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ENVIRONMENT BASED COST BENEFITS ANALYSIS OF LARGE DAM PROJECTS

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Introduction

Environment adhers to the surroundings, conditions and influences and defined as the totality of natural external conditions and influences that affect the way to live and develop (Freeman et al.1973). It is considered as natural capital asset, which directly and indirectly provides a vast economically valuable goods and services. The environmental resources are scarce in nature (Barbier and Costanza, 1987). Environmental Economics studies the cost of exploiting resources that lead to imbalance in the ecosystem. With population explosion and economic growth, the environmental resources are overexploited leading to deterioration of human welfare. Environmental Economics studies the cause and effect of the overexploitation of environment resources and the costs and benefits is the process for the society (Sankaran, 1994). The subject also has problem-solving orientation It proposes economic incentives for the environmental problems that arise due to the establishment of large dam projects.

Objectives and Methodology

The paper is construed with the following objectives:

1. To recognize various progress made about Ecological Economics.
2. To analyse cost benefit analysis and its progress and to assess the river valley projects.
3. To point out various problems with its repercussion of large dam projects in the economy.

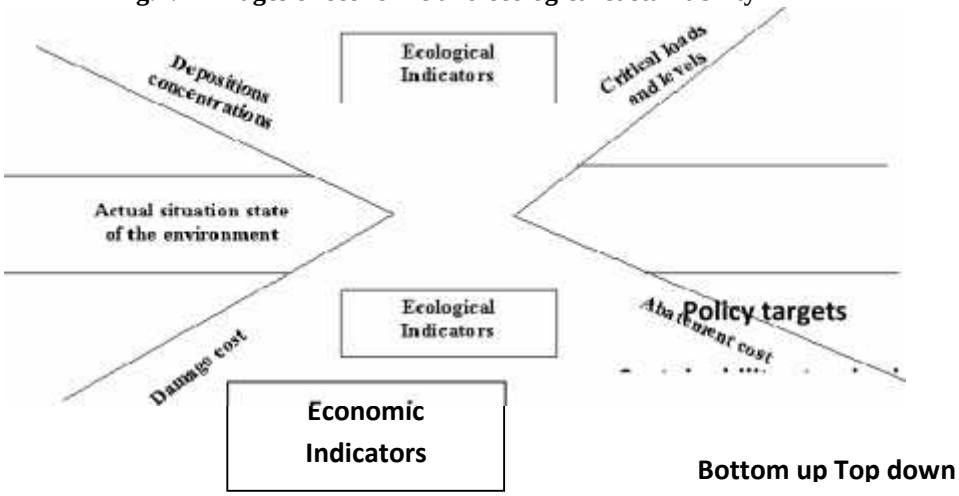
The methodology here adopted is descriptive and analytical. Secondary data have been collected for the purpose of the study. The data are collected from various sources such as books, journals, articles published and internet.

Recognisation of Ecological-Economics

Ecological Economics has a potted history {Pearce, 1991). The old roots of the sub-discipline are treated in Malthusian scarcity 1778), Ricardian scarcity (1817), Mills stationary state (1887), Jevon's coal question (1865), and so on (Sahu et al.1996). But its modern formulation is about three decades. Ecological Economics is the study of the symbiotic relationship between eco-system and economy with particular emphasis on stewardship to ensure sustainable development with the bio-physical constraints.

Ecological-Economics recognize the economy as a complex. The ecological and economic indicators are not exclusive but complementary. Each shows the approach to look at both types of indicators. Ecological approaches are placed on the upper and economic approaches on the lower half indicating about the linkages between ecological and economic sustainability (Fig-1)

Fig.1: Linkages of economic and ecological sustainability



Source: Rennings and Wiggering (1996)

The left side of the figure represents values for the actual situation of the environment, while the right side refers to policy targets. These approaches have to be used together for improving measures of sustainability Ecological economics is an open discipline and endeavours to achieve a synthesis of Environment Economics,BiophysicalEconomics and Institutional Economics. To deduce the ecological economic perspectives involved in a dam, it is highly essential to reflect upon the three components.

