ENVIRONMENT, LAND AND WATER

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Land according to the interpretation given in many literature includes things attached to the earth or permanently fastened to anything attached to the earth. Trees, soils, water and other natural assets as well as buildings and other man made fixtures are parts and parcels of the land resource. Water includes surface water, sub-surface water and ground water. Trees include natural forest cover as well as plantations established by the society. However when we make references to environment we are concerned with natural resources, the resources given by the nature. They include not only physical resources but also biological resources.

Land is the plain on which man interacts with the nature or his environment. Any activity of man on land results in a number of changes in environmental factors. In fact the environmental concern in development originated from experience of the first world countries as a direct result of rapid industrial development and consequent pollution of air and water. Hence almost all studies on this subject are centered around protection of environmental quality. However in the third world countries the environmental issue is a question of conservation of the environment rather than protection.

The third world countries such as Sri Lanka are predominantly agricultural countries who produce primary agricultural products both for domestic consumption and export markets. The land and water are the main natural resources in these countries as they facilitate crop production. Any activity related to crop production as in case of industrial activities makes many changes in the environment. Clearing of lands, construction of a reservoir changes the water regime of a river and introduction of new crops changes the habitation of the environment. Any developmental factors. All these manipulations are made with the intention of achieving some desirable objectives. However these manipulations bring into play a new dynamic natural mechanism which may result in some other changes which are not beneficial to the society. It is therefore necessary to identify and if possible to predict the possible environmental changes and their rapidity, importance and magnitude with a view to avoid or at least minimize possible adverse environmental effects.

There are a significant number of environmental changes or impacts identified to be associated with land and water development projects. Most of these impacts are synergistic and hence can not be separated from each other. In order to understand them it may be possible to discuss them as separate items but with necessary references to linkages. Importance and significance of and impact vary from location to location or project to project depending on environmental factors such as climate and physical features. Nevertheless most of the impacts are common to many land and water development projects although significance may be different.

In most of the literature on this subject in the third world major emphasis has been given to problems associated with soil namely soil erosion and loss of soil fertility. Soil erosion and loss of soil fertility are widely experienced adverse environmental impacts of development projects. Especially in the tropics where rainfall is intensive and hence erosive probability for soil erosion is very high. Erosion is a factor of erosivity of the rainfall, texture of the soil and gradient of the terrain. In the tropics more than fifty percent of the rainfall is estimated to be erosive. The scorching sun desiccates soils during the dry season if the soil is not covered with any type of vegetation. Steep slopes are also common in the tropics. In Sri Lanka it has been estimated that nearly twenty million metric tones of soil is annually lost due to sheet erosion alone. When gullies are developed the damage is much more. In the tropics soils are generally infertile and available nutrients are stored in a thin top soil cover. Soil erosion therefore can results in a complete loss of soil fertility.

Soils eroded from mountain slopes create siltation problems in rivers, reservoirs and down stream cultivable lands. Many cases have been reported in the Asian region where siltation of rivers has resulted in substantial changes in the river bed levels. Tharai rivers in Nepal and India are reported to have nearly a six inches rise in the bed levels resulting in unprecedented flood levels in the river basins. Floods can cause not only loss of crops and properties but also loss of valuable human lives. Siltation in reservoirs drastically reduce the life span of reservoirs. Mangla reservoir and Tabela dam in Pakistan are typical examples. Deposition of excessive nutrients in reservoirs and other water bodies creates the problem of "eutrophication". Eutrophication destroys fisheries and other aquatic life in water bodies and creates aesthetic nuisance to people living in the region. Fortunately in Sri Lanka eutrophication in water bodies has not reached the levels of a grave danger. Nevertheless possibility of having such situations cannot be overruled. It has been estimated that nutrient levels in many rivers in the region are reaching the danger levels jeopardizing the supply of drinking water to many communities.

Land and water development projects always envisage a change in the river flow pattern. Construction of a reservoir across a river reduces water suply to down stream. On one hand the reduction could be during the rainy season eliminating possibility of down stream floods. Similarly the reduction could be an overall reduction as water stored in the reservoir will be used for cultivation.

and other purposes in the upstream. Reduced water supply effects agricultural and other livelihoods in the down stream. Drastic reductions in the dry season may cause severe hardships to down stream population. Where water courses are being used for navigation effects of reduced water supply may create transport difficulties.

