ECONOMIC EVALUATION OF THE INTEGRATED REHABILITATION AND MANAGEMENT OF CRITICAL WATERSHED IN THE PHILIPPINES

Gideon Antiojo Umadhay, Jr.

Student recommended for
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not M.Agr. Econ as indicated.

Department of Agricultural Economics and Business
School of Applied and International Economics
Massey University
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ABSTRACT

The impacts of upper watershed land use practices on resource systems on-site and downstream have long been recognised as a major problem area in resource management in the Philippines. Increasing population levels and upland migration have worsened this problem with time. The consequences are seen in loss of upland productivity, poverty for upland farmers, loss of biodiversity, soil erosion, river siltation, sedimentation of reservoirs and irrigation systems, impacts on estuarine mangroves and coastal fisheries, increased flooding and drought, and so on. There is an urgent need to protect the resource system while at the same time providing for the needs of the upland population. Watershed rehabilitation is proposed as a strategy to achieve this.

Watersheds comprise of a sequence of linked resource systems which complicates the integrated rehabilitation and management of them. Management is also complicated by the fact that different agencies have responsibilities over different parts of the watershed and that the private parties within the watershed are there often illegally. Hence, any rehabilitation scheme needs to provide ways to make occupation legal for illegal occupants and at the same time provide incentives for them to cooperate with the rehabilitation strategy. In other words, any proposed scheme must be profitable to the occupants.

This study describes a strategy for watershed rehabilitation and analyses a case study example. The project's aim is to integrate social development and watershed rehabilitation. The social development component looks at people participation and the provision of land and opportunities to produce food. The rehabilitation component deals with reforestation and agroforestry to reduce soil degradation and increase water flow.

The project involves reforestation of 950 hectares, agroforestry on 3070 hectares, assisted natural regeneration of 716 hectares and production of agricultural crops on an area of 450 hectares.

The objectives of the study are to investigate watershed rehabilitation in terms of economic desirability, socio-economic impact and possible implementation constraints. A Benefit-Cost analysis on the data obtained from a feasibility study shows that the project, from an economic point of view, is very worthwhile. The sensitivity analysis further shows that the results are also very robust.

Implementation however, will not be an automatic process and the good economic results are not a foregone conclusion. Success of the project will to a large extent depend on cooperation by the occupants of the watershed. Recommendations are made as to how this cooperation can be achieved.

Overall however, the study shows that watershed rehabilitation is a strategy that is desirable from an economic and social point of view as well as clearly contributing to sustainable development of the Philippines.

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CHAPTER I

INTRODUCTION

"Man has a fundamental right to liberty, equality and satisfactory living conditions in an environment whose quality permits him to live in dignity and well-being. He has a solemn duty to protect and improve the environment for present and future generations...."

First Principle of the United Nations Conference on the Human Environment, Stockholm, 1972.

Watersheds, and the proper management of them, have become a major focus of resource managers in countries around the world. Much of the interest is the result of land use practices that have led to increased soil erosion. Not very recently, there has been increasing number of reports warning of high levels of soil erosion and deterioration of major watersheds (Bowonder, et.al., 1985; Brown, 1981;Eckholm, 1978). Sediment is building up in reservoirs and streambeds resulting in reduced irrigation and power production while at the same time increasing the incidence and severity of flooding. The impact of soil erosion is felt by rural people throughout the watershed through reduced incomes as well as inadequate supplies of wood and clean water.

These watershed problems are especially acute in developing countries like the Philippines where a growing population is exerting intense pressure on increasingly scarce land and water resources. Most people in these areas live and work on the land. So, as rural populations increase, lands formerly farmed extensively are now being farmed more intensively. Boserup (1965), argued that when population density is low, only a small portion of the total area available is cultivated, and land reverts to long periods of natural fallow. As population density rises, deforestation of upland areas intensify to have a more intensive cropping system while fallow years are decreased leading to increased soil erosion and downstream damages. Attempts to exploit the watershed resource beyond its carrying capacity will lead to an extensive damage to the land.

Increased soil erosion is the physical consequence of actions by people (i.e., deforestation and overgrazing) caused by socio-economic, political and institutional factors. The end result of erosion is a reduction in the productivity of forests, fisheries, agricultural and grazing lands; decreased returns from investments in hydroelectric power generation and irrigation projects; and losses of property and impairment of human health.

The practices required to protect watersheds from degradation are well recognised. However, the management of watersheds has been largely unsuccessful, partly because the socio-economic factors, although known to be important, are often ignored because of the difficulties involved in dealing with social issues (Blaikie, 1985).

Excessive logging and shifting cultivation leading to severe soil erosion and subsequent siltation of rivers, lakes and nearby shores, has caused a significant deterioration of the biophysical resources of the Philippine watersheds. Heavy siltation has reduced the capacity of water bodies to support aquatic life and irrigation and domestic uses have also been greatly reduced.

The original vegetation of watersheds in the Philippines is tropical rain forest. It protects the environment in its undisturbed state. Today much of these forested areas have been converted into other land uses, such as grassland, agriculture and logging. The removal of the forest mantle in our fragile mountains has led to a hydrologic imbalance. Experience and scientific investigations show that more floods and droughts occur every year. Just recenty, flashfloods in Iloilo, Leyte and Negros have left hundreds of casualties, and rendered thousands of people homeless, sowing destruction to life and property. All these were attributed to the loss of tropical forests in the mountainsides which leads to sedimentation of waterways.

The productivity and sustainability of agro-ecosystems are dependent on the conservation of the resource base. The destruction of Philippine watersheds through excessive logging, shifting cultivation and related practices has drastically affected nutrient cycling and energy flow in these ecosystems. Removal of the native vegetation cover (usually forests) aggravates the problem by exposing the soil to the elements and disrupting the regulative mechanisms controlling nutrient, moisture, energy and information flow. Consequently, these areas have become marginalized and hence, less able to support plant and animal life. Many higher forms of plants and animals can no longer be seen in these areas.

These effects, which now afflict thousands of subsistence Filipino upland farmers are not a recent development. The history of watershed degradation by forest destruction and overgrazing has been eloquently documented by ancient philosophers and writers.

1.1 Watersheds and Man Through Time

It is difficult to trace the origin of man's recognition of the relation of land use to the flow of water. Recognition certainly did not occur until civilization developed to the stage where man's activities and population were sufficient to make a sizable impact upon the nature of the land. Perhaps vague stirrings arose while man was still a nomadic herdsman, for the first concepts of property in land seem to have been applied to springs and wells [Ely and Wehrwein, 1940]. However, large populations and the growth of cities awaited the development of agriculture.

Paradoxically, increased food supplies from agriculture increased, rather than decreased, the pressure on uplands. Forests and forage in the hinterland belonged to a man who exploited it, and a growing demand for wood, wool and goat's milk cheese in the cities sent the wood cutters and shepherds higher into the hills.

Overexploitation of forestal zones and overgrazing has left the place barren and unproductive.

To peasant farmers on a precarious subsistence level of agriculture, they see protected watershed areas only as a denial of grazing opportunity for their livestock, or a withholding of fertile forest soil from their crops. Their marginal economic situation does not incline them to show interest in the fate of others living downstream and the harmful effects of watershed degradation is not of primary concern to them. They do not yet know or care about the importance of regulated flows of clean water for the prosperity of the country and its future generations.

In the last few years much attention has been focused on the adverse effects of man's activities on the world he inhabits. In the eyes of many a major threat to the continuation of life on the planet is no longer that of thermonuclear war but rather one brought about by the by-and-large peaceful economic activities of man. As the century draws to a close, the converging threats of global climate change, the destruction of the ozone layer, the unchecked growth in world population and the loss of biodiversity loom ominously as portents of an ecological crisis unprecedented in human history.

No single economic activity has drawn so much attention for its adverse environmental effects as that of the destruction of natural forests. This activity has been blamed for aggravating the greenhouse effect, for destroying multitudes of plant and animal species, for the desertification of formerly fertile lands, for soil erosion, for flooding, for the silting of rivers and estuaries and, no doubt for many other things besides. This is not a new phenomenon.

The extraordinary resistance of the human race to the lessons of our environment, are brought home sharply by the following quotation from Plato (*"Criteas"*, about 400 B.C.):

> *"There are mountains in Attica which can now support nothing but bees, but which were clothed, not so very long ago, with fine trees producing timber suitable for roofing the largest buildings. Roofs hewn from this timber are still in existence. There were also many lofty cultivated trees, while the country produced boundless pasture for cattle. The annual supply of rainfall was not lost, as it is at present, through being allowed to flow over a denuded surface to the sea, but was received by the country, in all its abundance, into her bosom where she stored it in her pervious potter's earth and so was able to discharge the drainage of the heights into the hollows in the form of springs and river with an abundant volume and a wide territorial distribution. The shrines that survive to the present day on the sites of extinct water supplies are evidence for the correctness of my present hypotheses."* [Cited by Pereira, 1973).

The destruction Plato was describing was on a relatively local scale. By the time of the fall of the Roman Empire, the environmental damage attributable to logging was on a much larger scale, and was possibly one of the causes of that fall. Based on history, the Roman provinces of North Africa, which had formerly been the breadbasket of the empire, producing half a million tons of grain a year and boasting some six hundred cities, were reduced to a hot barren desert, the harbours of their once bustling ports silted up and abandoned, victims of man's attitude to nature and its insatiable demand for wood. Wood was virtually the only known fuel; it was indispensable in the construction of buildings, furniture, chariots and ships. The ancient world's dependence on wood was perhaps even greater than the modern world's dependence on fossil fuels. To them, the natural world was inexhaustible; they saw no reason for not extracting from it as much as they wanted. Even the state gave legal title to undeveloped land to anyone who cleared it of forest. The essential role of the forest in maintaining the ecology of the region were not understood.

By the time of ancient Greece, the relation of land to water seemed well-recognized and widespread. The ancient Chinese expressed it in a proverb, *"To rule the mountain is to rule the river"* [Anonymous, Cited by Satterlund, 1972]. The Mediterranean region seemed to meet all the requirements to make it the birthplace of watershed management before the birth of Christ. Water was scarce while demand for irrigation and domestic use was increasing. Knowledge of the effects of poor land use existed. Here should have been the beginning.

But it was not since the rules, the laws, and the customs developed by civilized man were applied to the distribution and use of water, but not to the lands which were its source. Early civilization was a city phenomenon, which was unconcerned with watersheds as long as the supplies of wood and wool issued forth. The concept of private property did not apply to wildlands, and without it, there could be no concept of responsibility in their use. Absence of land use regulations contributed to watershed deterioration, and was occasionally remarked upon. The eighteenth and nineteenth century was a period of change and contradiction in watershed management. The destruction of forests over large portions of the different continents gave rise to destructive floods and droughts. Governments on several levels passed laws requiring protection and rehabilitation of forest lands [Marsh, 1972]. The prevailing opinions of the day can be summed up as follows:

> *It is a matter of common remark, that our streams diminish as our woodlands are cleared away, so as to materially injure the manufacturing interests depending on hydraulic power, and to require new sources of supply for our state canals, and for the use of cities and large towns. Many streams once navigable, are now entirely worthless for this use* [Hough, 1878].

Wise use and development of watersheds rests partly upon a public understanding of the basic physical, biological and social relationships of watershed management. To the degree that these are lacking, decisions may be made which are inconsistent with, or obstruct, the ability of our watersheds to serve our water resource needs.

A watershed is a basin-like geographical structure bounded by surrounding ridges. It has a network of stream tributaries that leads to a common mouth or drainage channel. It is a combination of components such as soil, water, terrain, vegetative cover and associated animal life [PCARRD, 1991].

In agriculture, watersheds primarily store water for irrigation. Rainfall absorbed in forested watersheds is slowly released to the streams and lakes throughout the year and used by lowland dwellers. Grass-covered watersheds also provide pasture to grazing animals. In addition, some watersheds in the country serve as human settlement areas.

An almost unanimous conclusion is that forested land is the source of quality water (Corbett, et al, 1978; Sopper, 1975; Tamm, et al., 1991). A Kasetsart University study (1982), found that river basins with less than 70 percent forest cover contained streams with higher values of pH, turbidity, electrical conductivity, total dissolved solids and hardness. Though the water in these basins was of lower quality than more forested basins, it was still acceptable for public water supply. Further deforestation, however, may result in an even greater decline in water quality. The reason is that forest functions to regulate the rate of discharge and to protect against erosion, sedimentation, leaching of nutrients and heating of surface water (Pope, 1977).

Watersheds provide water for industry, for domestic use and for hydroelectric power generation. An adequate volume of water stored in dams can run huge generator turbines, even during summer, since a well preserved watershed recharges the groundwater in the area. These forested watersheds with continuous water yield supply serves as a runoff storage structure that can be utilised for hydropower generation by the industrial plants. With proper management of watersheds, the continued use of this water can be ensured.

In the hydrologic cycle, water continuously moves from the Earth's surface to the atmosphere, then back. Rain that falls directly on vegetation, sips through canopy openings,or drips down to the ground, and percolates through the water table. It remains in the soil as moisture and after the saturation point of the soil has been reached, it flows down as surface runoff [PCARRD, 1991].

If a watershed is adequately covered by vegetation, the rivers and streams in the area are continuously fed by spring water throughout the year from subsurface flow and from the water table. The greatest depth of precipitation usually falls on forested land because forests are often located at higher elevations, initially capturing and gradually releasing water to vast areas below. Also a forest cover is almost always the best and most natural protection for streams because it maintains good water quality and stabilizes flow. *"Forested watersheds are thus the main source areas for man's supply of fresh water"* [Kunkle, 1974].

Man's use of forest land in watersheds, then, is the major influence on stream flow over much of the surface of the earth; that is on stream behaviour, water losses from a basin, floods, low flows and water quality. Vegetation cover in watersheds affects the runoff process by storing water on leaf and stem surfaces, increasing surface roughness, thus slowing runoff and affording greater opportunities for infiltration. Likewise, vegetation is adding to the storage capacity of the soil by the presence of roots, reducing the initial intensity of raindrop impact, and to a minor extent, by immediately absorbing moisture through the root system.

Flows of water are much faster but no less complex. The movement of water from its original landfall, to minor and major channels and ultimately to the sea, is influenced by antecedent moisture conditions, the inherent infiltration and storage capacity of the soil, vegetation and land use. Typically, in a mild rain and during the initial phases of more intense storms, water that reaches the ground through any vegetative canopy first enters into storage in the upper layers of the soil. According to Magrath and Doolette (1990), portion of this stored water will evaporate, some will be taken up by plants and transpired, and the remainder will percolate to the groundwater from which some portion will be returned as surface water. As the storage capacity of the soil diminishes, water accumulates on the land surface and moves downslope through various processes of inter- or overland flow. Depending on the length and intensity of the storm, topography and other factors, this inter- or overland flow may continue to a watercourse or may end in percolation into the downhill soil. If a storm of sufficient duration occurs and soils begin to be saturated or a storm of sufficient intensity occurs such that the soil's infiltration capacity is exceeded, then several processes deliver water to the drainage lines and streams.

During a typical rain storm only a small part of the basin around the channel actually yields surface runoff, whereas on the upper reaches of the basin the rain infiltrates, becomes subsurface flow and does not appear in the streams until long after the "storm hydrograph" is finished. Therefore, the high flows observed during storm runoff often come from only a small part of the catchment and the storm hydrograph contains only a very small part of the total rain falling on the basin [Betson,1969; Dunne and Black, 1970; Hewlett and Nutter, 1970; Whipkey, 1965].

Generally, the longer a storm continues, the larger is the surface runoff area or variable source area. It expands during a storm with groundwater coming from around the channel area overland [Kunkle, 1970].

In watershed areas devoid of, or with inadequate, vegetative cover, soil erosion problems or even landslides commonly occur. Due to reduced waterholding capacity of the watershed soil, tremendous runoff occurs during intense or extended rainfall. Soil erosion often results in serious and costly damage downstream in terms of siltation of reservoirs; heavy loads which harm fish [Tebo, 1968] and added treatment costs for municipal water supplies; damage to irrigation canals, bridges and other structures; siltation of river channels which raises flood levels; aesthetic and biological damage to lakes; and a tendency for eroded lands to yield higher runoff and lower dry season flows [Kunkle, 1972].

When soil on sloping land is farmed improperly, it begins to move under the impact of rain and ends up in places where it usually does more harm than good. Pimentel, et. al., (1976), reported that erosion on cropland degrades the productivity of the soil resource base necessary for crop and food production because plant nutrients and fine particles are increasing runoff because of poor infiltration.

As soil is carried from the farm by runoff, it may end up in local streams, rivers, canals, or irrigation and hydroelectric reservoirs. The loss of topsoil that reduces land productivity may also reduce irrigation, electrical generation and navigability of waterways. One reason for the rapid siltation rates is that multi-purpose dams are designed by engineers who sometimes fail to recognise the impoundments they build as part of a watershed, which often drains an area of several thousand hectares.

A well-forested watershed also helps maintain ecological balance, minimizes occurrence of floods and droughts, purifies and cool the air, controls soil erosion and serves as habitat of important plant and animal species.

The uplands[1] comprise about 18 million hectares of the Philippines' total land area of 30 million hectares. In these areas are located watersheds of various sizes which play a vital role in the agricultural, industrial and ecological programs of the government.

Through the years, the state of our watersheds has worsened. Ironically, much of this can be attributed to man and his destructive activities toward nature. In the Philippines, watersheds are often inhabited by large and increasing human and animal populations that hasten forest denudation. The causes of population pressure on marginal resources include unchecked population growth, declining

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1/Uplands in the Philippines are categorized as areas having slopes of 18 percent or greater.

absorption of labour in both industry and lowland agriculture, and widespread poverty. With an area of only about 30 million hectares, the Philippines' population is about 62 million, with a growth rate of 2.4% (World Bank, 1989). The economy has had increasing difficulty in absorbing population growth population growth, so unemployment and poverty are widespread.

1.2 Role of Forestry in the Economy

In the past, the forestry sector was one of the major contributors to the country's national income. Forestry share of GDP was 12.5 percent in 1970 but this dropped to only 1.3 percent in 1990. The export of logs and lumber, which reached its peak in the 1960's and early 1970's, characterised the largely exploitative approach to forest utilisation. The decline in the importance of the forestry sector is a direct result of the loss of forest cover. The Asian Development Bank (1994), reported that the government's log and lumber export bans (1986 and 1989 respectively) which attempted to halt forest destruction and strengthen the national wood processing industry thereby increasing foreign exchange receipts through (value-added) exports have had limited success.

The forestry sector of the Philippines directly provides some 292,000 full-time jobs, including about 274,000 in reforestation, forest management, wood production, wood processing industries and wood-based industries. The government and education sectors provide about 1,8,500 jobs in forest administration, education, training, research and extension. According to recent estimates, about eight million people are dependent on the forestry sector through the forestry related activities as well as farming on forest lands (ADB, 1994).

The conversion of forest land to agricultural land is seen as a step on the road to economic development, one taken by the industrialised countries early on in their development. Barnett and Turkman (1993), cited that in the 1960's and 1970's international development agencies such as the World Bank encouraged and financed many such deforestation projects.

1.3 Forest Resources of the Philippines

Philippine forests are dominated by species of the *Dipterocarpaceae*. Dipterocarp forests are of particular economic importance since they have a uniform stand structure with relatively high volumes of valuable timber and are well suited to management for sustainable timber production provided that a suitable silvicultural system and non-destructive harvesting methods are implemented. Because of this, they have been heavily logged with a large proportion of the output exported as logs and lumber. According to the Department of Environment and Natural Resources (DENR), only 3.88 million hectares of dipterocarp forests are left, of which 0.87 million hectares (22 percent) are identified as virgin forest. The total loss of forest cover between 1969 and 1993 of 4.8 million hectares corresponds to an average loss of about 200,000 hectares per annum. The current rate of forest destruction in the Philippines is estimated by the ADB (1994), at about 100,000 hectares per annum (2 percent).

As a result of forest destruction, forest plantations based on fast growing species must play an increasing role in supplying the country's future wood requirements. To meet future wood demand, DENR estimated that about 1.4 million hectares should be established by the year 2000. The major initiatives in industrial forest plantation establishment have come from the private sector. The government's reforestation program have suffered from major weaknesses such as lack of continued maintenance, silviculture or protection, and many have been destroyed by fire, encroachment or pests and diseases. There has also been insufficient attention paid to selection of the most suitable genetic material or development of successful establishment methods.

1.4 Environmental Degradation

Deforestation has had severe impacts on the environment, the most notable of which are the degradation of watersheds and consequent disastrous flooding with loss of both life and infrastructure. There is a strong association between population growth and deforestation in the Philippines (Figures 1 and 2). The continued high population growth rate is likely to be a key factor in maintaining the rate of forest destruction and forest protection initiatives must be linked to the country's population policy.

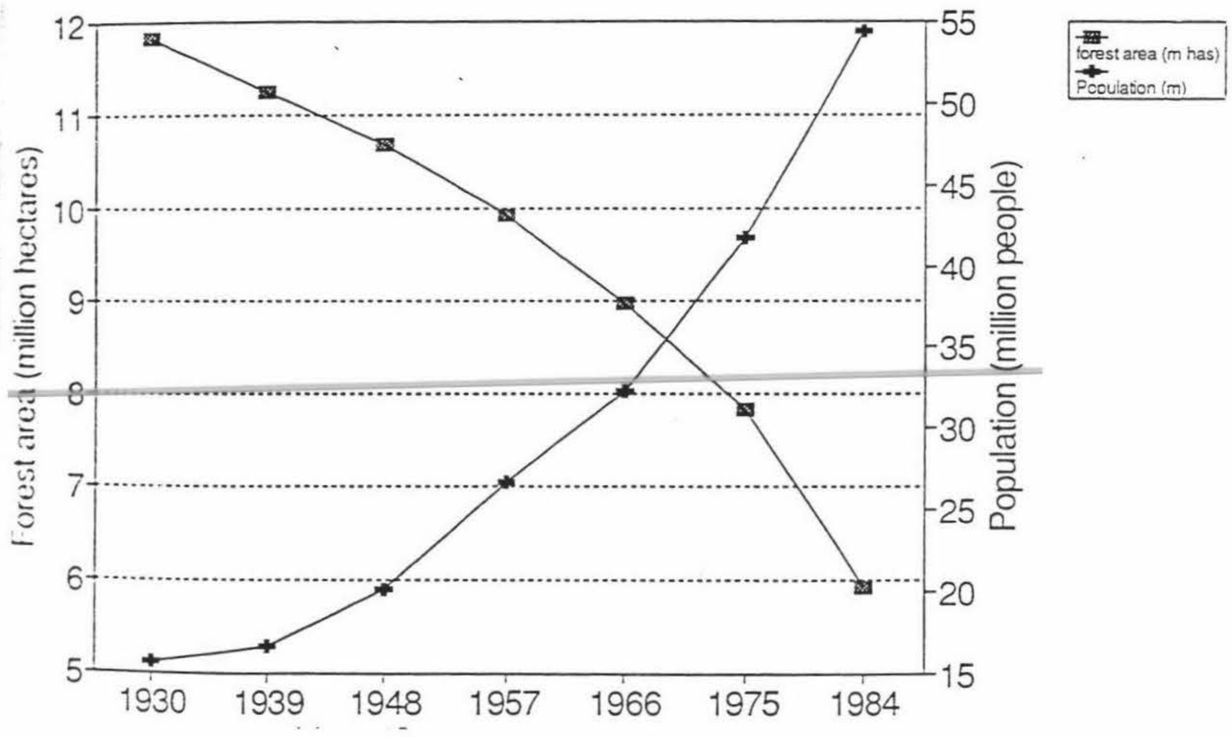

Figure 1. Forest Area and Population (1930-1984)

Source: Department of Environment and Natural Resources, 1985

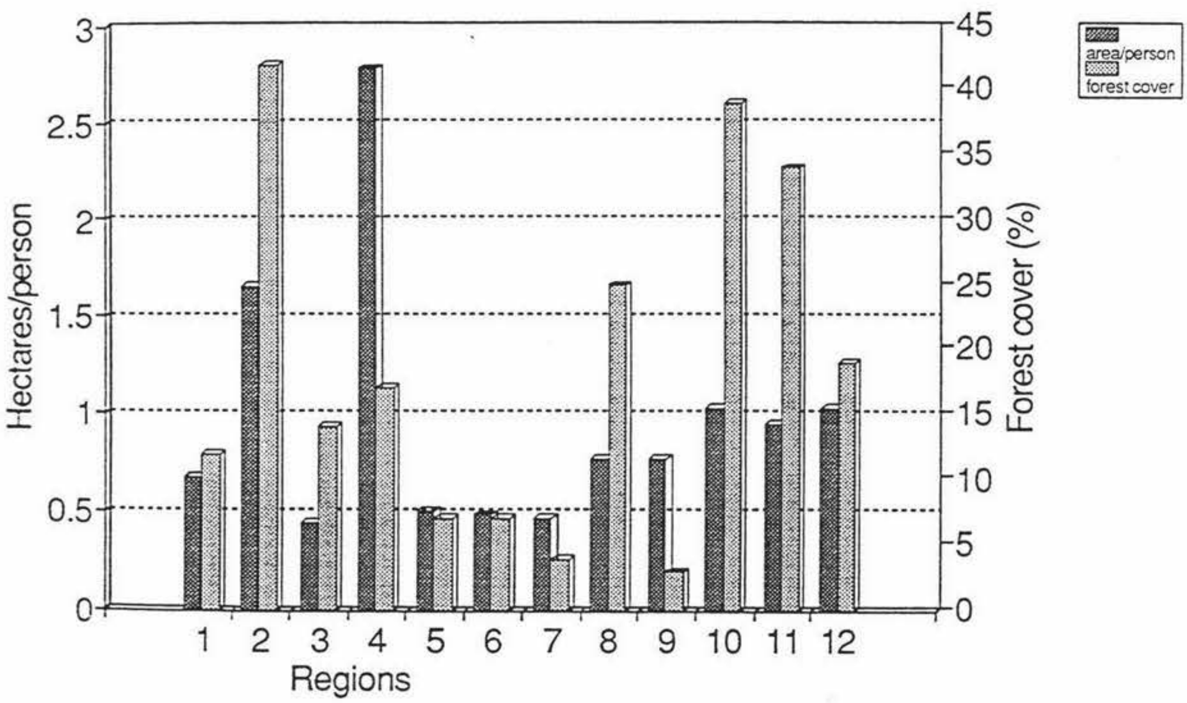

Figure 2. Correlation of Population Density and Forest Cover, 1980

Source: Department of Environment and Natural Resources, 1985

There are also links between logging rates and forest destruction and the national and international media have placed much of the blame for forest destruction on the timber industry. This has resulted in increasing political pressure for the banning of commercial logging. However, the enactment of a commercial log ban would ignore the fact that past logging moratoria have tended to accelerate, rather than arrest, the pace of forest destruction.