Cost-Benefit Analysis of Large Dam Project

Cost-benefit analysis is a practical way of assessing the desirability of projects which is implied for the enumeration and evaluation of costs and benefits. This involves drawing on variety of traditional sections of economics like, welfare economics, public finance and resources economics. Cost benefit analysis has a long history after Dupuits classical paper on the utility of public works and has a great path breaking contribution as long as 1844. Cost-benefit analysis has come into prominence among the economists in the recent past years in the world (Prest and Turvey, 1965).

Since 1930s social Cost-Benefit Analysis (CBA) has been used in public decision-making. Originally, the method of social cost-benefit analysis was applied for the assessment of public investments in economic infrastructure e.g. flood control, dams, roads, land reclamation, airports and so on. The province of cost benefit is usually confined to public projects because the advantages and disadvantages are defined in the terms of social gains and losses (Dasgupta and Pearce, 1972). Since the early 1970s economic analysis of environmental change have been incorporated into CBA. Now, CBA has been growing into a flourishing branch of EnvironmentalEconomics (Nentjest 1989). CBA plays a vital role in assessing the value of a project. A project without sizeable returns may prove disastrous for repayment of loans brought from various financial institutions (Mishra, 2000). One important justification of the natural forest and environment is to make valuation for economic appraisal. In the extended CBA which is a non-market technique, intuitive reasoning helps the decision making process (Brade and Pearce, 1991) (Pearce et al., 1990)

The Structure of Cost Benefit Analyses

There are several steps which can guide the CBA for implementation of any project in the decision making process. The essential steps are; defining the project, identification economically relevant impacts, physically quantifying impacts, calculating a monetary valuation, discounting and applying present value test.(Hanely and Spash, 1993, P.8).

Discounting of Cost and Benefit flows

All economic activities take place within the biophysical environment. The environment involved influence good and ill by the process of consumption, production, exchange and distribution. The economic agents such as households and firms use the environment as resource for benefits and costs but it is important to take immediate decision. These are determined through a discounting rate, which is important in investment that affect environment.

Discounting is the only means of accommodating uncertainty in environmental degradation and resource depletion. Uncertainly is the main function of time (Perrings 1987). Investment of capital in a project involves the sacrifice of present benefits for future benefits (Dasgupta and Pearce 1972). The relevant cost and benefit flows can be expressed in monetary amounts and convert them into present value (PV) term (Hanley and Spash 1993). In the allocation of public resources between the present and future goods and services, social discount rate or social time preference rate is to be used (Jhingan 1992).

The present value of a cost and benefit (X) received in time (t) is calculated as follows:

$$PV(X_t) = X_t[(1+i)^{-t}] \quad (1)$$

Or

$$PV(X_t) = X_t\left[\left(\frac{1}{1+i}\right)^t\right] \quad (2)$$

This factor always lies between +1 and 0. Higher the social discount rate (i), lower will be the discount factor and vice-versa. The rationale of the equation is simple. Take one rupee invested at an interest rate of 10%. In one year's time, this will have grown to Rs.1 (1+10%) or Rs.1 (1+0.1), which is Rs.1.10. Thus,Rs. 1.10 in one year's time is same the worth as Rs.1 now (Hanley and Spash 1993).

Applying the present value test

The main aim of CBA is to select projects and policies, which are efficient at the use of resources. An important criterion for the project evaluation is Net Present Value (NPV) Test (Hanley and Spach 1993). The NPV is equal to the present value of benefits minus the present value of operating and maintenance costs minus initial outlay. But the Net Present Value of Benefits = Gross Present Value of Benefits – Gross Present Value of Costs.

