A

Dissertation Report

On

Conjunctive Use of Ground Water & Surface Water, A Case Study of Nepal

(Submitted in partial fulfillment of the requirement for the award of the degree of MASTER OF TECHNOLOGY in WATER RESOURCES DEVELOPMENT)

By

Bhakta Kumar Lal

Enrolment No. 14548006

WATER RESOURCES DEVELOPMENT AND MANAGEMENT

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

May 2016

``````

# INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

## CANDIDATE'S DECLARATION

I hereby declare that the work which is being presented in this Dissertation, entitled, **"CONJUNCTIVE USE OF GROUND WATER & SURFACE WATER, A CASE STUDY OF NEPAL"**, in partial fulfillment of the requirements for the award of the degree of **Master of Technology** in **"Water Resources Development (Civil)"**, submitted in the Department of Water Resources Development and Management, Indian Institute of Technology, Roorkee is an authentic record of my own work carried out during a period from May 2015 to May 2016 under the supervision of Prof. Deepak Khare , Department of Water Resources Development and Management, Indian Institute of Technology Roorkee (IITR), Roorkee, India.

The matter presented in this dissertation has not been submitted by me for the award of any other degree of this or any other Institute.

Date: May, 2016

Place: WRD&M, IIT Roorkee (BHAKTA KUMAR LAL)

ENROLMENT NO. 14548006

---

## CERTIFICATE

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

(**Dr. Deepak Khare**)

Professor
Department of Water Resources Development and Management
Indian Institute of Technology
Roorkee – 247 677 Date: May, 2016
``````

``````

# ABSTRACT


## Conjunctive Use of Water

Major problem of the developing country is to maintain the food deficit for the people who are suffering for their survival. It is challenge to cope with the increasing population and decreasing the agricultural land. For high level production, it is requirement of government for making policy for the best agricultural technology with proper management of all vital factors e.g. Modern seeds, Pesticides, Herbicides, Proper Management of Irrigation, and Sound Institution. In our case, we have taken Narayani Irrigation System for studies with implementing the Conjunctive Use of Surface and Ground Water. There is vast changing in climate and it is major issue worldly affecting the natural environment and monsoon. So, the available surface water is also affected day by day gradually. At present, project is facing with the deficit of water for existing cropping pattern in culturable command area. The command area is potential for the good source of groundwater. So, we have studied the data of project and calculated the fulfillment of water demand by the use of deep tubewell to maintain smoothly the water demand for the cropping pattern that is liked by most farmers. We have calculated the Cost Benefit Ratio and External Rate of Return to compare the beneficial situation after the selection of conjunctive use in project area. There are 15 Blocks in which only 12 Blocks are under operation. So, we have taken 1-12 Blocks to study the conjunctive use. For continuous process of maintaining the irrigation system, it is important to maintain the ground water recharge.

## Ground water Recharge

Shallow aquifer and permeable alluvium has been recharging directly from the source of rainfall and infiltration from river. Infiltration rate is decreasing toward the southern from the study area. Seepage from lake and pond, water from the irrigational return, and precipitation are the main source of recharging the aquifer. In rainy season, aquifer became fully recharged and any additional creates the flooding of the area. So, site is very proper to be recharged to store the extra surface water. Thus, the management technique using conjunctive use is suitable to fulfill the demand of irrigation water to the farmers.
``````

``````

## ACKNOWLEDGEMENT

It is my great pleasure in expressing my heartfelt gratitude to my supervisor Prof. Deepak Khare, Department of Water Resources Development and Management, Indian Institute of Technology Roorkee, for his valuable guidance & infilling support for completion of the Dissertation Report. I am highly obliged to him for his keen interest, able guidance and encouragement throughout the writing. Working under his guidance is a privilege and an excellent learning experience that I will flourish in my life time.

I am extremely thankful to all, HOD & Prof. S. K. Mishra, Prof S.K. Tripathi, Dr Nayan Sharma, Prof M. L. Kansal, Dr Asish Pandey, Chairman and DAC, and Dr Thanga Raj Chelliah, Department of Water Resources Development and Management, IIT Roorkee for their kind cooperation.

Finally, I would like to express my family members, for their encouragement, support and advice in every phase of my life.

**BHAKTA KUMAR LAL**

Enrolment No: 14548006
``````

``````

# Contents
``````

``````
``````

``````

# LIST OF TABLES
``````

``````

# LIST OF FIGURES
``````

``````

# 1.0 INTRODUCTION

## 1.1 General

Food is most basic needs of the country. Specially, it is serious problem in less developed country where there is less production and high increasing population. It has requirement of the present situation to fulfill with many times of production by effort of proper fertilizer, pesticides, herbicides and conjunctive use of water management. To improve the agricultural production, there must be extension of services, strengthening of existing institutions, and legal and organizational supports. The major importance is to implement the proper water management. Success and efficiency depends on the proper quality, quantity and timing of irrigation. Water resources have certain limitations so, only proper utilization can be sustainable.

Types of resources of water,

- Fresh water from lake, streams, ponds and reservoirs.
- Fresh groundwater in water table condition.
- Rain, snow and ice from atmosphere.
- Soil moisture.
- Effluent water.

## 1.2 Concept of Conjunctive Use

Conjunctive use can be basically known as the good planning and co-ordination of surface and ground sources of water with proper management. Concept of hydrological cycle has been presented in **Fig.1.1**. For efficient maximization of water resources, it is a good technique. As we know, both sources have a strong relationship. So, we cannot make separate to each other. Ground is the best reservoir for storing the rainfall water for the critical period. This storage can be utilized for the deficit period and surface water can be used in those areas where over drafting takes place to for the purpose of recharging and irrigating the land.

By the proper integration and management of both water sources, there is the best result in utilization of water resources than the separate use.
``````

``````

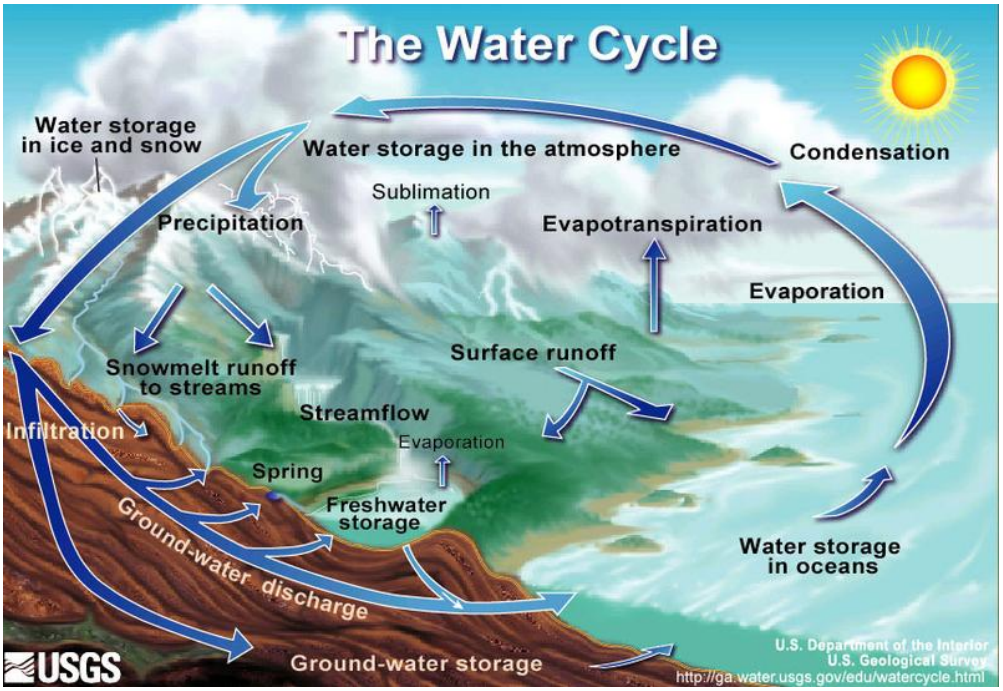



Figure 1.1: Hydrological cycle

Source: http://en.wikipedia.org/wiki/Water_cycle

The conjunctive use of water has certain advantageous which can be explained as below (Karanth in 1987)

- It maintain in peak period for the demand of farmer to irrigate. Thus, it helps to make cheaper canal construction by reducing the size.
- Schedule irrigation is possible due to availability of water resources in proper time.
- It helps to avoid the serious problem of salinization and water logging in the irrigated areas.
- Lining of canal can be avoided to save investment and to make recharging the ground source in aquifer.
- It also allows utilizing the sewage dirty water by mixing with fresh water of surface.

Though, it has many benefits, it has certain drawback that is disadvantageous.

- It consumes more electrical energy and due to variation of water level, the pumping efficiency also decreases.
- There is problem in fixing the tariff rate. Thus, it creates the administrative burden.
``````

``````

- Conjunctive use needs expert manpower for supervision of project operation with careful ground management.

- Unstable water supplies from two different needs extensive analysis to find equitable water rate.

- Reduction in ground water level due to over water pumping can make subsidence particularly in fully confined area. ( Karanth, 1987; Tiwari et al. 2009)

### 1.3 Positive and Negative Factors

#### 1.3.1 Positive Factors

These are the positive factors as following below:

- Surface and Groundwater provides larger sources of water supply and greater water conservation can be achieved.

- Groundwater can be used in dry periods and we can reduce the load of surface water distribution.

- Seepage water of canal can be used as recharging the ground aquifer and thus, we can save the lining cost of canal.

- Pumping of ground water sources can decrease the water level and drainage system can automatically improve.

- It provides higher level of utilization.

- It has high reliability of supply.

#### 1.3.2 Negative Factors

These are the negative factors as following below:

- It requires expert manpower's and careful water management. So, its operation is complex.
- It requires extensive analysis to fix equitable water rate.

- Over pumping of ground water can create the subsidence. Thus, damaging effects can be in canal and other structures.

- Extraction of ground water needs more energy consumption.
``````

``````

### 1.4 Extent of Conjunctive Use

These are to be considered to study the projects as given below:

- Project has not been planned and used the combined sources.
- Command area is diversion type of scheme.
- Irrigation system is suffering from lack of timely supply with adequacy.
- For high yield, only surface water is insufficient supply of source.

### 1.4.1 Case Study of Narayani Irrigation System as Conjunctive Use

In context of case study, we have considered all parameters as given below:

- It has been designed to irrigate in 37400 Ha of Culturable Command Area.
- It controls 3 districts, which are Parsa, Bara and Rautahat.
- It has 3 phases of development of Command Area.
- First and second phases have been divided into 12 Blocks, 1-6 and 7-12 respectively. Third phase is under development, Blocks 13, 14 and 15.
- Designed discharge is 850 Cusec(24.10 $m^3$/sec)

At present, average dependable (80%) discharge has been limited to 5.13 $m^3$/sec. Basis of data is from 1980 to1992 and its nature is decreasing due to different causes e.g. climate change, addition of culturable command area.

- There is critical demand of ground water from farmers on basis of farmer's questionnaire survey.
- Potential of shallow tubewell and deep tubewell district wise, Parsa-2958(STW)+154(DTW), Bara-2971(STW)+242(DTW) and Rautahat-2952(STW)+71(DTW)
- Assumed discharge of each shallow tubewell and deep tubewell are 10 litre per second and 60 litre per second respectively.
- Cropping pattern and ground water supplement have been taken on the basis of farmer's choice in questionnaires.
- Major theme of conjunctive use is to study economical factors e.g. the net benefit, benefit and cost investment ratio (B/C) and external rate of return (ERR).
``````

``````

(Ref: Department of Irrigation, Nepal)

### 1.5 Scope of Study

We have focused on the parts which are under the running project, but these are to be improved for better performance. So, we have defined the scope of limitation.

- Only Block 1-12 has been taken to study which has been completely under operation of project. Block 13-15 has been excluded as not completed yet.
- Quality of water is proper as requirement as project report .So, this has not be considered for further studies.
- It is running project .So, study of environment impact has been done in extensive way and not any bad impact is seen in society, culture and environment .Consequently, it is not matter of studies.

### 1.6 Objective

In view of the need of Narayani Irrigation Project in Nepal, Conjunctive water use is preferred in command area. Following objectives are outlined for the present study:

- To characterize the operational plan of the two system in term of space and time.
- To characterize the optimal capacities of surface and ground water facilities.
- To locate the effect of irrigation in ground water level.
- To study the groundwater utilization in canal command area and planning in the command.
- Economic analysis considering conjunctive use of surface and ground water.

### 1.7 Organization of dissertation

The contents of dissertation report are divided into nine chapters, as given below:

Chapter 1: It briefly introduces," The Conjunctive Use of Ground and Surface Water" and describes the objectives of dissertation.

Chapter 2: It provides a literature review.

Chapter 3: It describes methodology used to study the project area and its details.

Chapter 4: It describes the project site and its details.

Chapter 5: It describes the procedures used to analyze the conjunctive use .

Chapter 6: It explains the result and discussion.

Chapter 7: It explains the conclusion references.
``````

``````

Chapter 8: It explains the references .
``````

``````

# 2.0 LITERATURE REVIEW

## 2.1 Historical Background

This tool has been brought in use since 1960. Anxiety over the technical draft of more water has shifted into serious thoughts on water allocation as water resources are seen to be in finite limits. It has also been of specific interest in many regional rural development plans over the same. It became most useful in irrigation management. In policy of World Bank, it is very popular from 1980. It is sustainable with a good performance. (Prasad and Verdhen, 1990; Dhawan, 1988). It helps to farmers to choose the cropping pattern. Even heavy consuming paddy and rice can be grown. The farmers who are suffering from poverty have low risk of uncertainty. They can grow high value crops, HYV seeds, and related inputs like fertilizer and pesticides.

For new irrigation development becomes less, and the demand to produce more food increases, the need to use resources more resourcefully, and control existing irrigation schemes more creatively.

It is the combining process in optimum use of both sources for the maximum production. At farm level its use is the concern of farmers and system managers attempting to optimize the quantity, timing and reliability of supply and maintain soil fertility over the year. But in regional level the combined management of the resource is of interest to planners and water resource engineers looking for to maximize water availability, and increase the quantity and maintainability of supply in the longer term of vision. Preferably conjunctive use of resources expands the utility of available resources, and should not be used to explain the development of one resource merely to cover shortcomings in the condition of the other resource. It is exactly to deal with water logging problems, or to give back for failure in the surface water distribution system. Joint use has also appeared spreading widely for operational programme systematized by water management institutions.

This result of a literature survey of conjunctive water use, we looked at the depth of existing literature, the contexts in which study was performed, the models built to analyze options, and the use of study to inform policy options (or the failure to use study positively). By looking more at a variety of objectives at the back the current interest in conjunctive use, we hoped that we could make some recommendations on study approaches. In this paper, we look to promote the technique, and how this has affected the development of coherent study. (Vincent, Linden Dempsey, Peter, 1993)
``````

``````

## 2.2 Groundwater and Surface-Water as Conjunctive Resources

The interrelation between the ground water and surface water is compliment to each other as explained below:

- It is combined use of ground water and surface water to make optimization and avoid minimizing the undesirable effects of single use.
- It is actively managing the aquifer system as underground reservoir.
- Surface water involve lower delivery , lower withdrawal cost , variability in supply and water logging where as ground water involve dependable supply , expensive pumping and decline in ground water table. So, conjunctive use is the best way of utilization.
- In the past, water resources have mostly dealt as different sources and negligible use of ground water.
- For a good management, we should use the both sources effectively and realize the proper interrelationship of them.
- Identification of groundwater probable area in the Terai (shallow and deep aquifer) through geophysical survey and exploration tube wells.
- Exploration tube wells for water level fluctuation, groundwater reserves and water quality.
- Study and exploration of mountain and Karst aquifer
- To make sure proper recharge of groundwater has to be an increasingly important consideration in the future.
- To control pollution, surface water can cause degradation of ground-water quality and on the other hand , pollution of ground water can degrade surface water

(**Source:** Jacek Scibek, Diana M. Allen, Alex J. Cannon et al (2007) )

## 2.3 Complement to Resolve the Major Issue

There are many negative impact on society and economy due to different causes as given below:

- Growing Population
- Growing Economy
- Increasing Demand of Water
``````

``````

- Constant Amount of Water in The cycle
- Increasing Competition for Scarce Water
- Unequal distribution in Time and Space
- Need for Allocation and Conflict Resolution
- Peak Runoff River Only for a Few Month-Smallest Demand
- Problem of Water to Transfer from High Supply Season to High Demand Season
- Drawbacks of Surface Reservoir Are Evaporation , Sedimentation ,environmental Impacts and Distribution of Water
- Solution To Store as Surface Reservoir or Ground Reservoir

**2.4 Technical Alternative for the Improved Water Accessibility**

A lot of literature exists purely to sum up technological options. Tube wells may be brought to: (1) as supplement insufficient water, (2) helps to lessen salinization (3) helps to decrease water logging (4) helps to combine the different qualities to make available water of acceptable overall quality.

Additional groundwater irrigation may be supplied where canal supplies are inadequate, either for design or operation causes. Groundwater expansion in some areas may enable the areal degree of the system. Improvement of groundwater promotes a good return to investment.

In larger schemes in Pakistan and China, insufficient horizontal drainage and wasteful water use have caused water logging and salinity difficulties. Over-watering increases salts deposited at the surface, and the addition in water infiltrating to groundwater causes the water table to increase, increasing the concentration of salts in the rooting zone. Tube wells were introduced in the 1960s and 1970s to offer vertical drainage and increase the depth to water table and some of a smaller amount salty water is diverted for irrigation. In Pakistan, tubewell were commenced under community programmes as SCARP I & II (Salinity Control and Reclamation Project) to give vertical drainage to compensate water-logging and salinity troubles caused by rising water tables from canal irrigation. (Source: T.P. Tuong and B.A.M. Bouman)
``````

``````

## 2.5 Hydrology of the Use of Conjunctive Water

This segment sums up some hydrological features and problems in the use of conjunctive water in original theory - to maximize existing water in technical water resources development. Conjunctive use is an expression used to explain use of surface and groundwater to increase the extent used of both resources, to create maximum use of existing water resources, and reduces the losses from any resource. The term has the concern over rising insufficiencies of water. It is quite well defined cyclic climate and also moderately small catchments. Many of the Western countries at that moment, the organizational pattern for water extraction also made this model organizationally simple to consider. It released more water within a practical system under combined management. Nowadays with concern about finite funds, we are searching at much more complex alterations between users and between managers.

Usually, groundwater is drained to depict water tables. More water seeps from high flow and flood. Recharge can be natural or supported through artificial recharge. Ground water extraction would be in the majority in the season connected with heavy rainfall and flooding, both surface and ground water abstraction, to make sure that minimum base flow in rivers is protected. When ground water is high, it may supply to the base flow of the streams, and rivers.

Conjunctive water use in irrigation frequently expands to mobilizing good qualities and quantities which helps to avoid water logging and salinization. In an irrigation system, seepage water helps to recharge the aquifer. It includes seepage from any irrigated area, as well as from the base of connected distribution along with drainage canals, and basins. It supplies 'artificial recharge' to ground water. It has benefits that the reducing level of water table in dry season can be fulfilled by the seepage water of canal and overall efficiency can be increased. There is no waste of water. This is the major output of conjunctive use .

Reuse of canal seepage from a near surface aquifer gives the twin benefit of reducing the water table along with decreasing ground water uplifting prices. It decreases the necessity of improved hydraulic efficiencies by lining of canal. Tube wells give a additional source for irrigation. Right of irrigation is to control water logging and salinity. The role of this method is not only seen as a routine with main concern while looking at other purposes.

The practical problems of developing most favorable conjunctive use are important. There might be some of the institutional complication. Hydrological
``````

``````

difficulties might contain problems in determining the timing and volume of existing flows of the surface and ground water. We can sum up some elements in hydrological models in the use of conjunctive water, and the problem faced by technical experts in the field. The Estimation of seepage in addition to derivation as well as key limitations of groundwater movement has been particular difficulties. Even though, there is large no of groundwater theory availability related to ground water in the form of deep and heavy tube wells. There is not sufficient theory to explain the way of behaving in large-diameter dug wells or a good prediction about the change of water levels in wells over the time.

The concept of hydrology in conjunctive use can be appropriate at both a small and large level of scale, including local and regional stage. As utilization of water resource is increasing more heavily, administrators are interested for looking the ways to maximize the resources. Though, we shift to more complication in river basins with more severe climatic conditions. They are concentrated in farming, realistic hydrology has become more difficult. In those area where the time of going up and period of High River flows is changeable, there is not simple of drawing down water tables, in advance. What happens if the surface flow does not arrive and water levels fall? Who will give the additional pumping prices of such a policy or compensate cultivators without water? Possibly, flood flows should be accumulated and recharge supported so that flows should not loss to the sea. Conversely, where can be sited the ponds to recharge artificially on a huge scale? Who will finance the large amount of costs to recharge in areas especially where the connections to actual recharge are poor or unfortunately understood? In those areas where hard metamorphic rock, the depth of eroded rock and therefore, water storage possibility is limited. In such geology, storage might be refilled by one rain storm. How can it be scientifically draw down to make more surface flow infiltration rather than running off?

(Source: Rushton in Gorelick, 1986)
``````

``````

# 3.0 METHODOLOGY OF THE CONJUNCTIVE USE

## 3.1 Simulation and prediction models,

The model has wide use of application related to management of resources and environmental purposes also.

Simulation approaches give a structure for theorizing, evaluating and analyzing watercourse aquifer methods.

At first, Jay W. Forrester has developed a system dynamics which is based on perception considering the feedback with view of biological, physical and social. Flow diagram helps to observe the behavior and structure .Program flowchart, configuration and construction model are the process of model development. In complex system, computer approach is used to show the relationship between components and activities .The main feature is to make clear concept of endogenous configuration which show the process of elements. (Source: J.W. Forrester 1961)

### 3.2 Dynamic programming (DP)

It is used due to its benefits in model sequential assessment making procedures and ability to apply to the nonlinear systems, ability to add in stochasticity of hydrological processes in addition to get global optimality still in support of compound rules ( Provencher and Burt , 1994). It has certain limitation due to difficulties in dimensioning.

### 3.3 Linear Programming (LP)

It is mainly used broadly in optimization models for conjunctive use. Though, nonlinearities can happen as a result of the physical representation for its structure or else charge configuration for both water sources.

Aquifer interaction can be stood linearly for with the function, of river stage along with groundwater elevation where ground water stage is above or at the stream bed. Though, the stream phase is the nonlinear function with discharge, or reservoir release.

### 3.4 Hierarchical Optimization

This is initially used by Maddock in 1972 and 1973. It was the first defined by Bracken and McGill in 1974 while making the generalization of mathematical programming. In context, the constraint region is implied and determined with a series of optimization problems that should be solved in the predetermined way.