The problem of human encroachment in Philippine watersheds is consistent with the three basic issues raised by Malik (1984); Cruz (1986), that underlie many problems in developing countries: poverty, ever-increasing need for land and development processes and are compounded by another problem which is rapid population growth. The institutional problem is most apparent in forest lands.

While most governments consider forest lands as part of the public domain to be kept under forest cover, their limited enforcement capabilities make these *de facto* open access resources. Such forest lands have therefore been rapidly converted to non-sustainable agricultural uses, causing severe erosion impacts. On-site production potential is reduced, and downstream siltation of waterways and agricultural lands is increased. Because of the environmental externalities associated with upland farming, simple privatisation solutions are not efficient.

Also, because of population pressure problems, exclusion of the neediest from large areas of the public domain is neither equitable nor feasible. Human-induced threats to watersheds are numerous and widespread. According to Dixon and

Sherman (1990), the threats most often cited include illegal logging, cultivation of crops and collection of minor forest products, while Machlis and Tichnell (1985), identified unlawful entry, fire, illegal removal of animal life and vegetation and conflicting demands. If one looks at a hierarchy of human uses, collection of forest products is a relatively minor disturbance, logging has more severe effects, and shifting cultivation has the most profound effects (Hamilton, 1983).

Encroachment and overuse of a protected area resources by nearby residents are common when the people who have traditionally used its resources are usually denied access and receive no compensation. Pearce and Turner (1990), cited the self-interested behaviour of the "rational economic man" which leads him to exploit the resources around him for his self-interest. It is because of self-interest that nearby residents *"have to cultivate steep, fragile slopes using inappropriate technology, in the process destroying the existing resource base, and compromising future prospects for continued production and accelerating downstream and water disturbances"* [FAO, 1991, p.2].

1.5 Property Rights

Pearce and Turner (1990), argued that in an economy with well-defined and transferable property rights, individuals have every incentive to use natural resources as efficiently as possible. Environmental degradation occurs therefore when property rights are inadequately specified or not controlled by those who can benefit personally by putting the resources into its most efficient and valued use. Neglecting property rights would condemn the forests and their half billion human inhabitants, to continuing decline.

The first prerequisite for a sustainable forest economy is a property rights system that allies the interests of forest people with the health of forest ecosystem. This need not mean private ownership. Effective property rights systems, or "tenure regimes" range from private ownership to collective management by communities to state control. They also range from the inclusive- - covering land, trees, wildlife, and mineral deposits in perpetuity - - to the limited, covering particular activities in certain places and times. No single property rights system is always best. What matters is that governments match tenure laws with the social context. Whether the resource is land, timber, floral supplies, or indigenous knowledge, secure tenure is the first necessary condition of a sustainable forest economy. Without it, the people who manage the world's forests have little reason to safeguard the forests health.

Although management and enforcement are usually easier if the use is totally banned, this may not be the optimal policy [Dixon and Sherman 1990]. Such benefits like fuelwood, charcoal and other forest products are extremely important to local residents and must be weighed against the damage that might occur if the restrictions are not effective causing the resource to become damaged. Prior to the 1960's, shifting cultivators that squat on public lands in the Philippines were subject to incarceration and ejection (Aguilar, 1986). In the early 1970's, the government realized that its punitive approach to the 'slash and burn' problem did not work (USAID, 1990).

Rural development schemes that raise income, will reduce the need of nearby residents to encroach on the watershed. Another means of reducing demand is to develop supplies of another resource as a substitute. If the resource is used for food, developing alternative crops that can be grown intensively in buffer zones will reduce demand. Incentives such as guaranteeing employment or providing allotment of lands may benefit both the protected area and the people involved.

1.6 Maasin Watershed

The Maasin watershed is located in Iloilo, a province left with 2 percent forest cover and in which the destructive activities of the occupants in the area is contributing to further destruction of the already fragile ecology of the Western Visayas region. With the projected increase in the population and industrial activities anticipated with the implementation of the Regional Agro-Industrial Centre [KSP, 1991], the volume of water from the Tigum River the major channel of the watershed, will not be able to meet the domestic, industrial, commercial and agricultural demand without a timely rehabilitation of the watershed.

The Maasin watershed has an area of 6,150 hectares and is the source of potable water to the residents of Iloilo City and the neighbouring municipalities. It is also foreseen that the water requirement for irrigation will rise as agricultural programs are expanded to support the Panay Negros Agro-Industrial Special Development Project (PANAI-SDP). Out of the present 3,000 hectares depending on irrigation water in the area, only 1,000 hectares are serviced during the second cropping[2] [NIA, 1991].

Recognizing that water is indispensable to human survival as well as to the well-being of the country, it is therefore essential that the remaining resources and all its amenities should be properly managed, rehabilitated, conserved and protected from the destructive activities of man and animals [KSP, 1991].

1.7 Objectives of the Study

This study generally aims to contribute to the overall knowledge about the ex ante evaluation of watershed rehabilitation project schemes in the Philippines through the achievement of the following objectives:

1. To investigate watershed rehabilitation and management in the context of sustainable development under a continuing demand for water and continuing soil erosion;

2/Second cropping falls on the relatively dry months of November to February.

2. To analyze the economics of a government watershed rehabilitation project at Maasin, Iloilo; and

3. To identify constraints in the project's feasibility that need to be addressed by the government and/or non-government organizations.

1.8 Outline of Presentation

The **introductory part** of this study presents an overview of the relative importance of forested watersheds in our environment and its degradation inflicted by man through the years.

The **review of literature** follows and presents Philippine watersheds as a natural resource besieged with problems and how can it be rehabilitated and managed citing various models and approaches in a sustainable context to meet the increasing demand for water and contribute into the abatement of soil erosion. The chapter on **methodology** describes the Benefit-Cost Analysis (BCA) framework and shows how it applies to an ex ante evaluation of watershed rehabilitation and management from the government's point of view. Discount rate, time horizon, uncertainty and other related parameters are discussed.

In **the case study**, a proposed watershed rehabilitation project is presented and evaluated using the BCA framework.

To discover the factors which critically influence the viability of the project, a **sensitivity analysis** is presented to show which among the variables affect the result of the project appraisal.

The concluding part of the study summarizes the **results and findings** of the analysis and highlights the feasibility of the project. Conclusions are drawn and recommendations made regarding implementation bottlenecks which need to be resolved for successful project development.

CHAPTER II

REVIEW OF RELATED LITERATURE

"Obligations to protect the environment are incumbent on everyone, but responsibility which is an increasing function of power, rests particular with communities, governments and corporations."

Code of Environmental Practice
6th Economic Summit Nations Conference
on Bio-Ethics, Brussels, 1989.

Upland and forest ecosystems of the Philippines and the resident users of these areas are currently in a state of change and transition. Changes have resulted from dynamic interactions between man and ecosystem, and recently considerable attention has been focused upon apparent problems stemming from such interactions. Deforestation, increasing populations, shifting cultivation and watershed degradation with negative downstream effects have been viewed over the past several years as interrelated factors that together mean the destruction of Philippine upland forest ecosystems and further hardship for the already poor upland populations.

As the Philippines attempt to achieve the same economic feat as that achieved by its neighbours, there is a strong tendency to relax environmental protection. Cabanilla (1993), commented that quite understandably, when the economy is growing slowly and suffering from a high unemployment rate, policies designed to preserve a healthy environment seldom get implemented seriously. Meister (1992), noted that the Philippines does not lack the necessary laws and policies to protect the environment[3]. What it does lack is the will to implement the laws. This observation echoes well with the statements of frustrations of government bureaucrats (e.g., Environment and Natural Resources Secretary Fulgencio Factoran, Philippine Daily Inquirer, 19 January 1992) on the lack of support they get from political leaders in implementing laws to protect the environment.

Deforestation is defined as "the complete removal of existing forests and their replacement by other forms of land use" (Palo, et. al., 1992).

Deforestation has resulted from the combined effects of logging and expansion of shifting cultivation often into areas made accessible by logging. Damage to watersheds has received more attention, as flooding and drought are thought to have become more common in lowland rice-producing areas and as reservoirs built for irrigation and hydroelectric power generation suffer from siltation. Attempts were made at controlling and guiding the directions of upland development in order to benefit both upland ecosystems and the uplanders as well as society in the larger sense.

3Personal communication of Professor A.D. Meister, Visiting Professor at the University of the Philippines (Los Banos), cited by Cabanilla, 1993.

2.1 Upland Problems

Deforestation and soil erosion are extremely important problems in Philippines. Extensive erosion has occurred over 75 percent of all alienable and disposable land in the Philippines. The country has one of the highest rates of deforestation in the world. Based on 1976 LANDSET photographs, the Development Academy of the Philippines estimated that 30 percent of the country was under forest cover in the late 1970's. The Bureau of Forest Development (BFD) estimated that forest cover had dwindled by 3.62 million hectares between 1968 and 1980 (National Environmental Protection Council, 1980).

The Philippines contains 419 river basins including over 5 million hectares of watershed land rendered unproductive, degraded and unstable due to inappropriate land use (Alvarez, 1985). This has given rise to soil erosion, sedimentation of downstream waterways, declining water quality and possibly increased severity of localised flooding.

Originally, the Philippine uplands were covered by tropical forests. Currently, of a total land area of 30 million hectares, 16.7 million hectares (56%) are classified as public forest, about five million of which are characterized by the national government as "open, denuded and unproductive." Bonita (1977), concluded from aerial photographs that, instead of 56%, the Philippines now has only 30% forest cover in areas concentrated in some few provinces. Cabrido (1985), reported that about 9 million hectares of the 13 million hectares of cropland are eroded. There are presently about 4.5 million hectares of denuded grasslands, the result of logging, shifting cultivation, overgrazing and burning. In 13 of the 73 provinces, more than 50 percent of the total area is eroded. O'Sullivan (1985), reported that as much as 3.3 feet of soil has eroded away in places, exposing a substratum of boulders and stones. He cites farmers who claim corn yields have declined as much as 80 percent during the previous 15 years. The annual rate of deforestation in 1970 alone was 200,000 hectares per year and between 1971 and 1980, 1.24 million hectares of dipterocarp forests was converted to less productive second growth stands (Reyes, 1983).

Laws and regulations mandate acceptable forestry practices, but laxity in their enforcement has allowed both legal and illegal operators to engage in wanton timber cutting and the construction of substandard, inappropriately located and highly erosion-prone logging roads (Gabutan, 1988). Much of the responsibility for land degradation in certain areas must be borne by these logging interests. However, those practising agriculture in upland areas are responsible for many of the problems as well. Shifting agriculture, if the fallow period is of insufficient length, leads ultimately to land degradation. Poorly controlled grazing also degrades uplands. Farmers burn grass lands to stimulate new growth following the rainy season. This frequent burning, together with overgrazing which results in severe soil compaction, eventually renders such areas unproductive.

Observations show that degradation of tropical forest ecosystems is a dynamic process that often starts with timber cutting and continues as thin topsoils and nutrients are lost through erosion and leaching once the forest cover is removed. Losses can continue as lands are used for agriculture and become more serious as population and competition for resources increase, productive lands become scarcer, and the fallow cycles of shifting agriculture are reduced. Shifting cultivation is a land use system whereby a track of land is cleared, burnt and cropped for a few years and allowed to revert to fallow or secondary regrowth before being used again (FAO, 1984). Lands may eventually become unproductive, lack potentials for rehabilitation, continue to erode, and be converted into fire-prone grasslands of questionable productivity, while at the same time, the uplanders become poorer and have fewer alternatives for improving their circumstances. In the Philippines, it is estimated that recent immigrants to the uplands have an average per capita annual income of P2,168 (peso), well below the official poverty line (World Bank, 1989).

Many forms of human activities and their disruptive effects on the watershed's tropical rain forest have clearly impaired its hydrology, nutrient cycling, biotic stability and productivity. The continued use of conventional farming practices (i.e., cultivation of annual crops on steep slopes with incomplete ground cover) suggests that high denudation rates will continue unless soil conservation measures are adopted. The productivity of crops sensitive to adverse subsoil conditions, including most high value cash crops, will likely decline if soil erosion continues. These biological and physical impacts have been responsible for the poor socio-economic circumstances of the human communities in such upland areas.

The watershed's transformation into degraded, unproductive, and unstable areas is a result of ecological disruptions. The upland tropical rain forests are important in three ways. Hydrologically, in watersheds, the transformation of tropical rain forest into grasslands and intensively cultivated areas has produced changes in surface run-off and ground water flow. These changes are manifested by more frequent floods and drought. Physically and technically, degraded areas lack vegetation cover and have highly eroded soils. Socio-economically, resource utilisation often exceeds carrying capacity because of the marginal condition of the area, improper management, overpopulation or a combination of causes.

Based on current research, it could be concluded that the most widely recognised impact of watershed degradation on agriculture is the rapid deterioration of irrigation infrastructure, thereby jeopardising future food production. In almost all instances, this deterioration of the irrigation infrastructure is reported to be the result of economic activities of individuals and firms in the upper reaches of rivers serving as water supply sources for established irrigation facilities.

The Pantabangan watershed in Nueva Ecija illustrates the seriousness of deforestation. It totals 82,900 hectares and has a forest area of 36,915 hectares covering 44% of the watershed. Grasslands dominated by *Imperata* and *Themeda* comprise about 43%, and cropland makes up about 12% of the area. Soil erosion in the area is a serious problem (NIA, 1979). According to studies conducted prior to the construction of the Pantabangan dam, sediment yield for the watershed was estimated at 2,020 tons per square kilometre annually.

After twenty years, the Agno River Irrigation System (ARIS) now operates at only 25% capacity because of the silting of the intake and canal system. ARIS can irrigate only 9,546 hectares instead of the original 17,500 hectares intended. In 1976, losses from desilting costs and crop failure amounted to $4.4 million (UNEP, 1977; Coloma, 1984). It is reported in the study of Castaneda and Bhuiyan (1993), that the harvested area and total production in the ARIS has been declining through the years. Using a linear regression equation, they found that the benefited area declined by around 860 hectares per year during the wet season, and by 172 hectares during the dry season. As a result, total annual production has declined by an average of 3600 mt. from 1978-1988.

In a specific study of the Magat watershed serving the biggest irrigation system in the country today, Francisco (1993), notes that substantial soil erosion has arisen from the conversion of primary and secondary forest into open grasslands. The costs in terms of plant nutrient losses and reservoir sedimentation ultimately bringing about decreases in future agricultural production of areas served by the irrigation system, in addition to actual dredging costs, are estimated to be substantial.

Of the Magat watershed with an area of 414,300 hectares, 83% is affected by severe to excessive erosion. The sediment yield at the dam site was estimated at 2,050 tons per square kilometre annually during the planning of the Magat dam (Coloma, 1984). Hillside farms in the Magat watershed are estimated to lose 100 tons of soil per hectare every year (David, 1984). This implies the significance of implementing projects that preserve the ecological balance in the watershed area.

Delorino (1988), evaluated reservoir sedimentation in Northern Samar and reported that if the prevailing watershed conditions are left unattended, at the end of the 30th year, it is projected that about 36,666 cubic meters of sediment will be impounded in the reservoir. In contrast, if the vegetative method of controlling erosion is implemented, the expected volume of sediment was computed at only 27,191 cubic meters only. This implies that without watershed management, economic losses will be higher than with watershed management. An economic analysis was used to compare the benefits that can be derived from managing the watershed resources based on the results of the "with" and "without" watershed management alternatives. Based on the results of the study, there is indeed a great need for the implementation of a watershed management development plan in the project area in order to arrest on site and off site damage caused by soil erosion. Government action is needed to ensure effective management on the watershed. Most importantly, the support and cooperation of the settlers occupying the areas of the proposed project are sought.

Sediment is a pollutant and may carry soil adsorbed chemicals, which are themselves pollutant (Robinson, 1971). Sediment pollutes by muddying the water, inhibiting photosynthesis, clogging fish gills and increasing oxygen demand (Hartman, et. al., 1977). Sediment deposited in stream channels, reservoirs, estuaries, harbours and other conveyance structures reduces their capacity and requires costly removal (ASCE, 1975). In some cases, deposition along flood plains, which was once beneficial is now detrimental. Some flood plains are now being covered by less productive subsoils eroded from upland source areas where the productive topsoil has previously been eroded.

Poverty, inequitable land tenure and the lack of economic alternatives are the principal reasons farmers initially converted forests to farms (Belsky, 1984). The low productivity and instability of the upland resource base is reflected not only in the poor economic status of the approximately five million uplanders, but also in the lives of adjacent lowland communities affected by floods, drought and siltation.

A main objective of watershed development is to improve the conditions of farmers and to enhance the protective character of the upland ecosystem. Needed are productive and ecologically and socially based farming system. The human community determines upland technologies that are viable and culturally acceptable and the manner of introducing them. Aguilar (1986), reported that experiences in Antique, Pantabangan, Bicol and Makiling have shown that while it is easy to conceptualise an ideal upland technology, the socio-cultural environment will determine its rate of adoption. These experiences have shown that planning water systems for irrigation and domestic supply must be integrated with watershed development and rehabilitation to meet the expected life span of the project. Likewise, planners must always bear in mind the socio-cultural environment and people's participation in planning watershed development projects which will ultimately determine its failure or success.

2.2 Forestry Institutions and Policy

The Philippine constitution expressly mandates conservation and proper utilisation of the country's natural resources. More specific edicts are contained in the revised Forestry Code of the Philippines (Presidential Decree 705), by which the government has adopted a policy of jurisdiction over all watershed areas. The Forest Management Bureau is responsible for the administration, control regulation and management of these areas, unless a particular portion of a watershed is judged to be non-essential for forestry purposes, in which case it is approved for private ownership and transferred to the authority of the Lands Management Bureau.

Several other policies address the issue of watershed management. Forest management in general is based on multiple use, which has as its goal the production of varied goods and services from forest lands on a sustained yield basis (Goze, et. al., 1987). The Environmental Protection Act of the Philippines explicitly established the policy of managing watersheds to achieve and maintain an acceptable level of environmental quality. It mandates that all watershed management and development projects be designed and implemented for the protection of the environment. The Integrated Social Forestry Program (ISFP) of the Department of Environment and Natural Resources, for example, seeks the active participation of all those inhabiting watershed areas -- including shifting cultivators, loggers, ranchers, miners, settled upland farmers -- in the management of watershed resources.

In the Philippines, a framework of institutional instruments exists that is generally adequate to support much of the environmental and natural resources policies. However, the regulations are dispersed among several Presidential Decrees, Department Administrative Orders, Memorandum Circulars, Memorandum Orders and other instruments. The need to enact a new basic forestry law that compiles and streamlines all these rules and regulations has been recognised and a new Forestry Code is currently before Congress.

Watershed management in the Philippines is hindered by the fragmentation of watershed management activities and responsibilities among various government agencies and enterprises. For example, based on natural vegetative cover, all forest watersheds are under the jurisdiction of forestry agencies, particularly the Watershed Management Division of the Forest Management Bureau. However, the Department of Energy has major responsibilities for watershed areas located above reservoirs. Other government agencies may be involved as well, including those concerned with public works, rural development and municipal local government. Private agencies may also be involved to the extent that they are dependent on the water resources of the watershed. Clearly lacking, is a viable means of coordinating the various agencies involved in watershed management, and of mediating between their often divergent interests.

2.3 Rehabilitation Activities

Watershed management activities in the Philippines can be divided into two categories: vegetative measure and structural measures. The primary activity that falls under the category of vegetative measures is reforestation/afforestation. Reforestation is primarily the responsibility of the government, though forest concessionaires are required by law to reforest areas they have harvested.

Another vegetative measure that has met with some success is agroforestry. Several agroforestry approaches have been promoted, including: a modified taungya system, tree farming, strip planting of trees and agronomic crops, mixed tree gardens and living fences (Veracion, 1985). In 1975 the Forest Management Bureau initiated the Forest Occupancy Management Program, under which farmers are permitted to cultivate and develop a designated area into a permanent farmlot. The goal of the project is to settle upland shifting cultivators in order to reduce the negative impact shifting cultivation has on watersheds. As of 1983 nearly 9,000 families has been settled by 30 such projects.

Structural measures for watershed rehabilitation include bench terraces, check dams, gully plugs, riprap channels, reservoirs and gabions. A number of watershed management projects receiving funding from external sources have employed such structural measures including: the Ambuklao and Angat Pilot Projects established in the Upper Agno and the Angat River basins; the UP-FMB Upland Hydroecology Program; the German Training Program on Reforestation and

Erosion Control; the Bicol River Basin Development Program and the Antique Upland Development Program (Alvarez, 1985).

A comprehensive government program that employs both sorts of measures, and that addresses a wide range of watershed management issues is the Forest Ecosystem Management and Development Program launched to hasten reforestation of all open and degraded areas of the country.

2.4 Watershed Research

The Philippine Council for Agricultural Resources and Research Development (PCARRD) has identified the following goals for research in watershed management (Jasmin, 1986): (1) acceleration of reforestation efforts; (2) control and prevention of destructive factors in watershed areas; (3) immediate rehabilitation of degraded watershed areas to reestablish stable ecosystems while providing sustainable economic benefits. The PCARRD is a sectoral planning council for agriculture, forestry and natural resources. It provides central leadership in identifying national priorities consistent with those set by the National Economic and Development Authority (NEDA) and with the sectoral priorities of the Department of Agriculture and Fisheries (DAF) and DENR. The Council has the authority to recommend to the Department of Budget and Management (DBM) research proposals to be funded and has to ensure that research is not duplicated.

The main institutions conducting research on watershed management in the Philippines are the Forest Research Institute and the University of the Philippines at Los Banos in cooperation with other colleges, universities and agencies. Jasmin (1986), reported that research programs have been established for: (1) watershed characterisation and classification; (2) watershed protection and rehabilitation; (3) improvement of water yield; and (4) social and economic aspects of watershed management including economic analysis of the benefits of improving water yield, socio-economic factors affecting watershed conditions; evaluation of strategies currently employed for rehabilitation and improvement of degraded watersheds. Several recommendations were made by Jasmin (1986) to improve watershed research including the need for better equipment, increased funding and more trained personnel, particularly at FORI.

The World Neighbours Project at Guba, Cebu was successful because its strategies were based on a correct analysis of the needs and conditions of the farmers. In this project, the family was considered as an important factor when planning to promote the new technology (Cuyno, et. al., 1982). This approach espouses the principle that since the farm family is a unit of production and a way of life in a local community (Broom and Selznick, 1977), it is also the mirror of a society and for Filipinos, it is their "small world" (Castillo, 1979). Soil conservation activities was focused and organised around the family kinship unit, and was hooked to vegetable and crop production, which increased farmer income in a relatively short time. Land tenure security is satisfactory with the cooperation of the Bureau of Forest Development which is responsible for awarding a lease of twenty five years to the farmer occupants and who practice soil conservation and cropping pattern technologies in their area of tillage subject to renewal for another twenty five years as an incentive for conserving and developing the place.

The Antique Upland Development Program was successful due to community participation in strategic planning and implementation. It is the beneficiaries who identified the problem and solutions for upland development. The livestock component served as a major source of income to the farmers and as a motivating factor in program success due to its short-term economic period to gain project benefits. Credit and extension support was provided by the project thereby giving the beneficiaries access for farm input procurement. Livestock could be raised on a cut and carry basis, thereby circumventing land tenure problems. Household labour was available and the project staff was credible to the community. There is a good market for livestock and adapted forage species were available which are used at the same time on strip and contour cropping for soil conservation. Not to be left out was the provision of organisational capability building activities for the participants which will help them in the management of the project and maintain its sustainability.