It can be expressed mathematically as,

$$NPV = \sum B_t (1 + i)^{-t} - \sum C_t (1 + i)^{-}t \quad (3)$$

Where t= 0 the first year of the project t=1, the last year of the project,
B = benefit; C = Cost and i= discount rate.

In making the choice of a project either of the two rules may be followed:

1. The project will be selected, where the present value of benefits exceeds the present value of costs, that is

$$NPV = \sum B_t (1 + i)^{-t} > \sum C_t (1 + i)^{-}t \quad (4)$$

2. The ratio of the present value of benefits to costs is greater than one

$$\frac{\sum B_t (1+i)^{-t}}{\sum C_t (1+i)^{-t}} > 1 \quad (5)$$

The NPV criterion is considered as the most appropriate rule for project evaluation (Hanley and Spash 1993, Jhingan 1992, Prest and Turvey 1965, Dasgupta and Pearce 1972).

Concept of Valuation in Cost- Benefit Analysis

Improvement or deterioration in the quality of environment due to a project usually involves effects, which are observed by the market. Most of the environment services are not priced and therefore not counted in due costs by the firms and individuals. Obviously, the decision makers are putting a zero value to the environmental effects.

The concept of value has different meaning for different people. While some view in terms of equivalence, others talk about ethical judgments (Turner and Pearce, 1992 and Pearce, 1994). For the purpose of valuation, ethical judgments are important. By influencing people's preferences the judgments are translated into people's willingness to commit resources for forest conservation. But the true measure of value, that is needed in the context of decision making in environmental/ecological economics is the opportunities forgone in committing resources to forest conservation rather than for promotion of other desirable sectors such as education, health, transportation, communication and so on.

The conceptual and structural relationship between economics and ecology constitute the main theoretical basis for applying methodologies of economic science to valuation of environmental goods and services (Ravi and Puspagadan, 1996). The basic philosophy behind valuation is to provide a monetary measure of the opportunity costs to conservation of a piece of environment asset in terms of its value attainable for the next best forgone alternative utilisation (Nayak, 1998, p.160).

The value of natural environment of an area such as biodiversity, forest ,river and so on is measured by a comprehensive concept called Total Economic value (TEV) (Mishra, 1999p. 21). Since the process involves both economic benefits and ecological function, the term is better expressed as Total Economic-Ecologic Value (TEEV). Now it is a prediction only. Environmental Economists recognise two broad classes of value of environment such as Use Value (UV) and Non- Use Value (NUV). Use value (UV) can be realised either at present or future. Present Use Value (PUV) arises out of the current natural environment and resources either directly and indirectly. Direct Use Value (DUV) of an environmental resourses' relates to productive and consumptive value to the human kind may or may not be transacted through the market. The ecological functions

of the environment provide Indirect Use Value (IUV). Such values are derived from the roles the resources and systems of natural environment play to their supportive or protective activities (Mishra, 1999, p. 21). The Future Use Value (FUV) refers to the benefits obtainable from a piece of environmental resources' in future to the consumers and producers. Consumption of future use value are Option Value (OV) and Quasi Option Value (QV). Some have categorised these components under Use Value (UV) and others under Non- Use Value (NUV) (Perrings, 1996 and Mac Arther, 1996). Option Value (OV) is an insurance value (Pearce and Moran 1994). Arrow and Fisher (1994) developed the concept of Quasi Option Value (QV) to refer the value of the future information protected by preserving resourses.

Non- Use Value (NUV) also called as passive use values. It is derived from people's motivations to protect environment for reasons other than personal use. Such values are less tangible than use value (Mishra, 1999). Non Use Value includes Bequest Value (BV) and Existence Value (EV). The former is defined by Willingness To Pay (WTP) to ensure that the future generetions inherit a particular environmental asset. Existence Value, on the other hand, does not refer to any use either at present or in future of a certain environmental asset, rather it is simply derived from the existence of a particular asset (Mishra, 1999).