``````

``````

### 3.5 Models for Non Linear Programming

The solution for the conjunctive use problem with the nonlinear constraints due to very complex as well as some restrictions are nonlinear. Therefore, such type of a model is called nonlinear in the conjunctive use for optimization model. It can be exemplified to solve the conjunctive use as its problem, ground water flow in addition to mass transport models may need to run many times which problem cannot be solved. For example, ground water as quality problems and ground water as head constraint.

In spite of a lot of different optimization models in addition to its techniques which have been used in most conjunctive use for optimization work as reported in the many literature deal with hypothetical difficulties or simple cases including steady state difficulties. Due to lack of large scale complicated real world, conjunctive use optimization studies is almost certain with the great size of problem as consequence while considering many nodes cells with long time periods for model as groundwater flow and interaction between surface along with groundwater. Mostly, models for the conjunctive use is reported and created unplanned way for a certain problem. Engineers and scientists in water resources regions are attempting to expand around the world in a special kind of models for conjunctive use on the basis of purposes with objectives.(Source: S. Alireza Taghavi et al.in 1994)

### 3.6 Surface Water Model

It is resource allocation model of the water resources system. This type of model optimally distribute over a planning or design horizon, the water resources of a river basin to complete water demands of water use.

### 3.7 Vadose Zone Model

Soil moisture is a key variable for understanding hydrological processes in the Vadose zone. It plays an important role in weather and climate predictions from the regional to the global scale by controlling the exchange and partitioning of water and energy fluxes at the land surface. Agricultural and irrigation management practices, especially in semiarid and arid regions, largely depend on a timely and accurate characterization of temporal and spatial soil moisture dynamics in the root zone because of the impact of soil moisture on the production and health status of crops and salinization. In addition, soil moisture also plays a major role in the organization of natural ecosystems and biodiversity.
``````

``````

### 3.8 Groundwater Flow Model Incorporating Its Interaction with Surface Water

Conjunctive use planning can increase the efficiency, reliability, a cost effectiveness of water use, particularly in river basin with spatial or temporal imbalances in water demands and natural supplies. It can reduce deficiencies by using groundwater to supplement scarce surface water supplies during the drier seasons.

### 3.9 Model of Conjunctive use on The Basis of Purpose and Objective

The conjunctive use models are as following.

- A simple with ground water balance model
- A GIS linked conjunctive use groundwater and surface water flow model (MODFLOW)
- Interaction of surface water and ground water modeling,
- Multi objective conjunctive use models
- Conjunctive use optimization model
- Linear optimization model
- Integrated Groundwater and Surface water Model

Non linear optimization models :

At one side, the methods of widening of conjunctive use models and there are many scope. It has modeling options.

Some of modeling options as the conjunctive use can be given as below,

- Managing soil salinity through conjunctive use model
- Irrigation water management in command area through conjunctive use model.
- Optimal crop planning and conjunctive use of surface water and groundwater.
- Crop scheduling, nutrients and agricultural water management through conjunctive use model.
- Surface water modeling and management
- Surface water and groundwater interaction model.
- Groundwater pumping through conjunctive use model.
- Groundwater recharge estimation,
- Conjunctive Use of Surface Water and Groundwater for Sustainable Water Management
- Climate change on surface water and groundwater through conjunctive use model etc. Optimal allocation of surface water and groundwater in a basin.
``````

``````

### 3.10 Demand Model in Case Study of Narayani Irrigation Project at Present

In present case, conjunctive use of surface water and ground water is applied on the basis of farmer choice on their long experience of years. A simple survey with questionnaire has been done to farmers to select the cropping pattern. Thus, management of demand water has been considered by the combination of sources. Specially, the ground water has been added on the basis of shortage of water in availability of surface water. Farmers do not want to use much more ground water in sufficient because of high rate and uncertainty of productivity as there are several factors on which depends the productivity e.g. Fertilizer, Pesticide, Technique of farming, Quality of seeds, Availability of labor in proper time, Favorable climate and Efficient irrigation. People do not want to take more risk in high investment only in irrigation. They like to use groundwater for peak season as supplement and especially for cash crop like vegetable. So, conjunctive use has completely taken as demand basis of farmers.

In the study of project, farmers were asked to reply questionnaires which are the survey to find the interest of farmers for the conjunctive use in the command area as a good supplement from ground water sources. These are the questions which are asked in the field by sampling different regions covering the whole command area.

1. Tell the name of Institutions involved for the ground water in your area. Are you requiring the additional agent also?
2. Is government involvement adequate? Do you need any other support?
3. Are you able to manage in priorities wise of the grounder water source?
4. Do you think that rule and regulation is sufficient?
5. Tell about the challenges and obstacles in ground water sources?
6. Tell about any problem relating quantity and quality of ground water.
7. Suggest any new ideas about the strategy of investment from government in local or national level in ground water.
8. What do you think in awareness of illiterate farmer about the local institution and ground water resource?
9. Do you think that conjunctive use for irrigation is better?
10. Give any key message about the use of ground water resource and its prevention.

Farmers have taken keen interest on our survey work and almost 90 % have replied positively. Some people are telling as expensive and complexity to use the ground water source. We can conclude the answer of all participants as given below.

1. Most of them (90%) are positive and interested to use the ground water sources.
2. Some of them are thinking as expensive source and not strongly interested.
3. They demand the stable local institution for the stability of proposed project.
4. Tail portion of canal are more interested than others because tail farmers are always sufferer.
5. Some private sectors are interested to provide the service.
``````

``````

6. Government budget are not sufficient to speed up additional source of water.
7. Awareness to illiterate farmers is necessary to succeed the project relating conjunctive use.
8. Farmers are eager to use mainly for cash crop and peak period of paddy and wheat farming.
9. In conclusion, they have strong demand of conjunctive use of water resources.

### 3.11 Work Flow Process

It is work flow process in which components are represented by a solution model to solve the problem. It is used for designing and documentation by an algorithm. It guides for proper responsibility and taking decision timely in stepwise with regular sequence as denoted below. It helps to visualize the process from initial to final stage.

- Literature Review & Model selection
- Data Preparation
- Analysis of data
- Performance
- Result and discussion
``````

``````

# 4.0 PROJECT SITE AND DESCRIPTION

This project is located in between Nepal and India boarder. The head -works is located in Balmikinagar of Bihar. But, administrative office is in Parsa district (Birganj) of Nepal. Eastern canal is entered through the village development committee called Jankitole in Nepal. It covers the land having total culturable command area of 37400 hectares. The main purpose of project is to increase the food grain production .Consequently; it can improve the farmer's agricultural production and employ the local people to reduce the poverty level.

## 4.1 Narayani Irrigation Systems (NIS)

It is for covering the most command area by surface irrigation in the country. The location of NIS is shown in **Fig 4.1** and other is showing the details layout of Eastern Canal System in **Fig 4.2** . Nepal Eastern Canal has been constructed with proper design to irrigate the command area with 37400ha of land in the districts called Parsa, Bara and Rautahat. Barrage is constructed in Narayani River at Balmikinagar of Bihar state in India. It diverts the main flow through the Eastern Main Canal which is called as Tirhut Main Canal. It starts from Tirhut to the long distance of 92 km long with capacity of 2500 cusec and it feeds Ghorashahan Branch Canal with 1650 cusec in India and 850 cusec through Nepal Eastern Canal in Nepal near the India-Nepal boarder. It was constructed with proper design by the Indian Government. Then, it was handed over to Nepal during the period of 1975 and1976.

It was completed in three different stages. It has 81 km long main canal known as Nepal Eastern Canal with the discharge of 850 cusec (24.1 cumecs) .The canal water is diverted from Indian Don Canal. Total culturable command area has been divided into fifteen number of irrigation block named as Block-1, Block-2 and so on. The command area of each ranges from 1180 ha to 3349 ha. The system has 17 numbers of Main Secondary Canal (MSC), 50 numbers of Branch Secondary Canal (BSC), 408 km of Sub-Secondary Canal (SSC) and 1466 km of tertiary canal. The major hydraulic structures are Canal Head Regulator, Cross Regulator, Cross Drainage Structure, and Escape Channel & other prominent structure are Village Road Culvert, Drain Inlet, Foot Bridge and L.D. Siphon.
``````

``````

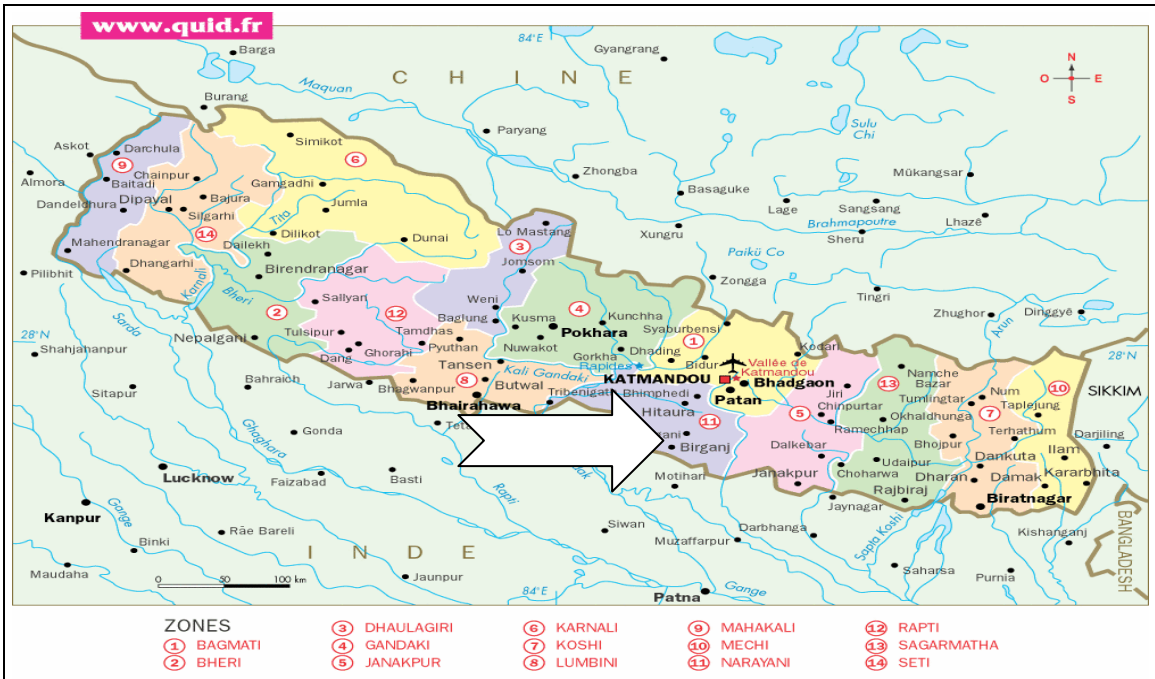



**Fig: 4.1, Location Map of Project (Source: www.quid.fr)**

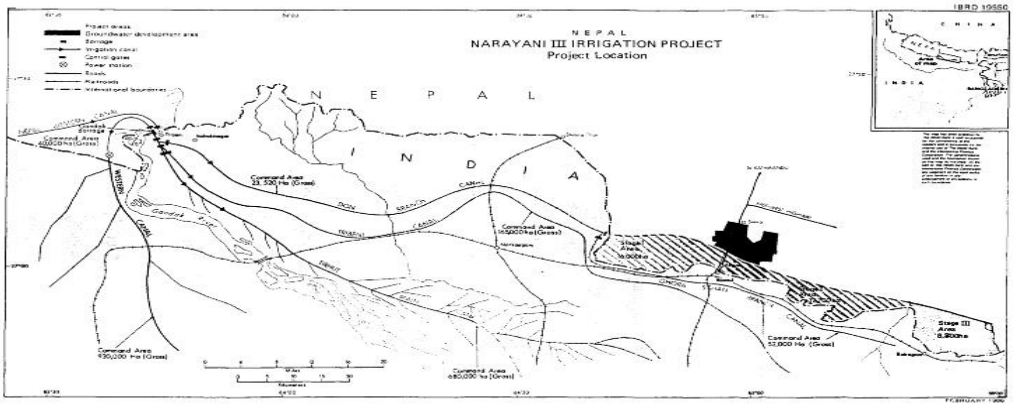



**Fig: 4.2, Details Layout Map of Project (www.doi.gov.np)**
``````

``````

### 4.1.1 Historical Background and Features of System

1. Agreement Signed between The Government of India and His Majesty's Government of Nepal on 4th December 1959.
2. System constructed by the Government of India during 1965-1975.
3. Command area- 37,400 ha
4. Design Discharge- 850 cusec (54.1 cumecs)
5. Physical System constructed during Gandak Project
   - Main Canal ( Nepal Eastern Canal)
   - Distributaries 9 Numbers
   - Other facilities like – Residential Buildings, Field Stations, Field Staff Quarter, Land acquisition etc.
6. Improvement of main canal and irrigation system development down to 7.5 ha. Irrigation units were constructed by Nepal under the Narayani Zone Irrigation Development Project during 1973-1992 under the financial support from the World Bank.

7. Canal Networks

| | | | | | |
|---|---|---|---|---|---|
| a) | Main Canal (NEC) | - | 81 km | | |
| b) | Main secondary canal (MSC) | - | 17 nos. | - | 137 km |
| c) | Branch Secondary canal ( BSC) | - | 50 nos | - | 233 km |
| d) | Sub-Secondary Canal (SSC) | - | 109 km. | | |
| e) | Tertiary Canal (TC) | - | 1467 km | | |
| f) | Structures | - | 3574 no | | |
| g) | Block | - | 15no | | |
``````

``````

### 4.1.2 Development Features of System

For a brief description of progress after their establishment, we can express from initial administrative works to complete view of a few command area and physical component. Narayani Management Division has drastically changed the life of people who are the poor farmers mostly. It has increased the growth of relation between the two countries Nepal and India. It covers the farming land of both countries. Major contribution has been done by Indian Government.**Fig.4.3** can show a few view of the Administrative Office, Head works, Command Area, Command Area Development, Controlling Seepage and Block 1

Narayani Irrigation Management Division 5


View of Headworks of Narayani


View of Command Area

Command Area Development

Canal Lining to Control Seepage


Narayani Block No 1

**Fig.4.3 View of Development in Narayani Irrigation System**
``````

``````

### 4.2 Major Finding about the Selected Project

These are the major findings in the study area while visiting the site as explained below:

- Necessity of Drainage Canal Development during on farm water management
- Necessity of Farmers Field School
- Sustainability Issues of Project
- Need to clarify integrated organization reform e.g. department of irrigation, department of Agriculture and National Agricultural Research Council and Stakeholders.
- Demonstration on farm development, improved water management, Agriculture development and Improvement of institutional support system are needed.
- Improving the water availability aspects for sustainable crop planning is needed.
- Scopes are limited to better management whatever water is available in command area.
- Need to focus on policy issues, Shortage of agricultural inputs, on farm issues and labor shortage.
- Development of water user association for better performance in sustaining the project activities and empowering them with policy support.
- Need to incorporate the new agricultural technology and water utilization technique.
- Need for land leveling and consolidation program for enhancing the irrigation efficiency.
- Lack of active participation of water user association in the operation, repair and maintenance of public sector irrigation scheme.
- The farmers are unlikely to pay the increased fees that are needed to cover maintenance cost since yields and outputs price is so low.
- Establishment of reliable and adequate information flow and to ensure the use of local knowledge.
- No complete database availability of members and beneficiaries which makes difficult to collect resources.
``````

``````

### 4.3 Data of Project

These are the general data of the project which has been studied for conjunctive use.

| | |
|---|---|
| Location | : Bara, Parsa and Rautahat |
| Latitude | : $27^0$ 10 ' 24 " N |
| Longitude | : $84^0$ 51 '24" E |
| Crops | : M.Paddy, E.Paddy, Wheat, Maize, Pulse, Oil Seeds, Vegetable and Potato |
| Soils | : Medium to fine textured alluvium |
| Area | : 31,500 Ha |
| No of farms | : 20,000 |
| Target of Irrigation | : 28,700 Ha with Surface and Ground Water |

The cropping pattern of project has been advised from initially by the expert of consultant. But, as project started to run, then farmers feel to alter the cropping pattern a little bit difference. Gradually, there was scarcity of water in peak season. Water is not sufficient as design discharge due to climate change and rainfalls is also affected.

In proposed cropping pattern, it is not changed. But, cropping intensity has been changed a little bit. Early, there was scarcity of water. To solve the problem, the concept of conjunctive use has been proposed. To clarify the situation, we have tried to illustrate “Proposed Cropping Pattern and Calendar in Project Area” as given in Table: 4.1
``````

``````

## Table 4.1 Proposed Cropping Pattern and Calendar in Project Area Table

PROJECT: **NARAYANI IRRIGATION SYSTEM** DISTRICT : **PARSA** CCA :28700 ha.

| ` | Crops | Area (ha) | % of CCA | Jan | | Feb | | March | | April | | May | | June | | July | | Aug. | | Sept. | | Oct. | | Nov. | | Dec. | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | |
| 1 | M. Paddy | 1448 | 5.0 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |
| 2 | E. Paddy | 28700 | 100.00 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |
| 3 | Wheat | 4592 | 16.00 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |
| 4 | Maize | 1837 | 6.40 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |
| 5 | Pulse | 2009 | 7.00 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |
| 6 | Oil seed | 2583 | 9.00 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |
| 7 | Vegetable | 4477 | 15.60 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |
| 8 | Potato | 1493 | 5.20 | | | | | | | | | | | | | | | | | | | | | | | | | I |
| | | | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | NI |

Cropping Intencity **164** %

NI - Non Irrigate I – Irrigated
``````

``````

# 5 .0 PROCEDURE FOR CONJUNCTIVE USE IN THE SELECTED PROJECT

For a good analysis, we have considered the different parameters.

- Determination of the size of project
- Time of completion
- Consideration of budgets and cost
- Technique of implementation
- Finding of constraints of the system
- Requirement of water user association
- Consideration of available resources

We have also applied "3 C" principles,

- **Consistency-**
  As far as possible, we have tried to find all problems and opportunities to make consistent decision in the project.
- **Comprehensiveness-**
  Analysis and assessment are made comprehensive to achieve its goal considering the real situation otherwise result cannot be in proper direction and sometimes, we cannot make successful completion of project.
- **Continuity-**
  Assumption is taken that project is continuous refining process. Nothing is discrete as a whole ultimate process. It should be continuous refined as the approaching situation

## 5 .1 Details Description of Procedure

- Calculation of Crop Water requirement and water balance:-
  Considering the evaporation, evapotranspiration, proposed and present crop calendar, crop water requirement, and water balance.
- Water requirement for per hectare of each crop has been calculated, and thus total water requirement has been calculated by multiplying the rate with the total crop areas.
``````

``````

- Sum of water requirement for monthly has been calculated.
- Maximum water requirement as deficit has been compared in twelve months and selected as the maximum deficit in the command area (28700 Ha).
- The supplement water has been calculated for fulfillment by the ground water with deep tubewell.
- Irrigating capacity of each deep tubewell has been assumed as 60 litres per second. Potentiality of deep tubewell has been found sufficient in command area as proved by the experiment throughout the year.
- The nos, of total deep tubewell has been found assuming the single command areas, then it was also calculated separately in each division of command area as 12 no's of block.
- Cropping intensity has been found to compare the situation of present and proposed future of the land to be irrigated.
  Cropping Intensity= Total cropping area during 12 months / Total culturable area

- For calculation of the productivity in command area, we have referred "Crop Budget" which consists yield, byproduct, gross return, and costs for seed, organic, chemicals, pesticides, labor and pair of animals. At last, net return can be calculated.
- The above calculation has been done for two cases, one is with conjunctive use in command area and other is without conjunctive use. Both cases is compared to find the benefits and costs.
- To find the positive impact of conjunctive use, we follow the economical parameters that is, Benefits and Costs Ratio(B/C) and Economic Rate of Return(ERR).These are the important parameters to compare the different blocks to each other and ultimately to observe the difference between with and without conjunctive use of water.

**Table 5.1** shows the details calculation of water requirement for the selected cropping pattern in total command area considering all affecting factor e.g. evaporation and transpiration as shown below.
``````

``````

# Table: 5 .1 Calculation of Water Requirement and Balance to Maintain the Whole Command Area

Name of Project: NARAYANI IRRIGATION SYSTEM

Name of Source: Narayani

Net command Area :-28700 Ha . Only 1-12 Block

| Crop | Area | Jan | | Feb | | Mar | | Apr | | May | | June | | July | Aug | | Sep | | Oct | | Nov | | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ha. | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| E.Paddy | 1448 | 0 | 0 | 0 | 0 | 3748 | 3994 | 3784 | 3878 | 2964 | 2827 | 1516 | 1052 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| M.Paddy | 28700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39482 | 38742 | 46998 | 28102 | 25273 | 24114 | 42595 | 42640 | 38928 | 0 | 0 | 0 |
| Wheat | 4592 | 3124 | 3504 | 4306 | 3730 | 1808 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6131 | 1735 | 2815 |
| Maize | 1837 | 0 | 0 | 0 | 0 | 0 | 0 | 1273 | 3363 | 2265 | 2403 | 732 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulse | 2009 | 594 | 1000 | 1556 | 1930 | 2373 | 2575 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 469 |
| Oilseed | 2583 | 703 | 1406 | 2106 | 2354 | 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 603 |
| Vegetable | 4477 | 2278 | 2852 | 3468 | 3592 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 893 | 944 | 1411 |
| Potato | 1493 | 892 | 1120 | 1376 | 1479 | 1564 | 1527 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1983 | 509 | 689 |
| Total Water Requirement(Litres Per Sec) | | 7591 | 9881 | 12811 | 13086 | 11511 | 8097 | 5057 | 7241 | 5229 | 5230 | 2249 | 1052 | 39482 | 38742 | 46998 | 28102 | 25273 | 24114 | 42595 | 42640 | 38928 | 9007 | 3187 | 5988 |
| Available Surface Water | | 5490 | 5490 | 6460 | 6460 | 6810 | 6810 | 0 | 0 | 7830 | 7830 | 6190 | 6190 | 10480 | 10480 | 12670 | 12670 | 8290 | 8290 | 11530 | 11530 | 0 | 0 | 5300 | 5300 |
| Balance | | -2101 | -4391 | -6351 | -6626 | -4701 | -1287 | -5057 | -7241 | 2601 | 2600 | 3941 | 5138 | -29002 | -28262 | -34328 | -15432 | -16983 | -15824 | -31065 | -31110 | -38928 | -9007 | 2113 | -688 |

Max No of DTW@60lps

649
``````

``````

## 5.2 Economic Analysis of the Selected Project for the Case Study

Economic analysis helps the project to determine the optimal exploration and production with certain uncertainties in prospects of cost and prices.