These experiences point out key determinants of the present upland farming system practices like socio-cultural environment, land tenure, channelling of information and materials and cropping patterns. The cases show that ultimately, it is the targeted beneficiaries who will determine the success or failure of a watershed program due to the above factors and non-consideration of it may hinder future viable entry points or intervention strategies. Specifically, these cases show that a stable, productive and socially acceptable upland development program can only be attained if there is adequate community involvement and participation.

Government agencies, research institutions, universities and private organisations now recognise the plight of people subsisting on the fragile watershed resources and are trying to develop and introduce technologies to assist upland farmers to better meet their needs. Such technology development and extension address problems associated with the production of food, fuelwood and cash crops. Productivity and stability are critical to upland farming.

2.5 Watershed Rehabilitation Technologies Against Soil Erosion

Major concerns of watershed development include increasing, stabilising and sustaining the productivity of upland farms and the rehabilitation of marginal upland areas. Soil erosion control, improvement of soil nutrient status and intensification of land use are important to productivity. Reforestation and grassland use are important elements of rehabilitation.

Introduced technologies for the upland farmer address production system problems. High soil erosion rates cause rapid soil nutrient losses and declining crop yields. Adverse environmental conditions include high wind speeds, high soil insulation and high seasonal variability in the availability of moisture.

Soil erosion has been recognised as perhaps the most critical factor responsible for the instability and non-sustainability of upland production systems. Bare plots in Negros lose as much as 290 tons of soil per hectare annually, and approximately 90 tons of soil per hectare erode from cropped land per year (Sajise, 1982). In Benguet, Colting (1981), reported a soil erosion rate of 62.3 tons per hectare per year in a bare plot of land with 29% slope. An erosion rate of 23 tons per hectare annually was recorded for bare plots with 27% slope in Bicol (Bocato, 1981). These erosion rates represent losses of mineral nutrients and organic matter required for crop production. Such losses necessitate erosion control technologies. Soil erosion and sedimentation by water result from detachment, transportation and deposition of soil particles (Foster and Meyer, 1977). Detachment is the dislodging of soil particles from the soil mass by the erosion agent. Once dislodged, soil particles are moved by transportation. Sedimentation is the disposition of soil particles carried by the run-off. The major erosive agents in water erosion are impacting raindrops and run-off water flowing over the soil.

Soil erosion control is based on three approaches: (1) reducing the velocity of run-off water; (2) increasing the infiltration rate of the soil; and (3) attenuating or dissipating the kinetic energy of raindrops before they hit the soil surface (PCARRD, 1984).

Engineering methods of controlling soil erosion change slope characteristics to reduce the amount and velocity of surface run-off and include terraces, dams, dikes and channels. Adoption of terracing has been problematical. Land tenure uncertainty hindered the adoption of terracing at an agroforestry project in Buhi, Camarines Sur (UHP, 1979) because tenant farmers in titled lands were uncertain in the sharing arrangement of benefits with the landowner. Likewise, landowners refused to grant permits for terracing out of the fear that tenants would claim the land they terraced. Bernales and De la Vega (1981), reported that the Antique Upland Development Project and the Farmer Occupancy Program in Dona Remedios, Bulacan, encountered problems in convincing farmers to adopt terracing due to high labour requirements and back-breaking activities in construction and maintenance.

Vegetative soil erosion control methods are less expensive alternatives than engineering methods. Vegetative techniques seek to maintain a living or dead vegetation cover on the soil (Highfill and Kimberlin, 1977). Vegetation cover attenuates the force of falling raindrops and increases the resistance of the soil to the erosive force of run-off. The vegetation used determines the degree of erosion control. For Mt. Makiling, a cropped area had the highest erosion rate,followed in decreasing order by a cogon grassland, an ipil-ipil plantation and a secondary forest (Pacardo and Samson, 1979).

David (1984), estimated that overgrazed grassland had the highest and primary forest areas the lowest, erosion rates in the Magat river watershed. Vegetative erosion control methods include soil-conserving tillage techniques, contour farming, contour strip cropping and soil conserving cropping patterns.

One of the foremost challenges of watershed management is to develop management plans to achieve diverse and conflicting goals and to identify a range of factors that will affect the success or failure of any watershed management plan. In more specific terms, however, the task is often to develop a watershed management strategy that will enable upland farmers to produce their food and wood requirements on a sustained basis without impairing the capacity of the catchment to yield water of the required quality, quantity and continuity.

Cruz, et.al.,(1986), estimated that 14.4 million people lived in the uplands in 1980 and 77 percent of them were on lands officially classified as public lands. Since many watersheds are already inhabited, the "protective" functions of a watershed have to be balanced with the "productive" needs of the inhabitants. Agroforestry is one of the most promising land use options when farmers are present in upland watersheds.

2.6 The Role of Agroforestry in Watershed Rehabilitation

Agroforestry is a multiple cropping technology or an intercropping of woody plants with food and/or forage crops. A more comprehensive definition: Agroforestry "is any sustainable land use system that maintains or increases total yields by combining food (annual) crops with tree (perennial) crops and/or livestock on the same unit of land, either alternatively or at the same time, using management practices that suit the social and cultural characteristics of the local people and the economic or cultural conditions of the area" (Bene, et.al., cited by Vergara, 1982).

Pollisco (1975), defined agroforestry as "the intensive development of the land by devoting that portion which is suitable to agriculture for the production of farm crops and livestock, and the remaining area which is marginal to sub-marginal to tree farming.

Agroforestry is a form of land use and management familiar to millions of farmers and forest dwellers, and has a social basis for existence (Rocheleau, 1987). Under this system, the food crops' principal role is to help meet the dietary needs of the farmers. The trees (either fruit trees or forest trees) help stabilise slopes, reduce erosion, maintain the productive capacity of hilly areas, and meet needs for fuelwood, poles, small timber, tree fruits and nuts, and fertiliser and fodder. Agroforestry therefore implies intercropping of trees and annual crops.

Relatedly, the transfer of agroforestry technology to watershed areas should make use of the hillyland household as a point of entry (Aragones, 1984). The farm household family members will be trained in agroforestry so that they will have the knowledge and skills needed to earn more, improve their lives, and make their communities more progressive.

In the Philippines, the agroforestry system actually originated in 1967 by the Paper Industries Corporation of the Philippines (PICOP) in Bislig, Surigao del Sur.

PICOP's experience on the profitability of the system included PICOP's participants earning an average of P4,000.00 per hectare on their first pulpwood crop at the selling price of P72.75 per cubic meter in 1978 which convinced the government to adopt the system (Matela, 1981).

However, it was only in 1976 that the Bureau of Forest Development conceptualised a nationwide agroforestry program which included the leasing of forestlands to qualified applicants for a total of 50 years and a renewal period, technical assistance and guidance, loans from the government credit institutions, marketing priorities to nearby wood processing land and other incentives embodied in Presidential Decree 705 (Revised Forestry Code of the Philippines).

A study of Castillo (1987), about the adoption of agroforestry technology by the hillyland households in Laoag, Ilocos Norte, showed that there was an increase in the number of households (from 18% to 82%) in the project barangays who claimed to have improved their economic status after the introduction of the agroforestry technology project. They noted that this could be due to financial rewards and diversified farm crops grown in their project.

In many rural areas, trees planted alone or in deliberate combination with annual crops play an important role in household food security (Arnold, 1987; FAO, 1989; Falconer, 1990). That is, trees in farming systems contribute to household access to food throughout the year. Trees enhance household food security directly by producing foods and indirectly through providing inputs into other food producing parts of the farm system and by providing fuel for cooking. Trees can also provide cash crops enabling many rural households to purchase food. For the farm household with limited resources and scant ability to meet subsistence demands through agriculture, trees can provide products to eat or sell during seasonal shortfalls in food and income.

Agroforestry as a form of vegetative soil erosion control is attractive because of the similarity of its structure to the tropical rain forest ecosystem and its multilayered canopy. The canopy increases the efficiency of light capture and utilisation. Light transmitted or reflected by one layer can be utilised by a succeeding layer of leaves. Moisture loss from the soil by evaporation is minimised by a complete canopy. The canopy also protects the soil from rain and decreases soil erosion. High species diversity is characteristic of the ecosystem. High diversity and the multiple layered canopy allow an essentially closed nutrient cycle. Agroforestry mimics the structure of the forest; thus, corresponding functional attributes are hopefully replicated as well. Grinnel (1982), has outlined some justifications and potentials of agroforestry: from the social point of view, the introduction of a forest component into the rural world helps to create new employment without inducing further deterioration of the agricultural soils. Introduction of a better crop diversification and especially by the production of timber outside the forests, can develop new possibilities for trade and new industries and will easily occupy local labour.

The ecological advantages of agroforestry particularly concern the microclimate and the soil. The development of a forest vegetation results from the optimal use of solar energy. Biological activities in a tropical forest soil are stimulated by environmental conditions, where the whole soil layer is protected by the trees against extreme temperatures, against erosion and against nutrient losses through leaching. Acidification of forest soils is hindered by a regular recycling of bases, tapped in deep layers by the tree roots.

Agroforestry can be cyclical, taungya, or integral (Vergara, 1982). Cyclical agroforestry includes traditional kaingin farming in which food cropping and forest fallow alternate. Taungya agroforestry is the early simultaneous planting of food crops and trees, followed by natural evolution towards pure forest. Integral agroforestry consists of the simultaneous but continuous planting of food crops and trees. Vergara (1982), says that integral agroforestry is best for stabilising hillside farming. Integral agroforestry has been characterised as acceptable to target beneficiaries, inexpensive to implement, more productive and sustainable than other systems, efficient in utilising available land resources and ecologically sound. As an integrated production system, it is expected to produce a mix of outputs not normally found in intensive monoculture or single-cropped systems. These products may be classified into two groups: food products yielded by both the agricultural crops and tree crops and wood products extracted from the trees. Lately, the mounting tension caused by food shortage, environmental degradation and the unabated increase in population has aroused world-wide interest in agroforestry. Many people have realised the need to set a balance between food production and environmental conservation. Today's challenge is to produce more food without sacrificing too much soil and environmental stability. Agroforestry is regarded as a relatively cheap alternative to reforestation where the farmers can establish tree crops and food crops while they are compensated in terms of food output and tree products.

Several efforts have already been made to reforest denuded areas all over the Philippines. Yet, very few of these reforestation projects are considered successful. Reasons suggested by Sajise (1991), included insufficient and inadequately trained personnel and shortage of funds. However, doubts on the part of the peasants about land security and land adequacy also played an important role. The general trend is for upland cultivators to want secure land titles before they begin to invest efforts in soil conservation and reforestation (Aguilar, 1986). This can be attributed to the lack of complete appreciation by the rural upland population of the value of a forest cover and the use of only forest species without the inclusion of horticultural cash crops (perennial or annuals) which are sources of food and income of the farmers.

Jordan, et. al., (1992), reported that in a plantation of long-lived species, an important problem is the long time interval during which there is no economic income from the land on which the trees are planted. Because of economic pressure, there is a temptation to cut the trees prematurely. An effort to remedy the problem is being tried in the Philippines by the Paper Industries Corporation of the Philippines joined with the Development Bank of the Philippines in a program that provides loans, technical assistance and a guaranteed market to individual landowners who produce pulpwood for nearby pulp mills (Kirchofer and Mercer, 1986). They can plant , harvest and reap an economic income within a time span of less than 10 years, a reasonable economic horizon. Investment would have to come from the government, international banks or development agencies.

An example of a successful agroforestry project according to Jacalne (1982), is found in Carranglan, Nueva Ecija, Philippines organised by the Bureau of Forest Development (BFD) and the Food and Agriculture Organisation (FAO) of the UN in 1979 primarily aimed at preventing the expansion of shifting cultivation. About 150 families each tilling one and a half to two hectares of land joined the project with BFD providing fruit and forest tree seedlings and technical assistance. Likewise, Castillo (1987), cited that the agroforestry project of the West Visayas State University at Inca, Lambunao, Iloilo has successfully carried out agroforestry projects on intercrropping coffee with *Leucaena* trees.

Recent reforestation programs have had a different approach. In addition to the planting of forest species, horticultural tree crops are being encouraged. This is in consideration of the immediate benefits that farmers could derive from the tree crops. Among the tree crops that are very popular in the upland sloping areas are coconut, coffee, cocoa, banana, abaca, citrus, jackfruit and cashew. These are definitely the major sources of income of the upland farmers.

Most of these horticultural crops are tree crops. Thus, they simulate the contributions of forest tree species in upland environment. If appropriate establishment and management of tree crops can be done, it is possible that an appropriate balance between economic returns and ecological/environmental protection can be achieved.

Agroforestry serves as an acceptable alternative in not only rehabilitating forest lands but also in developing the countryside through the active participation of the upland farmers who are the direct beneficiaries of the development technology. Agroforestry can serve as a means of creating employment opportunities for rural farm labour; producing raw materials for cottage industries; providing food and other products for home consumption; and protecting and improving the production potential of a given site or environment thereby increasing the human ecological carrying capacity.

Agroforestry, although an age-old land use practice is a new field of scientific research (Huxley, 1980; ICRAF, 1979, 1983). Nonetheless, the empirical evidence indicates good potential roles for agroforestry in many upper watersheds.

In an analysis and evaluation of agroforestry as an alternative environmental design for land use in the Philippines, Tabora (1991), concluded that agroforestry is beneficial and can be a solution to the problem of land degradation in the Philippines, by: (a) providing a new agrarian strategy; (b) restructuring the perception on natural resources, particularly on balancing between conservation, protection, exploitation and rehabilitation; and (c) providing new efficiencies in the use of limited land resources.

Studies of forest ecosystems have highlighted the protective role of trees in slope stabilisation. Ziemer (1981), and O'Loughlin (1974), have shown that the woody and extensive root systems of trees bind and anchor the weaker upper horizon of soil to fractures and crevices of bedrock and provide interlocking soil binders to reduce slips and slides. Thus, as long as there are sufficient numbers of strategically located trees in watersheds to perform this stabilisation role, it is possible to reduce shallow mass wasting and sedimentation.

Based on evidences collated from other existing researches on land use systems related to agroforestry, Nair (1984), reported that: the inclusion of compatible and desirable species of woody perennials on farmland can result in a marked improvement in soil fertility due to an increase in the organic matter content of the soil through addition of leaf litter and other plant parts; more efficient nutrient cycling within the system; increased activity of the favourable microorganisms in the root zone; marked improvements in the physical conditions of the soil and imparting stability to the ecosystem and reducing the rate of siltation of downstream aquatic ecosystems, dams and reservoirs.

In an unexploited natural forest, the "triple protective armour" provided by the crown layer, the undergrowth, and the litter mass, as well as the reduction of velocity and quantity of surface run-off by vegetative impediments, combines to stabilise slopes and minimise surface erosion. In an agroforestry situation, however, the threat of accelerated surface erosion is serious because of soil cultivation (Wiersum, 1984). Spaces between trees are cultivated for annual crops, and the disturbance of the soil surface can substantially increase soil loss. Placement of trees in relation to the topography becomes a critical management consideration. The primary role of the trees is to minimise natural erosion and to arrest the accelerated erosion brought about by intensive food cultivation intercropping activity.

The trees in agroforestry need to be artificially arranged in contour rows and spaced closely along the rows so that they may serve as effective erosion barriers and nutrient filters. Depending on the degree and length of slope erodibility of the soil, and intensity of rainfall, either contour rows or contour slips may be used as erosion bars. Over time, natural terraces form with the contour strips acting as terrace runners. Alley cropping type of agroforestry with trees deliberately arranged in contour strips, is a feasible alternative approach to joint food production and watershed protection in the Philippines.

When agroforestry production systems elevate yields beyond local consumption levels the problem of disposing of surplus outputs arises. According to Vergara (1987), some participants in government agroforestry programs have been known to withdraw when frustrated by the inability to sell their products in excess of subsistence requirements.

Multiple solutions to these problems are required such as: (1) improvement of access to markets through accelerated infrastructure development; (2) institutionalization of cooperative marketing organizations to facilitate product assembly at key points for easy sale to buyers; (3) selection of products that have greater storability, such as grains and nuts, and (4) selection of species that need not be harvested simultaneously at specific times of maturity and can continue to grow in volume and value when left unharvested, as in the case of root crops.

If markets are readily available for horticultural products, the agricultural crop component of an agroforestry system could be changed from subsistence type annual crops to market-oriented horticultural perennials. The combination of agricultural perennials with forest crops as exemplified by cocoa/*Leucaena* in the Philippines, provides much more soil protection than an annual/perennial crop combination. The frequent soil disturbance brought about by site preparation, planting, and harvesting of annual crops is avoided.

Tree farmers in the southern Philippines started out as agroforestry farmers intercropping annuals such as corn, taro and rice with nitrogen-fixing *Albizia*. The food crops were for domestic consumption while the tree crops were marketed at a nearby pulp and paper plant. As soon as it became evident to the farmers that they would earn more revenue by tree cropping exclusively rather than food crop/tree farming they shifted from agroforestry to specialised tree farming (Domingo, 1981). Their economic situation has improved as they moved from a subsistence to a market-oriented economy and their tree farming has contributed to greater site stability.

Watson and Laquihan (1985), reported that Sloping Agricultural Land Technology (SALT) a highly successful agroforestry approach which was developed by he Mindanao Baptist Centre involving cultivation of *Leucaena leucocephala* in hedgerows and growing both annual and perennial crops as well as grasses and goats in the cropping system, received wide acceptance in Bansalan, Davao del Sur due to high returns in cash crops and in improving the sustainability of their farms.

Success of motivating upland farmers to practice soil conservation through agroforestry depends to a large extent on their perception of the economic rewards from such practice and is greatly influenced by the nature of their tenure over land and vegetation. If they have long term access and control over the farms, they will consider it more worthwhile to apply productivity maintaining techniques. On the other hand, if they have insecure tenure and face the risk of eviction, they would rationally try to maximize immediate yields and not worry about the future capacity to produce. The most secure form of tenure on sloping swidden farms according to Payuan (1987), was introduced in the Philippines where there is a modification of state tenure through a twenty five-year lease system, renewal for another twenty five years, for public lands devoted to agroforestry.

Today, instead of agroforestry being merely the handmaiden of forestry, the system is being more and more utilized as an agricultural system, particularly for small-scale farmers. Today, the potential of agroforestry for soil conservation is generally accepted. Indeed, agroforestry is fast becoming recognized as a system which is capable of yielding both wood and food and at the same time of conserving and rehabilitating ecosystems.

2.7 Economic Feasibility of Agroforestry in Watershed Rehabilitation

Agroforestry is technically feasible as a land use system for hilly terrain, including upland watershed areas. Studies have been conducted to determine the economic benefits of agroforestry to the farmer. Mendoza (1977), in the Philippines, Rachie (1981) in Colombia, and Nair (1984) in Africa have shown that the *Leucaena*-corn-vegetables combination yielded higher aggregate physical outputs than annual monocropping. These studies examined yields in physical terms and stopped short of converting outputs and inputs into financial terms, thereby precluding the calculation of net financial returns to the farmer. Other researchers such as PCARRD (1983) and Corpuz (1984), quantified inputs and outputs in monetary terms and were able to demonstrate that agroforestry is financially attractive. They did not take into account however, the streams of off-site costs and benefits that occur over a longer period. As a result, the net discounted values they calculated are probably an understatement of the long-term productive potential of agroforestry.

Grinnel (1982), cited that economically, agroforestry appears to be able to contribute to solve the food crisis as well as the energy crisis. The production of fuelwood outside the forests is therefore a useful and necessary diversification, able to produce additional incomes for the farmers. Plantation costs are very low compared with other methods used to improve the stability and fertility of agricultural soils.

Economic analysis of agroforestry is more problematic from the societal viewpoint. Analytical methodologies are available, but there is a dearth of quantitative information, particularly about the environmental externalities of agroforestry. This information is essential to an accurate calculation of net social benefits.

Despite the absence of detailed economic analysis, decisions to employ agroforestry in place of annual cropping in densely populated and heavily calculated catchment areas have been, or are being made in some countries (Vergara, 1986). Such decisions are in part based on the readily visible capacity of "contour-strip" type of agroforestry to minimise erosion on steep slopes.

Numerous watershed projects employed cost-benefit analysis as an economic tool in evaluation. It showed that watershed rehabilitation and management has positive impact on crop yield and farmer's income (Reddy and Pandurangaiah, 1988; Singh, 1991; Ramanna, 1991; Mahandule, 1991; Shrivastava, 1991; Misra, 1991;

Ghosh, 1991; Alagumani, 1991; Randhir, 1991; Norman, 1991; Alshi, 1991; Sidhu, 1991). It also showed an increase in recharge of groundwater in watershed programme villages (Singh,1991; Ramanna, 1991; Ghosh, 1991; Randhir, et.al.,1991; Yadav, 1991; Singh, et.al.,1991; Biradar, 1991; Suryawanshi, 1991) and an increase in irrigated area (Singh, 1991; Mahandule, 1991; Norman, et.al., 1991).

Ex ante evaluation of watershed rehabilitation is conducted to form the basis of project feasibility studies or to examine policy options open to decision makers. The NIA and Mandela Agricultural Development Corporation (1979), in an ex ante evaluation of watershed conservation effects used projections without the project versus project effects with the project. The study focused on the economic gains from crop production. Attempts at evaluating the project from society's viewpoint were made by varying the costing of capital (interest rate) and labour. No special consideration was made for income redistributive effects, such as the assigning of heavier weights to changes in income of the poorer project beneficiaries.

Marginalization of watershed areas is a result of resource mismanagement. Logging and kaingin farming have been blamed. Seventy to eighty percent of the nutrients in a tropical rainforest is in the tree biomass. Removal of this biomass opens the closed nutrient cycle and allows nutrient losses, leaving limited nutrients in the soil which, in turn, are soon removed from the ecosystem. Open sites lead to soil erosion and surface water run-off. Erosion contributes to soil marginalization wherein the loss of top soil rich in organic matter destroys soil structure and its water holding and strong capacity.

The ideal watershed is able to sustain life and provide economic benefits. This means that it should have water of sufficient quantity to promote soil fertility and is of such quality as to be fit for human as well as animal use and consumption. That same water should flow in such a way as to be life supporting as it wends its way through the soil, to the river, down to the sea. All these positive characteristics of a watershed are made possible by the trees that make up the forest in a watershed.

Watershed improvement essentially entails reforestation which is the intentional restoration of the original forest of any given area to: (1) improve water yield characteristics; (2) restore soil fertility; (3) increase forest and agricultural production; (4) conserve genetic resources; and (5) conserve the local climate.

Examples of these forest production systems are those industrial tree plantations and tree farms around the Paper Industries Corporation of the Philippines (PICOP) and Nasipit Lumber Company in Bislig, Surigao. They are technically and economically viable, even in areas considered marginal for agriculture wherein farmers are permitted to cultivate and develop a designated area into a permanent farmlot. The goal of the project is to settle upland shifting cultivators in order to reduce the negative impact shifting cultivation has on watersheds. The plantations are grown for a sawtimber rotation but thinned for fuelwood and later pulpwood.

The establishment of more industrial tree plantations and tree farms is thus justified by the need to supplement the wood and related products from natural forests and the need to produce unavailable raw materials for new industries.

2.8 Sustainable Watershed Development

There has been a growing realization in national governments and multilateral institutions that it is impossible to separate economic development issues from environment issues; many forms of development erode the environmental resources upon which they must be based, and environmental degradation can undermine economic development. What is therefore required is a new approach in which development integrates production with resource conservation and enhancement, and that links both to the provision for all of an adequate livelihood base and equitable access to resources. The concept of sustainable development provides this framework for the integration of environmental policies and development strategies.

Sustainable development is a phrase popularised by Our Common Future, a 1987 report from the United Nations Commission on the Environment and Development. The report defined sustainable development as economic activity that *"meets the needs of the present without compromising the ability of future generations to meet their own needs"*. In as much as forested watersheds and forest products have played an important role in the economic development of many tropical countries, sustainable agroforestry is an important component of sustainable development. As natural forests have disappeared, governments and corporations have turned to agroforestry as an alternate system to meet the ever-increasing demand for food and wood products.

Merging environmental and economic considerations in decision making involves a fundamental realignment of the overall objectives of development planning in the light of a new awareness of the environmental implication of development activities. This means that the process of development should be viewed from the outset as a multipurpose undertaking that includes an explicit and defined concern for the quality of the environment. Within such a planning context, it is especially important that analysis and evaluation stress a key role that environmental quality can play in sustaining development. The information generated from these exercise will provide a better basis for formulating correct resource and environmental prices which are important in including sustainable development.

2.9 Looking Toward the Future

Although the Philippines has made significant steps in the implementation of watershed management projects, a comprehensive and coordinated watershed management strategy and program is still lacking (FAO, 1986). Legislation that promotes coordination of agencies, and that sets out guidelines for many of the specific details of watershed management including planning and monitoring, would be beneficial.

CHAPTER III

METHODOLOGY

"It is the clear duty of government, which is the trustee for unborn generations as well as for its present citizens, to watch over, and if need be, by legislative enactment, to defend, the exhaustible natural resources of the country from rash and reckless spoliation."