The various Components measuring the Total Economic-Ecologic Value (TEEV) can be expressed in the form of the following equation:

TEEV =UV+NUV
= (PUV+FUV) +NUV
= (DUV+IUV)+(OV+QV)+(BV+EV)

Since a number of value ideas are involved, one should be careful to avoid the trade-off between the components. Simple summation may involve double counting. One should, therefore, carefully, avoid double counting (Pearce and Moran, 1994). TEEV not adopted in this study though Polavaram Project is yet to be completed and its actual total environmental lose is quite unknown by the decision making process. Due to bias information TEEV is applicable only in ex-post studies here. It is a theoretical proposition and prediction only.

Components of Cost- Benefit Analysis of Dam Projects

Dam projects like, an estuarine barrage or a dam in the hills have many different forms in their engineering characteristics. Similarly, water investments are mainly for supply of water to an industrial area, provision of irrigation water to the cultivable land, prevention of flood damage. The other benefits are the development of internal navigation, fisheries, soil conservation and riverside recreation (Dasmann, et al., 1973). The details of Cost-Benefit Analysis inevitably differ from project to project here, it covers the sample only (Fig-2).

A comprehensive list of benefits would include the following:

1. Supply of water to dry lands,
2. Increasing the supply of food grains and industrial raw materials,
3. Growth of urban areas,
4. Electric power for large-scale industries,
5. Establishment of small – scale industries in the rural areas and generation of employment opportunities,
6. Controlling floods,
7. Promoting intensive agricultural development programmes
8. Navigation and development of fisheries,
9. Development of Tourist Spots.
10. Many reservoirs have affected the ancestral homes and land of the people, forced resettlement of the poor, damaged the environment and caused grave diseases and nutritional problems. A complete account of Social, Economical and Ecological costs should be included in determining the cost-benefit analysis of a dam project.

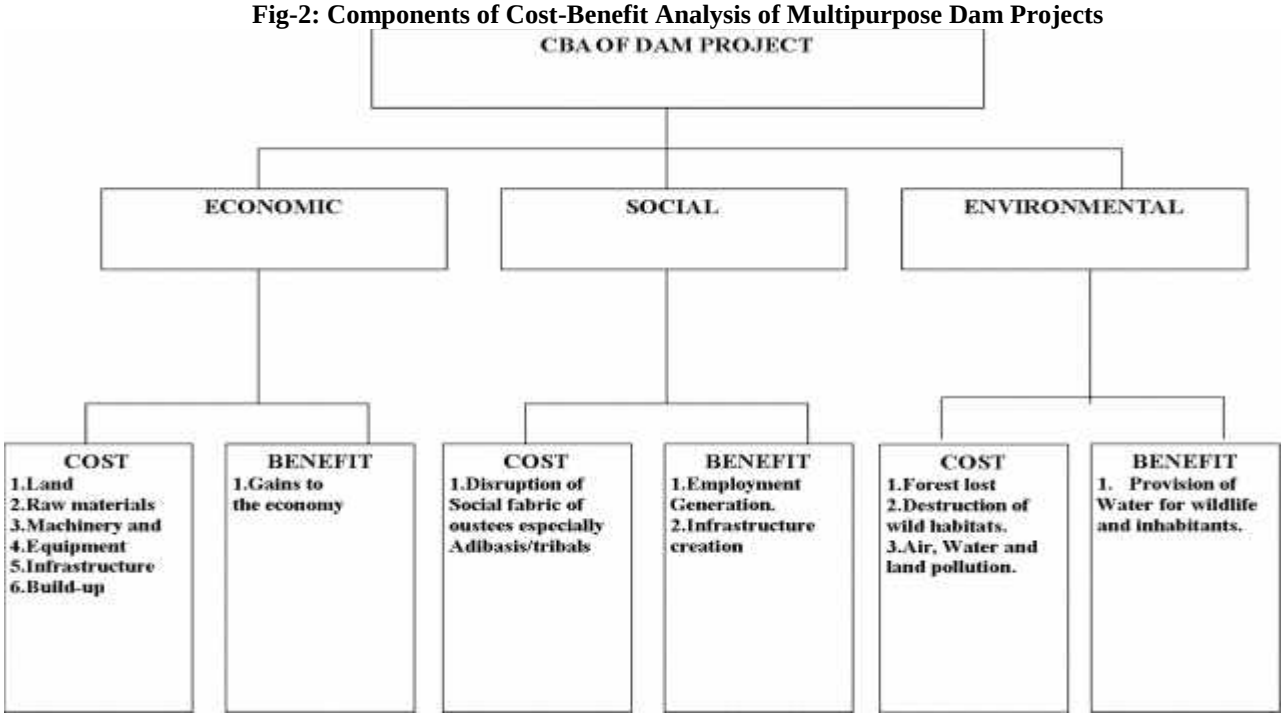
The following items cover the costs, which are commonly seen in a large dam projects (Dasmannet al., 1973).