Floods although they have adverse effects are a part and parcel of the resources given by the nature. Silt deposits supplied by the floods maintain fertility of river basins. Most of the alluvial soils in the river basins are the highest fertile lands in the tropics and they already account for significant quantities of food supply. A change in the flood cycle may result in a complete breakdown in the production pattern.

Land and water development projects are always associated with establishment of new settlements and development of new areas for cultivation. These development in upstream effects quality of the river water. Fertilizer applied in cultivation operations will find their way into river water through seepage and percolation. Discharge of waste from the settlements add coliforms and other bacterial pollutants into the water. Concentration of nitrites has resulted in increased infant morbidity and mortality in many parts of the world. Spread of bacterial diseases is always related to poor quality of drinking water.

Changes in river flow may have severe adverse effects on aquatic and beneathal life. Fish are virtually the only source of high quality animal protein for hundreds of million of the worlds poorest people in tropical countries. Sri Lanka is not an exception. High productivity of fisheries is related to the quality of water and suply of nutrients through the river systems. Emission of toxic chemicals mostly the organochlorines such as DDT, Dieldrin, and Aldrin create conditions which are lethal to aquatic life. Although organophosphates are not relatively persistence their effects could be much more in the short period.

Effects of changes in the river flow are most prominent in aquatic habitats such as mangroves, lagoons, estuaries, marshes, mudflats, seagrassbeds, and coral reefs. These aquatic habitats are the most productive ecosystems next to tropical rain forests. They provide habitats for many terrestial and aquatic animals. In addition to the resident fauna, there are species utilizing these ecosystems only as temporary habitats for spawning, nurseries, feeding ground or shelter. Most commercial species of shrimps are dependents of these ecosystems. Changes in river flow not only reduces the nutrient supply to these systems but also create condition which are lethal to aquatic life. In these systems where many organisms are already exposed to conditions at the extremes of their range of tolerance in the course of natural daily or seasonal fluctuations, a slight change may bring about a complete destruction to many organisms. For example a slight change in salinity levels may destroy entire shrimp population.

In the tropics one of the most important and frequently and widely discussed adverse effect of land and water development projects is the loss of forest cover. These projects throughout the world have become a major threat to existing forest cover. According to UNDP estimates 11 million hectares of forest land is annually cleared in tropical region for cultivation. The potential area for evergreen forests in the tropics is 1,184 million hectares and availability at present is only 765 million hectares. In Asia and Pacific region nearly 60 percent of the potential evergreen forests land is already cleared.

Clearing of forest cover effects the hydrological cycle. Precipitation under trees has been found to be greater than in the open during the dry season and less in the wet season, in an experiment carried out in the Horton plains. Forest cover effects river flows through increased infiltration and percolation. In an experiment carried out in Kenya where changing a forested watershed to tea plantation resulted in an increase in water yield approximately equivalent to 900 cubic meter per month for each hectare cleared. In the tropics where water availability is seasonal a change in hydrological cycle may cause severe hardships to village populations.

Tropical rain forests are the most diverse and productive ecosystems of the world. It has been found that they account for more than 25,000 flowering plants alone. Species diversity in the tropics is an essential component of the nature to ensure sustainability of the ecosystem. Some of the species are critical to the structure and function of the system, some are commercially or recreationally valuable, and some are rare and endangered and effects the well being of some other importart species. All the species in the world whether animal or plant are interdependent. Extinction of one species may have severe effects on some other species which was not even foreseen to be affected. Man is also one of the species who share the environment with other species and hence the effects of extinction of one species could be on man himself.

Species diversity in the tropics provides opportunities for many economic activities. They provide timber and fuel wood. They also provide chemical substances which could be used for production of many economically valuable items. These include insecticides, essential oils, drugs and medicines, gums, latex, resins and waxes. Potentials of most species are not yet properly identified and made use of. Many species are fast growing and hence could be used for economic activities to ease the energy and other related problems of the third world.