A.C. Pigou, The Economics of Welfare, 1952

Just as there is a physical, natural logic to a watershed and its use as an organizing unit for analysis, there is also a strong economic logic for the use of a watershed as an analytical unit. This follows from the flow of physical factors and the fact that actions in one part of the watershed e.g., upland deforestation can have effects on another, sometimes distant and usually downstream part of the watershed.

A basic concept in economics, which encompasses these interrelationships, is that of externalities - - usually defined as the situation when *"some of the benefits or costs of an action are external to the decision maker; that is, some of the benefits accrue to or some of the costs are imposed upon individuals who play no part in the decision"* (Randall, 1981). Externalities exist because improper upland cultivation practices can result in increased erosion and sedimentation on downstream fields or areas. These are negative externalities or costs. The reverse also holds - - an active reforestation program can lead to decreased erosion and consequent downstream benefits.

It would appear at first sight that many of these aspects defy quantification and therefore render economic analysis as being of little help in decision-making with respect to conservation. However if, as Samuelson (1973) describes it, economics is the study of *"how men and society end up choosing, with or without the use of money, to employ scarce productive resources which could have alternative uses"*, then it would appear that the questions facing society and indeed all of mankind, with respect to conservation or otherwise of natural forests, fall squarely within the realm of economic inquiry, and indeed in recent years economists have begun to grapple with some of the difficulties involved in the environmental decision-making.

Economic analysis of watersheds includes a search for ways in which externalities can first be identified and then explicitly incorporated into decisions. Since many watershed management actions are implemented in one location while causing change in other locations, there is not the direct cause-and-effect relationship that economic theory predicts as leading to efficient decision making. An upland slope stabilisation program may be designed to prevent sedimentation in a downstream reservoir and may not yield any measurable benefits in the upland or have not enough benefits to cover project costs. In this case the benefits are largely external to the project site but would be included in a broader watershed analysis.

In determining how a watershed is managed, the useful role of economics should not be overlooked. If watershed management is seen as serving two goals --

decreased soil erosion and reduced negative, downstream physical effects as well as improved economic and social well-being for watershed inhabitants -- economic analysis is imperative for analysing alternative management options.

As shown time and time again, if individuals perceive that a management option will benefit them and increase their welfare, it is likely to be adopted. But if the benefits accrue to someone else or are too far in the future, the management option will be rejected. Economic analysis can help sort out these effects and indicate what types of government policies may be necessary to ensure acceptance.

The final point should already be clear: people do count and are part of the solution as much as they are part of the problem. Even if farmers are in a watershed "illegally", it usually is impossible to remove them. Watershed management, therefore, has to work with people as much as, or even more than, with trees and soil. People use their resources to meet felt needs, and these needs have to be understood to develop reasonable, realistic management options. Non-use of the watershed or no erosion are usually unrealistic alternatives.

The interdisciplinary approach of integrated watershed management and rehabilitation is designed to deal with a range of problems facing watershed management. The approach suggests a solution to these pressing resource management questions, a solution that stresses people and the political-social-economic-institutional dimension as much as the biophysical.

3.1 Economic and Financial Analysis

Because of its broad scope, the watershed is a logical organising unit for an economic welfare analysis because few impacts are external to the watershed unit. Economic analysis of a watershed project or plan will usually be done in a benefit-cost analysis or project evaluation framework. This approach assist decision makers in deciding among alternative projects or plans.

The importance of economic analysis in the evaluation of alternatives is directly related to the importance of economic growth as a management objective. Benefit cost analysis provides a means to determine the contribution of each alternative to economic growth and thereby allows direct comparison of relative performance.

While the theoretical economic merit of a proposed watershed management activity can be determined independently of cash flow considerations, successful implementation and operation is directly dependent on funding. Many management activities require construction of facilities involving large initial investments. Implementation of such projects often involves use of borrowed funds to be repaid over an extended period of time. The financial analysis in this case must explore potential means of meeting repayment obligations such as tax revenues and user charges imposed on project beneficiaries. In addition to consideration of repayment of borrowed funds and associated interest, the financial analysis must also project operating and maintenance costs and identify sources of necessary funds.

Financial analysis is of substantially narrower scope than economic analysis. Since the focus is on meeting payment schedules, broader considerations of uncompensated benefits and costs are irrelevant (Cox, 1987). Debate over choice of discount rate reflecting the appropriate time preference is not an issue since only actual interest rates such as those applied to borrowed funds are needed. Problems of assigning values to project services without established prices do not exist since actual cash flows are the focus. But financial analysis is a basic component of the planning process because of the direct relationship between funding and the feasibility of watershed management activities.

Financial analysis seeks to develop an estimate of commercial profitability for a project. In a reforestation project, financial analysis is carried out from the point of view of specific entities involved which could include the individual farmer, the community, a corporation, and the government. It considers the monetary returns expected by such entities from investment of their funds and resources in a project. A financial analysis also provides information on when funds will be required (outflows) and when receipts (inflows) can be expected.

An economic analysis is an extension of the financial analysis concept, where the entity carrying out the analysis is the society rather than a specific entity within the society. As such, the economic analysis is also concerned with "profitability" albeit from the society's point of view, which is related to the returns that society as a whole can obtain in a given use of its limited resources.

Economic analysis also parallels the financial analysis in terms of procedure. However they differ in terms of what is included as costs and benefits and how costs and benefits are valued. In the financial analysis, benefits are defined in terms of actual monetary returns to a specific entity or entities in society from whose point of view of analysis is being carried out. These returns result from the sale or rental of goods and services in a market, and thus returns are measured in terms of "real market" or financial prices.

The costs in the financial analysis are represented by outflows of money from the entity(ies), mainly paid out for goods and services purchased in the market. In economic analysis, the concern is with what society gives up and what society gains from a project. Economic costs are thus defined in terms of the value of opportunities foregone by society because resources are used in the project rather than in their best alternative use. Thus costs in an economic analysis are referred to as "opportunity costs". Project benefits are defined in terms of increases in goods and services available to society as a whole due to the project.

Since both financial and economic analysis have much in common in terms of information requirements and procedure, they are generally carried out together. The steps in a financial analysis are more straightforward to carry out and clearer in concept. Therefore they generally precede the comparable steps in the economic analysis.

The foremost concerns of financial analysis is to ensure that there are adequate funds to carry the project through to completion and to recover and appropriate part of the costs charges. As with other revenue causing projects, the need to recover costs in reforestation merges with other concerns about the impact of the investment on the financial position of the participant and more broadly, about the overall financial viability or soundness of the activity.

These concerns make it all the more important to establish reliable estimates on projections of project costs and benefits, based on the technical feasibility study and with appropriate allowances for physical and price contingencies, to determine what remains to compensate the participant for its own labour, management skills and capital. In more specific terms, the analysis of rehabilitating watersheds through reforestation permits the assessment of financial incentives for farmers to participate in the project.

Techniques using changes in productivity as the basis for measurement are direct extensions of traditional benefit-cost analysis. Physical changes in production are valued using market prices for inputs and outputs or, when distortions exist, appropriately modified market prices. The monetary values thus derived are then incorporated into the economic analysis of the project. This approach is based directly on neoclassical welfare economics and the determination of social welfare. The benefits and costs of an action are counted regardless of whether they occur within the project boundaries or beyond them.

Changes in productivity caused by the project have to be identified both on site and off site. Changes on site are typically the outputs for which the project was designed and are included in any project analysis. Changes off site (both positive and negative) include all the environmental or economic externalities which were frequently ignored in the past. These off site effects must be included to give a true picture of project impacts.

The effects on productivity both of proceeding with the project and of not going ahead should be assessed. Even if alternative projects are being considered, the "without-project" option should be retained. The reason for this is to be able to specify the changes which will be brought about by the project as compared to what would happen if no project were undertaken.

In the evaluation of the without-project alternative, care must be taken to account for what might be expected to occur without the project. If the resource would be expected to degrade over time if no action were taken, this decline over time must be taken into account, to compare the actual differences of the with-project and without-project alternatives over time, not just a comparison to the current situation.

Assumptions have to be made about the time over which the changes in productivity must be measured, the correct prices to use, and any future changes expected in relative prices.

A critical objective of financial analysis is to assess the financial effects of the reforestation project on farmers, communities, corporations and others who may be participating in it. Increased income is probably the most important objective of an individual economic effort. An acceptable level of the overall returns of the project's ability to repay loans are important indicators of the efficiency of resource use.

The financial analysis addresses itself to the question of incentives to the farm families due for the additional effort and risk they will incur. Financial analysis works out a plan that projects the financial situation and sources/uses of funds of the various project participants and of the project itself. This plan provides a basis for determining the amount and timing of investment by the participants and for setting repayment terms and conditions for the credit extended to support the investment.

Benefit-cost analysis (BCA) is defined as a type of policy analysis in which the societal advantages and disadvantages of alternative policy measures are quantified into a single unit, usually a monetary unit. Conventional benefit-cost analysis assumes that the marginal value of a monetary unit is the same for all individuals who benefit from the program/project. But it may also be assumed that the marginal utility of income decreases in proportion to the increase of the individual's income level. In many countries, government policy with respect to income distribution among individuals, groups or regions is based on this assumption and such policy can be used to implement projects to redistribute income. In practice, however, a difficulty in project appraisal is to find suitable weights in assessing the income distribution effects of the project. A benefit-cost analysis which considers income distribution outcomes of a project is called a "social" BCA. Moreover, aspects of income distribution may be taken into account within a current generation - temporal, or between the present and future generations - intertemporal. Whereas, a BCA that incorporates the externalities or the effects of a project on environmental quality is called an extended benefit-cost analysis (Gittinger, 1986).

As a general concept, benefit cost analysis includes any systematic comparison of positive and negative effects associated with the activity being evaluated. In this broad approach, all impacts of a given activity can be considered, including impacts that can be quantified and other effects that can be described in qualitative terms only. In practice, however, benefit cost analysis tends to be limited to comparison of monetizable values, with other impacts left for separate evaluation.

Benefit cost analysis has potential to contribute to evaluation of alternative proposals. Identification of the alternative with potential to make the greatest contribution to economic growth provides a useful standard of comparison. Whenever two or more alternatives make equal contributions to other objectives, the superior alternative generally will be the one making the greatest contribution to economic growth. Where contributions to other objectives are unequal and an alternative is selected due to its enhancement of another objective, the results of the economic analysis provide a measure of the economic growth costs associated with advancing the other objective and therefore contribute to informed decision making.

Since watershed development physically takes place on an area of land it is important to take careful note of what use this land is being put to before the proposed project and what potential it has for development without the project. According to Copeland (1979), it is very rare indeed to find instances where the land to be occupied by the project has absolutely no productive value. The project is viewed as an investment proposal superimposed on the existing conditions in the hope of increased benefits accruing as a result of that particular investment.

The importance in the choice of viewpoint in project appraisal is twofold - first, in determining which costs and benefits are included in the analysis and, second, in determining the appropriate prices at which these costs and benefits should be valued. In financial cost-benefit analysis, the identification of money costs and money benefits faced by the firm is usually fairly straightforward, and market prices reflecting the basic resources costs to the company of project inputs and outputs are the appropriate prices to use in the valuation of costs and benefits. Those costs and benefits affecting anyone other than the firm are ignored, whether they are of an intangible or tangible nature. In the public sector, where project evaluation requires the national viewpoint to be taken, full economic analysis of a project is necessary, and this is not nearly straightforward. The full impact of the project on the whole economy must be measured.

3.2 Determination of Benefits

Benefits associated with a watershed management alternative are its total positive contributions, subject to the limitation that the contributions be reasonably monetizable if benefits and costs are to be analyzed in monetary terms. The limits of monetization cannot be defined completely. The range of potential benefits includes such diverse items as direct consumer products and services, inputs to productive processes, aesthetic enjoyment, health improvements, and greater security for human life. All of these categories of benefits can be subjected to attempts at monetization. This approach involving estimation of monetary values for all impacts of an activity is an attempt to make benefit cost analysis an all inclusive evaluation procedure that largely eliminates the need for other evaluation.

Monetizable benefit categories generally include the increased production of goods and services in a substantial range of activities affected by watershed management. Productivity increases can result from expansion in production, as in the case of increased agricultural output resulting from provision of irrigation water, and from decreased costs of production, as in the case of organic farming.

Since large scale watershed rehabilitation projects can produce hydrologic impacts over significant distances, certain benefits may be realised by parties other than the entity responsible for the project. Such effects are real benefits from the perspective of total social welfare even if the effect is not a specific project purpose and produces no compensation to the project owner. If the uncompensated effect occurs across a national boundary, however, it will not likely be viewed as a benefit from the perspective of the upstream nation since watershed management is typically viewed from the national perspective.

The issue of whether these effects resulting from economic linkages (usually called "secondary" benefits) should be counted as project benefits has been controversial. A key factor is the accounting perspective taken. From the local or regional perspective, such effects clearly constitute economic benefits. From a national perspective, however, such increased activity may not be a net benefit if it displaces other economic activity that would be undertaken in its absence (Mishan, 1976).

Determining the value of benefits can pose special difficulties. A generally accepted standard for determining value is the willingness of consumers to pay for the given product or service. While prevailing prices for the good or service in question may constitute a valid indication of value under appropriate circumstances, prices may not reflect value in certain situations (UNIDO, 1972). For example, prices may be considered invalid indications of value where they are maintained at artificially high or low levels due to government policies or other factors. Under such circumstances, adjustments in prevailing prices may be necessary for purposes of economic analysis (Mishan, 1976).

Even where benefit cost analysis is limited to reasonably monetizable project effects, certain benefit categories may be included where the product or service does not involve a significant level of transactions based on payment of a price. In the case of irrigation water, benefits can be measured as the value of increase in crop output resulting from use of the irrigation water supply (James and Lee, 1971).

The economic analysis of a project assesses its likely impact on the relevant development objectives by comparing the various ways in which the scarce resources required by the project might be used instead. These resources may include different types of labour and skills, land, imported and domestic materials and equipment, etc. Ray and van der Tak (1979) pointed out that the benefits and costs of a proposed project are always measured against an alternative situation - generally that of not proceeding with the project at all. Thus, the benefits and costs are those expected from the project over and above those expected without it. The definitions of benefits and costs of a project depend on the national objectives that are to be included in the analysis. An attempt to calculate the effects of a project on such broad objectives as economic growth, poverty alleviation, or income redistribution and to assign weights to them according to a country's socio-economic preferences, poses difficult problems for economic analysis since market prices do not necessarily provide a satisfactory basis for measurement. Prices which do reflect the proper weights to be given to the various objectives are called accounting or shadow prices. The shadow prices related to the income objective only are usually called "efficiency" prices, whereas those reflecting the project's effects on the economy's total income and on equity are called "social" prices.

Economic analysis is not merely a device for project justification. Rather, it should be seen as a tool for decision-making and for understanding the resource allocation problems facing the farmers and project planners. An important role of economic analysis is to identify and articulate areas of uncertainty and potential trade-offs.

Evaluation must include such standard economic criteria as changes in the gross and net income of participants, changes in the volume and value of production, and measures of the efficiency in the use of project resources. It must include also such direct and indirect benefits as changes in the efficiency and effectiveness of the marketing system, changes in employment, changes in the volume and type of business in the region, changes in tax revenues and expenditures. Equally important may be changes in patterns of consumption, participation in education, in health and other measures of well-being of people in the project area (World Bank, 1974).

One of the basic principles in benefit cost analysis is to develop and compare alternative scenarios of what is likely to happen with the project and without the project. The difference between the two is the impact of the project. In both cases analysts are faced with imagining what the future would be like under two different set of conditions. While one often can visualize what changes are likely to happen if the project is implemented, it is sometimes more difficult to visualize what is likely to happen if the project is not implemented. The absence of the project does not mean that no changes will take place. On the contrary, the lack of a soil conservation project may mean that soils continue to erode at an ever-increasing rate. The absence of a watershed rehabilitation project may mean an increasing deterioration of vegetation cover on fragile watershed soils and accelerating deforestation. The "without" project situation is seldom a static one. Therefore, it is important to trace down through the important biophysical and socio-economic linkages and determine changes with and without the project. An increase in productivity or reduced sedimentation refers to the differences in productivity or sedimentation between conditions with and without the project or activity. In any given case, productivity can still be declining with the project or activity, but at a slower rate than without the project; thus, at any given time there is a higher level of productivity over what it would have been without the project. The difference between with and without the project, is referred to as an "increase in capacity" for the reservoir because the soil conservation project increases reservoir capacity over what it would have been without the project.

The situation which can be predicted to exist if and when the project is carried out (usually referred to as the "with-project" situation) will be different from the one expected to exist if this is not carried out (the "without-project" situation). The existing situation must be defined in terms of erosion rates, reservoir sedimentation, trends in reduction of available irrigation water, losses of upstream production and so forth. This analysis essentially defines the "without" project conditions to be used as a basis for estimating project effects. For the proposed project alternative an attempt is made to estimate how conditions would change during the life of the project. This "with and without" project analysis provides the basic physical data for the evaluation. The economic assessment of a project consists of comparing the one with the other to determine whether the with-project situation is significantly better than the without-project one, and whether the difference between the two is large enough to pay for the cost of initial investment plus the benefits than the resources required for the investment would have generated elsewhere if the project is not carried out.

To carry out that comparison, i.e., to assess a project's worthiness, several activities must be performed. Both financial and economic analyses need to be presented in order to gather information whether the proposed project is worth doing, and to answer questions such as: is the value of outputs greater than value of inputs and is the proposed way of getting the outputs more efficient than alternative feasible ways of getting the same outputs? Both questions should be answered by the results of the analysis. Likewise, complete information on the impacts and desirability of the project from different perspectives can be derived from the analysis. The economic efficiency analysis will use value flow tables.

Several measures of project worth may be calculated - - net present value, internal rate of return or benefit-cost ratio. Decisions will have to be made on the discount rate, the appropriate time horizon, and what to include and exclude from the appraisal. Several economic impacts and measures need to be considered in addition to economic efficiency. These include measures related to income distribution, regional impacts and balance of payment effects. In very broad terms, these can be lumped into three groups: (i) to identify all costs and all benefits associated with the proposed project, (ii) to define the without-project situation, and (iii) to select a proper way of comparing the costs and benefits over time.

3.3 Determination of Costs

Since economic analysis is not limited to accounting of cash flows, costs like benefits potentially include a wide range of impacts without regard to the issue of actual payments made. Guidelines for determining costs are partially fixed by decisions regarding the determination of benefits since parallel treatment is desirable. If the positive effects on a particular activity are included as benefits, associated negative effects should be included as costs to allow a determination of the net effect. The same principles for treating price changes and discounting adopted for benefit analysis should be applied to analysis of costs as well.

The proper standard for determining the costs of a watershed project is the value of the opportunities foregone as a result of its implementation (UNIDO, 1972). The most obvious category of costs are direct expenditures by the party responsible for the project for planning, design, land acquisition, materials and labour used in construction, operation and maintenance, ad other costs incurred during the period of analysis as determined for purposes of benefit estimation. These items typically are included as costs since their use in a particular watershed rehabilitation activity precludes their use in an alternative activity.

A category of potential costs related to direct project expenditures includes expenditures necessary for achieving project benefits incurred by parties other than the project owner. Another category of costs includes uncompensated adverse impacts in the form of external diseconomies. Although the party responsible for watershed rehabilitation may not be required to make compensation for such effects, they represent opportunities foregone as a result of project implementation (Mishan, 1976). They therefore affect welfare and should be included in the analysis to determine the overall desirability of the activity in question. The identification of all relevant project costs and benefits must be carried out systematically, going through the network of project activities in order not to overlook any significant item. Both direct and indirect costs and benefits must be included, both on-site and elsewhere -- particularly downstream, and those likely to occur in the present as well as those likely to occur in the future.

Zimbelman (1987), suggested that particular care must be taken to identify items which are not quite visible, hidden or otherwise not readily apparent. Provision for physical contingencies must always be included, as well as contingencies for price variations whenever appropriate. Cost imposed on, and benefits accruing to, persons and activities other than those directly linked to the project -- the so-called externalities -- must be explicitly identified and included. Financial costs and benefits, as well as taxes, subsidies and transfer payments, must be included in the analysis at market prices (which the World Bank calls "financial" analysis), but excluded in the analysis at social prices ("economic" analysis).

Howe (1971), summarized the different categories of values or types of benefits and costs involved in a benefit-cost analysis. These are: (i) economic values for which market prices exist and correctly reflect societal opportunity costs or true scarcity, e.g., farm outputs which are not price supported; (ii) economic values for which market prices exist, but fail to reflect appropriate scarcity values or shadow prices, e.g., price-supported commodities/services; (iii) economic values for which no market prices exist, but for which appropriate social values can be estimated in money terms by inferring what consumers would be willing to pay for the product or service, either through direct surveys or indirect method of extra-market benefit estimation, e.g., of forest-based recreation or hunting and fishing resources; and (iv) values for which it is difficult to imagine any kind of market-like process capable of registering a meaningful monetary valuation, e.g. the preservation of a beautiful view, historic site or way of life.

Moreover, where money costs and benefits in an economy are distorted in various ways, a common approach is to value a project's elements according to their international or "border" prices, which is the value of a good if it were to enter international trade. Bridger and Winpenny (1987), pointed out that an exportable good would be measured f.o.b. (free on board, but would deduct domestic transport to the point of departure). An importable good would be measured c.i.f. (cost, insurance, freight, including domestic transport from the point of entry to the point of use).

Value estimates are combined with the physical data generated and total value flow tables developed. These tables indicate costs and benefits accrued over time. Appropriate adjustments are made for subsidies, taxes, loan payments and other strictly financial transactions.

The definition of the without-project situation is usually easy according to Zimbelman (1987), but maybe one of the trickiest part in the evaluation of projects. It is usually easier to forecast what will happen if a certain investment activity is carried out than what would if it is not. Again, a systematic approach is the most helpful hint. A project's investment costs are incurred in the first years of its life; its recurrent cost as well as its benefits show up later. In almost every project in the agricultural field, this leads to a cashflow with large negative entries in the first few years, which becomes progressively smaller and eventually positive, to then increase up to the project's "full development" year, when the flow of benefits attributable to the project reaches its peak. In most cases but not all, remains at that level for the rest of the projects life.

3.4 Decision Criteria for Determining Economic Feasibility, Project Scale and Ranking of Alternatives

Economic analysis can assist in several decisions within the planning process, including a determination of overall feasibility of each alternative, the scale to which each alternative should be developed, and the ranking of competing alternatives. Several methods of comparing benefits and costs can be used to determine economic feasibility of watershed management alternatives.

The fact that relative standing among alternatives can be affected by choice of ranking mechanism as well as by the merits of individual alternatives indicates the limitations of economic analysis for comparing dissimilar alternatives and emphasizes the need for caution (Eckstein, 1958).

Sassone and Schaffer (1978), concluded that since the utility of any quantity of any good is not the same when this quantity is available immediately or in a more or less remote future, a time decreasing weight must be applied to quantities obtained at different dates. The discount rate is the tool utilized to make them comparable. Two main groups of methods are utilized to perform the comparison. First, there are methods which rely on an externally determined rate of discount: cost-benefit ratio, net present worth and the like. And second, there are methods -- basically the internal rate of return - which compute the "intrinsic" rate of discount of a project's cash flow, i.e., the rate which equates over time the negative and the positive entries in the flow.

Two common discounted cash flow measures are the net present worth and the economic rate of return. The former indicates the difference between the present values of the total benefits and costs. The latter measure indicates the average return on project resources during the time they are committed to the project. "There is some argument concerning which measure is best under which circumstances. Each has its own use and both are recommended for calculation"

(Brooks, et al.,1982).

Net present value (NPV) or net present worth (NPW) is defined as the difference between the present values of project benefits and costs:

$$\mathbf{NPV} = \sum_{t=1}^{n} \frac{B^t - C^t}{(1+r)^t}$$

where:

b^t= benefits in year t

c^t= costs in period t

r = discount rate

n =discounting period

The decision rule for the NPV criterion is: accept the project with NPV greater than or equal to zero (0), and reject if otherwise.

One of the most commonly used measures of project worth in financial analysis is the financial internal rate of return (IRR). The IRR deals with the time streams of funds flowing to and from the project; specifically, the IRR is determined as the discount rate that equalizes the present value of the streams of financial costs and benefits over the life of the project.

$$\mathbf{IRR} = \sum_{t=1}^{n} \frac{B^t - C^t}{(1+k)^t} = 0$$

where:

t = benefit or cost in year t

k = discount rate for which the equation will be solved

t = time, Year 1 to n

n = discounting period

The IRR therefore uses the same basic information as is used in a net present value calculation. Although the discount rate is not prescribed but is determined as a result of the calculation, this does not do away with use of a prescribed discount rate to decide whether or not the project is attractive. The internal rate of return uses as the indication of merit the interest rate that must be applied in discounting to make the present worth of benefits equal the present worth of costs. The resulting rate can be compared to a target value to determine the desirability of the proposed investment. The annual rate of return on investment is defined as the ratio of annual net benefits to investments, expressed as a percentage. The inverse of this rate indicates the time necessary for the project to repay the investment and therefore can be used as an additional indication of project merit (ECAFE Secretariat, 1969; Riggs, 1982).

The measure represent the weighted average return over the life of the project to the resources engaged in the project. The decision rule for the internal rate of return is to accept a project with an IRR equal to or greater than the opportunity cost of capital.