Decision analysis is useful for the strategic planning, processing management, and other areas. It is useful for the assessment of complexity with the doubtful outcomes. It helps to make a correct identification and recommend most effective method.

### 5.2.1 Benefits and Cost Ratio

Benefit–cost analysis (BCA),

It is an efficient approach to estimate the strengths as well as weaknesses of options which can satisfy all activities and functional requirements for a project. This technique is useful to find out the options which can give the best approach to adopt and make practice in prospect of benefits in cost, labor and time savings.

It has mainly two purposes:

- It is useful to decide a sound investment in term of justification or feasibility,
- It also gives a basis to compare projects. It involves in comparing each option with the total anticipated cost against the total expected benefits to observe whether the net benefits is more than the cost of investment its weightage.

Benefits and costs, both are expressed in terms of the time value of money to express all flows of the benefits along with the flows of project costs over the project life( time ) in terms of " Net Present Value".

### 5.2.2 Economic Rate of Return (ERR)

It is the best defined as an analysis for *micro-economic growth* .It actually measures the expected enhancement in household incomes. It can also be thought as the best estimation of the pre-investment to observe the economic impact of the planned investment. It also consists of income which is expected to generate through the improvements in environment and societal life style. However, it does not try to quantify the broader social value.

ERR calculation is expected to cover these scenarios:
``````

``````

- Expected outcome by means of investment in the project
- Expected outcome without the project investment.
- It focuses to determine the efficiency of resource distribution. Therefore, it treats equally to each group.

Most significant elements of decision analysis are integrated into project management processes in all knowledge areas. The analysis of potential options is the part of each and every stage of the project. Evaluation of uncertainties is the part of risk management process in project. Well established decision analysis process is integrated to improve the performance of organization with overall project management considerably.

The time and cash flow are involved in a project, the economic rate of return follows from net present value the same as a function of the rate of return which is the rate of return whose function is zero .

We can calculate, the (period, cash flow) pairs $(n, C_n)$ where $n$ is a positive integer, the total number of periods $N$, and the $\mathrm{NPV}$, (net present value); the IRR is given by $r$ in:

$$\mathrm{NPV} = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n} = 0$$

Period $n$ in years, for simple calculation, $r$ is calculated using the period in which the majority of the problem is defined for example, we can use months if the cash flows take place at monthly and converted to annually.

## 5.3 Economic Analysis of the Conjunctive Use as Applied Technique and Assumptions

Stepwise description,

- Analysis for 1-12 blocks of the command area has been divided for seeing result separately.
- Time of the project has been taken and analyzed for 30 years.
- Assumption for initial investment has been taken as 10% initially in 1st year, 70 % during the end of 1st year and 20% up to the end of 2nd year.
- Operation and maintenance cost@3% per year of construction cost has been taken.
- Benefit has been assumed from 3rd year as 10%, 4th year 25%, and 5th year 50 % and 6th year 100 % as continuous up to life period.
- Interest rate for initial investment has been analyzed for 10% and 12%.
- Cash flow for investment and benefit has been converted to the present value worth.
``````

``````

- Benefit and Cost Ratio (B/C) and Economic Rate of Return, both has been calculated as its mathematical calculation.
- All values are compared to each other to find the positive impact of conjunctive use in irrigation by its economical parameters.

### 5.4 Economic Analysis for Calculation and Representation

In study area, we have assumed the initial cash investment if different ratio up to 3 years after it, only 3% of total construction cost is considered as the maintenance cost per year up to project life. The return benefit is assumed from 3$^{rd}$ year to 6$^{th}$ year partially.But, after 6$^{th}$ year 100 % benefits have been assumed. By converting the investment and benefits at the base of present worth, calculation of Benefits and Cost Ratio has been found to compare the present and proposed future condition of project. It has been shown in details in **Table: 5.2** Calculation of B/C Ratio.

Similarly, EIRR and B/C Ratio has been expressed by Figure **: 5.1 and Figure: 5.2** to show the variation with different blocks as given below with Bar Charts. The **Figure 5.3** shows the variation of B/C ratio with characteristics and similarly**, Figure 5.4** shows EIRR in different blocks of culturable command area as the ratio of surface water and ground water are different in all blocks. Initially, water flow discharged was designed for the assumption of a fixed cropping pattern, but it was changed with time due to different choices of farmers and due to shortage of water availability in peak period.
``````

``````

**Table: 5.2**

**Calculation (B/C Ratio)**

T.Cost = NRs. **843440000.00**

T.Benefit = NRs. **1070878354.80**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 84344000.00 | 76676363.64 | 75307142.86 | 0.00 | 0.00 | 0.00 |
| 2 | 590408000.00 | 487940495.87 | 470669642.86 | 0.00 | 0.00 | 0.00 |
| 3 | 168688000.00 | 126737791.13 | 120068786.44 | 107087835.48 | 80456675.79 | 76223006.08 |
| 4 | 25303200.00 | 17282426.06 | 16080641.04 | 267719588.70 | 182856081.35 | 170140638.56 |
| 5 | 25303200.00 | 15711296.42 | 14357715.22 | 535439177.40 | 332465602.45 | 303822568.86 |
| 6 | 25303200.00 | 14282996.75 | 12819388.59 | 1070878354.80 | 604482913.54 | 542540301.54 |
| 7 | 25303200.00 | 12984542.50 | 11445882.67 | 1070878354.80 | 549529921.40 | 484410983.52 |
| 8 | 25303200.00 | 11804129.54 | 10219538.09 | 1070878354.80 | 499572655.82 | 432509806.71 |
| 9 | 25303200.00 | 10731026.86 | 9124587.58 | 1070878354.80 | 454156959.84 | 386169470.28 |
| 10 | 25303200.00 | 9755478.96 | 8146953.20 | 1070878354.80 | 412869963.49 | 344794169.89 |
| 11 | 25303200.00 | 8868617.24 | 7274065.36 | 1070878354.80 | 375336330.44 | 307851937.40 |
| 12 | 25303200.00 | 8062379.31 | 6494701.21 | 1070878354.80 | 341214845.86 | 274867801.25 |
| 13 | 25303200.00 | 7329435.73 | 5798840.37 | 1070878354.80 | 310195314.42 | 245417679.69 |
| 14 | 25303200.00 | 6663123.39 | 5177536.04 | 1070878354.80 | 281995740.38 | 219122928.29 |
| 15 | 25303200.00 | 6057384.90 | 4622800.04 | 1070878354.80 | 256359763.98 | 195645471.69 |
| 16 | 25303200.00 | 5506713.55 | 4127500.03 | 1070878354.80 | 233054330.89 | 174683456.87 |
| 17 | 25303200.00 | 5006103.23 | 3685267.89 | 1070878354.80 | 211867573.54 | 155967372.20 |
| 18 | 25303200.00 | 4551002.93 | 3290417.76 | 1070878354.80 | 192606885.03 | 139256582.32 |
| 19 | 25303200.00 | 4137275.39 | 2937873.00 | 1070878354.80 | 175097168.21 | 124336234.22 |
| 20 | 25303200.00 | 3761159.45 | 2623100.89 | 1070878354.80 | 159179243.83 | 111014494.84 |
| 21 | 25303200.00 | 3419235.86 | 2342054.37 | 1070878354.80 | 144708403.48 | 99120084.68 |
| 22 | 25303200.00 | 3108396.24 | 2091119.97 | 1070878354.80 | 131553094.07 | 88500075.60 |
| 23 | 25303200.00 | 2825814.76 | 1867071.40 | 1070878354.80 | 119593721.89 | 79017924.65 |
| 24 | 25303200.00 | 2568922.51 | 1667028.04 | 1070878354.80 | 108721565.35 | 70551718.43 |
| 25 | 25303200.00 | 2335384.10 | 1488417.89 | 1070878354.80 | 98837786.68 | 62992605.74 |
| 26 | 25303200.00 | 2123076.46 | 1328944.54 | 1070878354.80 | 89852533.35 | 56243397.99 |
| 27 | 25303200.00 | 1930069.51 | 1186557.63 | 1070878354.80 | 81684121.23 | 50217319.63 |
| 28 | 25303200.00 | 1754608.64 | 1059426.45 | 1070878354.80 | 74258292.02 | 44836892.53 |
| 29 | 25303200.00 | 1595098.76 | 945916.48 | 1070878354.80 | 67507538.20 | 40032939.76 |
| 30 | 25303200.00 | 1450089.79 | 844568.28 | 1070878354.80 | 61370489.28 | 35743696.21 |
| | | **866960439.48** | **809093486.18** | | **6631385515.82** | **5316031559.42** |

**B.C. Ratio at 10 % Discount Rate = 7.65**

**B.C. Ratio at 12 % Discount Rate = 6.57**
``````

``````

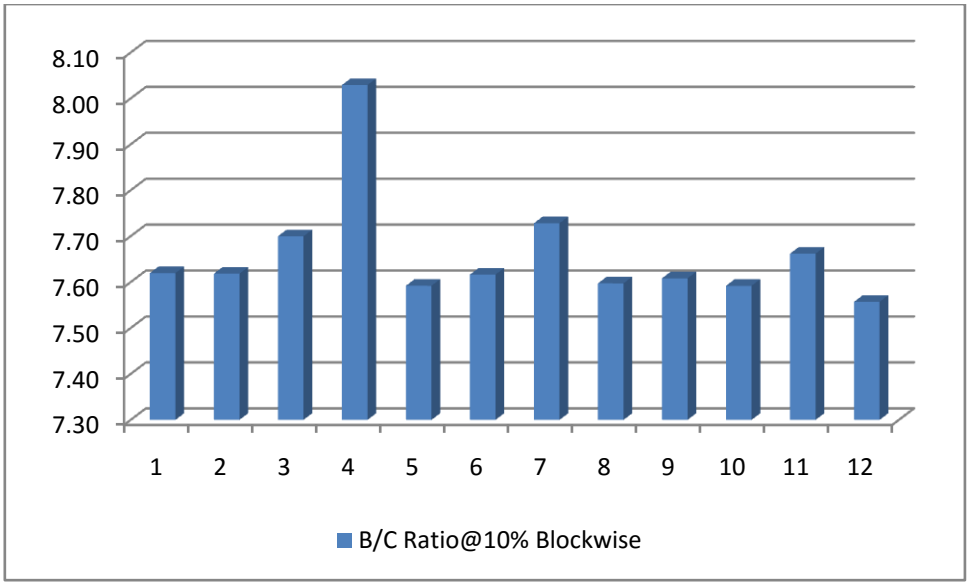



**Figure : 5.1 B/C Ratio Vs Block No. for Comparison**

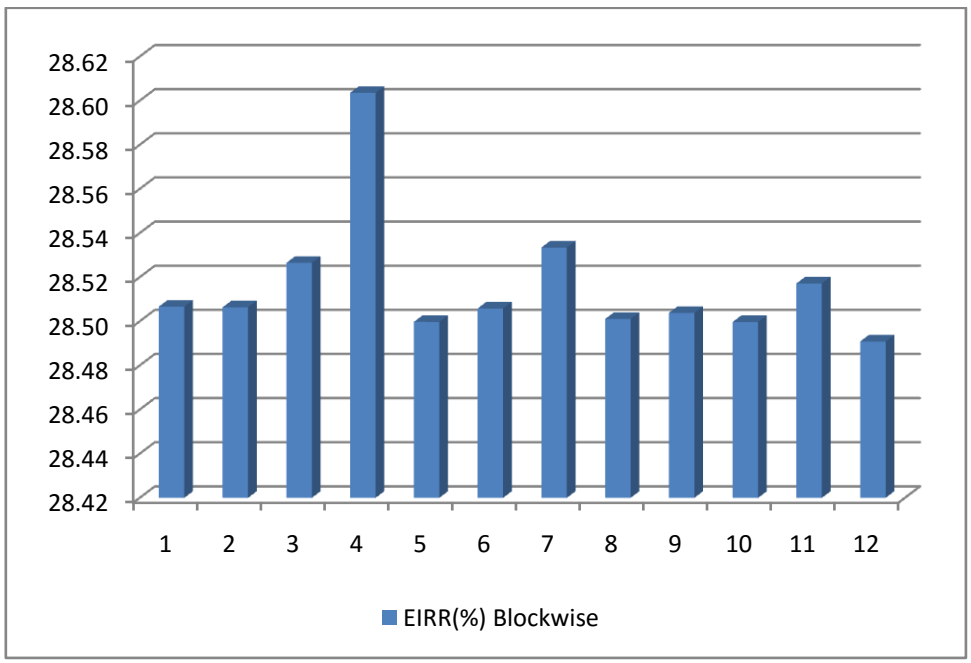



**Figure : 5.2 EIRR Values Vs Block No. for Comparison**
``````

``````

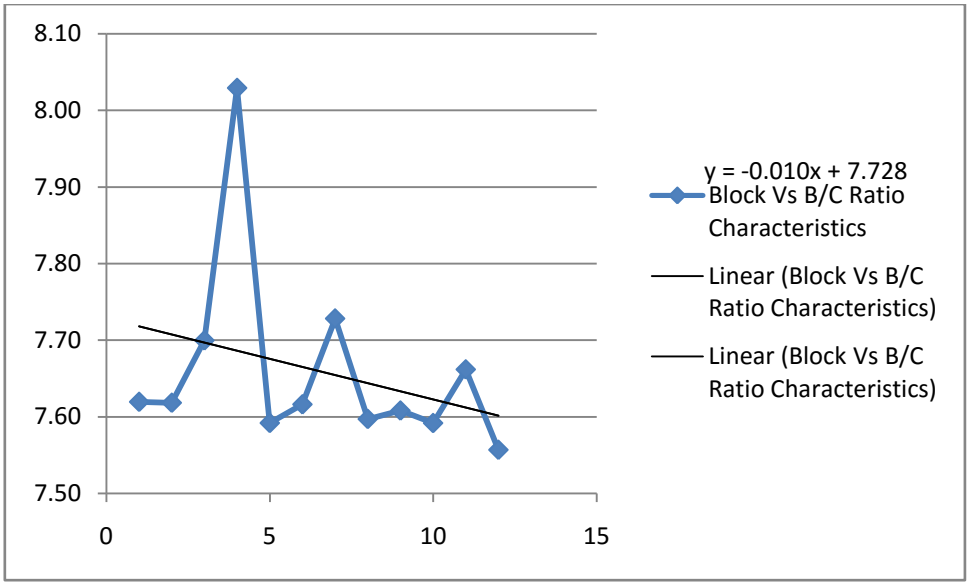



**Fig.5.3 Block Vs B/C Ratio Characteristics**

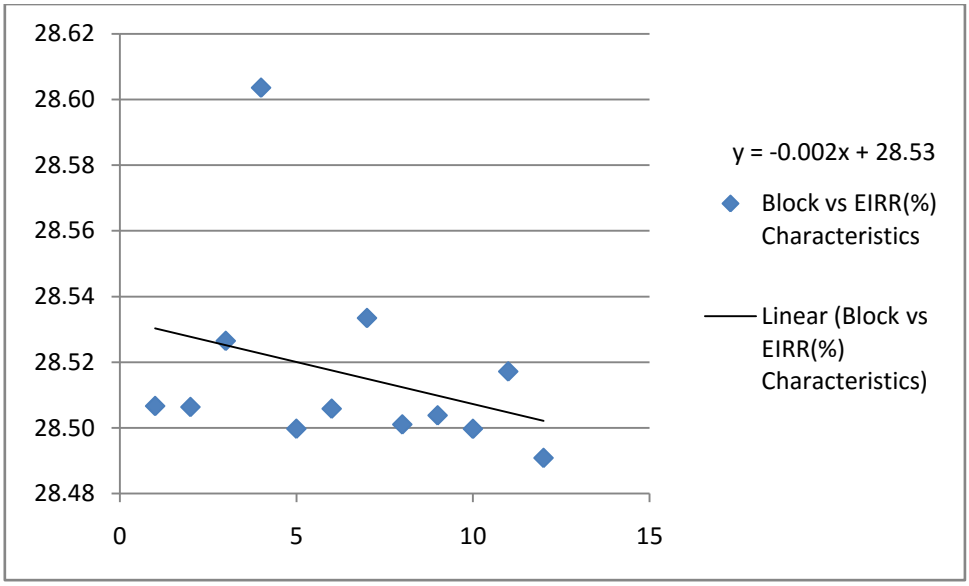



**Fig.5.4 Block Vs EIRR Characteristics**
``````

``````

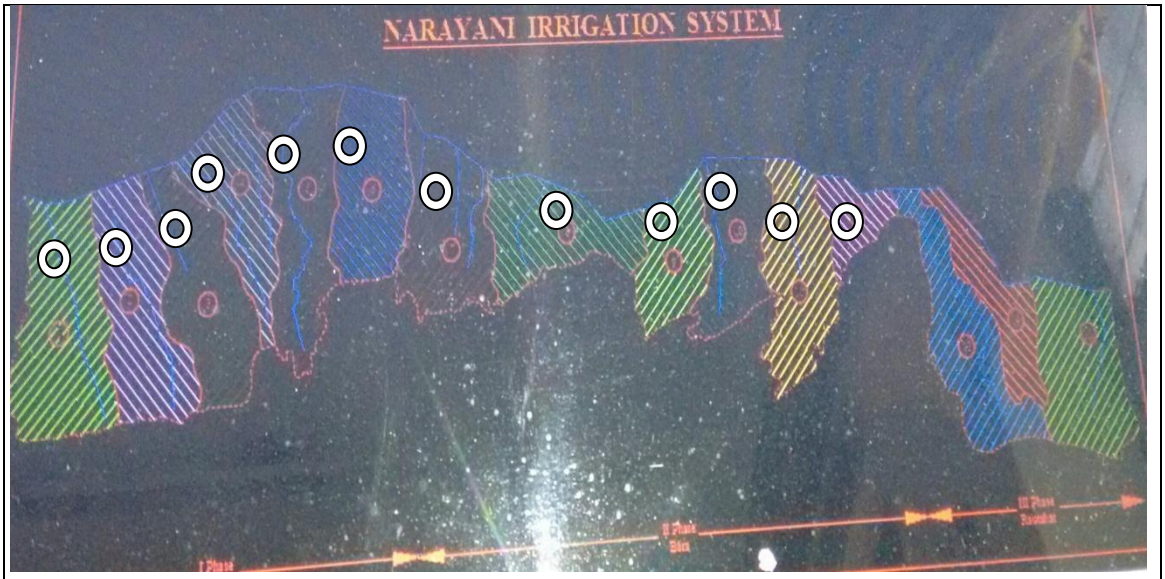
# 6.0 RESULT AND DISCUSSION

## 6.1 Observation and Discussion

- Before starting on new additional stage of project, it is observed that reassessing of water availability is very important otherwise confidence of farmers to the irrigation project can be lost.
- For effective implementation, beneficiaries should be participated from initial phase of discussion, design, construction, implementation and operation & maintenance for the successful project.
- Small farmers and all communities should be involved actively before investment for conjunctive use in project. Discussion with water user association is necessary to assure the reliability of water supply by the concept of conjunctive use.
- For sustainability of project, farmers should be convinced well for the collection of service charge to repair and maintenance on regular basis.
- Awareness program by public and government are necessary to utilize the available water resources.
- Conjunctive use is not only technique of a good irrigation. It has a good impact on institutional development, physical objectives, financial objectives, social objectives, development of private sector and poverty reduction.
- Conjunctive use can increase the dry season production in agriculture with equity, predictability and reliability of irrigation system.
- By implementation of conjunctive use in Narayani Irrigation System, we can increase the cropping intensity , B/C Ratio and ERR .

On the context of present study, the major theme is to fufill the water demand for the proposed cropping pattern. Surface water has been already fixed . So , we can add the water demand from farmers only by the supplement of ground water with deep tubewell. We have found the no's of deep tube wells required for each block from 1 to 12.**Fig: 6.1** has been presented as the required deep tube wells in command area covering the blocks 1 to 12 as given below.
``````

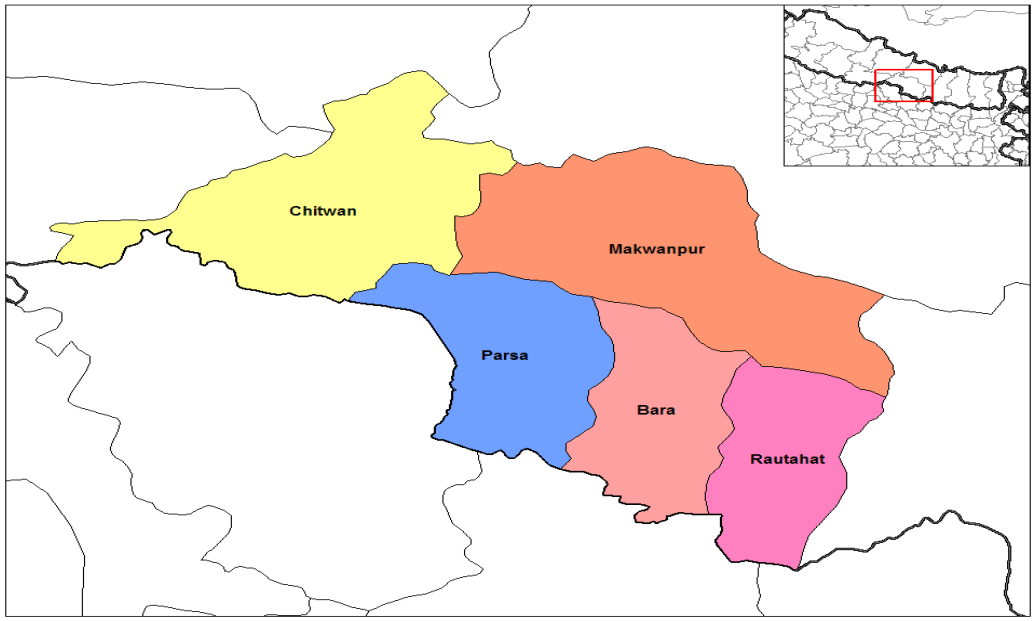
``````




1-12 Blocks with Surface Water and Ground Water (O-Deep Tubewell)

76, 68, 68, 53, 64, 64, 36, 63, 47, 53, 29, and 27 No's of

D-Tubewell (O) from 1 to 12 Blocks




1-12 Block in Parsa, Bara, and Rautahat District (NIP)

**Fig: 6.1 Layout of Deep Tubewell as Conjunctive Use in Command Area**
``````

``````

We have found the proposed conjunctive use of water very beneficial which has been expressed in terms of Benefits and Costs Ratio(B/C ) including Economic Internal Rate of Return(EIRR or ERR) including the Cropping Intensity and No of Deep Tubewell used in whole command area .This can be expressed in **Table: 6.1** Economical Output as given below.

