha)				Yield		Cropping intensity	
	Early paddy	Main Paddy	Wheat	Maize	Average (t/ha)	Increment in %	Average %	Increment in %
Irrigation line of credit (ILC) ²	(2.51) 3.01	(1.93) 2.71			(2.22) 2.86	29	(149) 178	29
Sunsari-Morang Irrigation Project- ³	(2.80) 3.50	(2.90) 3.40	(2.10) 2.70	(2.00) 3.00	(2.45) 3.15	29	(152) 178	26
Sunsari-Morang Irrigation Project-II ⁴	(1.60) 3.50	(2.40) 3.40	(1.40) 2.70	(1.60) 3.00	(1.75) 3.15	80	(129) 178	49
East Rapti Irrigation Project, Chitwan ⁵	(3.50) 3.75	(3.18) 3.95	(2.36) 2.87	(1.88) 2.09	(2.73) 3.17	16	(164) 229	65
Kankai Irrigation Project, Jhapa ⁶	(0.00) 4.50	(0.00) 3.20	(0.00) 1.50	(0.00) 1.60	(0.00) 2.70		(145) 190	45
Rajapur Irrigation Project, Bardiya ⁷	(0.00) 0.00	(2.49) 3.34	(1.70) 2.14	(0.85) 1.18	(1.68) 2.22	32	(186) 191	5
Marchawar Irrigation Project, Rupendehi ⁸	(0.00) 0.00	(1.52) 3.20	(1.46) 2.20	(0.00) 0.00	(1.49) 2.70	81	(135) 186	51
Bhairahawa-Lumbini GW Project ⁹	(0.00) 2.90	(1.70) 3.50	(1.00) 2.79	(0.00) 2.61	(1.35) 2.95	119	(120) 186	66
Narayani Irrigation Project-I, Parsa ¹⁰	(0.00) 0.00	(2.10) 3.20	(1.20) 2.60	(0.00) 2.00	(1.10) 2.60	(0.00) 1.36	(141) 188	47
Second Hill Irrigation Project ¹¹	(0.00) .0.00	(1.50) 2.60	(1.00) 1.60	(1.00) 1.80	(1.16) 2.00	72		
Mahakali Irrigation Project- I and II ¹²	(0.00) 0.00	(1.98) 3.65	(1.57) 2.12	(1.31) 2.32	(1.62) 2.70	66	(170) 195	25
	Paddy	Wheat	Linseed	Pulses	Mustard	Average	Increment (%)	

² Source: System performance and evaluation report, Halcrow/ GEOCE/East, 1997

³ Source: Project completion report of satge-II, World Bank, 1996

⁴ Source: Project completion report of satge-II, World Bank, 1996

⁵ Source: Project performance audit report, ADB, 2002

⁶ Source: Sustainable irrigation turnover study, DFID/ Wallingford, 2001

⁷ Source: Draft project completion report, ADB, 2003

⁸ Source: Final evaluation, UNCDF/ UNDP, 2002

⁹ Source: Project completion report, tahal Consultants, 1999

¹⁰ Source: Project completion report, World Bank, 1982

¹¹ Source: Feasibility study report of Mahakali-III, 2001

¹² Source: Feasibility study report of Mahakali-III, 2001

Chandra Canal Irrigation Project	(1.23) 2.30	(0.00) 1.93	(0.46) 0.56	(0.76) 0.76	(0.46) 0.60	(0.65) 1.23	112
	Paddy	Wheat	Lentil	Millet	Mustard	Average	Increment (%)
Chaurjaharitar Irrigation Project	(2.0) 3.00	(1.40) 2.00	(1.00) 1.50	(1.00) 2.00	(0.3) 0.4	(1.14) 1.78	56

Annex-2

List of Ongoing and New Projects

Projects	Command area in ha (target)	
	New	Rehabilitation
1. Department Of Irrigation (DOI):		
A. Surface irrigation projects		
1. Irrigation Development Project	3,100	1,000
2. Babai Irrigation Project	5,000	
3. Praganna Irrigation Project	300	5,000
4. Sikta Irrigation Project	3,000	
5. Community Managed Irrigated Agriculture Sector Project	6,200 2,000	20,000
6. Medium Irrigation Projects		8,000
7. Ranijamara Irrigation Project	2,500	
8. Mahakali Irrigation Project III	500	
9. Trishuli Irrigation Projects	16,000	
10. Command Area Development of Bagmati Irrigation Project	11,000	20,000 10,000
11. Nepal Irrigation Sector Project II (NISP)		
12. Syphon of Babai Irrigation Project		
13. Command Area Development of Babai Irrigation Project		
<u>B. Ground Water Irrigation Projects</u>		
1. Community Ground Water Irrigation Sector Project	49,000	
2. Shallow Tube Well Projects	10,000	
3. Deep Tube Well Projects	11,000	
<u>C. Non-conventional Irrigation Projects</u>	10,000	
2. Agriculture Development Bank, Nepal	38,000	
3. Ministry of Agriculture	10,000	
Total	177,600	64,000