3.5 Handling the Time Dimension

Application of benefit cost analysis to activities extending over a period of time involves several issues relating to the treatment of the time dimension in the analysis. One such issue is determination of the period of time during which benefits and costs will be considered. This period will be determined by the life of the project as determined by physical and economic conditions. Where long lived projects are involved, imposition of an upper limit on the period of analysis may be desirable due to the degree of uncertainty associated with benefits and costs occurring at distant future dates. If adopted, such limits should be applied consistently to all alternatives to maintain comparability.

Another general issue related to the time dimension is treatment of price changes occurring during the period of analysis. Since price changes will affect future cash flows involving benefit and cost payments, one approach is to estimate prices expected to exist at relevant future dates for use in calculations dependent on prices.

A third time related issue that arises during benefit cost analysis is the approach to be taken when summing benefits or costs that occur at different dates. Acceptance of the concept that value is time dependent means that a series of monetary values (e.g., a series of project benefits) expected to occur at different dates cannot be summed until converted to comparable terms at a common point in time, a conversion accomplished by standard discounting techniques. As a result of such considerations, economic analysis of public investments generally employs a discount rate greater than zero in recognition of the time preference concept (Samuelson, 1973).

3.6 Discount Rate

The choice of discount rate can have a significant effect on the apparent contribution of a given investment to economic growth. Benefits of watershed development projects tend to be affected more by discounting than are costs because of the greater concentration of costs near the beginning of many projects. Due to the tendency for later occurring benefits to undergo a greater reduction in value during discounting, an increase in discount rate is likely to reduce the present worth of benefits more than it reduces the present worth of costs.

Use of discounting in public investment decision processes involves special considerations. A major issue is choice of discount rate to reflect the appropriate time preference. In certain cases where money to be invested will be loaned from a financial firm or institution, use of the interest rate imposed by the lender has a certain appeal but may not be a true reflection of the appropriate time preference. Interest rates employed in private financial markets may be viewed as too high due to differences between the public and private sectors. Lower risk associated with public ventures and the existence of a longer time perspective in the public sector are often seen as reasons for adoption of a discount rate lower than private sector rates (Eckstein, 1958). Inclusion of an inflationary component in private sector interest rates is another potential reason for use of a lower discount rate.

Choice of discount rate therefore is an important policy decision. Due to the potential for the discount rate to affect the relative standing of alternatives, a central authority should specify the rate to be used in all economic analysis involving projects to be compared (Cox, 1987). Otherwise, differences in apparent economic worth among alternatives may be due to use of different discount rates rather than to differences inherent in the alternatives themselves.

However, before this can be done the appropriate time horizon and the proper discount rate to use in the economic analysis should be pre-determined. This is particularly important in watershed management decisions because of the inherent instability of hydrologic phenomena during a short time period (less than 20 years). In theory, an economic analysis should extend long enough to include all benefits and costs of a project. Dixon and Meister (1986) noted that two factors are important in selecting an appropriate time horizon for an investment project: (1) the expected useful life of the project in terms of yielding the outputs and associated economic benefits for which it was designed, and (2) the level of the discount rate use in the analysis of the project. Concerning the first factor, when beneficial project outputs become very small or cease altogether, the effective project life can be considered as terminated. As for the discount rate factor (which is selected exogenously), the higher the rate, the shorter the economic time horizon. The actual discount rate to be used in economic analysis will be country specific and will probably be established as a matter of government policy. The relevant discount rate for the government would be the social discount rate which is considered equal to the opportunity cost of capital. The opportunity cost of capital is normally prescribed by a central planning office. In the Philippines, that office is the National Economic and Development Authority. Important factors governing the choice of rate will be the opportunity cost of capital, donor or lending agency requirements, cost of money to the government, and government's current views of the private sector consumption-investment mix in relation to its concern for future generations.

Because of its political consequences, Page (1977), concluded that the government's rate of discount becomes a strategic number. Mishan (1972) and Enabor (1984) have likewise reported that the appropriate discount rate for the government is the social discount rate, equivalent to the rate government pays on its long term loans. In this context, Young (1992) showed that the social rate of discount to be used in evaluation of public investment projects should be at least as high as the marginal rate of time preference. If the social discount rate is adjusted for opportunity cost and risk, it may be substantially higher. Others however, have concluded that the use of a positive social discount rate discriminates against future generations and that investment decisions based on the NPV criterion will favour shorter term projects over longer-lived projects which generate the same undiscounted total benefits.

The true scarcity value of public investment fund is reflected by the opportunity cost of capital which is defined as the rate of return which funds would have earned in its best available alternative use. According to the Development Academy of the Philippines, studies of the World Bank indicate the opportunity cost of capital for developing countries, the Philippines included, to range from 10 to 12 percent.

Nevertheless,the use of a positive discount rate for achieving the efficiency goal cannot be faulted. To quote Sharefkin (1982), *"not wanting to discount is, in a sense like a government not wanting to have a fiscal policy - - - a logical impossibility"*.

Nadkarni, et. al., (1992), point out that the use of high discount rates is inappropriate in project analysis since these higher discount rates reflect both time preference and inflation. Helliwell (1975), also points out that high interest rate in project analysis can be very damaging to the interest of the environment. However, Dixon and Meister (1986), while recognizing the importance of the discount rate to be free from the effect of inflation, show that using zero or low discount rates is not the solution. Further, they point out that using low discount rates can lead to serious misallocation of resources in terms of achieving environmental objectives. According to them, the opportunity cost of capital, cost of borrowing money and the social rate of time preference are the criteria in selecting appropriate discount rate in economic analysis.

It is also important to note that all ex ante economic analysis of projects deal with the inflation issue by using real, constant dollar prices rather than current or nominal inflation-affected prices.

3.7 Sensitivity Analysis

Financial and economic project analysis can also be used to project what could happen to the earning potentials of a project under circumstances that are different from the "guesses" made about them during the planning stage. Sensitivity analysis is a straight-forward means of analysing the effects of risks and uncertainty in project analysis. It draws attention to the fact that projections are inevitably subject to a high degree of uncertainty. Uncertainty about various parameter values used in the analysis will exist. Uncertainty is an important problem when comparing benefits and costs because there is always some degree of error in the measurements. Guidelines recommend that studies include comparisons of the sensitivity of the results to uncertainty in the data and assumptions of future conditions. The objective is to help decision makers understand the effects of possible variation in conditions. Sensitivity studies vary the data and the assumptions as to economic, demographic, environmental, and other important conditions; and report the effects on benefits and costs. Typically, benefits and costs are calculated for high, low and medium levels of each important variable. This is an attempt to account for the variance or degree of error in the estimates of benefits and costs. Thus it is essential that the sensitivity of the chosen measures of project worth be tested in terms of alternative values for key parameters, e.g., the discount rate, benefit value estimates, cost assumptions and so forth.

Sensitivity analysis simply involves recalculations of project worth using other estimates of cost or return. The benefit cost analysis would be rerun for a range of prices and yields to determine the impact on the net present value. If the yield assumption is critical in determining whether the project is profitable, then additional information should be collected to reduce the uncertainty about the yield estimates. The new information would then be used to redo the benefit cost analysis.

The methodology described above will be applied to an integrated rehabilitation project in the Philippines. In the next chapter, the project area will be described, its salient topographic features, physiography, present land use, hydrology, human population and their forest activities and the potentials of the watershed area.

CHAPTER IV

THE CASE STUDY AREA: THE MAASIN CRITICAL WATERSHED

"...environmental degradation is so widespread in hillside areas because the social and economic factors associated with underdevelopment are there combined with a large resource subject to rapid deterioration under improper human use".

John De Boer, Sustainable Approaches to Hillside Agricultural Development,1989.

4.1 The Project Site and Background

The Western Visayas region is located in the central part of the Philippines. It is composed of one big island called Panay where the provinces of Antique, Aklan, Capiz and Iloilo are situated; a small island called Guimaras which is a sub-province of Iloilo; and the western half of Negros island, Negros Occidental (NEDA, 1985),(as shown in Figure 3).

Western Visayas has two distinct climatic seasons (PAGASA, 1989), dry from November to April and rainy from May to October. Aklan, Capiz and northeastern Iloilo, though do have enough rain all throughout the year.

Figure 3. Regional Map of Western Visayas

Western Visayas has a total land area of 2,022,100 hectares representing 6.74 percent of the national territory. Sixty-nine (69) percent of the land is classified alienable and disposable and only 26 percent is classified timberland (LMB, 1990).

Looking into the land cover situation of the region, the Forest Management Bureau (1990), reported that only 6.97 percent or 140,100 hectares show a forest cover. Of this area, only 41,000 hectares are considered closed canopy forest, or areas covered by more than 50 percent mature trees.

These statistics show the serious condition of the environment in the region. Agricultural activities have intruded into the forest land although an estimated 300,000 hectares are considered currently idle and can be put into productive agricultural use. Of the five provinces, Antique has the greatest amount of forest cover and Iloilo has the least, having only two percent cover.

The province of Iloilo, (Figure 4), the biggest in land area and population on Panay island, occupies the southern and northeastern portion of the island. It is bounded by Capiz on the north, the Visayas Sea on the east, the Panay Gulf and Iloilo Strait on the south and southeast, and Antique in the west. The records of the Provincial Planning Office (1991), shows that Iloilo has an area of 532,297 hectares with a population of 1,726,595. Iloilo City, capital of Iloilo province is the regional centre of Western Visayas.

Figure 4. Map of the Province of Iloilo

The project area is located in Maasin, a municipality in the western part of the province of Iloilo. It has an area of 6,150 hectares, equivalent to 30.32 percent of the total land area of the municipality. Fourteen (14) villages are found around it (KSP, 1991).

The watershed is situated at a geographical coordinate of 10 degrees 55' to 10 degrees 56' longitude and 122 degrees 26' to 122 degrees 27' latitude. To the northeast, it is bounded by the Municipality of Janiuay, on its southeast by Maasin, on its southwest by Alimodian, and on its northwest, by the province of Antique (Figure 5).

4.1.1 Irrigation, Domestic, Commercial and Industrial Water Demand

The ability of the National Irrigation Administration (NIA) to supply water to its irrigable areas depends on the volume of water coming from the Tigum River which is the catchment of the watershed run-off. Of the total Tigum River streamflow going to irrigable areas, it is estimated that 30 percent of its water originates from the Maasin watershed. The NIA harnesses the Maasin watershed as the source of water to irrigate a portion of its Tigum Irrigation Project which covers some areas in the Municipalities of Santa Barbara, Pavia, Leganes and a portion of Jaro in Iloilo City. At present, the irrigation system can only fully irrigate the total irrigable area of 2,280 hectares during the rainy season. During the second cropping season, only 1,000 hectares can be irrigated and no water is available during the third cropping season.

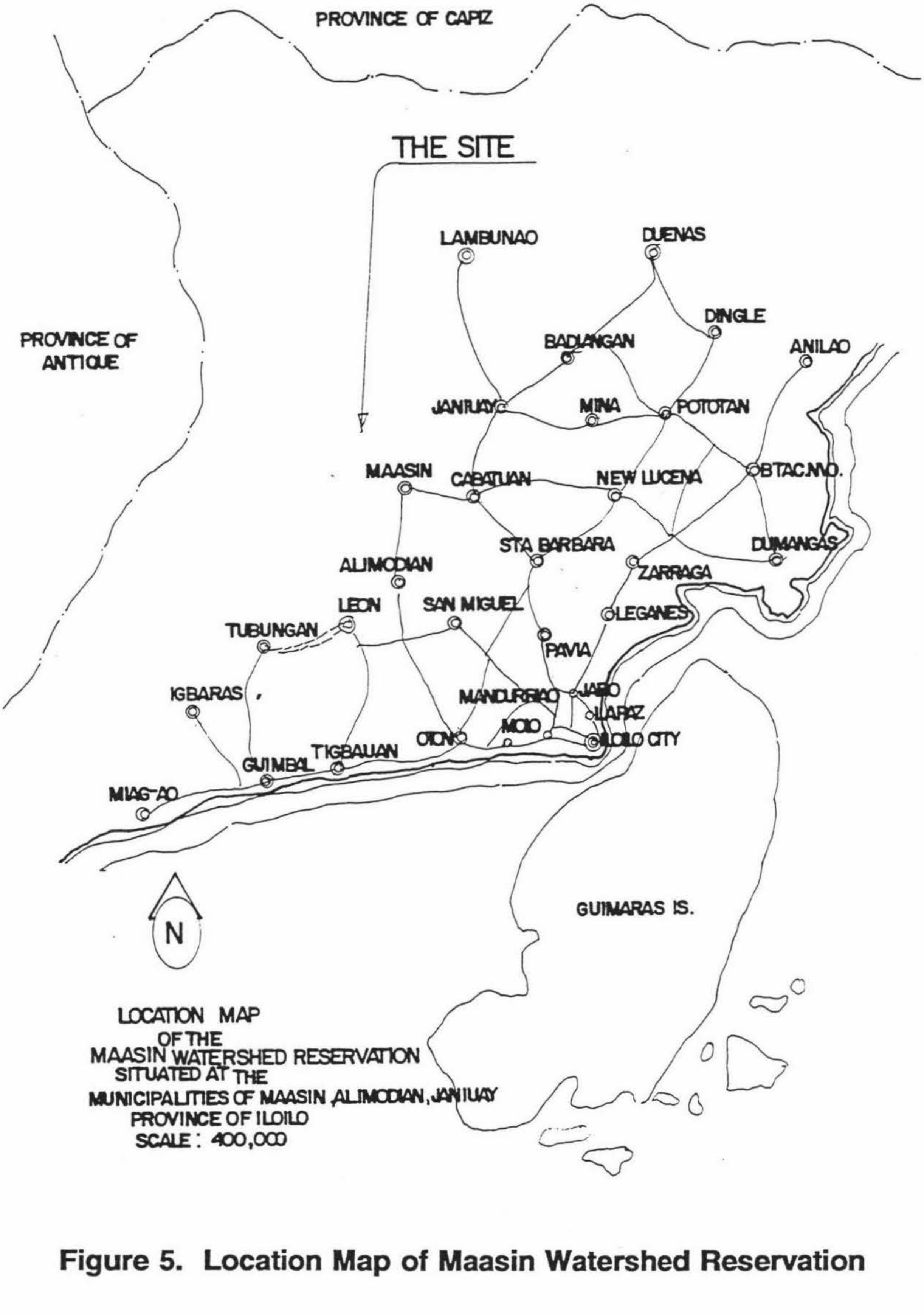

Figure 5. Location Map of Maasin Watershed Reservation

The insufficient supply of water for irrigation caused low agricultural productivity which could lead to the conversion of agricultural land to commercial and residential areas. The only way for NIA to expand its irrigation service is to increase its capacity to provide irrigation water for three cropping periods.

The source of potable water supplied by Metro Iloilo Water District (MIWD) to its consumers is also the Tigum River. At present, the total volume of water supplied by MIWD has a total of 6,876,600 cu.m. per year. In spite of this, all clients of MIWD do not have the luxury of being continuously supplied by water for the whole 24 hours due to the limited volume of water that the facilities of MIWD can supply. Table 1 shows the actual population served by MIWD.

4.1.2 Topography

Drainage area. The watershed embraces an area of 6,150 hectares of which 5,228 hectares are mountainous watershed; 870 hectares are flat to moderately rolling agricultural lands; and 52 hectares are waterways and stream beds.

Density and order of stream network. The project area has a stream network density of 10.70 meters per hectare. Its stream network is comprised of two rivers - the Tigum River as the main channel and the Inaman River as a tributary river - with a considerable number of tributary creeks (Figure 6).

The drainage density indicates that the watershed is well drained, hence, the potential discharge regimen from the watershed should exhibit a moderate maximum peak, increased minimum and prolonged discharge. On the other hand the high density of stream network reflects the poor topographic, lithological, pedological and vegetational controls of the watershed.

Watershed and channel length. With a regular sinuosity, the main channel is 13.380 kilometres long from its uppermost tip to the dam site. This reflects the length of the watershed. Qualitatively, the shape of the watershed is oblong.

Watershed channel relief or slope. The slope of the watershed ranges from 0 to over 50 percent, with a mean slope of 30 percent. For the purpose of land use suitability determination, slope composition is qualitatively and quantitatively expressed as flat to rolling, (0-8%), slightly rolling to moderately rolling (9-18%), rolling to steep (19-30%), steep to very steep (31-50%), and very steep to precipitous (over 50%). The hectareage and percentage of the various slope categories is shown in Table 2.

The slope ranges of the Inaman River ranges from 5.0 to 8.82 percent, and the upper Tigum River varies from 7.0 to 9.15 percent, and the lower Tigum River ranges from 1.0 to 2.28 percent. These indicate a uniformity in relief of the sub-watersheds. But they all have high relief so that the stream velocity is great and that the soil erosion is expected to be higher especially since man's activities are uncontrolled in the area. On the other hand, the slope of the lower Tigum River, from its confluence with Inaman River is low at only one (1%) percent. This

Table 1

POPULATION SERVED BY MIWD (1990).

AREA	Actual Population Served	Existing Population	Percent
1. Iloilo City	201,157	309,505	64.99
2. Pavia	14,955	23,814	62.80
3. Sta. Barbara	11,610	37,730	30.77
4. Cabatuan	10,989	40,892	26.87
5. Maasin	5,134	29,062	17.67
TOTAL	232,856	441,003	52.80

Source: NATIONAL CENSUS AND STATISTICS OFFICE and METRO ILOILO WATER DISTRICT, 1990

Table 2

WATERSHED SLOPE CATEGORY

Slope Category	Area (Has.)	Percentage
0- 8	307	4.99
9-18	615	10.00
19-30	3,070	49.92
31-50	1,230	20.00
50	928	15.09
TOTAL	6,150	100.00

Source: LANDS MANAGEMENT BUREAU, 1990.

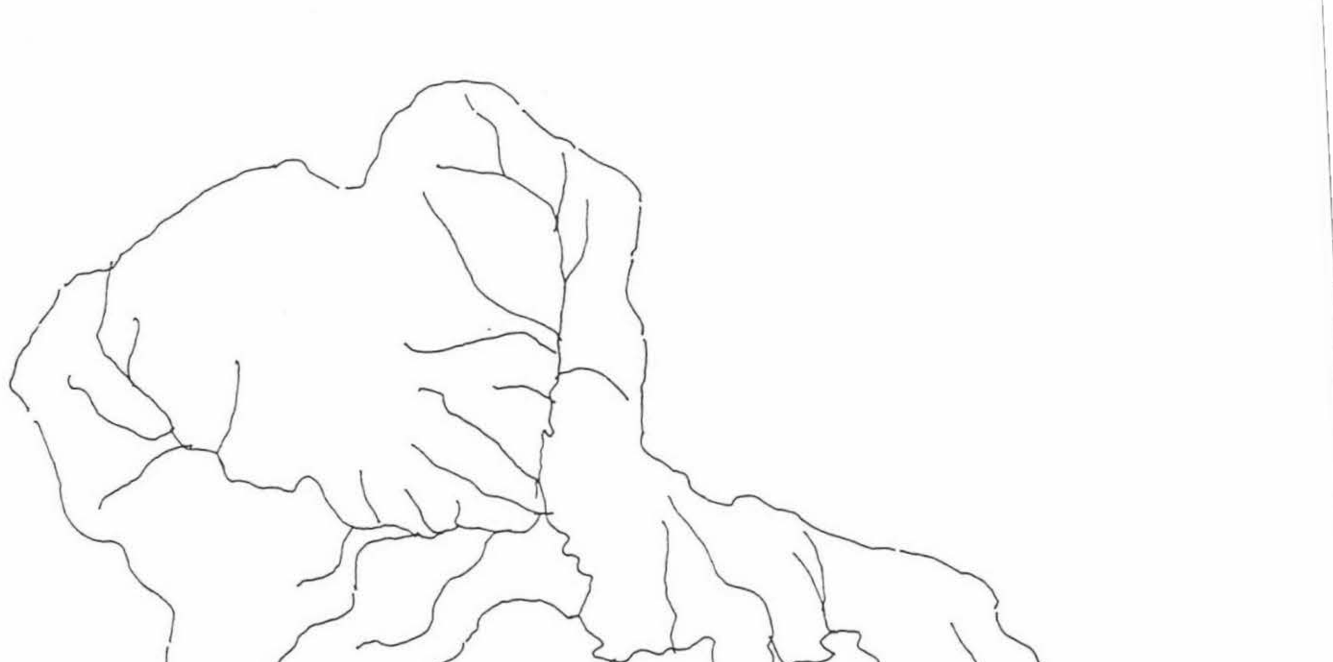

Figure 6. STREAM NETWORK ORDER AND PATTERN OF THE MAASIN WATERSHED

reflects a short time of hydrograph rise, a short time lag and a high peak discharge rate of the main channel in the time of peak flows at the upper tributary streams.

Bedload. The bedload of stream beds is made up of stones, gravel, small boulders, silt and clay. The transverse profile of stream beds is irregular due to the presence of small boulders and drops on the riverbeds particularly in the upper streams.

Channel reach deposition. The main channel is meandering, characterized by the presence of a good number of small eroding concave and convex banks with sand and silt deposits. The deepest point and the greatest width of the reach occur on the convex bank downstream of the point of greatest curvature. Sudden changes of slope which encourage deposition and periodic high discharge lead to the formation of alluvial deposits at the lower reach of the main channel.

Vegetation. The existing vegetation of the watershed was assessed using the available maps from the Department of Environment and Natural Resources (Table 3). The old growth forest comprise of dipterocarps such as white laua-an (*Pentacme contorta*) and bagtican (*Parashorea plicata*) mixed with midmountain miscellaneous species. Medium in density, stocking averages around 60 cubic meters per hectare of trees, 20 centimetres and over in diameter at breast height. This forest is found on mountain tops, ridges, steep slopes and gullies at the upper portion of the watershed usually at elevations 900 to 1500 meters above sea level.

The brushland is usually composed of batches of bamboo stands mixed with few trees found on ridges, hillsides and gullies at the lower portion of the watershed. Stands of bamboo usually average 200 clumps per hectare with an average number of six matured culms per clump. Out of the 23 percent (1,414 hectares) mapped out brushland, around 3 percent (185 hectares) are young forest plantation.

Table 3

MAJOR VEGETATIVE TYPES

Cover Type	Area (Has.)	Percentage
Old growth forest	492	8
Brushland/bamboo stand	1,414	23
Grassland/openland	2,460	40
Cultivated land	1,784	29
TOTAL	6,150	100

Source: COMMUNITY ENVIRONMENT AND NATURAL RESOURCES OFFICE, 1991.

Grassland is the dominant vegetation at the lower and middle portions of the watershed. The vegetation is mostly cogon (*Cylindrica imperata*) and themeda (*Themeda triandra*) where traditional grazing is practised. It has an estimated carrying capacity of 5 heads per hectare.

Out of the 1,784 hectares of cultivated lands, around 308 hectares are terraced agricultural lands, some irrigated, and the rest are comprised of patches of traditional kaingin cultivation which are scattered all over the watershed especially from the upper mid-portion (elevation 900 meters) down to the lower portion.

4.1.3 Physiography

Land elevation in the watershed ranges from 100 meters to 1500 meters above sea level (Table 4). Slope of ridges are generally facing east, northeast and southeast as most tributaries flow towards the east. This indicates that the watershed has full and complete exposure to the morning and mid-afternoon sunlight which ensures maximum photosynthetic activity for plant growth and development. On the other hand, this type of exposure reflects maximum evapotranspiration and evaporation activities on plants and bodies of water respectively.

4.1.4 Wildlife and Fisheries

Indigenous birds are found in the watershed, which cannot be found in the lowlands. These include the "baragbak", "tagwatihot", "ol-ol", "iyak" and others.

Fish and other aquatic resources are found in streams which are periodically caught by the uplanders for food.

Table 4

LAND ELEVATION IN THE WATERSHED

Stratum	Elevation (m)	Area (Has.)	Percentage
I	100 - 200	920	14.96
II	201 - 400	2,460	40.00
III	401 - 600	1,220	19.84
IV	601 - 800	550	8.94
V	801 - 1000	359	5.84
VI	above 1000	541	10.42
TOTAL		6,150	100.00

Source: LANDS MANAGEMENT BUREAU, 1991.

4.1.5 Recreational Potentials

Peaks and ridges, gorges, rock formations and streams are potential areas for recreational activities such as mountain climbing, camping, tramping, picnicking, swimming and sightseeing.

4.1.6 Present Land Use

Present land use in the watershed, as indicated by present vegetation and land development activities, includes protection forest (8%), brushland/bamboo stands(23%), grazing (40%), and agricultural (terraced, 5%; kaingin farms, 24%). The existing land use pattern found in the watershed is shown in Table 5. Patches of cultivation are quite extensive in the area and are potential causes of severe siltation of streams in the watershed. The occupation of the land by upland dwellers in the watershed is illegal as they have not been considered yet for inclusion in the Integrated Social Forestry program (ISF) of the DENR. However, it is possible to encompass them under the ISF program through proper coordination of the DENR and MIWD.