**Table: 6.1 Economical Output**

| Block | EIRR(%) | B/C Ratio@10% | Cropping Intensity(%) | No. of Deep Tubewell |
|---|---|---|---|---|
| 1 | 28.51 | 7.62 | 164.20 | 76 |
| 2 | 28.51 | 7.62 | 164.25 | 68 |
| 3 | 28.53 | 7.70 | 164.30 | 68 |
| 4 | 28.60 | 8.03 | 164.17 | 53 |
| 5 | 28.50 | 7.59 | 164.27 | 64 |
| 6 | 28.51 | 7.62 | 164.24 | 64 |
| 7 | 28.53 | 7.73 | 164.25 | 36 |
| 8 | 28.50 | 7.60 | 164.27 | 63 |
| 9 | 28.50 | 7.61 | 164.26 | 47 |
| 10 | 28.50 | 7.59 | 164.25 | 53 |
| 11 | 28.52 | 7.66 | 164.28 | 29 |
| 12 | 28.49 | 7.56 | 164.32 | 27 |
| **Average** | **28.52** | **7.66** | **164.26** | |
| **Standard Deviation** | **0.03** | **0.13** | **0.04** | |
| **Total** | | | | **647** |
``````

``````

# 7. 0 CONCLUSION

## 7.1 General

The purpose of the present study is to describe the evaluation of conjunctive use based on demand model in Narayani Irrigation System including the information about the favorable condition of the study area in different aspects.

Following conclusion can be drawn about the potential feature of ground water in study area relating its geology, water condition, static water level, and hydraulic gradient as found in the study of secondary data also which is concluded as a favorable condition for conjunctive use.

*Sub-surface Geology of the Study Area -*

The aquifers consist of gravel, sand, and pebble with silt and clay in alternate. Semi-confined and unconfined aquifers are made of gravel, sand, pebble, cobble and boulder.

Sediment distribution is uniform and homogeneous relatively. Depth of deep wells varies from 40 m to 126 m so on. Lithology is arranged of boulder, gravel, pebble, and sand with clays.

*Ground Water Conditions-*

The aquifer is mainly filled with highly permeable and porous unconsolidated to poorly consolidated alluvium that structures the large aquifer. The main aquifer system is homogeneous by their hydraulic properties and the tubewell logs. Groundwater is under unconfined or water table types in shallow aquifers and below semi-confined for deeper aquifers.

*Static Water Level-*

The depth to water level is found uniformly extend over the study area in pre-monsoon and post-monsoon season.

*Hydraulic gradient-*

Hydraulic gradient is found almost uniformly similar at the whole study area. Hydraulic gradient changes in every meter of horizontal distance. Recharging takes place properly by precipitation, rainfalls and stream seepage. So, aquifer is suitable as a good storage of water resource.In the wet season, the aquifers become completely replenished and any further possible recharge is rejected. It gives to extensive flooding. Sometimes, heavy rain
``````

``````

comes in the monsoon period including snow thaw from the Himalayas which cause very destructive and extensive flooding in the area. The recharge zone lies mostly along the northern side of the study area. The study area has good potential for both shallow and deep aquifers.

### 7.2 Specific

By the observation, it can be concluded that conjunctive use of surface water with supplement of ground water is suitable in study area.

As we observe the study area which is called Narayani Irrigation System, is the best system which is running very well with all parameters i.e. social, economical, technical, and political. But, due to passing of time, there is a little bit change in climate and ultimately, farmers are facing the scarcity of water in peak season in spite of availability of potential water resources. Only, surface water is not sufficient. So, we have studied the site and found the supplement source as ground water through deep tube wells that is completely based on the survey of farmer's choice and suggestion. We have not considered only ideal concept based on theory because it is running project .It needs exact solution that can be practically good for all farmer's demand. Farmers do not want to use more and more ground water because the service rate is high and electricity is also expensive. So, they do not like to take more risk in farming. But, they demand for the ground water in certain level as supplement source for the peak period especially.

We have recommended the total no of deep tube wells as 647 that is divided in 12 blocks of command area in different no's that is 76, 68, 68, 53, 64, 64, 36, 63, 47, 53, 29, and 27. Economically, this conjunctive methodology is feasible and beneficial. Economical parameters (B/C Ratio and ERR) are considerably higher than the present situation of project. Average Benefit-Cost Ratio is 7.66 and Economical Rate of Return is 28.52 % where as there is only 24% for surface water and 14% for ground water separately at present. Cropping intensity is slightly changed as average 164.26 % and considered to cover total command area with all the year round irrigation completely.
``````

``````

It is seen to be achieved due to implementation of the conjunctive use of water resources as shown below,

- Cropping intensity can be slightly increased up to 164.26 %
- Irrigation intensity can be drastically changed by more than 2 times from the present available irrigation system.
- Average Benefit Cost Ratio can be increased up to 7.66
- Economic Rate of Return can be increased from 14% to 28.52 %
- Poverty can be decreased due to upliftment of poor farmers.
- Ultimately, it is favorable and supportive to the annual plan of perspective to Government of Nepal.
``````

``````

# 8. 0 REFERENCE


1. Brunke, Matthias and Tom Gonser. 1997. *The Ecological Significance of Exchange Process between Rivers & Groundwater. Freshwater Biology*, Vol. 37. Page 1-33.

2. http://www.gwrdb.gov.np/index.php, Oct 2015

3. International Journal of Modern engineering Research (IJMER)Vol.2, Issue.6,Nov-Dec.2012 pp-4051-4059

4. Jacek Scibek, Diana M. Allen, Alex J. Cannon et al, *Journal of Hydrology,canada* (2007) 333, 165– 181

5. John B. Czarnecki, Brian R. Clark, and Gregory P. Stanton , *Water-Resources Investigations Report* 03-4233

6. John D. Bredehoeft and Robert A. Young, *U.S. Geological Survey*, *Water Resources Research* , Vol.19, No. 5, Pages 1111-1121, Oct 1983

7. J.W.Forrester System Dynamics Modeling :A Practical Approach,Volume-1,1961

8. Katarína Džubáková: *Rainfall – Runoff Modeling: Its development, Classification and Application University Press* ISBN-10: 0-19-569461-9

9. *K Subramanya*, Engineering Hydrology, Third edition, Tata Mc-Graw Hill Education Private Limited, New Delhi

10. Mott MacDonald, Guidelines for Good Governance, Department of Irrigation,Nepal,2002

11. Rushton in Gorelick, Practical Handbook of Soil, Vadose Zone, and Ground-Water Contamination , 1986

12. S. Alireza Taghavi, , Optimal Control of Ground-Water Quality Management: Nonlinear Programming Approach ,Nov 1994.
``````

``````

13. T.I. Eldho, Conjunctive Use of Water, Dept of Civil Engineering IIT Bombay, Module3-(L8-L11),Lecture 9, 2002

14. T.P. Tuong and B.A.M. Bouman,Rice Production Water Scarce Environments, International Rice Research Institute, DAPO Box 7777, Metro Manila, Philippines

15. Vincent, Linden Dempsey, Peter, Conjunctive Water Use for Irrigation : Good Theory , Poor Practice, Volume 9,Issue 3.Page. ,227-245 , 1993

16. Weston, Roy F., Inc. 1998. Final Report: Groundwater/ Surface Water Interactions, Conceptual Models and Assessment Endpoints. USEPA Work Assignment No. 3-353. July 1998.

17. Winter, Thomas C. et al. 1998. *Ground Water and Surface Water: A Single Resource. USGS Circular* #1139
``````

``````

# APPENDICES-A1
``````

``````

| Future of Project With Conjunctive Use | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Particulars | Unit | M.Paddy | E.Paddy | Wheat | Maize | Pulses | Oilseed | Vegetables | Potatoes |
| I | **YIELD** | t/ha | 3.75 | 3.20 | 2.50 | 2.50 | 0.80 | 0.80 | 10.00 | 18.00 |
| | Price | NRs/t | 15000.00 | 14000.00 | 16000.00 | 14000.00 | 50000.00 | 55000.00 | 20000.00 | 8500.00 |
| | Value | NRs/ha | 56250.00 | 44800.00 | 40000.00 | 35000.00 | 40000.00 | 44000.00 | 200000.0 | 153000.0 |
| | **BY PRODUCT** | t/ha | | | | | | | | |
| | Price | NRs/t | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Value | NRs/ha | 1500.00 | 1500.00 | 1500.00 | 1500.00 | 500.00 | 500.00 | 1500.00 | 600.00 |
| | **GR. RETURN** | NRs/ha | 57750.00 | 46300.00 | 41500.00 | 36500.00 | 40500.00 | 44500.00 | 201500.0 | 153600.0 |
| II | **SEED** | kg/ha | 30.00 | 30.00 | 100.00 | 25.00 | 40.00 | 9.00 | 2.00 | 1500.00 |
| | Price | NRs/kg | 27.00 | 25.00 | 33.00 | 25.00 | 150.00 | 200.00 | 200.00 | 30.00 |
| | Value | NRs/ha | 810.00 | 750.00 | 3300.00 | 625.00 | 6000.00 | 1800.00 | 400.00 | 45000.00 |
| | **ORGANICS** | t/ha | 6.00 | 6.00 | 6.00 | 6.00 | 5.00 | 6.00 | 32.00 | 30.00 |
| | Price | NRs/t | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 |
| | Value | NRs/ha | 1200.00 | 1200.00 | 1200.00 | 1200.00 | 1000.00 | 1200.00 | 6400.00 | 6000.00 |
| | **CHEMICALS** | kg/ha | 100.00 | 100.00 | 100.00 | 60.00 | 20.00 | 60.00 | 70.00 | 70.00 |
| | Price | NRs/kg | 40.29 | 40.29 | 36.72 | 36.72 | 27.79 | 33.74 | 32.89 | 32.89 |
| | Value | NRs/ha | 4029.00 | 4029.00 | 3672.00 | 2203.20 | 555.80 | 2024.40 | 2302.30 | 2302.30 |
| | **P** | kg/ha | 30.00 | 30.00 | 50.00 | 30.00 | 20.00 | 40.00 | 50.00 | 50.00 |
| | Price | NRs/kg | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 |
| | Value | NRs/ha | 1304.40 | 1304.40 | 2174.00 | 1304.40 | 869.60 | 1739.20 | 2174.00 | 2174.00 |
| | **K** | kg/ha | 30.00 | 30.00 | 25.00 | 30.00 | 20.00 | 20.00 | 40.00 | 40.00 |
| | Price | NRs/kg | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 |
| | Value | NRs/ha | 1250.10 | 1250.10 | 1041.75 | 1250.10 | 833.40 | 833.40 | 1666.80 | 1666.80 |
| | **PESTICIDES** | NRs/ha | 500.00 | 500.00 | 400.00 | 200.00 | 100.00 | 100.00 | 15000.00 | 1000.00 |
| | **LABOUR** | md/ha | 175.00 | 175.00 | 110.00 | 123.00 | 66.00 | 63.00 | 90.00 | 30.00 |
| | Price | NRs/md | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 |
| | Value | NRS/ha | 21000.00 | 21000.00 | 13200.00 | 14760.00 | 7920.00 | 7560.00 | 10800.00 | 3600.00 |
| | **Animal of Pair** | AD/ha | 44.00 | 44.00 | 40.00 | 25.00 | 19.00 | 24.00 | 60.00 | 60.00 |
| | Price | NRs/AD. | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 |
| | Value | NRs/ha | 13200.00 | 13200.00 | 12000.00 | 7500.00 | 5700.00 | 7200.00 | 18000.00 | 18000.00 |
| | **COST** | NRs/ha | 43293.50 | 43233.50 | 36987.75 | 29042.70 | 22978.80 | 22457.00 | 56743.10 | 79743.1 |
| **III** | **NET RETURN** | NRs/ha | 14456.50 | 3066.5 | 4512.25 | 7457.30 | 17521.20 | 22043.00 | 144756.9 | 73856.9 |

I
``````

``````

# APPENDIX A2

## Project without Conjunctive Use(At Present)

| | Particulars | Unit | M.Paddy | E..Paddy | Wheat | Maize | Pulses | Oilseed | Vegetables | Potatoes |
|---|---|---|---|---|---|---|---|---|---|---|
| I | **YIELD** | t/ha | 2.90 | 2.75 | 2.20 | 2.20 | 0.60 | 0.60 | 8.00 | 13.00 |
| | Price | NRs/t | 15000.00 | 14000.00 | 16000.00 | 14000.00 | 50000.00 | 55000.00 | 20000.00 | 8500.00 |
| | Value | NRs/ha | 43500.00 | 38500.00 | 35200.00 | 30800.00 | 30000.00 | 33000.00 | 160000.0 | 110500.0 |
| | **BY PRODUCT** | t/ha | | | | | | | | |
| | Price | NRs/t | | | | | | | | |
| | Value | NRs/ha | 1000.00 | 1000.00 | 750.00 | 250.00 | 240.00 | 150.00 | 0.00 | 0.00 |
| | **GROSS RETURN** | NRs/ha | 44500.00 | 39500.00 | 35950.00 | 31050.00 | 30240.00 | 33150.00 | 160000.0 | 110500.0 |
| II | **SEED** | kg/ha | 30.00 | 30.00 | 100.00 | 25.00 | 40.00 | 9.00 | 2.00 | 1000.00 |
| | Price | NRs/kg | 27.00 | 25.00 | 33.00 | 25.00 | 150.00 | 200.00 | 200.00 | 30.00 |
| | Value | NRs/ha | 810.00 | 750.00 | 3300.00 | 625.00 | 6000.00 | 1800.00 | 400.00 | 30000.00 |
| | **ORGANICS** | t/ha | 6.00 | 6.00 | 6.00 | 6.00 | 5.00 | 6.00 | 32.00 | 30.00 |
| | Price | NRs/t | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 | 200.00 |
| | Value | NRs/ha | 1200.00 | 1200.00 | 1200.00 | 1200.00 | 1000.00 | 1200.00 | 6400.00 | 6000.00 |
| | **CHEMICALS N** | kg/ha | 60.00 | 60.00 | 50.00 | 60.00 | 20.00 | 60.00 | 70.00 | 70.00 |
| | Price | NRs/kg | 39.70 | 39.70 | 27.79 | 36.72 | 27.79 | 33.74 | 32.89 | 32.89 |
| | Value | NRs/ha | 2382.00 | 2382.00 | 1389.50 | 2203.20 | 555.80 | 2024.40 | 2302.30 | 2302.30 |
| | **P** | kg/ha | 20.00 | 20.00 | 50.00 | 30.00 | 20.00 | 40.00 | 50.00 | 50.00 |
| | Price | NRs/kg | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 | 43.48 |
| | Value | NRs/ha | 869.60 | 869.60 | 2174.00 | 1304.40 | 869.60 | 1739.20 | 2174.00 | 2174.00 |
| | **K** | kg/ha | 20.00 | 20.00 | 20.00 | 30.00 | 20.00 | 20.00 | 40.00 | 40.00 |
| | Price | NRs/kg | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 | 41.67 |
| | Value | NRs/ha | 833.40 | 833.40 | 833.40 | 1250.10 | 833.40 | 833.40 | 1666.80 | 1666.80 |
| | **PESTICIDES** | NRs/ha | 500.00 | 500.00 | 400.00 | 200.00 | 100.00 | 100.00 | 15000.00 | 1000.00 |
| | **LABOUR** | md/ha | 165.00 | 165.00 | 100.00 | 115.00 | 55.00 | 60.00 | 90.00 | 30.00 |
| | Price | NRs/md | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 |
| | Value | NRS/ha | 19800.00 | 19800.00 | 12000.00 | 13800.00 | 6600.00 | 7200.00 | 10800.00 | 3600.00 |
| | **Animal of Pair** | AD/ha | 42.00 | 42.00 | 38.00 | 24.00 | 18.00 | 23.00 | 60.00 | 60.00 |
| | Price | NRs/AD. | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 | 300.00 |
| | Value | NRs/ha | 12600.00 | 12600.00 | 11400.00 | 7200.00 | 5400.00 | 6900.00 | 18000.00 | 18000.00 |
| | **COST** | NRs/ha | 38995.00 | 38935.00 | 32696.90 | 27782.70 | 21358.80 | 21797.00 | 56743.10 | 64743.10 |
| **III** | **NET RETURN** | NRs/ha | 5505.00 | 565.00 | 3253.10 | 3267.30 | 8881.20 | 11353.00 | 103256.9 | 45756.9 |
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 1)**

T.Cost = NRs. **98800000.00**

T.Benefit = NRs. **124960683.28**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 9880000.00 | 8981818.18 | 8821428.57 | 0.00 | 0.00 | 0.00 |
| 2 | 69160000.00 | 57157024.79 | 55133928.57 | 0.00 | 0.00 | 0.00 |
| 3 | 19760000.00 | 14845980.47 | 14064777.70 | 12496068.33 | 9388481.09 | 8894454.61 |
| 4 | 2964000.00 | 2024451.88 | 1883675.58 | 31240170.82 | 21337457.02 | 19853693.33 |
| 5 | 2964000.00 | 1840410.80 | 1681853.20 | 62480341.64 | 38795376.40 | 35453023.80 |
| 6 | 2964000.00 | 1673100.73 | 1501654.64 | 124960683.28 | 70537048.00 | 63308971.07 |
| 7 | 2964000.00 | 1521000.66 | 1340763.07 | 124960683.28 | 64124589.09 | 56525867.03 |
| 8 | 2964000.00 | 1382727.87 | 1197109.89 | 124960683.28 | 58295080.99 | 50469524.13 |
| 9 | 2964000.00 | 1257025.34 | 1068848.11 | 124960683.28 | 52995528.17 | 45062075.12 |
| 10 | 2964000.00 | 1142750.31 | 954328.67 | 124960683.28 | 48177752.88 | 40233995.64 |
| 11 | 2964000.00 | 1038863.92 | 852079.17 | 124960683.28 | 43797957.17 | 35923210.40 |
| 12 | 2964000.00 | 944421.74 | 760784.98 | 124960683.28 | 39816324.70 | 32074295.00 |
| 13 | 2964000.00 | 858565.22 | 679272.30 | 124960683.28 | 36196658.81 | 28637763.39 |
| 14 | 2964000.00 | 780513.84 | 606493.12 | 124960683.28 | 32906053.47 | 25569431.60 |
| 15 | 2964000.00 | 709558.03 | 541511.72 | 124960683.28 | 29914594.06 | 22829849.64 |
| 16 | 2964000.00 | 645052.76 | 483492.61 | 124960683.28 | 27195085.51 | 20383794.32 |
| 17 | 2964000.00 | 586411.60 | 431689.83 | 124960683.28 | 24722805.01 | 18199816.36 |
| 18 | 2964000.00 | 533101.45 | 385437.35 | 124960683.28 | 22475277.28 | 16249836.03 |
| 19 | 2964000.00 | 484637.68 | 344140.49 | 124960683.28 | 20432070.26 | 14508782.17 |
| 20 | 2964000.00 | 440579.71 | 307268.29 | 124960683.28 | 18574609.32 | 12954269.80 |
| 21 | 2964000.00 | 400527.01 | 274346.69 | 124960683.28 | 16886008.48 | 11566312.32 |
| 22 | 2964000.00 | 364115.47 | 244952.40 | 124960683.28 | 15350916.80 | 10327064.57 |
| 23 | 2964000.00 | 331014.06 | 218707.50 | 124960683.28 | 13955378.91 | 9220593.37 |
| 24 | 2964000.00 | 300921.87 | 195274.55 | 124960683.28 | 12686708.10 | 8232672.65 |
| 25 | 2964000.00 | 273565.34 | 174352.28 | 124960683.28 | 11533371.00 | 7350600.58 |
| 26 | 2964000.00 | 248695.76 | 155671.68 | 124960683.28 | 10484882.72 | 6563036.23 |
| 27 | 2964000.00 | 226087.06 | 138992.57 | 124960683.28 | 9531711.57 | 5859853.78 |
| 28 | 2964000.00 | 205533.69 | 124100.51 | 124960683.28 | 8665192.33 | 5232012.30 |
| 29 | 2964000.00 | 186848.81 | 110804.03 | 124960683.28 | 7877447.58 | 4671439.56 |
| 30 | 2964000.00 | 169862.55 | 98932.17 | 124960683.28 | 7161315.98 | 4170928.17 |
| | | **101555168.62** | **94776672.24** | | **773815682.66** | **620327166.99** |

**B.C. Ratio at 10 % Discount Rate = 7.62**

**B.C. Ratio at 12 % Discount Rate = 6.55**
``````

``````

**OMPUTATION OF B.C. RATIO(BLOCK 2)**

T.Cost = NRs. **88400000.00**

T.Benefit = NRs. **111789252.65**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 8840000.00 | 8036363.64 | 7892857.14 | 0.00 | 0.00 | 0.00 |
| 2 | 61880000.00 | 51140495.87 | 49330357.14 | 0.00 | 0.00 | 0.00 |
| 3 | 17680000.00 | 13283245.68 | 12584274.78 | 11178925.26 | 8398892.01 | 7956938.20 |