Forests not only provide timber and other economically valuable substances but also facilitate maintenance of fertility of tropical soils. The tropical forests are the highest productive ecosystems of the world. Some tropical forests have estimated to produce more than 3200 grams of biomass per cubic meter per year. More than 80 percent of the nutrients in tropical ecosystems is held in the trees and there is a well developed mechanism related to forest organisms which recycles actively nutrients within the system. Clearance of forest cover results in a complete destruction of the recycling system and the nutrients. In the tropics the rate of soil erosion from forest areas may be accelerated by a factor of between 2 to 2000 depending on the type of disturbance.

Forests, to a greater extent, are the scavengers in the world environment. The assimilative capacity of the environment with regard to atmospheric pollutants such as carbon dioxide and carbon monoxide depends on the forest cover. Carbon dioxide exchange rate of some of the montana rain forests have been recorded to be as high as 164 grams per cubic meter per day.

Land and water development projects always compete with wild life for their habitats. Large extent of wild life habitats have been already cleared for agricultural operations. Protection of wild life species is related to the species diversity discussed earlier and providing opportunities for future generations to exploit the potentials related to them. Some of these animals could be required in future for domestication or genetic revival of domesticated species. Furthermore research on natural populations of animals including insects provide a theoretical basis for developing biological controls. Some of these species are the potential control agents of many environmental hazards. A natural area preserved provides a permanent reservoir of potential control agents. Research on patterns of natural resistance of wild species suggests directions for future breeding programme.

Aesthetic value related to wildlife can not be under estimated specially in regard to the third world countries. Natural and wild life parks are a major source of foreign exchange earning in many tropical countries. In a country where tourism has been given high priority wild life plays a major role in attracting tourists.

Land and water development usually change the water regime of a river valley. Irrigation facilities provided for new lands not only bring new Areas under cultivation but also make some already cultivable areas unproductive. The problem is associated with salinity and alkalinity, water logging and inundation. Almost all the reservoirs are constructed across rivers inundating large extents of fertile cultivable lands. These lands are lost for ever for agricultural production. Salinity, alkalinity and water logging are related to supply of water. Excessive use of water increase capillary action and brings salts dissolved in ground water to surface. Poor drainage facilities have aggravated the problem in many parts of the third world. Inadequate supply of water has also increased salinity as water supplied is not sufficient to wash out the salts supplied through fertilizer and irrigation water. Low lying areas are usualy affected by water logging in any of the irrigation systems. No accurate estimates have been prepared with regard to the extents affected by salinity, alkalinity and water logging in Sri Lanka but a general estimate shows that nearly 200,000 hectares of land are plagued by this problem.

Changes introduced to ground water levels are another aspects to be considered. Diversion of a river may deny drinking water to people who are dependent on ground water in the region. Exploitation of ground water for agricultural purposes has created many unforeseen dufficulties to rural villagers. In most cases the advantages were to the elite groups while, poorest of the poor were denied of even drinking water facilities.

Tropical regions are the home for a large diversity of insects and some of them are the vectors of many debilitating diseases. Debilitating diseases common in the tropics include malaria, shistosomiasis, opisthorchiasis, filariasis, trypanosomiasis (sleeping sickness), dengu fever, encephalities, and onchocerciasis (river blindness). All these diseases are related to vectors which thrive in tropical climates. However the nature has its own protections against these vectors being uncontrollable. For example in areas where most vectors breed climate is characterized with low rain fall and a long dry season and water is naturally very scarce and conditions for vector breeding are consequently very limited. This homeostatic equilibrium is radically altered by the water development projects through providing water from other sources. Records from many irrigation projects in the tropics accounts for significant increases of the numbers affected by the water born diseases.

Effects on social environmental have to be given more emphasis as ultimate objective of all the land and water development projects is to improve the quality of human life. Social effects of a project depend on many factors including acceptability of new developments to the society, their absorption capacity and perception about development. Any new proposal should be introduced in the proper context only with moderate changes. These principles are described as contextualism and increamentalism. People in a region may have their own perceptions about development and their absorption capacity is limited by the perceptions as well as educational levels. Any new development beyond their capacity may result in displacement and alienation of them rather than in development.