1. Loss of agricultural, forest or minerally productive lands.
2. Loss of homes, villages, religious and cultural sites.
3. Loss of community facilities like schools, health centers, etc.
4. Misleading information on resettlement sites and facilities.
5. Resettlement site selection without studying soil condition, agricultural potential, water needs and supplies, disease and transportation.

a. Tendency towards selecting government forest reserve lands for resettlement, leading to loss of valuable watershed protection and timber production.

6. Lack of funds, planning capabilities and trained personnel to implement and manage a successful resettlement programme.
7. Difficulties involved in movement of people from fertile lowland to poorer quality upland sites including-
   a. Lower agricultural production associated with less productive soils and unfamiliar land use practices;
   b. Exposure to new disease environments and intensification of new diseases due to population density;
   c. Reduce crop diversity and loss of river fisheries contributing to nutritional improvement;
   d. Lack of potable household and irrigation water;
   e. Fewer potential cash crops and loss of income.
8. Inadequate compensation of evacuees for losses, sometimes based on faulty land valuation.
9. Spontaneous colonization of areas in the reservoir catchment zone causing accelerated erosion and sedimentation.

Fig-2: Components of Cost-Benefit Analysis of Multipurpose Dam Projects



Source: Mishra,2002

Cost- benefit Analysis of Large Dam Projects in India

In India, D.R. Gadgil first made systematic attempt on CBA of Dam Projects. He had surveyed the Godavari and Pravara canal system in Maharastra. Before the survey, the planning Commission Research Programmes Committee headed by D. R. Gadgil initiated the study of the Cost-Benefit Ratio of six irrigation projects in the year 1958. The irrigation projects are,

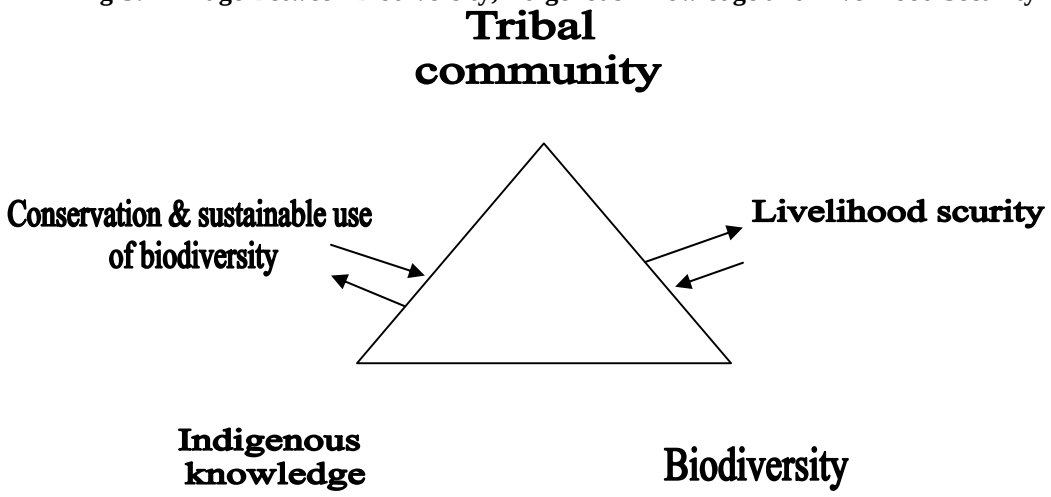
1. The Sardar Canal in Uttar Pradesh
2. The Tribani Canal in Bihar
3. The Damodar canal in West Bengal
4. The Gang Canal in Rajastan
5. The Cauvery Methur Project in Tamil Nadu
6. The Nizam Sagar Project in Andhra Pradesh