| 4 | 2652000.00 | 1811351.68 | 1685393.94 | 27947313.16 | 19088390.93 | 17761022.76 |
| 5 | 2652000.00 | 1646683.35 | 1504816.02 | 55894626.32 | 34706165.33 | 31716112.07 |
| 6 | 2652000.00 | 1496984.86 | 1343585.73 | 111789252.65 | 63102118.78 | 56635914.40 |
| 7 | 2652000.00 | 1360895.33 | 1199630.12 | 111789252.65 | 57365562.53 | 50567780.72 |
| 8 | 2652000.00 | 1237177.57 | 1071098.32 | 111789252.65 | 52150511.39 | 45149804.21 |
| 9 | 2652000.00 | 1124706.88 | 956337.79 | 111789252.65 | 47409555.81 | 40312325.19 |
| 10 | 2652000.00 | 1022460.80 | 853873.02 | 111789252.65 | 43099596.19 | 35993147.49 |
| 11 | 2652000.00 | 929509.82 | 762386.63 | 111789252.65 | 39181451.08 | 32136738.83 |
| 12 | 2652000.00 | 845008.93 | 680702.35 | 111789252.65 | 35619500.98 | 28693516.81 |
| 13 | 2652000.00 | 768189.94 | 607769.95 | 111789252.65 | 32381364.53 | 25619211.44 |
| 14 | 2652000.00 | 698354.49 | 542651.74 | 111789252.65 | 29437604.12 | 22874295.93 |
| 15 | 2652000.00 | 634867.71 | 484510.48 | 111789252.65 | 26761458.29 | 20423478.51 |
| 16 | 2652000.00 | 577152.47 | 432598.65 | 111789252.65 | 24328598.44 | 18235248.67 |
| 17 | 2652000.00 | 524684.06 | 386248.79 | 111789252.65 | 22116907.68 | 16281472.03 |
| 18 | 2652000.00 | 476985.51 | 344864.99 | 111789252.65 | 20106279.71 | 14537028.59 |
| 19 | 2652000.00 | 433623.19 | 307915.17 | 111789252.65 | 18278436.10 | 12979489.82 |
| 20 | 2652000.00 | 394202.90 | 274924.26 | 111789252.65 | 16616760.09 | 11588830.19 |
| 21 | 2652000.00 | 358366.27 | 245468.09 | 111789252.65 | 15106145.53 | 10347169.81 |
| 22 | 2652000.00 | 325787.52 | 219167.94 | 111789252.65 | 13732859.58 | 9238544.48 |
| 23 | 2652000.00 | 296170.47 | 195685.66 | 111789252.65 | 12484417.80 | 8248700.43 |
| 24 | 2652000.00 | 269245.89 | 174719.34 | 111789252.65 | 11349470.72 | 7364911.10 |
| 25 | 2652000.00 | 244768.99 | 155999.41 | 111789252.65 | 10317700.66 | 6575813.48 |
| 26 | 2652000.00 | 222517.26 | 139285.19 | 111789252.65 | 9379727.87 | 5871262.03 |
| 27 | 2652000.00 | 202288.42 | 124361.77 | 111789252.65 | 8527025.34 | 5242198.24 |
| 28 | 2652000.00 | 183898.56 | 111037.30 | 111789252.65 | 7751841.22 | 4680534.15 |
| 29 | 2652000.00 | 167180.51 | 99140.44 | 111789252.65 | 7047128.38 | 4179048.35 |
| 30 | 2652000.00 | 151982.28 | 88518.25 | 111789252.65 | 6406480.34 | 3731293.17 |
| | | **90865150.87** | **84800180.43** | | **692251951.41** | **554941831.08** |

**B.C. Ratio at 10 % Discount Rate = 7.62**

**B.C. Ratio at 12 % Discount Rate = 6.54**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 3)**

T.Cost = NRs. **88400000.00**

T.Benefit = NRs. **112983263.36**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 8840000.00 | 8036363.64 | 7892857.14 | 0.00 | 0.00 | 0.00 |
| 2 | 61880000.00 | 51140495.87 | 49330357.14 | 0.00 | 0.00 | 0.00 |
| 3 | 17680000.00 | 13283245.68 | 12584274.78 | 11298326.34 | 8488599.80 | 8041925.52 |
| 4 | 2652000.00 | 1811351.68 | 1685393.94 | 28245815.84 | 19292272.28 | 17950726.61 |
| 5 | 2652000.00 | 1646683.35 | 1504816.02 | 56491631.68 | 35076858.68 | 32054868.94 |
| 6 | 2652000.00 | 1496984.86 | 1343585.73 | 112983263.36 | 63776106.70 | 57240837.39 |
| 7 | 2652000.00 | 1360895.33 | 1199630.12 | 112983263.36 | 57978278.82 | 51107890.53 |
| 8 | 2652000.00 | 1237177.57 | 1071098.32 | 112983263.36 | 52707526.20 | 45632045.11 |
| 9 | 2652000.00 | 1124706.88 | 956337.79 | 112983263.36 | 47915932.91 | 40742897.42 |
| 10 | 2652000.00 | 1022460.80 | 853873.02 | 112983263.36 | 43559939.00 | 36377586.98 |
| 11 | 2652000.00 | 929509.82 | 762386.63 | 112983263.36 | 39599944.55 | 32479988.38 |
| 12 | 2652000.00 | 845008.93 | 680702.35 | 112983263.36 | 35999949.59 | 28999989.62 |
| 13 | 2652000.00 | 768189.94 | 607769.95 | 112983263.36 | 32727226.90 | 25892847.88 |
| 14 | 2652000.00 | 698354.49 | 542651.74 | 112983263.36 | 29752024.46 | 23118614.18 |
| 15 | 2652000.00 | 634867.71 | 484510.48 | 112983263.36 | 27047294.96 | 20641619.80 |
| 16 | 2652000.00 | 577152.47 | 432598.65 | 112983263.36 | 24588449.96 | 18430017.68 |
| 17 | 2652000.00 | 524684.06 | 386248.79 | 112983263.36 | 22353136.33 | 16455372.93 |
| 18 | 2652000.00 | 476985.51 | 344864.99 | 112983263.36 | 20321033.03 | 14692297.26 |
| 19 | 2652000.00 | 433623.19 | 307915.17 | 112983263.36 | 18473666.39 | 13118122.55 |
| 20 | 2652000.00 | 394202.90 | 274924.26 | 112983263.36 | 16794242.17 | 11712609.42 |
| 21 | 2652000.00 | 358366.27 | 245468.09 | 112983263.36 | 15267492.88 | 10457686.98 |
| 22 | 2652000.00 | 325787.52 | 219167.94 | 112983263.36 | 13879538.98 | 9337220.52 |
| 23 | 2652000.00 | 296170.47 | 195685.66 | 112983263.36 | 12617762.71 | 8336804.04 |
| 24 | 2652000.00 | 269245.89 | 174719.34 | 112983263.36 | 11470693.38 | 7443575.03 |
| 25 | 2652000.00 | 244768.99 | 155999.41 | 112983263.36 | 10427903.07 | 6646049.14 |
| 26 | 2652000.00 | 222517.26 | 139285.19 | 112983263.36 | 9479911.88 | 5933972.44 |
| 27 | 2652000.00 | 202288.42 | 124361.77 | 112983263.36 | 8618101.71 | 5298189.68 |
| 28 | 2652000.00 | 183898.56 | 111037.30 | 112983263.36 | 7834637.92 | 4730526.50 |
| 29 | 2652000.00 | 167180.51 | 99140.44 | 112983263.36 | 7122398.11 | 4223684.38 |
| 30 | 2652000.00 | 151982.28 | 88518.25 | 112983263.36 | 6474907.37 | 3771146.76 |
| | | **90865150.87** | **84800180.43** | | **699645830.73** | **560869113.66** |

**B.C. Ratio at 10 % Discount Rate = 7.70**

**B.C. Ratio at 12 % Discount Rate = 6.61**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 4)**

T.Cost = NRs. **68900000.00**

T.Benefit = NRs. **91826886.10**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 6890000.00 | 6263636.36 | 6151785.71 | 0.00 | 0.00 | 0.00 |
| 2 | 48230000.00 | 39859504.13 | 38448660.71 | 0.00 | 0.00 | 0.00 |
| 3 | 13780000.00 | 10353117.96 | 9808331.81 | 9182688.61 | 6899089.87 | 6536056.37 |
| 4 | 2067000.00 | 1411788.81 | 1313615.87 | 22956721.53 | 15679749.69 | 14589411.55 |
| 5 | 2067000.00 | 1283444.37 | 1172871.31 | 45913443.05 | 28508635.81 | 26052520.63 |
| 6 | 2067000.00 | 1166767.61 | 1047206.53 | 91826886.10 | 51833883.28 | 46522358.26 |
| 7 | 2067000.00 | 1060697.83 | 935005.83 | 91826886.10 | 47121712.08 | 41537819.88 |
| 8 | 2067000.00 | 964270.75 | 834826.63 | 91826886.10 | 42837920.07 | 37087339.17 |
| 9 | 2067000.00 | 876609.78 | 745380.92 | 91826886.10 | 38943563.70 | 33113695.69 |
| 10 | 2067000.00 | 796917.98 | 665518.68 | 91826886.10 | 35403239.73 | 29565799.72 |
| 11 | 2067000.00 | 724470.89 | 594213.11 | 91826886.10 | 32184763.39 | 26398035.47 |
| 12 | 2067000.00 | 658609.90 | 530547.42 | 91826886.10 | 29258875.81 | 23569674.53 |
| 13 | 2067000.00 | 598736.27 | 473703.05 | 91826886.10 | 26598978.01 | 21044352.25 |
| 14 | 2067000.00 | 544305.70 | 422949.15 | 91826886.10 | 24180889.10 | 18789600.23 |
| 15 | 2067000.00 | 494823.37 | 377633.17 | 91826886.10 | 21982626.45 | 16776428.77 |
| 16 | 2067000.00 | 449839.42 | 337172.48 | 91826886.10 | 19984205.86 | 14978954.26 |
| 17 | 2067000.00 | 408944.93 | 301046.85 | 91826886.10 | 18167459.88 | 13374066.31 |
| 18 | 2067000.00 | 371768.12 | 268791.83 | 91826886.10 | 16515872.62 | 11941130.63 |
| 19 | 2067000.00 | 337971.02 | 239992.71 | 91826886.10 | 15014429.65 | 10661723.78 |
| 20 | 2067000.00 | 307246.38 | 214279.20 | 91826886.10 | 13649481.50 | 9519396.23 |
| 21 | 2067000.00 | 279314.89 | 191320.72 | 91826886.10 | 12408619.55 | 8499460.92 |
| 22 | 2067000.00 | 253922.63 | 170822.07 | 91826886.10 | 11280563.22 | 7588804.39 |
| 23 | 2067000.00 | 230838.75 | 152519.70 | 91826886.10 | 10255057.48 | 6775718.21 |
| 24 | 2067000.00 | 209853.41 | 136178.31 | 91826886.10 | 9322779.52 | 6049748.40 |
| 25 | 2067000.00 | 190775.83 | 121587.77 | 91826886.10 | 8475254.11 | 5401561.07 |
| 26 | 2067000.00 | 173432.57 | 108560.51 | 91826886.10 | 7704776.47 | 4822822.38 |
| 27 | 2067000.00 | 157665.97 | 96929.03 | 91826886.10 | 7004342.24 | 4306091.42 |
| 28 | 2067000.00 | 143332.70 | 86543.78 | 91826886.10 | 6367583.86 | 3844724.48 |
| 29 | 2067000.00 | 130302.46 | 77271.23 | 91826886.10 | 5788712.60 | 3432789.71 |
| 30 | 2067000.00 | 118456.78 | 68992.17 | 91826886.10 | 5262466.00 | 3064990.81 |
| | | **70821367.59** | **66094258.27** | | **568635531.51** | **455845075.53** |

**B.C. Ratio at 10 % Discount Rate = 8.03**

**B.C. Ratio at 12 % Discount Rate = 6.90**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 5)**

T.Cost = NRs. **83200000.00**

T.Benefit = NRs. **104849065.40**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 8320000.00 | 7563636.36 | 7428571.43 | 0.00 | 0.00 | 0.00 |
| 2 | 58240000.00 | 48132231.40 | 46428571.43 | 0.00 | 0.00 | 0.00 |
| 3 | 16640000.00 | 12501878.29 | 11844023.32 | 10484906.54 | 7877465.47 | 7462949.38 |
| 4 | 2496000.00 | 1704801.58 | 1586253.12 | 26212266.35 | 17903330.61 | 16658369.14 |
| 5 | 2496000.00 | 1549819.62 | 1416297.43 | 52424532.70 | 32551510.20 | 29747087.75 |
| 6 | 2496000.00 | 1408926.93 | 1264551.28 | 104849065.40 | 59184564.01 | 53119799.56 |
| 7 | 2496000.00 | 1280842.66 | 1129063.64 | 104849065.40 | 53804149.10 | 47428392.46 |
| 8 | 2496000.00 | 1164402.42 | 1008092.54 | 104849065.40 | 48912862.82 | 42346778.98 |
| 9 | 2496000.00 | 1058547.66 | 900082.62 | 104849065.40 | 44466238.92 | 37809624.09 |
| 10 | 2496000.00 | 962316.05 | 803645.20 | 104849065.40 | 40423853.57 | 33758592.94 |
| 11 | 2496000.00 | 874832.77 | 717540.36 | 104849065.40 | 36748957.79 | 30141600.84 |
| 12 | 2496000.00 | 795302.52 | 640661.03 | 104849065.40 | 33408143.44 | 26912143.61 |
| 13 | 2496000.00 | 723002.29 | 572018.78 | 104849065.40 | 30371039.50 | 24028699.65 |
| 14 | 2496000.00 | 657274.81 | 510731.05 | 104849065.40 | 27610035.90 | 21454196.12 |
| 15 | 2496000.00 | 597522.56 | 456009.87 | 104849065.40 | 25100032.64 | 19155532.25 |
| 16 | 2496000.00 | 543202.32 | 407151.67 | 104849065.40 | 22818211.49 | 17103153.79 |
| 17 | 2496000.00 | 493820.29 | 363528.27 | 104849065.40 | 20743828.63 | 15270673.03 |
| 18 | 2496000.00 | 448927.54 | 324578.82 | 104849065.40 | 18858026.03 | 13634529.49 |
| 19 | 2496000.00 | 408115.95 | 289802.52 | 104849065.40 | 17143660.02 | 12173687.04 |
| 20 | 2496000.00 | 371014.50 | 258752.25 | 104849065.40 | 15585145.48 | 10869363.43 |
| 21 | 2496000.00 | 337285.91 | 231028.79 | 104849065.40 | 14168314.07 | 9704788.78 |
| 22 | 2496000.00 | 306623.55 | 206275.71 | 104849065.40 | 12880285.52 | 8664989.98 |
| 23 | 2496000.00 | 278748.68 | 184174.74 | 104849065.40 | 11709350.47 | 7736598.20 |
| 24 | 2496000.00 | 253407.89 | 164441.73 | 104849065.40 | 10644864.06 | 6907676.96 |
| 25 | 2496000.00 | 230370.81 | 146822.97 | 104849065.40 | 9677149.15 | 6167568.72 |
| 26 | 2496000.00 | 209428.01 | 131091.94 | 104849065.40 | 8797408.32 | 5506757.78 |
| 27 | 2496000.00 | 190389.10 | 117046.38 | 104849065.40 | 7997643.92 | 4916748.02 |
| 28 | 2496000.00 | 173081.00 | 104505.69 | 104849065.40 | 7270585.39 | 4389953.59 |
| 29 | 2496000.00 | 157346.36 | 93308.65 | 104849065.40 | 6609623.08 | 3919601.42 |
| 30 | 2496000.00 | 143042.15 | 83311.30 | 104849065.40 | 6008748.25 | 3499644.12 |
| | | **85520142.00** | **79811934.52** | | **649275027.86** | **520489501.11** |

**B.C. Ratio at 10 % Discount Rate = 7.59**

**B.C. Ratio at 12 % Discount Rate = 6.52**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 6)**

T.Cost = NRs. **83200000.00**

T.Benefit = NRs. **105184880.91**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 8320000.00 | 7563636.36 | 7428571.43 | 0.00 | 0.00 | 0.00 |
| 2 | 58240000.00 | 48132231.40 | 46428571.43 | 0.00 | 0.00 | 0.00 |
| 3 | 16640000.00 | 12501878.29 | 11844023.32 | 10518488.09 | 7902695.79 | 7486852.06 |
| 4 | 2496000.00 | 1704801.58 | 1586253.12 | 26296220.23 | 17960672.24 | 16711723.35 |
| 5 | 2496000.00 | 1549819.62 | 1416297.43 | 52592440.46 | 32655767.71 | 29842363.12 |
| 6 | 2496000.00 | 1408926.93 | 1264551.28 | 105184880.91 | 59374123.11 | 53289934.15 |
| 7 | 2496000.00 | 1280842.66 | 1129063.64 | 105184880.91 | 53976475.56 | 47580298.35 |
| 8 | 2496000.00 | 1164402.42 | 1008092.54 | 105184880.91 | 49069523.23 | 42482409.24 |
| 9 | 2496000.00 | 1058547.66 | 900082.62 | 105184880.91 | 44608657.48 | 37930722.53 |
| 10 | 2496000.00 | 962316.05 | 803645.20 | 105184880.91 | 40553324.99 | 33866716.55 |
| 11 | 2496000.00 | 874832.77 | 717540.36 | 105184880.91 | 36866659.08 | 30238139.77 |
| 12 | 2496000.00 | 795302.52 | 640661.03 | 105184880.91 | 33515144.62 | 26998339.08 |
| 13 | 2496000.00 | 723002.29 | 572018.78 | 105184880.91 | 30468313.29 | 24105659.90 |
| 14 | 2496000.00 | 657274.81 | 510731.05 | 105184880.91 | 27698466.62 | 21522910.62 |
| 15 | 2496000.00 | 597522.56 | 456009.87 | 105184880.91 | 25180424.20 | 19216884.48 |
| 16 | 2496000.00 | 543202.32 | 407151.67 | 105184880.91 | 22891294.73 | 17157932.58 |
| 17 | 2496000.00 | 493820.29 | 363528.27 | 105184880.91 | 20810267.94 | 15319582.66 |
| 18 | 2496000.00 | 448927.54 | 324578.82 | 105184880.91 | 18918425.40 | 13678198.80 |
| 19 | 2496000.00 | 408115.95 | 289802.52 | 105184880.91 | 17198568.54 | 12212677.50 |
| 20 | 2496000.00 | 371014.50 | 258752.25 | 105184880.91 | 15635062.31 | 10904176.34 |
| 21 | 2496000.00 | 337285.91 | 231028.79 | 105184880.91 | 14213693.01 | 9735871.73 |
| 22 | 2496000.00 | 306623.55 | 206275.71 | 105184880.91 | 12921539.10 | 8692742.62 |
| 23 | 2496000.00 | 278748.68 | 184174.74 | 105184880.91 | 11746853.73 | 7761377.34 |
| 24 | 2496000.00 | 253407.89 | 164441.73 | 105184880.91 | 10678957.93 | 6929801.19 |
| 25 | 2496000.00 | 230370.81 | 146822.97 | 105184880.91 | 9708143.58 | 6187322.49 |
| 26 | 2496000.00 | 209428.01 | 131091.94 | 105184880.91 | 8825585.07 | 5524395.08 |
| 27 | 2496000.00 | 190389.10 | 117046.38 | 105184880.91 | 8023259.15 | 4932495.61 |
| 28 | 2496000.00 | 173081.00 | 104505.69 | 105184880.91 | 7293871.96 | 4404013.94 |
| 29 | 2496000.00 | 157346.36 | 93308.65 | 105184880.91 | 6630792.69 | 3932155.30 |
| 30 | 2496000.00 | 143042.15 | 83311.30 | 105184880.91 | 6027993.35 | 3510852.95 |
| | | **85520142.00** | **79811934.52** | | **651354556.41** | **522156549.34** |

**B.C. Ratio at 10 % Discount Rate = 7.62**

**B.C. Ratio at 12 % Discount Rate = 6.54**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 7)**

T.Cost = NRs. **46800000.00**

T.Benefit = NRs. **60036350.97**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 4680000.00 | 4254545.45 | 4178571.43 | 0.00 | 0.00 | 0.00 |
| 2 | 32760000.00 | 27074380.17 | 26116071.43 | 0.00 | 0.00 | 0.00 |
| 3 | 9360000.00 | 7032306.54 | 6662263.12 | 6003635.10 | 4510619.91 | 4273268.88 |
| 4 | 1404000.00 | 958950.89 | 892267.38 | 15009087.74 | 10251408.88 | 9538546.60 |
| 5 | 1404000.00 | 871773.54 | 796667.31 | 30018175.49 | 18638925.24 | 17033118.93 |
| 6 | 1404000.00 | 792521.40 | 711310.09 | 60036350.97 | 33888954.98 | 30416283.80 |
| 7 | 1404000.00 | 720474.00 | 635098.30 | 60036350.97 | 30808140.89 | 27157396.25 |
| 8 | 1404000.00 | 654976.36 | 567052.05 | 60036350.97 | 28007400.81 | 24247675.23 |
| 9 | 1404000.00 | 595433.06 | 506296.48 | 60036350.97 | 25461273.46 | 21649710.02 |
| 10 | 1404000.00 | 541302.78 | 452050.42 | 60036350.97 | 23146612.24 | 19330098.24 |
| 11 | 1404000.00 | 492093.43 | 403616.45 | 60036350.97 | 21042374.76 | 17259016.28 |
| 12 | 1404000.00 | 447357.67 | 360371.83 | 60036350.97 | 19129431.60 | 15409835.97 |
| 13 | 1404000.00 | 406688.79 | 321760.56 | 60036350.97 | 17390392.37 | 13758782.11 |
| 14 | 1404000.00 | 369717.08 | 287286.22 | 60036350.97 | 15809447.61 | 12284626.89 |
| 15 | 1404000.00 | 336106.44 | 256505.55 | 60036350.97 | 14372225.10 | 10968416.86 |
| 16 | 1404000.00 | 305551.31 | 229022.81 | 60036350.97 | 13065659.18 | 9793229.34 |
| 17 | 1404000.00 | 277773.92 | 204484.65 | 60036350.97 | 11877871.98 | 8743954.77 |
| 18 | 1404000.00 | 252521.74 | 182575.58 | 60036350.97 | 10798065.44 | 7807102.47 |
| 19 | 1404000.00 | 229565.22 | 163013.91 | 60036350.97 | 9816423.12 | 6970627.21 |
| 20 | 1404000.00 | 208695.65 | 145548.14 | 60036350.97 | 8924021.02 | 6223774.29 |
| 21 | 1404000.00 | 189723.32 | 129953.69 | 60036350.97 | 8112746.38 | 5556941.33 |
| 22 | 1404000.00 | 172475.75 | 116030.08 | 60036350.97 | 7375223.98 | 4961554.76 |
| 23 | 1404000.00 | 156796.13 | 103598.29 | 60036350.97 | 6704749.08 | 4429959.61 |
| 24 | 1404000.00 | 142541.94 | 92498.47 | 60036350.97 | 6095226.43 | 3955321.08 |
| 25 | 1404000.00 | 129583.58 | 82587.92 | 60036350.97 | 5541114.94 | 3531536.68 |
| 26 | 1404000.00 | 117803.26 | 73739.22 | 60036350.97 | 5037377.22 | 3153157.75 |
| 27 | 1404000.00 | 107093.87 | 65838.59 | 60036350.97 | 4579433.83 | 2815319.42 |
| 28 | 1404000.00 | 97358.06 | 58784.45 | 60036350.97 | 4163121.67 | 2513678.05 |
| 29 | 1404000.00 | 88507.33 | 52486.12 | 60036350.97 | 3784656.06 | 2244355.40 |
| 30 | 1404000.00 | 80461.21 | 46862.61 | 60036350.97 | 3440596.42 | 2003888.75 |
| | | **48105079.87** | **44894213.17** | | **371773494.60** | **298031176.97** |

**B.C. Ratio at 10 % Discount Rate = 7.73**

**B.C. Ratio at 12 % Discount Rate = 6.64**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 8)**

T.Cost = NRs. **81900000.00**