The traditional societies have developed their own methodologies which are compatible with the given environmental conditions. These age old traditional methods ensure a sustainable economy although it remains at a lower level. Systems like Chena cultivation pasturalism and mixed cropping have their own benefits. In these systems crop failures are relatively minimum. A system developed for intensive cropping is a way of maintaining an ecosystem in an artificially young state of high production. When an ecosystem is maintained in an artificially young state it requires large auxiliary energy subsidies in diverse forms such as fertilizer, fuel for machinery, irrigation, genetic selection or pest control. If these requirements are not met the project can result in a total breakdown of the system rather than in a development.

Foregoing discussion attempted to identify possible environmental problems associated with land and water. However the environmental concern in development is not for arguing against development but for identifying better means and ways of development. What is required is to evaluate environmental issues as well as select the best alternatives for development in order to ensure a sustainable, and hiigher level of living condition for people. A mere description of environmental effects or even a detailed study may not assist the policy makers in making a decision. What is

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therefore necessary is to quantify the possible impacts and present them in some form so that the findings can be used in the planning process.

An argument put forward by many environmentalists is that many environmental impacts are not quantifiable. Although there is a truth in its a negative approach in environmental issue will not provide an answer as the question is centered around selecting the best alternatives for development. None can postulate an environmental theory which prohibits implementation of any project which has some adverse environmental impacts because any project which is planned to bring about a change in nature is destined to have adverse environmental impacts. Hence such a theory results in a total abandonment of development. The approach therefore should be to identify all the adverse effects including environmental impacts and all the benefits so that an evaluation can be made to determine whether the specific project as a whole is beneficial to the society.

The only possibility is to express both adverse and beneficial environmental impacts in terms of economic values so that they can also be evaluated together with other economic benefits and costs. The value to a society of a environmental consequence from a project is the amount the society is willing to pay for having that consequence in case of a benefit, or the amount the society is willing to pay to avoid that consequence in case of an adverse effect. The first choice is identified as "equivalent variation" and the second as "compensating variation". What is therefore necessary is to find out the equivalent variation in case of beneficial impacts and compensating variation in case of adverse effects.

The need for including environmental impacts into the project planning process has been clearly identified and many attempts have been made to develop a methodology for the purpose. Techniques such as checklists, matrices, overlay mapping, net works, system diagrams and simulation models are being presently used in the developed world to identify environmental impacts and their significance, persistence, nature and locations or probable areas to be affected. On the basis of these identifications they are being quantified and assessed using the decision analysis approach.

The decision analysis approach heavily depends on public participation and it implies that the people are adequately knowledgeable to make rational decisions. In a developing country where majority are poor and powerless, and the knowledge on environmental issues is rather weak this method is liable to have undue influences of the professional and technocrats. This is already discernible in many countries where most of the environmentalists have become a group who are consistently opposing any development project instead of proposing alternative development methods. This biocentric approach to development has not only created implementational problems but also is discouraging policy makers in considering environmental issues in the planning process.

It therefore appears that only possible alternative in developing countries is to evaluate the impacts in economic terms and to include them in conventional cost benefit analysis which is very familiar to many development planners. The cost benefit analysis has a clearly defined social objective, maximizing the value of aggregate consumption or the net surplus of a project. The tools of cost benefit analysis are designed to facilitate efficient allocation of economic tools can help to explain how environmental resources should be allocated to maximize social benefits. Further many environmental impacts such as pollution, degradation of land resource are economic problems because all technological options available for control are economic solutions. These technologies are aimed at either reducing the rate of throughput of material and energy, (which can be achieved through either reducing the rate of production or increasing the technical and engineering efficiency) or recovering residual materials and recycling, or changing the composition of the GNP, or treating the residuals to make them less harmful to the environment or selecting the time and place of discharge so as to minimize the damage or augmenting the waste assimilative capacity of the environment. All these options require economic resources for implementation. It could therefore be concluded that the best method in taking environmental issues into consideration in the planning process is to evaluate the environmental impacts on economic terms and use them in cost benefit analysis of a project so that ultimate IRR and the Net Present Worth or value of the project will represent the environmental aspects as well.

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