Another study was done by Sovani and NilakanthaRath to evaluate the "Cost- benefit of Hirakud Dam Project." of Odisha in the year 1960. Similar surveys were also conducted by Baljit Singh and S.Mishra on " Cost Benefit Analysis of Sardar Canal" in the year 1965 (Jhingan, 1992, P.551) In modern India assessment through Cost Benefit Analysis of large dam projects get a momentum and opposed by various groups in the country only for large scale displacement and environment deterioration.

Major problems of Large Dam project

Some major problems observed in construction of large Dam projects areanalysed below;

Fig-3: Linkage Between Biodiversity,Indigenous Knowledge and Livelihood Security



Source: Perrings,2002

The above figure shows the linkages between biodiversity, indigenous knowledge and the livelihood security of tribal community. The livelihood can be made secure when threatened biodiversity are corrected..

The Gap Between the Words and the Work of the Project Authority

According to the estimate 15% or more than tribal population have been displaced or affected by development projects. The uprooting of the tribal people from their homes and habitat for building dam has been one of the shocking scandals of post-independence India. Providing monetary compensation has not been much use. It was not adequate. The tribal people who have given lump sum amounts of money could not use it properly. They were nothing in a short period of time. The rehabilitation projects were flawed as the tribal people put in area which had no similarity with the habitat they were used to. They were even given to rocky or barren land. Displacement has meant that the evacuated tribal people are driven to take up back breaking jobs in the unorganized sector.

In the decision making, when a project come to an existence big assurance will be committed by the Public authority not towards its minimization of displacement but also to provide adequate rehabilitation scheme at its initial plan formulation stage. After evacuation of the project affected people in the site, experience shows that there will be a long gap between the words and the work. The Hirakud dam commenced on 1964 (Nayak-2010) completely failed not only its development policy but also rehabilitation policy. People till today have not received any compensation towards displacement. In case of Balimela dam Project, commenced in 1961, survey conducted in the cut-off area proved that people still today have not received compensation and rehabilitation rather they lived in far from the human civilization and facing great difficulties by losing their ancestral homes. The past experience shows that the actual gap between works and words are prevailing in all the multipurpose dam projects.

Conclusion

Project evaluation is an integral part of development. Dam projects have many dimensions. The major benefits of the projects are based on the engineering characteristics. The wide provision of benefits are water supply, generation of hydroelectricity, prevention of flood damage, fishery, navigation and recreation (Press and Turvey,1965). Now, large dam projects are no more considered as the temple of socio-economic progress throughout the world including India. The environmentalists argue that big dams cause big damages in terms of loss of human settlements, people's resources, forests, wildlife and wilderness areas. Big river valley projects involve large land use changes which affect biodiversity and ultimate sustainability of human economy. For investment in mega dam projects environmental protection is normally a less prominent item. For a public decision mechanism, cost benefit analysis plays a vital role in assessing the value of a project. The advantages and

disadvantages are defined in terms of social gains and losses. The value of forest loss and bio-diversity depletion must be included. The exploitation of nature without regard to physical or bio-physical factors is not sustainable.

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