T.Benefit = NRs. **103281926.34**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 8190000.00 | 7445454.55 | 7312500.00 | 0.00 | 0.00 | 0.00 |
| 2 | 57330000.00 | 47380165.29 | 45703125.00 | 0.00 | 0.00 | 0.00 |
| 3 | 16380000.00 | 12306536.44 | 11658960.46 | 10328192.63 | 7759723.99 | 7351403.51 |
| 4 | 2457000.00 | 1678164.06 | 1561467.92 | 25820481.59 | 17635736.35 | 16409382.84 |
| 5 | 2457000.00 | 1525603.69 | 1394167.78 | 51640963.17 | 32064975.18 | 29302469.36 |
| 6 | 2457000.00 | 1386912.45 | 1244792.66 | 103281926.34 | 58299954.87 | 52325838.14 |
| 7 | 2457000.00 | 1260829.50 | 1111422.02 | 103281926.34 | 52999958.97 | 46719498.34 |
| 8 | 2457000.00 | 1146208.63 | 992341.09 | 103281926.34 | 48181780.88 | 41713837.80 |
| 9 | 2457000.00 | 1042007.85 | 886018.83 | 103281926.34 | 43801618.98 | 37244498.04 |
| 10 | 2457000.00 | 947279.86 | 791088.24 | 103281926.34 | 39819653.62 | 33254016.11 |
| 11 | 2457000.00 | 861163.51 | 706328.79 | 103281926.34 | 36199685.11 | 29691085.81 |
| 12 | 2457000.00 | 782875.92 | 630650.70 | 103281926.34 | 32908804.65 | 26509898.04 |
| 13 | 2457000.00 | 711705.38 | 563080.99 | 103281926.34 | 29917095.13 | 23669551.83 |
| 14 | 2457000.00 | 647004.89 | 502750.88 | 103281926.34 | 27197359.21 | 21133528.42 |
| 15 | 2457000.00 | 588186.27 | 448884.71 | 103281926.34 | 24724872.01 | 18869221.80 |
| 16 | 2457000.00 | 534714.79 | 400789.92 | 103281926.34 | 22477156.37 | 16847519.46 |
| 17 | 2457000.00 | 486104.35 | 357848.15 | 103281926.34 | 20433778.52 | 15042428.09 |
| 18 | 2457000.00 | 441913.05 | 319507.27 | 103281926.34 | 18576162.29 | 13430739.37 |
| 19 | 2457000.00 | 401739.13 | 285274.35 | 103281926.34 | 16887420.27 | 11991731.58 |
| 20 | 2457000.00 | 365217.39 | 254709.24 | 103281926.34 | 15352200.24 | 10706903.20 |
| 21 | 2457000.00 | 332015.81 | 227418.97 | 103281926.34 | 13956545.67 | 9559735.00 |
| 22 | 2457000.00 | 301832.56 | 203052.65 | 103281926.34 | 12687768.79 | 8535477.67 |
| 23 | 2457000.00 | 274393.23 | 181297.01 | 103281926.34 | 11534335.27 | 7620962.21 |
| 24 | 2457000.00 | 249448.39 | 161872.33 | 103281926.34 | 10485759.33 | 6804430.54 |
| 25 | 2457000.00 | 226771.27 | 144528.86 | 103281926.34 | 9532508.49 | 6075384.41 |
| 26 | 2457000.00 | 206155.70 | 129043.63 | 103281926.34 | 8665916.81 | 5424450.37 |
| 27 | 2457000.00 | 187414.27 | 115217.53 | 103281926.34 | 7878106.19 | 4843259.26 |
| 28 | 2457000.00 | 170376.61 | 102872.79 | 103281926.34 | 7161914.71 | 4324338.62 |
| 29 | 2457000.00 | 154887.83 | 91850.71 | 103281926.34 | 6510831.56 | 3861016.63 |
| 30 | 2457000.00 | 140807.12 | 82009.56 | 103281926.34 | 5918937.78 | 3447336.28 |
| | | **84183889.78** | **78564873.04** | | **639570561.35** | **512709942.85** |

**B.C. Ratio at 10 % Discount Rate = 7.60**

**B.C. Ratio at 12 % Discount Rate = 6.53**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 9)**

T.Cost = NRs. **61100000.00**

T.Benefit = NRs. **77162942.08**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 6110000.00 | 5554545.45 | 5455357.14 | 0.00 | 0.00 | 0.00 |
| 2 | 42770000.00 | 35347107.44 | 34095982.14 | 0.00 | 0.00 | 0.00 |
| 3 | 12220000.00 | 9181066.87 | 8697954.63 | 7716294.21 | 5797366.05 | 5492305.80 |
| 4 | 1833000.00 | 1251963.66 | 1164904.64 | 19290735.52 | 13175831.92 | 12259611.17 |
| 5 | 1833000.00 | 1138148.79 | 1040093.43 | 38581471.04 | 23956058.04 | 21892162.80 |
| 6 | 1833000.00 | 1034680.71 | 928654.85 | 77162942.08 | 43556469.17 | 39093147.86 |
| 7 | 1833000.00 | 940618.83 | 829156.11 | 77162942.08 | 39596790.16 | 34904596.30 |
| 8 | 1833000.00 | 855108.03 | 740317.96 | 77162942.08 | 35997081.96 | 31164818.13 |
| 9 | 1833000.00 | 777370.93 | 660998.18 | 77162942.08 | 32724619.96 | 27825730.47 |
| 10 | 1833000.00 | 706700.85 | 590176.94 | 77162942.08 | 29749654.51 | 24844402.21 |
| 11 | 1833000.00 | 642455.32 | 526943.70 | 77162942.08 | 27045140.47 | 22182501.97 |
| 12 | 1833000.00 | 584050.29 | 470485.45 | 77162942.08 | 24586491.33 | 19805805.33 |
| 13 | 1833000.00 | 530954.81 | 420076.29 | 77162942.08 | 22351355.76 | 17683754.76 |
| 14 | 1833000.00 | 482686.19 | 375068.12 | 77162942.08 | 20319414.32 | 15789066.75 |
| 15 | 1833000.00 | 438805.63 | 334882.25 | 77162942.08 | 18472194.84 | 14097381.03 |
| 16 | 1833000.00 | 398914.21 | 299002.01 | 77162942.08 | 16792904.40 | 12586947.34 |
| 17 | 1833000.00 | 362649.28 | 266966.08 | 77162942.08 | 15266276.73 | 11238345.84 |
| 18 | 1833000.00 | 329681.16 | 238362.57 | 77162942.08 | 13878433.39 | 10034237.36 |
| 19 | 1833000.00 | 299710.15 | 212823.72 | 77162942.08 | 12616757.63 | 8959140.50 |
| 20 | 1833000.00 | 272463.77 | 190021.18 | 77162942.08 | 11469779.66 | 7999232.59 |
| 21 | 1833000.00 | 247694.34 | 169661.77 | 77162942.08 | 10427072.42 | 7142171.96 |
| 22 | 1833000.00 | 225176.67 | 151483.72 | 77162942.08 | 9479156.74 | 6376939.25 |
| 23 | 1833000.00 | 204706.06 | 135253.32 | 77162942.08 | 8617415.22 | 5693695.75 |
| 24 | 1833000.00 | 186096.42 | 120761.90 | 77162942.08 | 7834013.84 | 5083656.92 |
| 25 | 1833000.00 | 169178.56 | 107823.12 | 77162942.08 | 7121830.76 | 4538979.40 |
| 26 | 1833000.00 | 153798.70 | 96270.64 | 77162942.08 | 6474391.60 | 4052660.18 |
| 27 | 1833000.00 | 139817.00 | 85955.93 | 77162942.08 | 5885810.55 | 3618446.59 |
| 28 | 1833000.00 | 127106.36 | 76746.37 | 77162942.08 | 5350736.86 | 3230755.88 |
| 29 | 1833000.00 | 115551.24 | 68523.54 | 77162942.08 | 4864306.24 | 2884603.46 |
| 30 | 1833000.00 | 105046.58 | 61181.73 | 77162942.08 | 4422096.58 | 2575538.81 |
| | | **62803854.28** | **58611889.41** | | **477829451.10** | **383050636.41** |

**B.C. Ratio at 10 % Discount Rate = 7.61**

**B.C. Ratio at 12 % Discount Rate = 6.54**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 10)**

T.Cost = NRs. **68900000.00**

T.Benefit = NRs. **86826966.26**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 6890000.00 | 6263636.36 | 6151785.71 | 0.00 | 0.00 | 0.00 |
| 2 | 48230000.00 | 39859504.13 | 38448660.71 | 0.00 | 0.00 | 0.00 |
| 3 | 13780000.00 | 10353117.96 | 9808331.81 | 8682696.63 | 6523438.49 | 6180171.96 |
| 4 | 2067000.00 | 1411788.81 | 1313615.87 | 21706741.56 | 14825996.56 | 13795026.69 |
| 5 | 2067000.00 | 1283444.37 | 1172871.31 | 43413483.13 | 26956357.38 | 24633976.23 |
| 6 | 2067000.00 | 1166767.61 | 1047206.53 | 86826966.26 | 49011558.88 | 43989243.26 |
| 7 | 2067000.00 | 1060697.83 | 935005.83 | 86826966.26 | 44555962.62 | 39276110.06 |
| 8 | 2067000.00 | 964270.75 | 834826.63 | 86826966.26 | 40505420.56 | 35067955.41 |
| 9 | 2067000.00 | 876609.78 | 745380.92 | 86826966.26 | 36823109.60 | 31310674.47 |
| 10 | 2067000.00 | 796917.98 | 665518.68 | 86826966.26 | 33475554.18 | 27955959.35 |
| 11 | 2067000.00 | 724470.89 | 594213.11 | 86826966.26 | 30432321.98 | 24960677.99 |
| 12 | 2067000.00 | 658609.90 | 530547.42 | 86826966.26 | 27665747.26 | 22286319.63 |
| 13 | 2067000.00 | 598736.27 | 473703.05 | 86826966.26 | 25150679.33 | 19898499.67 |
| 14 | 2067000.00 | 544305.70 | 422949.15 | 86826966.26 | 22864253.93 | 17766517.57 |
| 15 | 2067000.00 | 494823.37 | 377633.17 | 86826966.26 | 20785685.39 | 15862962.11 |
| 16 | 2067000.00 | 449839.42 | 337172.48 | 86826966.26 | 18896077.63 | 14163359.03 |
| 17 | 2067000.00 | 408944.93 | 301046.85 | 86826966.26 | 17178252.39 | 12645856.28 |
| 18 | 2067000.00 | 371768.12 | 268791.83 | 86826966.26 | 15616593.08 | 11290943.10 |
| 19 | 2067000.00 | 337971.02 | 239992.71 | 86826966.26 | 14196902.80 | 10081199.20 |
| 20 | 2067000.00 | 307246.38 | 214279.20 | 86826966.26 | 12906275.27 | 9001070.71 |
| 21 | 2067000.00 | 279314.89 | 191320.72 | 86826966.26 | 11732977.52 | 8036670.28 |
| 22 | 2067000.00 | 253922.63 | 170822.07 | 86826966.26 | 10666343.20 | 7175598.46 |
| 23 | 2067000.00 | 230838.75 | 152519.70 | 86826966.26 | 9696675.64 | 6406784.34 |
| 24 | 2067000.00 | 209853.41 | 136178.31 | 86826966.26 | 8815159.67 | 5720343.16 |
| 25 | 2067000.00 | 190775.83 | 121587.77 | 86826966.26 | 8013781.52 | 5107449.25 |
| 26 | 2067000.00 | 173432.57 | 108560.51 | 86826966.26 | 7285255.93 | 4560222.55 |
| 27 | 2067000.00 | 157665.97 | 96929.03 | 86826966.26 | 6622959.93 | 4071627.27 |
| 28 | 2067000.00 | 143332.70 | 86543.78 | 86826966.26 | 6020872.67 | 3635381.50 |
| 29 | 2067000.00 | 130302.46 | 77271.23 | 86826966.26 | 5473520.61 | 3245876.33 |
| 30 | 2067000.00 | 118456.78 | 68992.17 | 86826966.26 | 4975927.82 | 2898103.87 |
| | | **70821367.59** | **66094258.27** | | **537673661.86** | **431024579.75** |

**B.C. Ratio at 10 % Discount Rate = 7.59**

**B.C. Ratio at 12 % Discount Rate = 6.52**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 11)**

T.Cost = NRs. **37700000.00**

T.Benefit = NRs. **47946992.54**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 3770000.00 | 3427272.73 | 3366071.43 | 0.00 | 0.00 | 0.00 |
| 2 | 26390000.00 | 21809917.36 | 21037946.43 | 0.00 | 0.00 | 0.00 |
| 3 | 7540000.00 | 5664913.60 | 5366823.07 | 4794699.25 | 3602328.52 | 3412772.22 |
| 4 | 1131000.00 | 772488.22 | 718770.95 | 11986748.14 | 8187110.26 | 7617795.14 |
| 5 | 1131000.00 | 702262.02 | 641759.77 | 23973496.27 | 14885655.02 | 13603205.61 |
| 6 | 1131000.00 | 638420.01 | 572999.80 | 47946992.54 | 27064827.31 | 24291438.59 |
| 7 | 1131000.00 | 580381.83 | 511606.96 | 47946992.54 | 24604388.47 | 21688784.45 |
| 8 | 1131000.00 | 527619.85 | 456791.93 | 47946992.54 | 22367625.88 | 19364986.12 |
| 9 | 1131000.00 | 479654.41 | 407849.94 | 47946992.54 | 20334205.34 | 17290166.18 |
| 10 | 1131000.00 | 436049.46 | 364151.73 | 47946992.54 | 18485641.22 | 15437648.37 |
| 11 | 1131000.00 | 396408.60 | 325135.47 | 47946992.54 | 16805128.38 | 13783614.62 |
| 12 | 1131000.00 | 360371.45 | 290299.53 | 47946992.54 | 15277389.44 | 12306798.77 |
| 13 | 1131000.00 | 327610.41 | 259196.01 | 47946992.54 | 13888535.85 | 10988213.18 |
| 14 | 1131000.00 | 297827.65 | 231425.01 | 47946992.54 | 12625941.69 | 9810904.63 |
| 15 | 1131000.00 | 270752.41 | 206629.47 | 47946992.54 | 11478128.81 | 8759736.28 |
| 16 | 1131000.00 | 246138.55 | 184490.60 | 47946992.54 | 10434662.55 | 7821193.10 |
| 17 | 1131000.00 | 223762.32 | 164723.75 | 47946992.54 | 9486056.86 | 6983208.13 |
| 18 | 1131000.00 | 203420.29 | 147074.78 | 47946992.54 | 8623688.06 | 6235007.26 |
| 19 | 1131000.00 | 184927.54 | 131316.76 | 47946992.54 | 7839716.42 | 5566970.77 |
| 20 | 1131000.00 | 168115.94 | 117247.11 | 47946992.54 | 7127014.92 | 4970509.61 |
| 21 | 1131000.00 | 152832.68 | 104684.92 | 47946992.54 | 6479104.48 | 4437955.01 |
| 22 | 1131000.00 | 138938.80 | 93468.68 | 47946992.54 | 5890094.98 | 3962459.83 |
| 23 | 1131000.00 | 126308.00 | 83454.18 | 47946992.54 | 5354631.80 | 3537910.56 |
| 24 | 1131000.00 | 114825.45 | 74512.66 | 47946992.54 | 4867847.09 | 3158848.72 |
| 25 | 1131000.00 | 104386.77 | 66529.16 | 47946992.54 | 4425315.54 | 2820400.64 |
| 26 | 1131000.00 | 94897.07 | 59401.04 | 47946992.54 | 4023014.12 | 2518214.86 |
| 27 | 1131000.00 | 86270.06 | 53036.64 | 47946992.54 | 3657285.57 | 2248406.12 |
| 28 | 1131000.00 | 78427.33 | 47354.14 | 47946992.54 | 3324805.06 | 2007505.47 |
| 29 | 1131000.00 | 71297.57 | 42280.48 | 47946992.54 | 3022550.06 | 1792415.60 |
| 30 | 1131000.00 | 64815.97 | 37750.43 | 47946992.54 | 2747772.78 | 1600371.07 |
| | | **38751314.34** | **36164782.83** | | **296910466.47** | **238017440.90** |

**B.C. Ratio at 10 % Discount Rate = 7.66**

**B.C. Ratio at 12 % Discount Rate = 6.58**
``````

``````

**COMPUTATION OF B.C. RATIO(BLOCK 12)**

T.Cost = NRs. **35100000.00**

T.Benefit = NRs. **44029144.90**

| Year | Intial cash flow | Pre. value at discount rate of | | Benefit | Pre. value at discount rate of | |
|---|---|---|---|---|---|---|
| | | 10% | 12% | | 10% | 12% |
| 1 | 3510000.00 | 3190909.09 | 3133928.57 | 0.00 | 0.00 | 0.00 |
| 2 | 24570000.00 | 20305785.12 | 19587053.57 | 0.00 | 0.00 | 0.00 |
| 3 | 7020000.00 | 5274229.90 | 4996697.34 | 4402914.49 | 3307974.82 | 3133907.57 |
| 4 | 1053000.00 | 719213.17 | 669200.54 | 11007286.23 | 7518124.60 | 6995329.39 |
| 5 | 1053000.00 | 653830.15 | 597500.48 | 22014572.45 | 13669317.45 | 12491659.63 |
| 6 | 1053000.00 | 594391.05 | 533482.57 | 44029144.90 | 24853304.46 | 22306535.05 |
| 7 | 1053000.00 | 540355.50 | 476323.72 | 44029144.90 | 22593913.14 | 19916549.15 |
| 8 | 1053000.00 | 491232.27 | 425289.04 | 44029144.90 | 20539921.04 | 17782633.17 |
| 9 | 1053000.00 | 446574.79 | 379722.36 | 44029144.90 | 18672655.49 | 15877351.04 |
| 10 | 1053000.00 | 405977.08 | 339037.82 | 44029144.90 | 16975141.36 | 14176206.29 |
| 11 | 1053000.00 | 369070.08 | 302712.34 | 44029144.90 | 15431946.69 | 12657327.04 |
| 12 | 1053000.00 | 335518.25 | 270278.87 | 44029144.90 | 14029042.44 | 11301184.86 |
| 13 | 1053000.00 | 305016.59 | 241320.42 | 44029144.90 | 12753674.95 | 10090343.62 |
| 14 | 1053000.00 | 277287.81 | 215464.66 | 44029144.90 | 11594249.95 | 9009235.38 |
| 15 | 1053000.00 | 252079.83 | 192379.16 | 44029144.90 | 10540227.23 | 8043960.16 |
| 16 | 1053000.00 | 229163.48 | 171767.11 | 44029144.90 | 9582024.75 | 7182107.29 |
| 17 | 1053000.00 | 208330.44 | 153363.49 | 44029144.90 | 8710931.59 | 6412595.79 |
| 18 | 1053000.00 | 189391.31 | 136931.69 | 44029144.90 | 7919028.72 | 5725531.96 |
| 19 | 1053000.00 | 172173.91 | 122260.44 | 44029144.90 | 7199117.02 | 5112082.10 |
| 20 | 1053000.00 | 156521.74 | 109161.10 | 44029144.90 | 6544651.84 | 4564359.02 |
| 21 | 1053000.00 | 142292.49 | 97465.27 | 44029144.90 | 5949683.49 | 4075320.55 |
| 22 | 1053000.00 | 129356.81 | 87022.56 | 44029144.90 | 5408803.17 | 3638679.07 |
| 23 | 1053000.00 | 117597.10 | 77698.72 | 44029144.90 | 4917093.79 | 3248820.60 |
| 24 | 1053000.00 | 106906.45 | 69373.85 | 44029144.90 | 4470085.27 | 2900732.67 |
| 25 | 1053000.00 | 97187.69 | 61940.94 | 44029144.90 | 4063713.88 | 2589939.89 |
| 26 | 1053000.00 | 88352.44 | 55304.41 | 44029144.90 | 3694285.34 | 2312446.33 |
| 27 | 1053000.00 | 80320.40 | 49378.94 | 44029144.90 | 3358441.22 | 2064684.22 |
| 28 | 1053000.00 | 73018.55 | 44088.34 | 44029144.90 | 3053128.38 | 1843468.06 |
| 29 | 1053000.00 | 66380.50 | 39364.59 | 44029144.90 | 2775571.26 | 1645953.62 |
| 30 | 1053000.00 | 60345.91 | 35146.95 | 44029144.90 | 2523246.60 | 1469601.45 |
| | | **36078809.90** | **33670659.88** | | **272649299.95** | **218568544.95** |

**B.C. Ratio at 10 % Discount Rate = 7.56**

**B.C. Ratio at 12 % Discount Rate = 6.49**
``````

``````

# APPENDICES B1

**COMPUTATION OF EIRR(BLOCK 1)**

Analysis is carried out on the following assumptions:-

| | | | | | |
|---|---|---|---|---|---|
| Project Life = | | | 30 Years | | |
| Construction cost = | | | | NRs | 98800000.00 |
| Construction Period = | 3 Year | | | | |
| Operation & Maintenance Cost per Year = @ | 3.00 | % of const.cost = | | NRs | 2964000.00 |
| Construction cost in first year at Start = | 10 | % | | NRs | 9880000.00 |
| Construction cost in first year end = | 70 | % | | NRs | 69160000.00 |
| Construction cost in second year = | 20 | % | | NRs | 592800.00 |

Benefit starts from third year:-

| | | | | | |
|---|---|---|---|---|---|
| Total Benefit = | | | | NRs | 124960683.28 |
| 3rd year Benefit = | 10 | % of | T.Benefit = | NRs | 12496068.33 |
| 4th year Benefit = | 25 | % of | T.Benefit = | NRs | 31240170.82 |
| 5th year Benefit = | 50 | % of | T.Benefit = | NRs | 62480341.64 |
| 6th year Benefit = | 100 | % of | T.Benefit = | NRs | 124960683.28 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 9880000.00 | 0 | -9880000.00 | -8372881.36 | -8302521.0 |
| 2 | 69160000.00 | 0 | -69160000.00 | -49669635.16 | -48838358.87 |
| 3 | 592800.00 | 12496068.33 | 11903268.33 | 7244696.59 | 7063587.67 |
| 4 | 2964000.00 | 31240170.82 | 28276170.82 | 14584534.34 | 14100442.80 |
| 5 | 2964000.00 | 62480341.64 | 59516341.64 | 26015141.45 | 24940285.53 |
| 6 | 2964000.00 | 124960683.3 | 121996683.28 | 45191419.16 | 42960196.12 |
| 7 | 2964000.00 | 124960683.3 | 121996683.28 | 38297812.85 | 36101005.14 |
| 8 | 2964000.00 | 124960683.3 | 121996683.28 | 32455773.60 | 30336979.11 |
| 9 | 2964000.00 | 124960683.3 | 121996683.28 | 27504892.88 | 25493259.76 |
| 10 | 2964000.00 | 124960683.3 | 121996683.28 | 23309231.26 | 21422907.36 |
| 11 | 2964000.00 | 124960683.3 | 121996683.28 | 19753585.81 | 18002443.16 |
| 12 | 2964000.00 | 124960683.3 | 121996683.28 | 16740326.96 | 15128103.50 |
| 13 | 2964000.00 | 124960683.3 | 121996683.28 | 14186717.76 | 12712692.01 |
| 14 | 2964000.00 | 124960683.3 | 121996683.28 | 12022642.17 | 10682934.46 |
| 15 | 2964000.00 | 124960683.3 | 121996683.28 | 10188679.81 | 8977255.85 |
| 16 | 2964000.00 | 124960683.3 | 121996683.28 | 8634474.41 | 7543912.48 |
| 17 | 2964000.00 | 124960683.3 | 121996683.28 | 7317351.20 | 6339422.25 |
| 18 | 2964000.00 | 124960683.3 | 121996683.28 | 6201145.08 | 5327245.59 |
| 19 | 2964000.00 | 124960683.3 | 121996683.28 | 5255207.70 | 4476676.97 |
| 20 | 2964000.00 | 124960683.3 | 121996683.28 | 4453565.84 | 3761913.42 |