As to land suitability, the lower portion is suited for agricultural activity. Agroforestry may be implemented in slopes and hills adjacent to areas with 0 to 18 percent slope. The higher portion of the watershed is suited for timber and

Table 5

EXISTING LAND USE PATTERN FOUND INSIDE THE WATERSHED

Land Use Pattern	Area (Has.)	Description/Status
1. Agricultural	870	Slope from 0-18 percent. At present, 50 percent of this area is under cultivation.
2. Agroforestry	3,070	Slope from 19-30 percent. Mostly grassland and brushland.
3. Forest cover		Slope of 31 percent and over.
	492	Existing forest cover. Old growth forest, in very steep slope.
	1,666	Generally unproductive open grassland/brushland and hill tops.
4. Waterways	52	Areas occupied by creeks and the Inaman and Tigum Rivers
TOTAL	**6,150**	

Source: COMMUNITY ENVIRONMENT AND NATURAL RESOURCES OFFICE, 1991.

other forest resource production. The highest portion should be reserved for protection forest, for water, wildlife and other amenity production.

4.1.7 Climate

The watershed falls under climatic Type II of the Philippines climatic classification. It has no distinct dry season with a very pronounced maximum rainfall from June to November (PAGASA, 1990). Rainfall data during the period is shown in Table 6.

Rainfall. Evaluation of the five-year rainfall data in the watershed by PAGASA (1990) disclosed a mean average monthly rainfall of 190.8 millimetres.

Air temperature. Temperature reached a monthly average of 28 degrees centigrade. The temperature ranges from 26.9 degrees centigrade in January to 29.81 degrees centigrade in May (Table 7). Variation in temperature is narrow and it is conducive to the growing of tropical crops.

Relative Humidity, Wind Direction and Evaporation. Relative humidity in Iloilo registered a yearly average of 79.1 percent. Monthly average relative humidity during a five-year period varies from 72.0 percent in March and April and 83.4 percent in August or a range of 11.2 percent (Table 8).

The average monthly evaporation varies from 26.6 mm. in January and 29.3 mm in April or a range of 2.7 mm (Table 9).

Table 6

AVERAGE MONTHLY RAINFALL (mm.)
(1986 TO 1990)

MONTH	YEAR 1986	1987	1988	1989	1990	AVE. (mm)
January	40.2	30.1	13.7	94.1	94.1	54.4
February	15.3	12.0	13.3	33.0	0.6	14.8
March	51.5	1.0	13.1	58.8	8.0	26.5
April	49.2	5.7	85.2	68.7	9.1	43.6
May	70.4	41.9	197.6	253.5	262.1	165.1
June	254.2	162.4	483.0	323.5	602.1	365.1
July	300.8	452.7	323.5	308.5	326.6	342.4
August	892.4	224.5	264.9	672.7	466.1	504.1
September	257.5	517.0	272.7	160.0	182.0	277.8
October	182.4	152.0	561.6	138.2	124.6	231.8
November	248.9	212.3	312.7	37.4	319.5	276.2
December	97.4	21.8	39.4	8.8	22.7	38.0
TOTAL	2460.2	1833.4	2580.7	2157.2	2417.6	11449.1
AVERAGE	205.0	152.4	215.1	179.0	201.5	190.8

Source: PAGASA, 1990.

Table 7

AVERAGE MONTHLY TEMPERATURE (DEGREES CENTIGRADE) (1986-1990)

MONTH	Average Temperature YEAR					
	1986	**1987**	**1988**	**1989**	**1990**	**Ave.**
January	26.4	26.4	27.9	26.9	26.9	26.9
February	27.1	26.6	28.0	26.5	28.4	27.3
March	27.8	28.6	29.1	27.3	28.9	28.0
April	29.1	30.4	29.8	28.9	30.7	29.8
May	29.4	31.1	29.9	28.7	30.0	29.8
June	28.5	29.7	27.8	27.7	28.7	28.5
July	27.9	28.1	27.8	27.7	28.1	28.3
August	28.0	28.5	28.3	27.1	28.4	28.0
September	28.2	28.1	27.9	28.0	28.4	28.1
October	28.2	28.8	27.2	29.5	28.2	28.2
November	28.2	28.1	27.3	27.9	27.7	27.8
December	27.0	27.7	25.9	27.0	26.5	27.0
TOTAL	335.8	342.1	336.9	332.9	341.0	1689.1
MEAN	28.0	28.5	28.1	27.7	28.5	28.2

Source: PAGASA, 1991

Table 8

AVERAGE MONTHLY RELATIVE HUMIDITY (%)

MONTH	YEAR 1986	1987	1988	1989	1990	AVE.
January	79.7	77.0	79.0	84.0	84.0	80.7
February	71.7	77.0	79.0	84.0	71.0	76.7
March	73.0	69.0	66.0	83.0	69.0	72.0
April	72.9	66.0	75.0	79.0	67.0	72.0
May	74.0	67.0	77.0	83.0	73.0	74.8
June	78.0	75.0	85.0	87.0	80.1	81.0
July	80.8	81.0	86.0	86.0	82.0	83.2
August	82.0	80.0	84.0	89.0	82.0	83.4
September	80.0	82.0	87.0	85.0	81.0	83.0
October	80.0	79.0	88.0	82.0	80.0	81.8
November	80.0	82.0	86.0	80.0	81.0	81.8
December	77.0	81.0	85.0	78.0	78.0	79.8
TOTAL	929.1	915.0	976.0	1000.0	928.1	4748.2
MEAN	77.4	76.2	81.3	83.3	77.3	79.1

Source: PAGASA, 1990.

Table 9

AVERAGE MONTHLY EVAPORATION (mm.)
1980-1985

MONTH	Average Evaporation (mm.)
January	26.6
February	28.2
March	28.9
April	29.3
May	29.2
June	28.4
July	28.1
August	28.0
September	27.9
October	28.1
November	28.6
December	27.1
TOTAL	338.5
MEAN	28.2

Source: PAGASA, 1991.

The wind in general is northeasterly from November to May and southwesterly from June to October.

4.1.8 Hydrology

Ground water storage. A major portion of the watershed is classified as difficult in terms of groundwater characteristics. The average static water level is 5.34 meters below ground surface. On the other hand, the average well depth has been calculated to be around 3.54 meters. At the upper side of the watershed, a small portion has been found to be shallow well areas. In addition, 10 creeks have been found to have dried up and are in critical condition. Most of the upper streams are being tapped for irrigation through manmade diversion canals for rice and corn cultivations.

Precipitation inputs. The total annual rainfall inputs for the last five years (1985 to 1990), range from 1833.4 mm. to 2580.7 mm. with a variability of 32.6 percent. Similarly, the average monthly precipitation in the watershed fluctuates from 14.8 mm. in February to 504.1 mm. in August with a seasonal variability of 489.3 mm.

Water yield. Water yield in the watershed is limited from December to April and excessive from June to November. Seasonal and yearly variations also occur. Although data are not complete, streamflow of the watershed from 1986 to 1989 is shown in Table 10. The data give a very wide variation in the streamflow, i.e., 0.2117 cu.m./sec. in March 1989 and 18.7387 cu.m./sec. in December 1988.

Table 10

Average Daily Stream Flow (cu.m./sec) of Tigum River

Month	YEAR			
	1986	1987	1988	1989
January	1.6407	2.5748	-	-
February	-	5.2439	0.3348	-
March	-	0.8135	2.9410	0.2117
April	-	0.3276	1.9846	1.9098
May	-	0.2212	-	2.2681
June	5.4360	0.8535	-	-
July	5.5369	2.4609	-	-
August	13.3831	5.0866	-	-
September	1.0212	4.3021	4.3021	16.1116
October	4.5640	15.0668	13.8345	-
November	0.0001	0.9192	-	-
December	0.9526	3.1948	18.7387	-

Source: Metro Iloilo Water District (MIWD), 1990.

Soil erosion and sedimentation. Field evaluation indicates that active gullies and unstable passageways contribute significantly to stream sedimentation. Sediment deposition coming from the whole grassland area of the watershed is estimated to be about 50 to 80 tons per hectare of soil erosion (KSP, 1991). It is prominent along the river banks which contribute to the sedimentation of streams. Besides, on-going cultivation activities are adding to the siltation of the rivers. Gully formation and sheet erosions are beginning to be felt especially along denuded river banks and exposed grasslands.

Water quality. Much pollution is caused by the people's careless use of the soil in the watershed. Through their failure to control erosion, the soil has become a major pollutant of the streams. Debris derived from the soil has contributed to the deterioration of the watershed. Sediment that goes with the water clog pipelines, fills up sedimentation tanks and even goes with the faucet to the end users.

Excessive application of fertilisers in paddy fields tends to increase the amount of plant nutrients carried by the water. Water draining from arable lands usually contain more nitrate than that from grassland or forest irrespective of whether nitrogen fertilizer has been applied. The condition in the watershed with regards to water quality is not alarming. Water colour, dissolved oxygen, biochemical oxygen demand and totally dissolved solids are still within the standards. According to MIWD, on the whole, the water is still safe for drinking.

4.1.9 The Rock Type

Based on the Land Management Unit Map prepared by the Bureau of Soils and Water Management, the watershed may be classified into five broad rock types, such as: (1) broad alluvial plain on the lowest portion or gully bottom; (2) shales, low relief hills on the lower middle portion; (3) high basaltic hills on the upper middle portion; (4) complex volcanic mountains on mountain tops; and (5) hugh shales/sandstones on the northeastern divide.

The geologic characteristics of the watershed originated from the volcanic rocks of andesitic/basaltic composition at the mountain tops and upper slopes and of volcanic conglomerates of tuffaceous matrix at the lower slopes. During weathering, the rocks are subjected to mechanical processes which result to the formation of alluvial deposits.

4.1.10 The Soil Type

The watershed is generally composed of clay loam as per report of the Bureau of Soils (1990), of the Department of Agriculture, covering more than 95 percent of the watershed, starting from elevation of 200 meters upward. The soil is very light to dark brown, friable to granular with columnar to prismatic structure which crumbles easily. When dry, the loose surface soil is powdery but becomes sticky when wet. However, it dries up easily. The depth ranges from 25 to 59 centimetres. while concretions and gravel are present in the subsoil. When erosion reaches the layer, the process is greatly accelerated until a conspicuous gulley is formed. The substratum, down to a considerable depth, is brown to chocolate brown clay loam.

A small portion in low-lying areas in the middle section of the watershed, is classified under the sandy clay loam type. The surface soil of this type is light brown to brown, loose and slightly friable and has a depth that ranges from 20 to 25 centimetres.

At the flat to gently rolling portion of the watershed within elevation of 100 to 200 meters, the soil is generally silt loam , dark brown with depths ranging from 50 to 66 centimetres. This portion is generally described as the alluvial plain of the watershed.

Results of the chemical analysis of soil disclosed that the mountainous portion of the watershed is suitable for forest crop production. The organic matter content on mountain tops ranges from 1.5 to 2.0 percent; on middle portion, ranges from 0.5 to 2.0 percent; and at the lower elevation, varies from 1.0 to 2.0 percent.

Similarly, the soil in the entire mountainous portion is generally slightly acidic (pH 5.9) to slightly alkaline (pH 7.5). Whereas, at the lower elevation (alluvial plain), the soil is generally slightly acidic (pH 6.3) to neutral (pH 7.0).

On the other hand, soil nutrient content in the entire mountainous area is generally low to high; nitrogen (N) 0.03 to 0.10 percent; phosphorus (P) 23.0 to 49.0 parts per million (ppm); and potassium (K) 1348 to 1600 ppm.

Infiltration rates vary from 0.25 to 1.5 centimetres per hour (cm./hr.) in clay loam; from 0.77 to 4.5 cm./hr. in silt clay.

4.2 Socio-economic Description

The Maasin watershed is surrounded by 14 barangays, 8 in Maasin, 5 in Alimodian, and 1 in Janiuay. The presence of these villages makes the watershed very accessible and vulnerable to human incursions. A road along the watershed ridge connects the Maasin barangays.

4.2.1 Household and Population

A population of 9,071 in the 14 barangays around the watershed was reported by the National Census and Statistics Office (NCSO) 1990, with households numbering 1,492 (Table 11). The data registered a decrease in population of barangay residents in the watershed area. Some groups opted to settle in the lowlands permanently due to the almost exhausted vegetative cover of the watershed.

4.2.2 Watershed Related Activities

Of the 278 heads of household, KSP (1991), reported that a great majority are transient tillers (83.1%), 9 percent are transient labourers and 5.8 percent are stayers. A few household heads expressed they are claimants (1.8%) of the land they till and are transient resource gatherers (0.4%).

Table 11
Households and Populations
Maasin Watershed Reservation

Municipality/Barangay	No. of Household		No. of Person	
	1980	1990	1980	1990
Alimodian				
Bagsakan	46	44	286	270
Bugang	104	123	655	837
Dao	35	62	274	445
Punong	19	24	135	117
Umingan	61	75	429	567
Sub-total	265	328	1779	2236
Maasin				
Trangka	190	113	872	699
Bolo	108	143	730	859
Dagami	257	232	1461	1387
Daja	131	169	850	1015
Nagba	159	182	1013	1137
Punong	64	37	398	200
Santa Rita	45	48	239	306
Abay	63	75	359	390
Sub-total	1017	999	5922	5993
Janiuay				
Canauilian	151	165	750	842
Total	1433	1492	8451	9071

Source: National Census and Statistics Office, Census on Population and Housing, May 1990.

4.2.3 Water System

Only Barangay Bugang from the municipality of Alimodian and Daja in Maasin has a piped-in water system. However, due to poor water delivery, many households have relied on manual water pumps for their domestic use. Residents in the rest of the barangays have to fetch water from far-away places to their homes for their needs.

4.2.4 Property Control

In the 14 barangays surrounding the watershed, only few households have private lands. A great majority depend on the watershed area for their economic activities, especially farming which involves cultivating of the land. The high percentage of households farming within the watershed area can be attributed to the settler's perception of having "the right to use the land" and a "free-for-all opportunity". The size of farmholdings ranges from 0.25 hectare to 8 hectares, averaging 1.63 hectares per household. A great majority (77.2%) occupy farms with sizes ranging from 1 to 2 hectares; 14% from 2.1 to 5 hectares and 13.3 percent below 1 hectare. Four households or 1.44% cultivate farms ranging from 6 to 8 hectares.

Apart from the farms tilled within the watershed, more than one-third (34.9%) of the household head occupants have other farms maintained outside the watershed reservation. These farms are not far from the reservation and mostly are in the peripheral boundaries. On the average, each household has 1.2 hectares of farm maintained outside the watershed area.

4.3 Farming Practices and Characteristics

The study of the watershed area looked into the appropriate scheme to reforest the denuded portion of the watershed. It identified and proposed a social development program mechanism to ensure sustainability of expected gains particularly for the 30 percent bottom poor who are dependent for their livelihood and survival on the resources of the watershed. Details of the agricultural economy in the project area were as follows:

4.3.1 Family Income

KSP (1991), reported that income of family labour comes from on-farm, off-farm and non-farm production. Evidently, on-farm income shows a low range of P1,500.00 to P15,000.00 a year. Income from bamboo production is P900.00 to P2,500.00 represented on farm by sales of bamboo poles and culms. Bamboo processing gives an income between P2,080.00 to P23,000.00 and is regarded as the most dependable source of family income during the lean months of April to August.

Most field labour is done by individual household members. Labour beyond the household level includes exchange labour which usually includes free noon meal for the workers.

4.3.2 Crop Production and Disposal

Crop yield on a per hectare basis is very low. According to the Department of Agriculture (1991), many farmers claimed that it no longer pays to grow rice or corn without fertilizer. Furthermore, corn planted for the second cropping failed to bear kernels due to lack of water.

The need for food, despite the poor yield of rice and corn still drew most of the watershed occupants to grow the said crops. Those having marketed rice or corn claimed that they did so because of surplus of what the family could consume for one cropping season. Others claimed they marketed their produce because of immediate need for cash.

Due to high market potential of bamboos, it is not surprising that bamboo has become the major crop in all barangays.

4.3.3 Cropping Systems

Monocropping and double cropping are the outstanding cropping systems on many farms. Third cropping is practised only in few lowland rice farms which have access to irrigation water.

Rice-rice is a common practice in the lowland farms. Either rice or corn alone fits most of the upland farms. In some cropping seasons, warranted by favourable weather conditions, rice-corn or corn-corn are used in the uplands. Few farmers grow stands of tomato, peanut and tobacco. For almost all crops, the first heavy rains signal the onset of the planting season (April to May).

In general, farmers use traditional practices in maintaining their crops. This is evidenced by their minimal use of fertilizer. According to the Bureau of Soils of the Department of Agriculture, not one farmer has had his soil analyzed, neither do they have access to information regarding soil liming and the profitability of organic farming. Farm manure from pig, carabao and cow is abundant in their backyards but is not being utilised. Only a few farmers use farm chemicals to control insect pests in corn. While terraced-like farms dominate the hilly areas, they are not structured terraces but simply made to facilitate cultivation, not to primarily conserve soil or water. Farm terracing is also common in irrigated farms along the creeks and rivers.

4.3.4 Vegetable Production and Marketing

Rainfall distribution dictates the availability and abundance of vegetables during the rainy season and none during the dry season. Except in Barangay Daja and Barangay Bugang, where vegetables are grown during summer, residents of the other barangay find it impractical to raise vegetables during the dry months since residents have to get water from far-flung places. Large quantities of farm products are purchased directly by traders. Smaller quantities of production however, are sold directly to end users at the market place or at the neighbourhood.

CHAPTER V

THE INTEGRATED REHABILITATION AND MANAGEMENT OF MAASIN CRITICAL WATERSHED

"We have not inherited the earth from our fathers, we are borrowing it from our children".

L.R. Brown, Building a Sustainable Society, 1981.

The critical problems of the watershed revolve around people. Their intended or inadvertent destructive activities affect vegetative cover and bring about the need for immediate intervention to restore and replenish the soil cover to enable the watershed to function effectively. There are ways by which people within the watershed can be relocated without use of undue force and intimidation, and with a lesser capital outlay involved.

Forest occupancy inside the Maasin watershed has existed already for several years. Social, economic and environmental problems, resulting from weak local community structures and institutions, lack of sustainable economic opportunities, lack of adequate support services from the government and inappropriate upland farming systems have all led to unabated watershed deterioration. Any plan to rehabilitate the watershed should concentrate on both restoration and development to ensure a high degree of project success. A social and economic development alternative would not only lessen the pressure exerted by the occupants on the watershed resources but would also enable them to participate in the undertaking where they themselves are part of the whole development effort.

5.1 Agroforestry with Social Development Component

The agroforestry proposal with a social development dimension, which is recommended as the most viable scheme for the rehabilitation and development of the Maasin watershed, has three major components, namely: (1) Social Development; (2) Forestation through agroforestry, reforestation and natural regeneration; and (3) Project Management. Project implementations is expected to take a maximum period of seven years. Reforestation for selected permanent cover is expected to be accomplished within the first three years. Agroforestry development will be concentrated in the first three years, tapering off to maintenance operations over the next four years.

The production of agricultural crops will be a continuous activity for the thirty year project time frame because this is being undertaken by the occupant-participants of the program. Assistance to the agricultural crop production component is expected to begin in the second year after the process to legitimise, settle and mobilise the watershed occupants has been completed. Assisted natural regeneration will be undertaken also within a three year period.

The integrated rehabilitation and management of Maasin critical watershed recommends agroforestry as a viable approach for soil conservation and to improve the water retention capacity of the area and help alleviate poverty among the settlers of the watershed. The challenge is to produce more food without sacrificing too much soil and environmental stability.

Agroforestry is projected in the feasibility study as a means of: (i) creating employment opportunities for rural farm labour; (ii) producing raw materials for cottage industries; (iii) providing food and other products for home consumption; and (iv) protecting and improving the production potential of Maasin watershed area through a continuous supply of water, thereby increasing the human ecological carrying capacity (DENR, 1992).

On the whole, agroforestry used as a strategy to integrate the community with the concern of rehabilitating the Maasin watershed, aims to achieve the following: (1) to attain a certain degree of conservation of soil and water resources; (2) to alleviate the problem of food shortage of poverty groups in the watershed by making available for production of food and livelihood activities specified areas in the watershed; and (3) to undertake a continuing program through a community organization and development strategy in order to effect and sustain changes in attitude and behaviour particularly toward valuing the watersheds. The three objectives are not hierarchal in nature but are integrated and unified.

This rehabilitation approach will address not only the physical degradation of the watershed, but more importantly, the socio-economic problems of the community living within. The selected components are elements of successful experiences in Philippine watershed management.

It is envisioned that the social development component of the project will motivate occupants into providing the needed manpower to undertake massive reforestation and intensive protection work and also provide them with knowledge and skills to practice beneficial agroforestry techniques, increasing their productivity and income without exerting pressure on watershed resources. Their manpower potential will be harnessed for on-site and off-site developmental projects. Most important is the occupants' continuing assistance in guarding against destruction and encroachment. Policing functions in the entire watershed will be a shared responsibility of government personnel assigned to the management group and of the occupants.

For this to be successful, community organisation will be used to create the conditions for development through participation. It will be used as a strategy for mobilizing the thirty percent bottom poor among watershed occupants to become fully involved in the activities that aim to improve their lives. It aims to present opportunities for socio-economic growth through the utilisation of human resources through time. Option for land tenure shall be discussed with the group and the community-managed project shall be encouraged. A possible tenure of 25 years that is renewable may be opted for by the beneficiaries.

The social development component will, during the first three years, have nine workers. One supervisor. a communication specialist, a process documentor and seven community organisers.The numbers will be trimmed down during the fourth and fifth year and phase out will start at the sixth year.

The watershed model selected for the reforestation component is termed by the DAP-DENR (1984), the Zoning Farms and Forests Model. A zoned forest and farm configuration is the result when migrant farmers farm the most accessible areas (usually riverbanks and along roads with flat terrain) while the most steep and inaccessible areas are still protected. This is true in the Maasin watershed where 50 percent of the flat land (land with a slope of up to 18 percent) is already tilled and the forest cover is only found on the very steep slopes. The summary of present and future cropping pattern and production of the area is shown in Table 12.

5.2 Project Sustainability

The various project components in this recommended strategy of agroforestry for the rehabilitation of the Maasin watershed are designed to sustain the planned gains of the project. One of the purposes of this project is that the organisations formed will continue to run the project so that it becomes a case of self-governance. Sources of funds will come from the income of the forest. Agencies installing facilities to tap or use the resources of the watershed have to pay for the continuous protection of the forest. People using the forest as a park or tourist spot will pay fees. Eventually, trees will take the place of agricultural activities, but as long as pieces of land are used for agroforestry, fees, rental or some form of taxation will be elicited from those who benefit from the resources. This, all adds up to the income of the management protecting the watershed. These income generation sources were not included in the economic analysis due to lack of data.

Table 12

Summary of Present and Future Cropping Pattern and Production

	Area Cropped		Productn (ton/ha)	
Crop	**Present**	**With Project**	**Present**	**With Project**
A. Upstream				
Upland rice	150	160	0.80	2.00
Corn	135	140	0.95	1.66
Sweet potato	50	50	2.00	3.75
Peanuts	50	50	0.095	0.44
Pigeon pea	50	50	0.15	0.30
TOTAL	435	450		
B. Downstream				
Irrigated Rice				
Crop 1	2280	4000	1.00	3.00
Crop 2	1000	2200	1.20	3.25
Mungo	250	400	0.16	0.60

5.3 The Data

The cost and return estimates, expressed in economic terms for every component have been based on the feasibility study report of the watershed prepared by the Department of Environment and Natural Resources (1992), Philippines. These data from the mentioned agency were used as a basis to compute the streams of costs and benefits for the economic analysis.

As argued earlier, the role of economic analysis in justifying resources allocations has increased over time with water becoming scarcer. Although a project may be feasible, this does not make it economically desirable. Funds expended in this project could be used elsewhere. It is for this reason that the data from the feasibility report (DENR, 1992), have been used to perform an economic analysis. The next section will report on this analysis.

5.4 The Economic Analysis

The economic analysis views the project from the perspective of the government and will assess the net benefits to society of the rehabilitation of this watershed. The direct benefits that can be derived with the rehabilitation and management of the watershed are: (a) a reforested area of 4,736 hectares due to assisted natural regeneration, agroforestry and reforestation for areas more than 18% slope in contrast to 592 hectares old forest without the project. It is envisioned by the

project that reforestation activities will help in the abatement of soil erosion and sedimentation and will help increase streamflow all throughout the year. Table 13

Table 13

Land Use Pattern Before and After the Project

(In Hectares)

With		Without	
On-site			
Assisted Nat. Regen.	716	Old growth forest	592
Agroforestry	3070		
Reforestation	950	Openland/grassland	5071
Agriculture	450		
Waterways	52	Cultivated area	435
Existing forest	592		
Rockland & ravines	320	Waterways	52
TOTAL	6150		6150
Off-site			
First cropping	4000	First cropping	2280
Second cropping	4000	Second cropping	1000

illustrates the land use pattern before and after the project; (b) increased income from agricultural crops on-site and off-site brought about by improved soil condition and increased water supply for irrigation. The project will pave the way for opportunities to adopt soil conserving multiple cropping systems instead of a monocropped rice/corn in the uplands and irrigated rice downstream; (c) additional benefits brought about by increased water supply for domestic use; (d) an increased irrigated area of 4000 hectares per cropping season compared to the present area of 2280 hectares.

For the without situation, the present slash and burn farming system is assumed to continue resulting in increased soil erosion and degradation of the area due to deforestation and overgrazing and leading to continuous shortage of water for domestic and agricultural use. Without further information, it was not possible to estimate how degradation would affect production and returns and for that reason, returns are kept constant at the pre-implementation level. If at this level the project turns out to be profitable then, any reduction in productivity in the "without" case would further improve the economic worthwhileness of the project.

The costs and benefits attributed to the project are identified and only the relevant streams of costs and benefits are included in the economic analysis to determine the worth of the project to society. Projected costs obtained from the feasibility study and watershed project development manual were expressed in economic terms. Interest and subsidies, being transfer payments, are ignored in the analysis. Accounting depreciation is also ignored and investment costs are incorporated in the analysis at the time they occur. The viability indicators used are the net present value and the internal rate of return. Cost and benefit flows are expressed in August 1991 values. The rate of discount used is 12 percent as specified by the government for public work type of projects. The period of analysis is 30 years.

5.4.1 Cost Assumptions

The total cost needed to complete the project is estimated at P330,489,202 M. The funding for the project is to be obtained from the Official Development Assistance of the government of the Philippines. Unit costs for agriculture and forest activities were derived from the data in the feasibility study by the DENR. A cost summary is presented in Table 14, the individual components of which will be explained below:

(i) Assisted Natural Regeneration

(a) Development for assisted natural regeneration will take place on 300 hectares for the first year, 216 hectares for the second year, and 200 hectares for the third year (see Appendix Table A.1).

(b) Yearly costs for the activity were obtained by multiplying the cost per hectare times the number of hectares to be developed each year.

(c) The forested area at present is 492 hectares and the total area for development is 716 hectares covering those areas in the higher and steeper portions of the watershed not covered by the regular reforestation activities.

(d) A total cost of P8,415,362.8 M is needed to regenerate the old growth trees in the first five years.

(e) Annual field administration and supervision cost is assumed at 30 percent of the total cost/hectare.

Table 14
Summary of Costs

INTEGRATED REHABILITATION AND MANAGEMENT OF MAASIN WATERSHED
SCHEDULE OF COSTS

YEAR	REFOREST	AGROFOR	AGRICROP	ASSSISTED NATURAL REGEN	SOCIAL DEV	PROJECT MGMT	TOTAL
1	7165605.3	12283894.8	0	2565990	1000000	4113200	27128690.1
2	6837068.4	14201903.6	777700	2423512.8	950000	1812000	27002184.8
3	7432886.4	15531045.6	1232900	2509380	870000	1812000	29388212
4	1191636	6516730.5	1849350	660480	500000	1812000	12530196.5
5	595818	5482957	2034285	256000	500000	1812000	10681060
6	0	1092333	2237713.5	0	0	1993200	5323246.5
7	0	600783.15	2461484.85	0	0	2192520	3062268
8	0	0	2707633.34	0	0	0	2707633.335
9	0	0	2978396.67	0	0	0	2978396.669
10	0	0	3276236.34	0	0	0	3276236.335
11	0	0	3603859.97	0	0	0	3603859.969
12	0	0	3964245.97	0	0	0	3964245.966
13	0	0	4360670.56	0	0	0	4360670.562
14	0	0	4796737.62	0	0	0	4796737.619
15	0	0	5276411.38	0	0	0	5276411.38
16	0	0	5804052.52	0	0	0	5804052.518
17	0	0	6384457.77	0	0	0	6384457.77
18	0	0	7022903.55	0	0	0	7022903.547
19	0	0	7725193.9	0	0	0	7725193.902
20	0	0	8497713.29	0	0	0	8497713.292
21	0	0	9347484.62	0	0	0	9347484.622
22	0	0	10282233.1	0	0	0	10282233.08
23	0	0	11310456.4	0	0	0	11310456.39
24	0	0	12441502	0	0	0	12441502.03
25	0	0	13685652.2	0	0	0	13685652.23
26	0	0	15054217.5	0	0	0	15054217.46
27	0	0	16559639.2	0	0	0	16559639.2
28	0	0	18215603.1	0	0	0	18215603.12
29	0	0	20037163.4	0	0	0	20037163.44
30	0	0	22040879.8	0	0	0	22040879.78
TOTALS	23223014.1	55709647.7	225966778	8415362.8	3820000	15546920	330489202.1

(ii) Agricultural Crops

This refers to the agricultural crop production activities of farmer-beneficiaries on-site, on those portions of land allocated to them for cultivation. Starting the second year, beneficiaries are expected to produce agricultural crops with program assistance after they have been properly and legitimately installed on their allocated watershed portion, have signed a memorandum of understanding with the watershed management and have gone through an orientation process prescribed in the program. Program assistance for this component will be confined to the initial years of the project and will consist of the provision of selected seeds, technology assistance and some support infrastructures. Marketing and post harvest assistance will also be provided as needed. The bigger investment outlay will be provided by the occupants themselves (i.e., labour). A total amount of P225,966,778 M will be incurred as component cost for agricultural crop production (see Appendix Table A.2). Some of the cost assumptions are:

(a) The level area (0-18% slope) which can be planted with agricultural crops totals 450 hectares. It will employ three cropping patterns simultaneously and an area of one hundred fifty hectares will be developed annually starting from year 2 to 4 (the pattern is: upland rice and corn, 50 hectares; sweet potato, pigeon pea and bush sitao, 50 hectares; and rice and peanuts, 50 hectares). From years 5 to 30 an area of 450 hectares will be devoted for agricultural crops and no further expansion of tillage will be allowed. The area of cultivated agricultural land without the project is 435 hectares.

(b) All costs for agricultural crop production are increased annually by 10% as an inflationary allowance.

(c) It is assumed that family labour cost in agricultural crop production will be the counterpart of the farmer-beneficiaries. The production of agricultural crops will be a continuous activity for the 30 year project time frame.

(d) Without the project, about 150 hectares of the watershed is devoted to rice; 135 hectares to corn and 50 hectares each for sweet potato, pigeon pea and peanuts. The phasing of the "with" project development is shown in Appendix Table A.2. Upland rice, corn and secondary crops are cropped once and a fallow period is being observed for the rest of the year.

(e) Without the project, the per hectare annual yield of upland rice is 0.80 tons while corn yield average 0.95 tons annually from an effective area of 150 hectares and 135 hectares respectively. Prices of the agricultural crops are all expressed in economic values and are taken from the project feasibility study (see Appendix Table A 2.1).

(f) Without the project, the irrigated area downstream cropped to rice is 2,280 hectares and 1,000 hectares for the first and second cropping respectively and 250 hectares is planted to mungo if there is insufficient irrigation water for the third cropping with a yield of 0.16 tons per hectare and with an economic unit cost of P16,000/ton (refer to Appendix Table A 2.2).

(g) The yield of irrigated rice downstream during the first cropping without the project was estimated as 1.00 ton per hectare and 1.20 tons per hectare for the second cropping or a total annual production of 2.20 tons. The economic price of rice is P7000/ton. Rice yield with the project was estimated to increase to 3.00 tons and 3.25 tons/hectare for the first and second cropping respectively.

(h) With the project, sweet potato has an assumed yield of 3.75 tons per hectare with a cost of P3000/ton. Pigeon pea's yield per hectare was 0.30 ton with a unit price of P6500/ton (see Appendix Table A 2.3).

(i) The yield of peanuts with the project was estimated as 0.44 ton/hectare with an economic price of P12,000/ton (shown in Appendix Table A 2.4).

(j) Present farm practices downstream involve mainly planting of HYV on about 90% of the total cropped area for paddy rice at an average of 50 kg/ha/cropping. For corn, an average rate of 17 kg/ha/crop is planted to the field. The most common fertilizers applied were urea and muriate of potash applied at a rate of 70 kg/ha. annually.

(k) About 50% of the total rice in the area is being sold to the local buyers from Iloilo City and neighbouring towns. Trucking cost in Western Iloilo is on average P1.00 per ton/km. Secondary crops like peanuts and bush sitao are raised for consumption but 60% of it is sold to the traders from Iloilo City.

(iii) Reforestation

(a) This will be started immediately in the first year of the project implementation. Phasing of development is 350 hectares for the first year; 300 for the second; and 300 for the third year. The total area to be developed is 950 hectares (Appendix Table A.3).

(b) To arrive at total cost per activity per year, cost per hectare is multiplied by the number of hectares to be developed per year. An estimated amount of P23,223,014.1 M is needed to reforest the area.

(iv) Agroforestry

(a) Agroforestry has three components: the reforestation, shade and fruit trees, and the hedgerows and fruit trees. At present, a total area of 3,070 hectares is classified as under agroforestry system but 50% of it is generally unproductive open grassland.

(b) Identified activities like maintenance and protection for nursery and infrastructure has been provided to sustain initial activities for project success.

(c) The reforestation consists of an area of 1,500 hectares and will be developed for permanent forest cover with the participation of the forest occupants and within the peripheral area of their cultivated portions. Six hundred (600) hectares for the first year, four hundred fifty (450) for the second year, and four hundred fifty (450) for the third year. The cost of reforesting the mentioned area is P36,680,620 M (Appendix Table A.4).

(d) The shade and fruit trees component will be implemented on the hill tops, upper mid-hill and mid-hill slopes and an area of 1,000 hectares will be developed. In this component, phasing of development will start in the second year and will end on the fifth year with 250 hectares to be developed per year. A total cost of P17,287,677 M will be incurred for this component;

(e) The hedgerows and fruit trees component consists of a total of 570 hectares. Development will start in the second year of operation and will end in the fifth year. Development per year are 170, 150, 150 and 100 hectares respectively. This component has a total cost of P1,741,350 M.

(f) A total cost of P55,709,647.7 M is needed for the three components of agroforestry.

(v) Community Organisation

(a) Community organisation costs include personal services, maintenance and operating cost, transportation and travel, supplies and training.

(b) The social development component is to have a complement of 13 workers for the first year. This is broken down into a supervisor, communication specialist, process documenter, office assistant and seven community organisers. The number will be trimmed down to nine during the fourth and fifth year as phase out activities are starting to be implemented. Social development intervention shall be completely phased out in the fifth year.

(c) A contingency cost of 2% from years 1 to 3 and 5% from years 4 to 5 will be incurred.

(d) A total cost of P3,820,000 M is needed for the community organisation activities (Appendix Table A.5).

(vi) Project Management

(a) A total cost of P15,546,920 M was estimated for project management (Appendix Table A.5). These costs consist of personnel services, maintenance and other operating costs, building, equipment, furniture and fixtures, water and electrical facilities and meeting/conference cost.

(b) Personnel services and maintenance and operating expenses will increase by 10% for year 6 and 7 as inflationary allowance.

(c) This component will be continuous for the time frame of seven years, after which it is expected that all institutional structures for its perpetual existence shall become operational and self-liquidating.

(d) Management and supervision costs are included in the corresponding schedule of each specific project component to avoid confusion of accounts for every component cost involved. Supervision and management costs have been estimated for the timetable of seven years after which the project is expected to become self-sustaining and self-governing.

5.4.2 Benefit Assumptions

The project will provide quantitative and qualitative benefits accruing either directly or indirectly, both on-site and off-site. Quantitatively, the on-site benefits are farmer's income from project intervention and the ecological value assigned to mature trees.

The ideal watershed is able to sustain life and provide economic benefits. This means that it should have water of sufficient quantity to promote soil fertility and is of such quality as to be fit for human as well as animal use and consumption. All these positive characteristics of a watershed are made possible by the trees that make up the forest in a watershed.

The value of trees reflect erosion and sedimentation damages foregone and other ecological benefits to society. In the feasibility report (DENR, 1992), these values were given a rather arbitrary magnitude of P450.00/tree from year 8 to 20 and

P620.00 from year 21 to 30. Qualitatively, the project in longer terms, may yet bring about ecological stability, leading to sustainability of expected gains not only for the occupants of the Maasin watershed and other direct consumers but also the society as a whole. Trees are believed to be appropriate for watershed improvement: it maintains a certain degree of environmental soundness/ecological balance and increase in the supply of wood and related forest products for economic considerations. Off-site, improved conditions in the watershed will increase water yield for domestic, commercial and agricultural consumption.

Upon completion of the project, the area of irrigated land downstream will increase from 2,280 hectares to 4,000 hectares of riceland. Two rice croppings are guaranteed for the farmers without risk of crop failure due to drought. The assurance of irrigation water, improved extension services and expanded credit facilities will encourage farmers to increase cropping intensity and adopt scientific farming technology. Cropping intensity is estimated to increase to 175 percent.

The values for benefit calculations were derived from the feasibility study of the DENR (1992), wherein rehabilitation and development efforts are estimated for reforestation, agriculture and off-site benefits. Direct project benefits are derived from the following: (1) Reforestation and assisted natural regeneration on 950 hectares and 716 hectares respectively; (2) agroforestry on 3,070 hectares; and (3) off-site benefits, from the additional volume of water for domestic and commercial uses of potable water supply in the MIWD service area and through increased farmers' income in rice production as a result of additional irrigation water brought about by project intervention. A total amount of P6,159,438,542.5 is the accrued benefits of the project. Table 15 shows the summary of on-site and off-site benefits and in what follows, the individual components are briefly discussed.

(i) Reforestation

(a) The number of hectares planted to trees to which a value i.e., foregone damages and other ecological benefits is assigned, will increase cumulatively. An estimate of 100 trees/hectare planting density was assumed from the eighth year of the project up to the 30th year where reforestation benefits will be realized. Project benefits are measured by the value assigned to mature trees which will function to regulate water's rate of discharge and to protect against erosion, sedimentation and leaching of nutrients. A simplifying assumption was that the foregone damages will provide an approximation of gross benefits due to the project.

(b) The arbitrary value per tree is estimated at P450.00 from year 8 to 20 and P620.00 from year 21 to 30. The increase in tree value depends on the age and size of the tree since fruit trees and hedges planted on the slopes will provide a physical obstruction that will slow overland flow, by protecting the topsoil and minimise its transport.

(c) To arrive at the estimated benefits, the number of trees per hectare is multiplied by the value per tree and then multiplied by the number of hectares

Table 15

SUMMARY OF TOTAL ONSITE AND OFFSITE BENEFITS					
YEAR	REFORESTN	AGROFORE	AGRCROPS	OFFSITE	TOTAL
0					
1					
2			3348105		3348105
3			11881745		11881745
4		1035000	16411065	131762500	149208565
5		2298000	16411065	144971460	163680525
6		3811000	16411065	146184682.5	166406747.5
7		6565000	16411065	147527475	170503540
8	21375000	40315000	16411065	149545970	227647035
9	21375000	40315000	16411065	150381500	228482565
10	21375000	40315000	16411065	151900350	230001415
11	21375000	40315000	16411065	151900350	230001415
12	21375000	40315000	16411065	151900350	230001415
13	21375000	40315000	16411065	151900350	230001415
14	21375000	40315000	16411065	151900350	230001415
15	21375000	40315000	16411065	151900350	230001415
16	21375000	40315000	16411065	151900350	230001415
17	21375000	40315000	16411065	151900350	230001415
18	21375000	40315000	16411065	151900350	230001415
19	21375000	40315000	16411065	151900350	230001415
20	21375000	40315000	16411065	151900350	230001415
21	29450000	53065000	16411065	151900350	250826415
22	29450000	53065000	16411065	151900350	250826415
23	29450000	53065000	16411065	151900350	250826415
24	29450000	53065000	16411065	151900350	250826415
25	29450000	53065000	16411065	151900350	250826415
26	29450000	53065000	16411065	151900350	250826415
27	29450000	53065000	16411065	151900350	250826415
28	29450000	53065000	16411065	151900350	250826415
29	29450000	53065000	16411065	151900350	250826415
30	29450000	53065000	16411065	151900350	250826415
TOTALS	572375000	1068454000	458328605	4060280937.5	6159438542.5

planted. A total of P572,375,000 M was the computed benefits for reforestation (Appendix Table A.6).

(ii) Agroforestry

(a) Shade and fruit trees benefits per hectare are estimated at P750, P1500, P2500, and P4000 per year from year 4, 5, 6 and 7 to 30 respectively (Appendix Table A.7).

(b) Hedgerows and fruit trees benefits per hectare are estimated at P500, P1400, P2300 and P4500 from year 4, 5, 6 and 7 to 30 respectively. A total of P1,068,454,000 was the derived benefits from hedgerows, shade and fruit trees.

(c) Appendix Table A.8 shows the benefits from agricultural crops. Income from agricultural crops per hectare from year 4 to 30 has been constant after the projected maximum hectares for the different cropping patterns were met.

(iii) Off Site Benefits

(a) Incremental water yield with project intervention is used as the basis to compute the domestic and commercial use of water. A total of P4,060,280,937.5 is the accrued off-site benefits due to the project.

(b) A water yield increase was assumed to start in year 4 after total project implementation is completed.

(c) Water yield that goes for domestic and commercial use is converted into monetary term using the average rate of P2.50/cu.m. charged by MIWD to their consumers. It is constant from year 10-30 based on the assumption that the 21,560,140 cu.m./yr. is the maximum capacity that the Maasin watershed can supply (Appendix Table A.9).

(d) Due to increased water yield, the present irrigated area of 2,280 hectares,was projected by the NIA to increase into an area of 4,000 hectares. This was used for computing irrigation benefits. Average production per hectare is pegged at 3.5 tons and is converted into monetary benefit by multiplying it by P7,000.00 per ton.

5.5 The Results

The results of the economic analysis of this project are expressed in terms of net present value calculated at a discount rate of 12 percent. The internal rate of return is the rate of discount that equates the discounted streams of costs and benefits. Table 16 shows the economic analysis ('with'-'without') of the project, while Table 17 illustrates the sensitivity analysis for this situation.

Based on the economic analysis, a large amount of return to investment accrued for the society due to the onsite and offsite benefits. This is due to increased

Table 16

ECONOMIC ANALYSIS OF THE INTEGRATED REHABILITATION AND MANAGEMENT OF MAASIN WATERSHED

Parameter:

Discount Rate 0.12

	COSTS						TOTAL	BENEFITS WITH PROJECT						BENEFITS WITHOUT PROJECT				NET	NET CASH	DNCF
YEAR	REFORES	AGROFOR	AGRICROP	ANR	SOCIALDEV	PROMGT	COSTS	REFOREST	AGROFOR	AGRICROP	DOMESTIC	IRRIGN	TOTAL	AGRCROP	DOMESTIC	IRRIGN	TOTAL	CHANGE	FLOW	
0																				
1	7165605.3	12283895	0	2565990	1000000	4113200	27128690.1						0	4446850			4446850	-4446850	-31575540.1	-28192446.5
2	6837068.4	14201904	777700	2423512.8	950000	1812000	27002184.8			3348105			3348105	4446850			4446850	-1098745	-28100929.8	-22401889.2
3	7432886.4	15531046	1232900	2509380	870000	1812000	29388212			11881745			11881745	4446850			4446850	7434895	-21953317	-15625937.4
4	1191636	6516730.5	1849350	660480	500000	1812000	12530196.5		1035000	16411065	33762500	98000000	149208565	4446850	12106293	19152000	35705142.5	113503422.5	100973226	64170310.56
5	595818	5482957	2034285	256000	500000	1812000	10681060		2298000	16411065	46971460	98000000	163680525	4446850	12106293	19152000	35705142.5	127975382.5	117294322.5	66555948.61
6	0	1092333	2237713.5	0	0	1993200	5323246.5		3811000	16411065	48184682.5	98000000	166406747.5	4446850	12106293	19152000	35705142.5	130701605	125378358.5	63520578.34
7	0	600783.15	2461484.9	0	0	2192520	3062268		6565000	16411065	49527475	98000000	170503540	4446850	12106293	19152000	35705142.5	134798397.5	131736129.5	59590734.81
8	0	0	2707633.3	0	0	0	2707633.335	21375000	40315000	16411065	51545970	98000000	227647035	4446850	12106293	19152000	35705142.5	191941892.5	189234259.2	76428543.44
9	0	0	2978396.7	0	0	0	2978396.6685	21375000	40315000	16411065	52381500	98000000	228482565	4446850	12106293	19152000	35705142.5	192777422.5	189799025.8	68443431.45
10	0	0	3276236.3	0	0	0	3276236.33535	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	191020036.2	61503339.3
11	0	0	3603860	0	0	0	3603859.96889	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	190692412.5	54819511.84
12	0	0	3964246	0	0	0	3964245.96577	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	190332026.5	48853490.6
13	0	0	4360670.6	0	0	0	4360670.56235	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	189935601.9	43528337.75
14	0	0	4796737.6	0	0	0	4796737.61859	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	189499534.9	38775359.32
15	0	0	5276411.4	0	0	0	5276411.38044	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	189019861.1	34533221.93
16	0	0	5804052.5	0	0	0	5804052.51849	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	188492220	30747164.17
17	0	0	6384457.8	0	0	0	6384457.77034	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	187911814.7	27368292.41
18	0	0	7022903.5	0	0	0	7022903.54737	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	187273369	24352952.14
19	0	0	7725193.9	0	0	0	7725193.90211	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	186571078.6	21662166.6
20	0	0	8497713.3	0	0	0	8497713.29232	21375000	40315000	16411065	53900350	98000000	230001415	4446850	12106293	19152000	35705142.5	194296272.5	185798559.2	19261135.59
21	0	0	9347484.6	0	0	0	9347484.62155	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	205773787.9	19046341.9
22	0	0	10282233	0	0	0	10282233.0837	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	204839039.4	16928412.45
23	0	0	11310456	0	0	0	11310456.3921	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	203810816.1	15038783.48
24	0	0	12441502	0	0	0	12441502.0313	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	202679770.5	13352969.58
25	0	0	13685652	0	0	0	13685652.2344	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	201435620.3	11849109.24
26	0	0	15054217	0	0	0	15054217.4579	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	200067055	10507683.67
27	0	0	16559639	0	0	0	16559639.2036	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	198561633.3	9311265.804
28	0	0	18215603	0	0	0	18215603.124	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	196905669.4	8244296.186
29	0	0	20037163	0	0	0	20037163.4364	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	195084109.1	7292882.848
30	0	0	22040880	0	0	0	22040879.78	29450000	53065000	16411065	53900350	98000000	250826415	4446850	12106293	19152000	35705142.5	215121272.5	193080392.7	6444622.651

NPV	855910613.5
IRR	0.731093458

Table 17

SENSITIVITY ANALYSIS

irrigable area (hectares)	npv	irr
	855910613.5	0.7310935
1000	440389190.1	0.4488547
1500	509642760.7	0.4999674
2000	578896331.3	0.5495737
2500	648149901.8	0.5975146
3000	717403472.4	0.6437339
3500	786657043	0.6882428
4000	855910613.5	0.7310935
4500	925164184.1	0.7723609
5000	994417754.7	0.8121309
5500	1063671325	0.8504932

rice yield	npv	irr
	855910613.5	0.7310935
1	460175924.6	0.4635975
1.5	539322862.4	0.5214238
2	618469800.1	0.5771779
2.5	697616737.9	0.6307043
3	776763675.7	0.6819874
3.5	855910613.5	0.7310935
4	935057551.3	0.7781319
4.5	1014204489	0.8232313
5	1093351427	0.8665253
5.5	1172498365	0.9081445

price of rice (P)	npv	irr
	855910613.5	0.7310935
2000	460175924.6	0.4635975
3000	539322862.4	0.5214238
4000	618469800.1	0.5771779
5000	697616737.9	0.6307043
6000	776763675.7	0.6819874
7000	855910613.5	0.7310935
8000	935057551.3	0.7781319
9000	1014204489	0.8232313
10000	1093351427	0.8665253
11000	1172498365	0.9081445
12000	1251645302	0.9482125

discount rate	npv	irr
	855910613.5	0.7310935
0.08	1401406953	0.7310935
0.09	1230610495	0.7310935
0.1	1085672854	0.7310935
0.11	962000286.1	0.7310935
0.12	855910613.5	0.7310935
0.13	764437257.4	0.7310935
0.14	685178058.6	0.7310935
0.15	616178134.7	0.7310935
0.16	555838710.1	0.7310935
0.17	502845849.1	0.7310935
0.2	377985091.9	0.7310935

price of water	npv	irr
	855910613.5	0.7310935
0.5	630618074	0.6057395
1	686941208.9	0.6388935
1.5	743264343.8	0.6707736
2	799587478.6	0.7014773
2.5	855910613.5	0.7310935
3	912233748.4	0.7597026
3.5	968556883.3	0.7873779
4	1024880018	0.8141853
4.5	1081203153	0.8401844

water yield	npv	irr
	855910613.5	0.7310935
15000000	811187938.6	0.7289844
17000000	824822609.5	0.7296311
19000000	838457280.4	0.7302745
21560140	855910613.5	0.7310935
23000000	865726622.1	0.7315517
25000000	879361293	0.7321856
27000000	892995963.9	0.7328163
29000000	906630634.8	0.733444
30000000	913447970.2	0.7337567

production of rice, corn and cash crops like peanuts, pigeon pea and sweet potato. From the present annual production of 2.20 tons/hectare of rice, it will increase to 6.25 tons/hectare at full project development. Increase in rice production is an important factor to help alleviate the incidence of poverty and hunger in the area. The production of agricultural crops in the area will have an annual net revenue of P16,411,065 M at full implementation of the project.