| 21 | 2964000.00 | 124960683.3 | 121996683.28 | 3774208.34 | 3161271.78 |
| 22 | 2964000.00 | 124960683.3 | 121996683.28 | 3198481.65 | 2656530.91 |
| 23 | 2964000.00 | 124960683.3 | 121996683.28 | 2710577.67 | 2232378.91 |
| 24 | 2964000.00 | 124960683.3 | 121996683.28 | 2297099.72 | 1875948.67 |
| 25 | 2964000.00 | 124960683.3 | 121996683.28 | 1946694.68 | 1576427.45 |
| 26 | 2964000.00 | 124960683.3 | 121996683.28 | 1649741.25 | 1324728.95 |
| 27 | 2964000.00 | 124960683.3 | 121996683.28 | 1398085.81 | 1113217.61 |
| 28 | 2964000.00 | 124960683.3 | 121996683.28 | 1184818.48 | 935476.98 |
| 29 | 2964000.00 | 124960683.3 | 121996683.28 | 1004083.46 | 786115.11 |
| 30 | 2964000.00 | 124960683.3 | 121996683.28 | 850918.18 | 660600.93 |
| | | | | **281329391.58** | **254553080.60** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.51** % **21.43%**
``````

``````

**`COMPUTATION OF EIRR(BLOCK 2)**

Analysis is carried out on the following assumptions:-

Project Life = 30 Years

Construction cost = NRs 88400000.00

Construction Period = 3 Year

| | | | | | |
|---|---|---|---|---|---|
| Operation & Maintenance Cost per Year = @ | 3.00 | % of const.cost = | | NRs | 2652000.00 |
| Construction cost in first year at Start = | 10 | % | | NRs | 8840000.00 |
| Construction cost in first year end = | 70 | % | | NRs | 61880000.00 |
| Construction cost in second year = | 20 | % | | NRs | 530400.00 |

Benefit starts from third year:-

| | | | | | |
|---|---|---|---|---|---|
| Total Benefit = | | | | NRs | 111789252.65 |
| 3rd year Benefit = | 10 | % of | T.Benefit = | NRs | 11178925.26 |
| 4th year Benefit = | 25 | % of | T.Benefit = | NRs | 27947313.16 |
| 5th year Benefit = | 50 | % of | T.Benefit = | NRs | 55894626.32 |
| 6th year Benefit = | 100 | % of | T.Benefit = | NRs | 111789252.65 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 8840000.00 | 0 | -8840000.00 | -7491525.42 | -7428571.4 |
| 2 | 61880000.00 | 0 | -61880000.00 | -44441252.51 | -43697478.99 |
| 3 | 530400.00 | 11178925.26 | 10648525.26 | 6481021.22 | 6319003.29 |
| 4 | 2652000.00 | 27947313.16 | 25295313.16 | 13047041.12 | 12613982.23 |
| 5 | 2652000.00 | 55894626.32 | 53242626.32 | 23272842.66 | 22311289.07 |
| 6 | 2652000.00 | 111789252.6 | 109137252.65 | 40427880.48 | 38431846.27 |
| 7 | 2652000.00 | 111789252.6 | 109137252.65 | 34260915.66 | 32295669.14 |
| 8 | 2652000.00 | 111789252.6 | 109137252.65 | 29034674.29 | 27139217.76 |
| 9 | 2652000.00 | 111789252.6 | 109137252.65 | 24605656.18 | 22806065.35 |
| 10 | 2652000.00 | 111789252.6 | 109137252.65 | 20852251.00 | 19164760.80 |
| 11 | 2652000.00 | 111789252.6 | 109137252.65 | 17671399.15 | 16104841.01 |
| 12 | 2652000.00 | 111789252.6 | 109137252.65 | 14975761.99 | 13533479.84 |
| 13 | 2652000.00 | 111789252.6 | 109137252.65 | 12691323.72 | 11372672.13 |
| 14 | 2652000.00 | 111789252.6 | 109137252.65 | 10755359.09 | 9556867.34 |
| 15 | 2652000.00 | 111789252.6 | 109137252.65 | 9114711.09 | 8030980.96 |
| 16 | 2652000.00 | 111789252.6 | 109137252.65 | 7724331.43 | 6748723.49 |
| 17 | 2652000.00 | 111789252.6 | 109137252.65 | 6546043.59 | 5671196.21 |
| 18 | 2652000.00 | 111789252.6 | 109137252.65 | 5547494.57 | 4765711.10 |
| 19 | 2652000.00 | 111789252.6 | 109137252.65 | 4701266.58 | 4004799.25 |
| 20 | 2652000.00 | 111789252.6 | 109137252.65 | 3984124.22 | 3365377.52 |
| 21 | 2652000.00 | 111789252.6 | 109137252.65 | 3376376.46 | 2828048.33 |
| 22 | 2652000.00 | 111789252.6 | 109137252.65 | 2861335.98 | 2376511.21 |
| 23 | 2652000.00 | 111789252.6 | 109137252.65 | 2424861.00 | 1997068.24 |
| 24 | 2652000.00 | 111789252.6 | 109137252.65 | 2054966.95 | 1678208.60 |
| 25 | 2652000.00 | 111789252.6 | 109137252.65 | 1741497.42 | 1410259.33 |
| 26 | 2652000.00 | 111789252.6 | 109137252.65 | 1475845.27 | 1185091.88 |
| 27 | 2652000.00 | 111789252.6 | 109137252.65 | 1250716.33 | 995875.53 |
| 28 | 2652000.00 | 111789252.6 | 109137252.65 | 1059929.09 | 836870.19 |
| 29 | 2652000.00 | 111789252.6 | 109137252.65 | 898244.99 | 703252.26 |
| 30 | 2652000.00 | 111789252.6 | 109137252.65 | 761224.57 | 590968.29 |
| | | | | **251666318.16** | **227712586.17** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.51** % **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 3)**

Analysis is carried out on the following assumptions:-

Project Life = 30 Years

Construction cost = NRs 88400000.00

Construction Period = 3 Year

Operation & Maintenance Cost per Year = @ 3.00 % of const.cost = NRs 2652000.00

Construction cost in first year at Start = 10 % NRs 8840000.00

Construction cost in first year end = 70 % NRs 61880000.00

Construction cost in second year = 20 % NRs 530400.00

Benefit starts from third year:-

Total Benefit = NRs 112983263.36

3rd year Benefit = 10 % of T.Benefit = NRs 11298326.34

4th year Benefit = 25 % of T.Benefit = NRs 28245815.84

5th year Benefit = 50 % of T.Benefit = NRs 56491631.68

6th year Benefit = 100 % of T.Benefit = NRs 112983263.36

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 8840000.00 | 0 | -8840000.00 | -7491525.42 | -7428571.4 |
| 2 | 61880000.00 | 0 | -61880000.00 | -44441252.51 | -43697478.99 |
| 3 | 530400.00 | 11298326.34 | 10767926.34 | 6553692.40 | 6389857.77 |
| 4 | 2652000.00 | 28245815.84 | 25593815.84 | 13201005.48 | 12762836.19 |
| 5 | 2652000.00 | 56491631.68 | 53839631.68 | 23533799.21 | 22561463.79 |
| 6 | 2652000.00 | 112983263.4 | 110331263.36 | 40870179.70 | 38852307.99 |
| 7 | 2652000.00 | 112983263.4 | 110331263.36 | 34635745.51 | 32648998.31 |
| 8 | 2652000.00 | 112983263.4 | 110331263.36 | 29352326.71 | 27436133.03 |
| 9 | 2652000.00 | 112983263.4 | 110331263.36 | 24874853.14 | 23055573.98 |
| 10 | 2652000.00 | 112983263.4 | 110331263.36 | 21080384.02 | 19374431.91 |
| 11 | 2652000.00 | 112983263.4 | 110331263.36 | 17864732.22 | 16281035.22 |
| 12 | 2652000.00 | 112983263.4 | 110331263.36 | 15139603.57 | 13681542.20 |
| 13 | 2652000.00 | 112983263.4 | 110331263.36 | 12830172.52 | 11497094.29 |
| 14 | 2652000.00 | 112983263.4 | 110331263.36 | 10873027.56 | 9661423.77 |
| 15 | 2652000.00 | 112983263.4 | 110331263.36 | 9214430.14 | 8118843.51 |
| 16 | 2652000.00 | 112983263.4 | 110331263.36 | 7808839.10 | 6822557.57 |
| 17 | 2652000.00 | 112983263.4 | 110331263.36 | 6617660.25 | 5733241.65 |
| 18 | 2652000.00 | 112983263.4 | 110331263.36 | 5608186.65 | 4817850.13 |
| 19 | 2652000.00 | 112983263.4 | 110331263.36 | 4752700.55 | 4048613.55 |
| 20 | 2652000.00 | 112983263.4 | 110331263.36 | 4027712.33 | 3402196.26 |
| 21 | 2652000.00 | 112983263.4 | 110331263.36 | 3413315.54 | 2858988.46 |
| 22 | 2652000.00 | 112983263.4 | 110331263.36 | 2892640.29 | 2402511.31 |
| 23 | 2652000.00 | 112983263.4 | 110331263.36 | 2451390.07 | 2018917.07 |
| 24 | 2652000.00 | 112983263.4 | 110331263.36 | 2077449.21 | 1696568.96 |
| 25 | 2652000.00 | 112983263.4 | 110331263.36 | 1760550.18 | 1425688.20 |
| 26 | 2652000.00 | 112983263.4 | 110331263.36 | 1491991.68 | 1198057.31 |
| 27 | 2652000.00 | 112983263.4 | 110331263.36 | 1264399.73 | 1006770.85 |
| 28 | 2652000.00 | 112983263.4 | 110331263.36 | 1071525.19 | 846025.93 |
| 29 | 2652000.00 | 112983263.4 | 110331263.36 | 908072.20 | 710946.16 |
| 30 | 2652000.00 | 112983263.4 | 110331263.36 | 769552.71 | 597433.75 |
| | | | | **255007159.94** | **230781858.69** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.53** % **21.43%**

**COMPUTATION OF EIRR(BLOCK 4)**
``````

``````

Analysis is carried out on the following assumptions:-

Project Life = 30 Years

Construction cost = NRs 68900000.00

Construction Period = 3 Year

Operation & Maintenance Cost per Year = 3.00 % of const.cost @ = NRs 2067000.00

Construction cost in first year at Start = 10 % NRs 6890000.00

Construction cost in first year end = 70 % NRs 48230000.00

Construction cost in second year = 20 % NRs 413400.00

Benefit starts from third year:-

Total Benefit = NRs 91826886.10

3rd year Benefit = 10 % of T.Benefit = NRs 9182688.61

4th year Benefit = 25 % of T.Benefit = NRs 22956721.53

5th year Benefit = 50 % of T.Benefit = NRs 45913443.05

6th year Benefit = 100 % of T.Benefit = NRs 91826886.10

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 6890000.00 | 0 | -6890000.00 | -5838983.05 | -5789916.0 |
| 2 | 48230000.00 | 0 | -48230000.00 | -34638035.05 | -34058329.21 |
| 3 | 413400.00 | 9182688.61 | 8769288.61 | 5337259.78 | 5203834.54 |
| 4 | 2067000.00 | 22956721.53 | 20889721.53 | 10774685.97 | 10417051.35 |
| 5 | 2067000.00 | 45913443.05 | 43846443.05 | 19165684.36 | 18373824.38 |
| 6 | 2067000.00 | 91826886.1 | 89759886.10 | 33249892.77 | 31608255.30 |
| 7 | 2067000.00 | 91826886.1 | 89759886.10 | 28177875.23 | 26561559.08 |
| 8 | 2067000.00 | 91826886.1 | 89759886.10 | 23879555.28 | 22320637.88 |
| 9 | 2067000.00 | 91826886.1 | 89759886.10 | 20236911.25 | 18756838.55 |
| 10 | 2067000.00 | 91826886.1 | 89759886.10 | 17149924.79 | 15762049.20 |
| 11 | 2067000.00 | 91826886.1 | 89759886.10 | 14533834.57 | 13245419.50 |
| 12 | 2067000.00 | 91826886.1 | 89759886.10 | 12316808.95 | 11130604.62 |
| 13 | 2067000.00 | 91826886.1 | 89759886.10 | 10437973.69 | 9353449.26 |
| 14 | 2067000.00 | 91826886.1 | 89759886.10 | 8845740.42 | 7860041.40 |
| 15 | 2067000.00 | 91826886.1 | 89759886.10 | 7496390.18 | 6605076.80 |
| 16 | 2067000.00 | 91826886.1 | 89759886.10 | 6352873.04 | 5550484.71 |
| 17 | 2067000.00 | 91826886.1 | 89759886.10 | 5383790.71 | 4664272.86 |
| 18 | 2067000.00 | 91826886.1 | 89759886.10 | 4562534.50 | 3919557.03 |
| 19 | 2067000.00 | 91826886.1 | 89759886.10 | 3866554.66 | 3293745.40 |
| 20 | 2067000.00 | 91826886.1 | 89759886.10 | 3276741.24 | 2767853.28 |
| 21 | 2067000.00 | 91826886.1 | 89759886.10 | 2776899.35 | 2325927.13 |
| 22 | 2067000.00 | 91826886.1 | 89759886.10 | 2353304.54 | 1954560.61 |
| 23 | 2067000.00 | 91826886.1 | 89759886.10 | 1994325.88 | 1642487.91 |
| 24 | 2067000.00 | 91826886.1 | 89759886.10 | 1690106.68 | 1380241.94 |
| 25 | 2067000.00 | 91826886.1 | 89759886.10 | 1432293.79 | 1159867.18 |
| 26 | 2067000.00 | 91826886.1 | 89759886.10 | 1213808.30 | 974678.30 |
| 27 | 2067000.00 | 91826886.1 | 89759886.10 | 1028651.10 | 819057.39 |
| 28 | 2067000.00 | 91826886.1 | 89759886.10 | 871738.22 | 688283.52 |
| 29 | 2067000.00 | 91826886.1 | 89759886.10 | 738761.20 | 578389.52 |
| 30 | 2067000.00 | 91826886.1 | 89759886.10 | 626068.82 | 486041.61 |
| | | | | **209293971.15** | **189555845.07** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.60** % **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 5)**

Analysis is carried out on the following assumptions:-

| | | | | | |
|---|---|---|---|---|---|
| Project Life = | | | 30 | Years | |
| Construction cost = | | | | NRs | 83200000.00 |
| Construction Period = | 3 | Year | | | |
| Operation & Maintenance Cost per Year = @ | 3.00 | % of const.cost = | | NRs | 2496000.00 |
| Construction cost in first year at Start = | 10 | % | | NRs | 8320000.00 |
| Construction cost in first year end = | 70 | % | | NRs | 58240000.00 |
| Construction cost in second year = | 20 | % | | NRs | 499200.00 |
| Benefit starts from third year:- | | | | | |
| Total Benefit = | | | | NRs | 104849065.40 |
| 3rd year Benefit = | 10 | % of | T.Benefit = | NRs | 10484906.54 |
| 4th year Benefit = | 25 | % of | T.Benefit = | NRs | 26212266.35 |
| 5th year Benefit = | 50 | % of | T.Benefit = | NRs | 52424532.70 |
| 6th year Benefit = | 100 | % of | T.Benefit = | NRs | 104849065.40 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 8320000.00 | 0 | -8320000.00 | -7050847.46 | -6991596.6 |
| 2 | 58240000.00 | 0 | -58240000.00 | -41827061.19 | -41127039.05 |
| 3 | 499200.00 | 10484906.54 | 9985706.54 | 6077609.29 | 5925676.18 |
| 4 | 2496000.00 | 26212266.35 | 23716266.35 | 12232586.34 | 11826560.93 |
| 5 | 2496000.00 | 52424532.7 | 49928532.70 | 21824221.80 | 20922520.22 |
| 6 | 2496000.00 | 104849065.4 | 102353065.40 | 37914803.56 | 36042846.78 |
| 7 | 2496000.00 | 104849065.4 | 102353065.40 | 32131189.45 | 30288106.54 |
| 8 | 2496000.00 | 104849065.4 | 102353065.40 | 27229821.57 | 25452190.37 |
| 9 | 2496000.00 | 104849065.4 | 102353065.40 | 23076119.98 | 21388395.27 |
| 10 | 2496000.00 | 104849065.4 | 102353065.40 | 19556033.88 | 17973441.40 |
| 11 | 2496000.00 | 104849065.4 | 102353065.40 | 16572910.07 | 15103732.27 |
| 12 | 2496000.00 | 104849065.4 | 102353065.40 | 14044839.04 | 12692211.99 |
| 13 | 2496000.00 | 104849065.4 | 102353065.40 | 11902405.97 | 10665724.36 |
| 14 | 2496000.00 | 104849065.4 | 102353065.40 | 10086784.72 | 8962793.58 |
| 15 | 2496000.00 | 104849065.4 | 102353065.40 | 8548122.64 | 7531759.31 |
| 16 | 2496000.00 | 104849065.4 | 102353065.40 | 7244171.73 | 6329209.51 |
| 17 | 2496000.00 | 104849065.4 | 102353065.40 | 6139128.58 | 5318663.45 |
| 18 | 2496000.00 | 104849065.4 | 102353065.40 | 5202651.34 | 4469465.08 |
| 19 | 2496000.00 | 104849065.4 | 102353065.40 | 4409026.56 | 3755853.01 |
| 20 | 2496000.00 | 104849065.4 | 102353065.40 | 3736463.19 | 3156179.00 |
| 21 | 2496000.00 | 104849065.4 | 102353065.40 | 3166494.23 | 2652251.26 |
| 22 | 2496000.00 | 104849065.4 | 102353065.40 | 2683469.68 | 2228782.57 |
| 23 | 2496000.00 | 104849065.4 | 102353065.40 | 2274126.85 | 1872926.53 |
| 24 | 2496000.00 | 104849065.4 | 102353065.40 | 1927226.14 | 1573887.84 |
| 25 | 2496000.00 | 104849065.4 | 102353065.40 | 1633242.50 | 1322594.83 |
| 26 | 2496000.00 | 104849065.4 | 102353065.40 | 1384103.81 | 1111424.22 |
| 27 | 2496000.00 | 104849065.4 | 102353065.40 | 1172969.33 | 933969.94 |
| 28 | 2496000.00 | 104849065.4 | 102353065.40 | 994041.81 | 784848.69 |
| 29 | 2496000.00 | 104849065.4 | 102353065.40 | 842408.31 | 659536.71 |
| 30 | 2496000.00 | 104849065.4 | 102353065.40 | 713905.35 | 554232.53 |
| | | | | **235842969.05** | **213381148.68** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)
Where as Stage I and II Have

= **28.50** % **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 6)**

Analysis is carried out on the following assumptions:-

Project Life = 30 Years

Construction cost = NRs 83200000.00

Construction Period = 3 Year

Operation & Maintenance Cost per Year = @ 3.00 % of const.cost = NRs 2496000.00

Construction cost in first year at Start = 10 % NRs 8320000.00

Construction cost in first year end = 70 % NRs 58240000.00

Construction cost in second year = 20 % NRs 499200.00

Benefit starts from third year:-

Total Benefit = NRs 105184880.91

3rd year Benefit = 10 % of T.Benefit = NRs 10518488.09

4th year Benefit = 25 % of T.Benefit = NRs 26296220.23

5th year Benefit = 50 % of T.Benefit = NRs 52592440.46

6th year Benefit = 100 % of T.Benefit = NRs 105184880.91

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 8320000.00 | 0 | -8320000.00 | -7050847.46 | -6991596.6 |
| 2 | 58240000.00 | 0 | -58240000.00 | -41827061.19 | -41127039.05 |
| 3 | 499200.00 | 10518488.09 | 10019288.09 | 6098048.05 | 5945604.00 |
| 4 | 2496000.00 | 26296220.23 | 23800220.23 | 12275888.82 | 11868426.10 |
| 5 | 2496000.00 | 52592440.46 | 50096440.46 | 21897615.82 | 20992881.86 |
| 6 | 2496000.00 | 105184880.9 | 102688880.91 | 38039200.21 | 36161101.64 |
| 7 | 2496000.00 | 105184880.9 | 102688880.91 | 32236610.35 | 30387480.37 |
| 8 | 2496000.00 | 105184880.9 | 102688880.91 | 27319161.31 | 25535697.79 |
| 9 | 2496000.00 | 105184880.9 | 102688880.91 | 23151831.62 | 21458569.57 |
| 10 | 2496000.00 | 105184880.9 | 102688880.91 | 19620196.29 | 18032411.40 |
| 11 | 2496000.00 | 105184880.9 | 102688880.91 | 16627284.99 | 15153286.89 |
| 12 | 2496000.00 | 105184880.9 | 102688880.91 | 14090919.48 | 12733854.53 |
| 13 | 2496000.00 | 105184880.9 | 102688880.91 | 11941457.19 | 10700718.09 |
| 14 | 2496000.00 | 105184880.9 | 102688880.91 | 10119878.97 | 8992200.08 |
| 15 | 2496000.00 | 105184880.9 | 102688880.91 | 8576168.62 | 7556470.65 |
| 16 | 2496000.00 | 105184880.9 | 102688880.91 | 7267939.51 | 6349975.34 |
| 17 | 2496000.00 | 105184880.9 | 102688880.91 | 6159270.77 | 5336113.73 |
| 18 | 2496000.00 | 105184880.9 | 102688880.91 | 5219720.99 | 4484129.19 |
| 19 | 2496000.00 | 105184880.9 | 102688880.91 | 4423492.37 | 3768175.79 |
| 20 | 2496000.00 | 105184880.9 | 102688880.91 | 3748722.34 | 3166534.27 |
| 21 | 2496000.00 | 105184880.9 | 102688880.91 | 3176883.34 | 2660953.17 |
| 22 | 2496000.00 | 105184880.9 | 102688880.91 | 2692274.02 | 2236095.10 |
| 23 | 2496000.00 | 105184880.9 | 102688880.91 | 2281588.15 | 1879071.51 |
| 24 | 2496000.00 | 105184880.9 | 102688880.91 | 1933549.28 | 1579051.69 |
| 25 | 2496000.00 | 105184880.9 | 102688880.91 | 1638601.09 | 1326934.20 |
| 26 | 2496000.00 | 105184880.9 | 102688880.91 | 1388644.99 | 1115070.75 |
| 27 | 2496000.00 | 105184880.9 | 102688880.91 | 1176817.79 | 937034.25 |
| 28 | 2496000.00 | 105184880.9 | 102688880.91 | 997303.21 | 787423.74 |
| 29 | 2496000.00 | 105184880.9 | 102688880.91 | 845172.21 | 661700.62 |
| 30 | 2496000.00 | 105184880.9 | 102688880.91 | 716247.64 | 556050.94 |
| | | | | **236782580.80** | **214244381.58** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.51** % **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 7)**

Analysis is carried out on the following assumptions:-

| | | | | | | |
|---|---|---|---|---|---|---|
| Project Life = | | | | 30 | Years | |
| Construction cost = | | | | | NRs | 46800000.00 |
| Construction Period = | 3 | Year | | | | |
| Operation & Maintenance Cost per Year = @ | 3.00 | % of const.cost = | | | NRs | 1404000.00 |
| Construction cost in first year at Start = | 10 | % | | | NRs | 4680000.00 |
| Construction cost in first year end = | 70 | % | | | NRs | 32760000.00 |
| Construction cost in second year = | 20 | % | | | NRs | 280800.00 |
| Benefit starts from third year:- | | | | | | |
| Total Benefit = | | | | | NRs | 60036350.97 |
| 3rd year Benefit = | 10 | % of | T.Benefit = | | NRs | 6003635.10 |
| 4th year Benefit = | 25 | % of | T.Benefit = | | NRs | 15009087.74 |
| 5th year Benefit = | 50 | % of | T.Benefit = | | NRs | 30018175.49 |
| 6th year Benefit = | 100 | % of | T.Benefit = | | NRs | 60036350.97 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 4680000.00 | 0 | -4680000.00 | -3966101.69 | -3932773.1 |
| 2 | 32760000.00 | 0 | -32760000.00 | -23527721.92 | -23133959.47 |
| 3 | 280800.00 | 6003635.097 | 5722835.10 | 3483094.12 | 3396020.85 |
| 4 | 1404000.00 | 15009087.74 | 13605087.74 | 7017352.90 | 6784432.12 |
| 5 | 1404000.00 | 30018175.49 | 28614175.49 | 12507519.82 | 11990752.24 |
| 6 | 1404000.00 | 60036350.97 | 58632350.97 | 21719272.02 | 20646932.60 |
| 7 | 1404000.00 | 60036350.97 | 58632350.97 | 18406162.73 | 17350363.53 |
| 8 | 1404000.00 | 60036350.97 | 58632350.97 | 15598442.99 | 14580137.42 |
| 9 | 1404000.00 | 60036350.97 | 58632350.97 | 13219019.48 | 12252216.32 |
| 10 | 1404000.00 | 60036350.97 | 58632350.97 | 11202558.88 | 10295980.10 |
| 11 | 1404000.00 | 60036350.97 | 58632350.97 | 9493693.97 | 8652084.12 |
| 12 | 1404000.00 | 60036350.97 | 58632350.97 | 8045503.36 | 7270658.92 |
| 13 | 1404000.00 | 60036350.97 | 58632350.97 | 6818223.19 | 6109797.41 |
| 14 | 1404000.00 | 60036350.97 | 58632350.97 | 5778155.24 | 5134283.54 |
| 15 | 1404000.00 | 60036350.97 | 58632350.97 | 4896741.73 | 4314523.98 |
| 16 | 1404000.00 | 60036350.97 | 58632350.97 | 4149781.13 | 3625650.41 |
| 17 | 1404000.00 | 60036350.97 | 58632350.97 | 3516763.67 | 3046765.05 |
| 18 | 1404000.00 | 60036350.97 | 58632350.97 | 2980308.19 | 2560306.76 |
| 19 | 1404000.00 | 60036350.97 | 58632350.97 | 2525684.91 | 2151518.29 |
| 20 | 1404000.00 | 60036350.97 | 58632350.97 | 2140410.94 | 1807998.56 |
| 21 | 1404000.00 | 60036350.97 | 58632350.97 | 1813907.58 | 1519326.52 |
| 22 | 1404000.00 | 60036350.97 | 58632350.97 | 1537209.81 | 1276744.98 |
| 23 | 1404000.00 | 60036350.97 | 58632350.97 | 1302720.18 | 1072894.94 |
| 24 | 1404000.00 | 60036350.97 | 58632350.97 | 1104000.15 | 901592.39 |
| 25 | 1404000.00 | 60036350.97 | 58632350.97 | 935593.35 | 757640.66 |
| 26 | 1404000.00 | 60036350.97 | 58632350.97 | 792875.72 | 636672.82 |
| 27 | 1404000.00 | 60036350.97 | 58632350.97 | 671928.58 | 535019.18 |
| 28 | 1404000.00 | 60036350.97 | 58632350.97 | 569431.00 | 449595.95 |
| 29 | 1404000.00 | 60036350.97 | 58632350.97 | 482568.64 | 377811.72 |
| 30 | 1404000.00 | 60036350.97 | 58632350.97 | 408956.48 | 317488.84 |
| | | | | **135624057.14** | **122748477.62** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.53** % **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 9)**

Analysis is carried out on the following assumptions:-

| | | | | | | |
|---|---|---|---|---|---|---|
| Project Life = | | | | 30 | Years | |
| Construction cost = | | | | | NRs | 61100000.00 |
| Construction Period = | 3 | Year | | | | |
| Operation & Maintenance Cost per Year = @ | 3.00 | % of const.cost = | | | NRs | 1833000.00 |
| Construction cost in first year at Start = | 10 | % | | | NRs | 6110000.00 |
| Construction cost in first year end = | 70 | % | | | NRs | 42770000.00 |
| Construction cost in second year = | 20 | % | | | NRs | 366600.00 |
| Benefit starts from third year:- | | | | | | |
| Total Benefit = | | | | | NRs | 77162942.08 |
| 3rd year Benefit = | 10 | % of | T.Benefit = | | NRs | 7716294.21 |
| 4th year Benefit = | 25 | % of | T.Benefit = | | NRs | 19290735.52 |
| 5th year Benefit = | 50 | % of | T.Benefit = | | NRs | 38581471.04 |
| 6th year Benefit = | 100 | % of | T.Benefit = | | NRs | 77162942.08 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 6110000.00 | 0 | -6110000.00 | -5177966.10 | -5134453.8 |
| 2 | 42770000.00 | 0 | -42770000.00 | -30716748.06 | -30202669.30 |
| 3 | 366600.00 | 7716294.208 | 7349694.21 | 4473250.80 | 4361424.77 |
| 4 | 1833000.00 | 19290735.52 | 17457735.52 | 9004505.77 | 8705627.17 |
| 5 | 1833000.00 | 38581471.04 | 36748471.04 | 16063095.37 | 15399423.67 |
| 6 | 1833000.00 | 77162942.08 | 75329942.08 | 27904586.39 | 26526861.21 |
| 7 | 1833000.00 | 77162942.08 | 75329942.08 | 23647954.57 | 22291480.01 |
| 8 | 1833000.00 | 77162942.08 | 75329942.08 | 20040639.47 | 18732336.14 |
| 9 | 1833000.00 | 77162942.08 | 75329942.08 | 16983592.77 | 15741458.94 |
| 10 | 1833000.00 | 77162942.08 | 75329942.08 | 14392875.23 | 13228116.76 |
| 11 | 1833000.00 | 77162942.08 | 75329942.08 | 12197351.89 | 11116064.50 |
| 12 | 1833000.00 | 77162942.08 | 75329942.08 | 10336738.89 | 9341230.68 |
| 13 | 1833000.00 | 77162942.08 | 75329942.08 | 8759948.21 | 7849773.68 |
| 14 | 1833000.00 | 77162942.08 | 75329942.08 | 7423684.92 | 6596448.47 |
| 15 | 1833000.00 | 77162942.08 | 75329942.08 | 6291258.41 | 5543234.01 |
| 16 | 1833000.00 | 77162942.08 | 75329942.08 | 5331574.92 | 4658179.84 |
| 17 | 1833000.00 | 77162942.08 | 75329942.08 | 4518283.83 | 3914436.84 |
| 18 | 1833000.00 | 77162942.08 | 75329942.08 | 3829054.10 | 3289442.72 |
| 19 | 1833000.00 | 77162942.08 | 75329942.08 | 3244961.10 | 2764237.58 |
| 20 | 1833000.00 | 77162942.08 | 75329942.08 | 2749967.03 | 2322888.72 |
| 21 | 1833000.00 | 77162942.08 | 75329942.08 | 2330480.54 | 1952007.33 |
| 22 | 1833000.00 | 77162942.08 | 75329942.08 | 1974983.51 | 1640342.29 |
| 23 | 1833000.00 | 77162942.08 | 75329942.08 | 1673714.83 | 1378438.90 |
| 24 | 1833000.00 | 77162942.08 | 75329942.08 | 1418402.40 | 1158352.02 |
| 25 | 1833000.00 | 77162942.08 | 75329942.08 | 1202035.93 | 973405.06 |
| 26 | 1833000.00 | 77162942.08 | 75329942.08 | 1018674.52 | 817987.44 |
| 27 | 1833000.00 | 77162942.08 | 75329942.08 | 863283.49 | 687384.41 |
| 28 | 1833000.00 | 77162942.08 | 75329942.08 | 731596.18 | 577633.96 |
| 29 | 1833000.00 | 77162942.08 | 75329942.08 | 619996.76 | 485406.69 |
| 30 | 1833000.00 | 77162942.08 | 75329942.08 | 525420.99 | 407904.78 |
| | | | | **173657198.65** | **157124405.50** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.50** % **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 10)**

Analysis is carried out on the following assumptions:-

| | | | | | |
|---|---|---|---|---|---|
| Project Life = | | | 30 | Years | |
| Construction cost = | | | | NRs | 68900000.00 |
| Construction Period = | 3 | Year | | | |
| Operation & Maintenance Cost per Year = @ | 3.00 | % of const.cost = | | NRs | 2067000.00 |
| Construction cost in first year at Start = | 10 | % | | NRs | 6890000.00 |
| Construction cost in first year end = | 70 | % | | NRs | 48230000.00 |
| Construction cost in second year = | 20 | % | | NRs | 413400.00 |
| Benefit starts from third year:- | | | | | |
| Total Benefit = | | | | NRs | 86826966.26 |
| 3rd year Benefit = | 10 | % of | T.Benefit = | NRs | 8682696.63 |
| 4th year Benefit = | 25 | % of | T.Benefit = | NRs | 21706741.56 |
| 5th year Benefit = | 50 | % of | T.Benefit = | NRs | 43413483.13 |
| 6th year Benefit = | 100 | % of | T.Benefit = | NRs | 86826966.26 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 6890000.00 | 0 | -6890000.00 | -5838983.05 | -5789916.0 |
| 2 | 48230000.00 | 0 | -48230000.00 | -34638035.05 | -34058329.21 |
| 3 | 413400.00 | 8682696.626 | 8269296.63 | 5032949.22 | 4907131.39 |
| 4 | 2067000.00 | 21706741.56 | 19639741.56 | 10129960.21 | 9793725.40 |
| 5 | 2067000.00 | 43413483.13 | 41346483.13 | 18072928.83 | 17326217.75 |
| 6 | 2067000.00 | 86826966.26 | 84759966.26 | 31397764.76 | 29847571.88 |
| 7 | 2067000.00 | 86826966.26 | 84759966.26 | 26608275.22 | 25081993.18 |
| 8 | 2067000.00 | 86826966.26 | 84759966.26 | 22549385.78 | 21077305.19 |
| 9 | 2067000.00 | 86826966.26 | 84759966.26 | 19109648.97 | 17712021.17 |
| 10 | 2067000.00 | 86826966.26 | 84759966.26 | 16194617.77 | 14884051.40 |
| 11 | 2067000.00 | 86826966.26 | 84759966.26 | 13724252.35 | 12507606.22 |
| 12 | 2067000.00 | 86826966.26 | 84759966.26 | 11630722.33 | 10510593.46 |
| 13 | 2067000.00 | 86826966.26 | 84759966.26 | 9856544.35 | 8832431.48 |
| 14 | 2067000.00 | 86826966.26 | 84759966.26 | 8353003.68 | 7422211.33 |
| 15 | 2067000.00 | 86826966.26 | 84759966.26 | 7078816.68 | 6237152.38 |
| 16 | 2067000.00 | 86826966.26 | 84759966.26 | 5998997.19 | 5241304.52 |
| 17 | 2067000.00 | 86826966.26 | 84759966.26 | 5083895.92 | 4404457.58 |
| 18 | 2067000.00 | 86826966.26 | 84759966.26 | 4308386.37 | 3701224.86 |
| 19 | 2067000.00 | 86826966.26 | 84759966.26 | 3651174.89 | 3110272.99 |
| 20 | 2067000.00 | 86826966.26 | 84759966.26 | 3094216.01 | 2613674.78 |
| 21 | 2067000.00 | 86826966.26 | 84759966.26 | 2622216.96 | 2196365.36 |
| 22 | 2067000.00 | 86826966.26 | 84759966.26 | 2222217.76 | 1845685.18 |
| 23 | 2067000.00 | 86826966.26 | 84759966.26 | 1883235.39 | 1550995.95 |
| 24 | 2067000.00 | 86826966.26 | 84759966.26 | 1595962.20 | 1303357.94 |
| 25 | 2067000.00 | 86826966.26 | 84759966.26 | 1352510.34 | 1095258.77 |
| 26 | 2067000.00 | 86826966.26 | 84759966.26 | 1146195.20 | 920385.52 |
| 27 | 2067000.00 | 86826966.26 | 84759966.26 | 971351.86 | 773433.21 |
| 28 | 2067000.00 | 86826966.26 | 84759966.26 | 823179.55 | 649943.88 |
| 29 | 2067000.00 | 86826966.26 | 84759966.26 | 697609.78 | 546171.32 |
| 30 | 2067000.00 | 86826966.26 | 84759966.26 | 591194.73 | 458967.50 |
| | | | | **195304196.20** | **176703266.42** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.50** % **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 11)**

Analysis is carried out on the following assumptions:-

| | | | | | |
|---|---|---|---|---|---|
| Project Life = | | | 30 | Years | |
| Construction cost = | | | | NRs | 37700000.00 |
| Construction Period = | 3 | Year | | | |
| Operation & Maintenance Cost per Year = @ | 3.00 | % of const.cost = | | NRs | 1131000.00 |
| Construction cost in first year at Start = | 10 | % | | NRs | 3770000.00 |
| Construction cost in first year end = | 70 | % | | NRs | 26390000.00 |
| Construction cost in second year = | 20 | % | | NRs | 226200.00 |
| Benefit starts from third year:- | | | | | |
| Total Benefit = | | | | NRs | 47946992.54 |
| 3rd year Benefit = | 10 | % of | T.Benefit = | NRs | 4794699.25 |
| 4th year Benefit = | 25 | % of | T.Benefit = | NRs | 11986748.14 |
| 5th year Benefit = | 50 | % of | T.Benefit = | NRs | 23973496.27 |
| 6th year Benefit = | 100 | % of | T.Benefit = | NRs | 47946992.54 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 3770000.00 | 0 | -3770000.00 | -3194915.25 | -3168067.2 |
| 2 | 26390000.00 | 0 | -26390000.00 | -18952887.10 | -18635689.57 |
| 3 | 226200.00 | 4794699.254 | 4568499.25 | 2780529.69 | 2711019.70 |
| 4 | 1131000.00 | 11986748.14 | 10855748.14 | 5599274.12 | 5413422.37 |
| 5 | 1131000.00 | 23973496.27 | 22842496.27 | 9984665.64 | 9572133.69 |
| 6 | 1131000.00 | 47946992.54 | 46815992.54 | 17342120.18 | 16485892.62 |
| 7 | 1131000.00 | 47946992.54 | 46815992.54 | 14696712.01 | 13853691.28 |
| 8 | 1131000.00 | 47946992.54 | 46815992.54 | 12454840.69 | 11641757.38 |
| 9 | 1131000.00 | 47946992.54 | 46815992.54 | 10554949.74 | 9782989.39 |
| 10 | 1131000.00 | 47946992.54 | 46815992.54 | 8944872.66 | 8220999.49 |
| 11 | 1131000.00 | 47946992.54 | 46815992.54 | 7580400.56 | 6908402.93 |
| 12 | 1131000.00 | 47946992.54 | 46815992.54 | 6424068.27 | 5805380.62 |
| 13 | 1131000.00 | 47946992.54 | 46815992.54 | 5444125.65 | 4878471.11 |
| 14 | 1131000.00 | 47946992.54 | 46815992.54 | 4613665.81 | 4099555.55 |
| 15 | 1131000.00 | 47946992.54 | 46815992.54 | 3909886.28 | 3445004.67 |
| 16 | 1131000.00 | 47946992.54 | 46815992.54 | 3313462.95 | 2894961.90 |
| 17 | 1131000.00 | 47946992.54 | 46815992.54 | 2808019.45 | 2432741.10 |
| 18 | 1131000.00 | 47946992.54 | 46815992.54 | 2379677.50 | 2044320.25 |
| 19 | 1131000.00 | 47946992.54 | 46815992.54 | 2016675.84 | 1717916.17 |
| 20 | 1131000.00 | 47946992.54 | 46815992.54 | 1709047.33 | 1443627.04 |
| 21 | 1131000.00 | 47946992.54 | 46815992.54 | 1448345.19 | 1213131.96 |
| 22 | 1131000.00 | 47946992.54 | 46815992.54 | 1227411.18 | 1019438.63 |
| 23 | 1131000.00 | 47946992.54 | 46815992.54 | 1040178.97 | 856671.11 |
| 24 | 1131000.00 | 47946992.54 | 46815992.54 | 881507.60 | 719891.69 |
| 25 | 1131000.00 | 47946992.54 | 46815992.54 | 747040.34 | 604951.00 |
| 26 | 1131000.00 | 47946992.54 | 46815992.54 | 633085.03 | 508362.19 |
| 27 | 1131000.00 | 47946992.54 | 46815992.54 | 536512.74 | 427195.11 |
| 28 | 1131000.00 | 47946992.54 | 46815992.54 | 454671.81 | 358987.49 |
| 29 | 1131000.00 | 47946992.54 | 46815992.54 | 385315.10 | 301670.16 |
| 30 | 1131000.00 | 47946992.54 | 46815992.54 | 326538.22 | 253504.34 |
| | | | | **108089798.15** | **97812334.16** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

= **28.52** % Where as Stage I and II Have **21.43%**
``````

``````

**COMPUTATION OF EIRR(BLOCK 12)**

Analysis is carried out on the following assumptions:-

| | | | | | | |
|---|---|---|---|---|---|---|
| Project Life = | | | | 30 | Years | |
| Construction cost = | | | | | NRs | 35100000.00 |
| Construction Period = | 3 | Year | | | | |
| Operation & Maintenance Cost per Year = @ | | 3.00 | % of const.cost = | | NRs | 1053000.00 |
| Construction cost in first year at Start = | | 10 | % | | NRs | 3510000.00 |
| Construction cost in first year end = | | 70 | % | | NRs | 24570000.00 |
| Construction cost in second year = | | 20 | % | | NRs | 210600.00 |
| Benefit starts from third year:- | | | | | | |
| | Total Benefit = | | | | NRs | 44029144.90 |
| | 3rd year Benefit = | 10 | % of | T.Benefit = | NRs | 4402914.49 |
| | 4th year Benefit = | 25 | % of | T.Benefit = | NRs | 11007286.23 |
| | 5th year Benefit = | 50 | % of | T.Benefit = | NRs | 22014572.45 |
| | 6th year Benefit = | 100 | % of | T.Benefit = | NRs | 44029144.90 |

| Year | Const.Cost(NRs) | Benefit (NRs) | Cash Flow(NRs) | Present worth of cash flow at discount rate of ( % ) | |
|---|---|---|---|---|---|
| | | | | 18 | 19 |
| 1 | 3510000.00 | 0 | -3510000.00 | -2974576.27 | -2949579.8 |
| 2 | 24570000.00 | 0 | -24570000.00 | -17645791.44 | -17350469.60 |
| 3 | 210600.00 | 4402914.49 | 4192314.49 | 2551572.03 | 2487785.72 |
| 4 | 1053000.00 | 11007286.23 | 9954286.23 | 5134310.10 | 4963891.48 |
| 5 | 1053000.00 | 22014572.45 | 20961572.45 | 9162496.50 | 8783933.75 |
| 6 | 1053000.00 | 44029144.9 | 42976144.90 | 15919719.50 | 15133719.74 |
| 7 | 1053000.00 | 44029144.9 | 42976144.90 | 13491287.71 | 12717411.54 |
| 8 | 1053000.00 | 44029144.9 | 42976144.90 | 11433294.67 | 10686900.46 |
| 9 | 1053000.00 | 44029144.9 | 42976144.90 | 9689232.77 | 8980588.62 |
| 10 | 1053000.00 | 44029144.9 | 42976144.90 | 8211214.22 | 7546713.12 |
| 11 | 1053000.00 | 44029144.9 | 42976144.90 | 6958656.11 | 6341775.74 |
| 12 | 1053000.00 | 44029144.9 | 42976144.90 | 5897166.20 | 5329223.31 |
| 13 | 1053000.00 | 44029144.9 | 42976144.90 | 4997598.47 | 4478338.91 |
| 14 | 1053000.00 | 44029144.9 | 42976144.90 | 4235252.94 | 3763310.01 |
| 15 | 1053000.00 | 44029144.9 | 42976144.90 | 3589197.41 | 3162445.39 |
| 16 | 1053000.00 | 44029144.9 | 42976144.90 | 3041692.72 | 2657517.13 |
| 17 | 1053000.00 | 44029144.9 | 42976144.90 | 2577705.70 | 2233207.67 |
| 18 | 1053000.00 | 44029144.9 | 42976144.90 | 2184496.35 | 1876645.10 |
| 19 | 1053000.00 | 44029144.9 | 42976144.90 | 1851268.09 | 1577012.69 |
| 20 | 1053000.00 | 44029144.9 | 42976144.90 | 1568871.27 | 1325220.75 |
| 21 | 1053000.00 | 44029144.9 | 42976144.90 | 1329551.92 | 1113630.88 |
| 22 | 1053000.00 | 44029144.9 | 42976144.90 | 1126738.92 | 935824.27 |
| 23 | 1053000.00 | 44029144.9 | 42976144.90 | 954863.49 | 786406.95 |
| 24 | 1053000.00 | 44029144.9 | 42976144.90 | 809206.35 | 660846.18 |
| 25 | 1053000.00 | 44029144.9 | 42976144.90 | 685768.09 | 555332.92 |
| 26 | 1053000.00 | 44029144.9 | 42976144.90 | 581159.40 | 466666.32 |
| 27 | 1053000.00 | 44029144.9 | 42976144.90 | 492507.96 | 392156.57 |
| 28 | 1053000.00 | 44029144.9 | 42976144.90 | 417379.63 | 329543.34 |
| 29 | 1053000.00 | 44029144.9 | 42976144.90 | 353711.55 | 276927.17 |
| 30 | 1053000.00 | 44029144.9 | 42976144.90 | 299755.55 | 232711.91 |
| | | | | **98925307.93** | **89495638.22** |

**EIRR** =Low rate + [( Discount at low rate / (Discount at low rate - Discount at high rate)] * ( HR-LR)

Where as Stage I and II Have

= **28.49** % **21.43%**
``````

``````
``````