Additional project benefits will be from the imputed value of trees estimated to have the most profound effect in the area in terms of improved soil condition, abatement of soil erosion and increased streamflow.

At a discount rate of 12 percent, the NPV is P855,910,613.5 M and the IRR is 73.10%, showing that this is a worthwhile project to be undertaken. Both measures indicated that the project represents an economically efficient use of resources. given the 12 percent discount rate. In the sensitivity analysis, all factors tested for uncertainty such as irrigable area, yields of rice and water, prices of both rice and water and discount rate exhibited positive NPV's and IRR's greater than the discount rate used. This indicates that even with fairly major changes in costs and benefits (less favourable to the project), the rate of return still remains above the 12 percent social discount rate assumed to be relevant for the Philippines. Thus, the sensitivity analysis likewise confirms the economic desirability of the project. In the sensitivity analysis, using a lower discount rate increases the value of the NPV while applying a higher one will reduce the NPV. Extending the time horizon will increase the NPV because of the fact that project costs have tapered off from the 11th year onwards while onsite and offsite benefits accumulated annually have large returns due to project intervention. Thus, even applying a 20 percent discount rate would still give a positive NPV and IRR for the project. Sensitivity analysis shows that the project is worthy to implement and will undoubtedly contribute positive impacts to agricultural production and increased water supply for irrigation and domestic use.

A benefit cost analysis was done on the project without the imputed value of trees or assigning it at zero value (Appendix Table A.12). The analysis shows that the project remained economically feasible and attractive even without the benefits of reforestation component. Benefit from agroforestry is greatly reduced when the imputed value for trees was ignored, but it did not make the totality of the project unviable. It exhibited a positive NPV of P651,247,634 while the IRR is 70.86% and remain above the discount rate used. However, the ecological benefits inherent with trees will be greatly affected i.e., regulated rate of discharge of water, protection against soil erosion, sedimentation and leaching of nutrients and reduction in soil fertility. This aspect is not covered by the study due to unavailability of data.

These values should give an idea to a planner or decision-maker about the relationship of the rehabilitation and management of watersheds and environmental stability of the area. In a sense, these values from the economic analysis provide the baseline figures for the direct benefits of watershed rehabilitation to society as a whole.

Chapter VI

Conclusion and Recommendations

"Few of us have the greatness to bend history itself, but each of us can work to change a small portion of events, and in the total of these acts will be written the history of this generation".

Robert F. Kennedy

The objectives of the project are to integrate the community concerns with the need of rehabilitating the Maasin watershed to attain a certain degree of conservation of soil and water resources and to alleviate the problem of food shortage of poverty groups in the watershed.

The economic analysis shows that the integrated rehabilitation and management of Maasin watershed bring about substantial benefits to the locality and the nation as a whole. The net present value of the project at a discount rate of 12 percent generated an amount of P879,216,973 M with an internal rate of return of 73.09%. This indicates that the project is a profitable investment. The sensitivity of project returns show that it is a very stable project as indicated by the positive NPVs and IRRs that are much higher than the discount factor used in the analysis. Changes in parameters such as irrigable area, rice and water yields and prices of both rice and water were tested at different levels and all showed that the project is highly desirable in terms of economic returns.

6.1 On-site Benefits

The intended beneficiaries of the project on-site are the farmers occupying the Maasin watershed area. Overall, the results imply that the project would be beneficial to these farmers in terms of increased production levels of agricultural crops which means a community that is self-sufficient and higher family per capita income. Due to increased purchasing power of the farmers in the area, improved health condition of these families will provide access to their children for better education.

In terms of the national viewpoint, the reforestation and agroforestry component introduced to the watershed will improve forest cover and as a result, help in the ecological stability and preservation of indigenous plants and animals in the area. Most importantly, through appropriate farming practices brought about by the project, it will improve the land quality of the watershed which will lead to the prevention of soil erosion and sedimentation in the reservoirs and irrigation channels constructed by the national government. The aesthetic values of the place will likewise be enhanced in the process of reforesting the area. Improvement in soil retention for water is another plus factor to the beneficiaries where water retained in the soil is being released to the stream tributaries and will provide even distribution of water in the area all-year round.

Furthermore, the reforestation project will increase the supply of fuelwood and other tree products that may be used for income generating activities and industries. These positive effects of the project will affect the quality of life of the beneficiaries and the community as a whole in that the scheme will lead to recognition and organisation of "illegal" occupants of the watershed into a self-governed group. The land tenure security incentives will help stabilise the place ecologically and economically. The social development program will likewise help contribute to the social awareness and change of attitudes in the importance of watershed conservation. The usual indiscriminate activities associated with slash and burn agriculture will be contained.

6.2 Off-site Benefits

The intended beneficiaries off-site are the consumers served by MIWD with potable water. The other beneficiaries are the farmers who will benefit from an increased volume of irrigation water to be supplied by the NIA through the Tigum River which originates from the Maasin watershed.

The increased water yield to be supplied by the Maasin watershed after a number of years will mean that more population will have access to quality potable water. An unquantified benefit in this study is the positive effect of the increased water supply for commercial and industrial use. The water supply for industries will be one of the basic considerations for investors to put up business establishments in the Regional Agro-Industrial Centre (RAIC) in Pavia and Iloilo City. The farmers who are beneficiaries of NIA irrigation will also gain from the increased water supply by increasing utilisation of their agricultural land. Correspondingly, this will mean increased agricultural productivity and income to the farmers.

6.3 Strong and Weak Points of the Project

The rehabilitation of the Maasin watershed will result in the protection of the environment and will ensure sustainable ecological balance. The area can serve as a flora and fauna tourist destination due to the abundance of wild birds and exotic tropical forest trees and flowers like huge teak trees, tropical vines and epiphytes and premium dipterocarp trees. The ravines, river channels, rock formations and walk tracks is highly suitable for sightseeing, rafting and tramping.

The project has also an income distribution effect in that the cost of the project which will be incurred by the government through the Official Development Assistance fund will come from the privileged class (in form of taxes collected) rechanneled through this project to the less privileged members of society. Finally, project success will have a wider impact on the surrounding areas in terms of faster economic development.

From the point of view of the government, the results of the analysis offer no doubt about the project's positive contribution to societal welfare, particularly in terms of its potential benefits to the environment through rehabilitation and protection of the endangered upland area. Yet, the actual extent of these effects on the target beneficiaries' socio-economic welfare need to be probed. While the project is desirable for the society as a whole, it is not specific as to the extent of the effects on the target beneficiaries' economic/financial status. These farmers must be assured that they will have substantial benefits in return for their efforts before they will join into the project implementation. Thus, information about the financial impact on farmers is needed before the project starts.

Since the financial analysis of the project was not included in the scope of the study, some aspects in ex ante project evaluation should take into account certain factors like the amount of loan capital to be provided per hectare to each project beneficiary and its rate of interest. Likewise the effects of inflation on project inputs and outputs must be taken up in the financial analysis and the results presented to the beneficiaries in order for them to decide on the merits of the project.

Direct incentives such as food for work or the distribution of free seedlings from the government nurseries could be used as one of the options to elicit farmer participation in project management and implementation. But these incentives must be designed to permit the upland people to dedicate time and effort to the start-up of activities which are productive and will eventually in a short period become financially independent of the inputs received during the establishment phase.

The project must likewise involve non-government organisations in providing support to rural organisations in their formation, in the training of community leaders, in the generation of political and social awareness, etc. NGO's being independent from the government structure can be more flexible and directly responsive to the needs of the beneficiaries and may have easier access to minority groups and peoples.

With more research and information on the on-site and off-site impacts of watershed rehabilitation, it would be possible to perform an economic analysis that is more comprehensive than the analysis done in this study. In spite of these limitations, this study indicates that society gains from rehabilitating watersheds such as Maasin. Thus, the results reported here argue for more research that allows for the design of better strategies for dealing with the Philippines' pressing watershed rehabilitation and management problems.

6.4 General Recommendations for Sustainability of Maasin Watershed

Sustainable development implies that production processes can continue over a long period of time without degrading the resource base. The first prerequisite for a sustainable watershed rehabilitation at Maasin is a property rights system which addresses the interests of forest people with the preservation of forest ecosystem. Whether the resource is land or timber, secure tenure will ultimately determine the sustainability of these project gains. To quote Durning (1993), *"neglecting property rights would condemn the forests and its inhabitants to continuing decline"*.

In the now epic paper, The Tragedy of the Commons, Dr. Garrett Hardin defined (mistakenly) common property resources (i.e., watersheds) as unmanaged, "open access" no man's land, doomed to degradation as each individual withdrew more of the resource than would be optimal from the perspective of the users as a whole. This argument had a powerful influence in promoting policies in favour of government appropriation and management of common property natural resources like forested watershed areas.

In Maasin watershed, the resource nationalized by the government is not an open access land, but portions of it have claimants and actually possessed by the local inhabitants for decades. By assuming ownership and responsibility for watershed management, the national government caused an observed management system to break down, creating in fact the very type of open access situation it intended to control. The Hardin paper's influence among the country' economic policy makers need a reassessment in the role of local communities in sustainable management. A reexamination of the potential of collective management through a community organisation is recommended.

An important element for effective local or joint control of the watershed is legal recognition by the government to legitimize and empower local control mechanisms ---to effect a self-reliant, participatory populace in watershed management and will ensure the sustainable benefits and resource conservation.

To arrest the adverse effects of human encroachment and exploitation of the

Maasin watershed, effective measures are needed for immediate implementation by the concerned institutions present in the region in order to address socio-economic problems that hinder economic development in the upland areas:

(a) The key to success is to involve local people from the watershed area in planning and implementation to enable them to use their land and other resources that will improve productivity, while at the same time reducing the negative impacts on soil and water resources, both in the watershed itself and in downstream areas;

(b) Take the challenges of transforming watershed management from a government concern mainly with public land management, to a situation where the local population is increasingly the active partner, with government being placed in an advisory and supporting role;

(c) Examine the adaptation of structural and vegetative approaches to counter watershed degradation (natural and human-made) in the context of integrated watershed management project;

(d) Important question to be addressed in management of the watershed is to find and provide adequate financial resources for these watershed inhabitants that is community-based in nature and that costs and benefits are appropriately distributed among individuals that carry out the watershed management activities and those that benefit from them;

(e) Michaelsen (1991), recommends that for an effective integrated watershed management, a mechanism for inter-agency coordination of ground-level action is needed for adoption. This is true in Maasin where coordination of implementing institutions is essential for appropriate rural development as well as for the optimum sustainable use of the resource;

(f) Forest policies of the region are largely reaction-based, rather than anticipatory in nature. A regional forest land use planning model has to be devised to incorporate the production, distributive and ecological effects in various ways of using the uplands specifically the watershed areas.

6.5 Conclusion

This research, in essence, analyzed a case study of watershed rehabilitation and management employing agroforestry with social development as a strategy. Overall, the results imply that the project would be beneficial to the region in particular and to the country in general. If some of the recommendations mentioned earlier are acted on with regard to implementation, this could be a successful project. However, success of the project will ultimately depend on the cooperation of the occupants.

In light of these findings, there is a need to carry out more investigations on other issues that are relevant to the rehabilitation and management of the watershed like property rights. This must be addressed not just by the project implementors but by the legislative bodies in both the local and national administrative levels. As such, a political will to implement the pertinent laws which address the rationalisation of land use and ownership in watershed areas is needed. To quote Professor A.D. Meister, *"The Philippines does not lack the necessary laws and policies to protect the environment, what it does lack is the will to implement the laws"* (cited by Cabanilla, 1993).

In the actual implementation of the project certain problems may be encountered that can lessen the expected benefits or amplify the projected costs which all, in turn, can substantially diminish its well-meaning effects. Natural calamities such as drought, typhoon and outbreak of pests on crops are factors that can hamper project implementation and reverse its desirable impacts. Thus, the project implementors must be prepared to address any problem arising from these causes.

On the other hand, ex-ante evaluation conducted in this study carries just one side of the story about watershed rehabilitation and management, and their possible contribution in sustainable development of the uplands. An ex-post evaluation of the project is needed to complement this study. The identified benefits and costs can serve as basis for further analysis and future evaluation of the project. It is hoped that the framework of analysis applied in this study will be useful in the appraisal of other watershed rehabilitation projects in the Philippines.

Finally, for watershed rehabilitation and management in the Philippines to succeed, government and non-government organisations must provide watershed occupants some feasible alternative means of earning a living because no matter how one would look at the shifting cultivation problem, it is the occupant's desire to improve their economic life and desire for subsistence that motivates and impels them to cut the trees and cultivate the watersheds.

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APPENDICES

Appendix Table A.1

OPERATING COSTS ASSISTED NATURAL REGENERATIO (In Pesos)

	[1] Cost/Hectare*	[2] Year 1	[3] Year 2	[4] Year 3	[5] Year 4	[6] Year 5	[7] Year 6	[8] Year 7	[9] TOTAL
No. of hectares		300	216	200	0	0	0	0	716
ACTIVITIES									
Brushing/clearing of fire breaks	640	192000	138240	128000	0	0	0	0	458240
Ring weeding of all naturally growing weeds twice annually (800 pioneers)	360	108000	77760	72000	0	0	0	0	257760
(800 pioneers)	360	108000	77760	72000	0	0	0	0	257760
Seedling cost @P1.00 each	800	240000	172800	160000	0	0	0	0	572800
Supplemental planting (800*1.57) including transport cost	1256	376800	271296	251200	0	0	0	0	899296
Maintenance Weeding Pressing down of grass (3 times annually)	1400	420000	302400	280000	0	0	0	0	1002400
	1920	0	576000	414720	384000	0	0	0	1374720
	1280	0	0	384000	276480	256000	0	0	916480
Fertilizer/fertilizing	450	135000	97200	90000	0	0	0	0	322200
Infrastructure									
Footpath (1mx50m)	250	75000	54000	50000	0	0	0	0	179000
Breakhouse	250	75000	54000	50000	0	0	0	0	179000
Lookout tower	75	22500	16200	15000	0	0	0	0	53700
Field Adm. and Sup. (30% of total cost)	2712.3	813690	585856.8	542460	0	0	0	0	1942006.8
TOTALS		2565990	2423512.8	2509380	660480	256000	0	0	8415362.8

*Source of cost/hectare were obtained from the project feasibility study.
Cols.2-8 = Col 1*No. of hectares developed annually

Appendix Table A.2

OPERATING COSTS FOR AGRICULTURAL CROPS

Parameters				
Year	UR/C Costs	SwtPota, Pea, Sitao Costs	Rice/Peanut Costs	Hectares
2	2995	10687	1672	50
3	4175	5384	2770	100
4	4175	5384	2770	150

YEAR				TOTAL
0	0	0	0	0
1	0	0	0	0
2	149750	544350	83600	777700
3	417500	538400	277000	1232900
4	626250	807600	415500	1849350
5	688875	888360	457050	2034285
6	757762.5	977196	502755	2237713.5
7	833538.8	1074916	553030.5	2461484.85
8	916892.6	1182407	608333.6	2707633.34
9	1008582	1300648	669166.9	2978396.67
10	1109440	1430713	736083.6	3276236.34
11	1220384	1573784	809692	3603859.97
12	1342422	1731162	890661.2	3964245.97
13	1476665	1904279	979727.3	4360670.56
14	1624331	2094706	1077700	4796737.62
15	1786764	2304177	1185470	5276411.38
16	1965441	2534595	1304017	5804052.52
17	2161985	2788054	1434419	6384457.77
18	2378183	3066860	1577861	7022903.55
19	2616002	3373546	1735647	7725193.9
20	2877602	3710900	1909211	8497713.29
21	3165362	4081990	2100132	9347484.62
22	3481898	4490189	2310146	10282233.1
23	3830088	4939208	2541160	11310456.4
24	4213097	5433129	2795276	12441502
25	4634407	5976442	3074804	13685652.2
26	5097847	6574086	3382284	15054217.5
27	5607632	7231495	3720513	16559639.2
28	6168395	7954644	4092564	18215603.1
29	6785235	8750109	4501820	20037163.4
30	7463758	9625119	4952002	22040879.8
TOTAL	76406089	98883063	50677626	225966778

Appendix Table 2.1

COST AND RETURN ANALYSIS OF UPLAND RICE & CORN F
IN UNTERRACED AREAS PER HECTARE WITH THE PROJEC

TEM		YEAR 1	YEAR 2	YEAR 3
1.0 OUTPUT/REVENUE				
1.1 Yield (kg)*				
1.1.1 Rice		1000	2000	2000
1.1.2 Corn		1512	1663	1663
1.2 Price/kg*	Price/kg (P)			
1.2.1 Rice	7	7000	14000	14000
1.2.2 Corn	3.8	5745.6	6319.4	6319.4
1.3 Gross Revenue		12745.6	20319.4	20319.4
2.0 INPUTS/EXPENSES*				
2.1 Rice				
2.1.1 Seeds		500	600	600
2.1.2 Fertilizer		500	1200	1200
2.1.3 Insecticide		200	400	400
2.1.4 Labour		2200	4100	4100
Sub-total		3400	6300	6300
2.2 Corn				
2.2.1 Seeds		990	1089	1089
2.2.2 Fertilizer		470	517	517
2.2.3 Insecticide		335	369	369
2.2.4 Labour		2000	2816	2816
Sub-total		3795	4791	4791
Total Expenses		7195	11091	11091
NET RETURNS		5550.6	9228.4	9228.4
TOTAL EXPENSES WITHOUT LABOUR		2995	4175	4175

*Values used for yield, price and expenses were obtained from the

COST AND RETURN ANALYSIS OF UPLAND RICE & CORN FARMIN
IN UNTERRACED AREAS PER HECTARE WITHOUT THE PROJECT

TEM		YEAR 1	YEAR 2	YEAR 3
1.0 OUTPUT/REVENUE				
1.1 Yield (kg)				
1.1.1 Rice		800	800	800
1.1.2 Corn		950	950	950
1.2 Price/kg	Price/kg (P)			
1.2.1 Rice	7	5600	5600	5600
1.2.2 Corn	3.8	3610	3610	3610
1.3 Gross Revenue		9210	9210	9210
2.0 INPUTS/EXPENSES				
2.1 Rice				
2.1.1 Seeds		400	400	400
2.1.2 Fertilizer		250	250	250
2.1.3 Insecticide		100	100	100
2.1.4 Labour		2000	2000	2000
Sub-total		2750	2750	2750
2.2 Corn				
2.2.1 Seeds		400	400	400
2.2.2 Fertilizer		200	200	200
2.2.3 Insecticide		120	120	120
2.2.4 Labour		1000	1000	1000
Sub-total		1720	1720	1720
Total Expenses		4470	4470	4470
NET RETURNS		4740	4740	4740
TOTAL EXPENSES WITHOUT LABOUR		1470	1470	1470

Appendix Table A 2.2

COST-RETURN ANALYSIS OF RICE-MUNGBEAN FARMING S PROJECT

TEM		YEAR 1	YEAR 2	YEAR 3
1.0 OUTPUT/REVENUE				
1.1 Yield (kg)*				
1.1.1 Rice		3250	3250	3500
1.1.2 Mungbean		200	600	600
1.2 Price/kg*	Price/kg (P)			
1.2.1 Rice	7	22750	22750	24500
1.2.2 Mungbean	16	3200	9600	9600
1.3 Gross Revenue (P)		25950	32350	34100
2.0 INPUTS/EXPENSES*				
2.1 Rice				
		600	500	500
2.1.2 Fertilizer		710	1922	1922
2.1.3 Herbicide		0	360	360
2.1.4 Insecticide		220	300	300
2.1.5 Labour				
*Land Preparation		1800	1800	1800
*Transplanting		340	340	340
*Weeding		400	400	400
*Fertilising		20	40	40
*Spraying		40	40	40
*Harvesting & Threshing		680	680	680
*Drying & Cleaning		40	40	40
Sub-total		4850	6422	6422
2.2 Mungbean				
2.2.1 Seeds		270	270	270
2.2.2 Fertilizer		0	1055	1055
2.2.3 Insecticide		0	35	35
2.2.4 Labour				
*Land Preparation		1050	1050	1050
*Planting		80	80	80
*Weeding		100	320	320
*Fertilising		0	20	20
*Spraying		0	40	40
*Harvesting		240	320	320
		40	40	40
Sub-total		1780	3230	3230
Total Expenses		6630	9652	9652
3.0 NET RETURNS		19320	22698	24448
TOTAL EXPENSES WITHOUT LABOUR		1800	4442	4482

*Values used for yield, prices and inputs were obtained from the feasibility study of the project prepared by the DENR.

COST-RETURN ANALYSIS OF RICE-MUNGBEAN FARMING SYS/HE WITHOUT THE PROJECT

TEM		YEAR 1	YEAR 2	YEAR 3
1.0 OUTPUT/REVENUE				
1.1 Yield (kg)				
1.1.1 Rice		1200	1200	1200
1.1.2 Mungbean		160	160	160
1.2 Price/kg	Price/kg (P)			
1.2.1 Rice	7	8400	8400	8400
1.2.2 Mungbean	16	2560	2560	2560
1.3 Gross Revenue (P)		10960	10960	10960
2.0 INPUTS/EXPENSES				
2.1 Rice				
2.1.1 Seeds		300	300	300
2.1.2 Fertilizer		500	500	500
2.1.3 Herbicide		150	150	150
2.1.4 Insecticide		120	120	120
2.1.5 Labour				
*Land Preparation		1000	1000	1000
*Transplanting		300	300	300
*Weeding		350	350	350
*Fertilising		20	20	20
*Spraying		20	20	20
*Harvesting & Threshing		500	500	500
*Drying & Cleaning		20	20	20
Sub-total		3280	3280	3280
2.2 Mungbean				
2.2.1 Seeds		200	200	200
2.2.2 Fertilizer		0	500	500
2.2.3 Insecticide		0	20	20
2.2.4 Labour				
*Land Preparation		500	500	500
*Planting		30	30	30
*Weeding		50	50	50
*Fertilising		0	10	10
*Spraying		0	30	30
*Harvesting		240	240	240
*Threshing & Cleaning		20	20	20
Sub-total		1040	1600	1600
Total Expenses		4320	4880	4880
3.0 NET RETURNS		6640	6080	6080
TOTAL EXPENSES WITHOUT LABOUR		1270	1790	1790

Appendix Table A 2.3

COST AND RETURN ANALYSIS OF A HECTARE SWT POTAT AND BUSH SITAO FARMING SYSTEM WITH THE PROJECT

ITEM		YEAR 1	YEAR 2	YEAR 3
1.0 OUTPUT/REVENUE				
1.1 Yield (Kgs.)*				
1.1.1 Sweet Potato		3750	3750	3750
1.1.2 Pigeon Pea		300	300	300
1.1.3 Bush Sitao		3000	3000	3000
1.2 Price/kg. *	Price/kg. (P)			
1.2.1 Sweet Potato	3	11250	11250	11250
1.2.2 Pigeon Pea	6.5	1950	1950	1950
1.2.3 Bush Sitao	3.5	10500	10500	10500
1.3 Gross Revenue (P)		23700	23700	23700
2.0 INPUTS/EXPENSES*				
2.1 Sweet Potato				
2.1.1 Seeds/cuttings		3333	0	0
2.1.2 Fertilizer		1850	1850	1850
2.1.3 Insecticide		125	125	125
2.1.4 Labour		2475	2475	2475
Sub-total		7783	4450	4450
2.2 Pigeon pea				
2.2.1 Seeds		45	0	0
2.2.2 Fertilizer		1189	1189	1189
2.2.3 Insecticide		125	125	125
2.2.4 Labour		850	850	850
Sub-total		2209	2164	2164
2.3 Bush sitao				
2.3.1 Seeds		2125	0	0
2.3.2 Fertilizer		1585	1585	1585
2.3.3 Insecticide		510	510	510
2.3.4 Labour		2250	2250	2250
Sub-total		6470	4345	4345
Total Expenses		16462	10959	10959
NET RETURNS		7238	12741	12741
TOTAL EXPENSES WITHOUT LABOR		10887	5384	5384

*Values used for prices, yield and inputs were obtained from the feasibility study of the project prepared by the DENR.

COST AND RETURN ANALYSIS OF A HECTARE SWEET POTATO, P AND BUSH SITAO FARMING SYSTEM WITHOUT THE PROJECT

ITEM		YEAR 1	YEAR 2	YEAR 3
1.0 OUTPUT/REVENUE				
1.1 Yield (Kgs.)*				
1.1.1 Sweet Potato		2000	2000	2000
1.1.2 Pigeon Pea		150	150	150
1.1.3 Bush Sitao		2000	2000	2000
1.2 Price/Kg.*	Price/Kg. (P)			
1.2.1 Sweet Potato	3	6000	6000	6000
1.2.2 Pigeon Pea	6.5	975	975	975
1.2.3 Bush Sitao	3.5	7000	7000	7000
1.3 Gross Revenue (P)		13975	13975	13975
2.0 INPUTS/EXPENSES*				
2.1 Sweet Potato				
2.1.1 Seeds/cuttings		3333	0	0
2.1.2 Fertilizer		1850	1850	1850
2.1.3 Insecticide		125	125	125
2.1.4 Labour		2475	2475	2475
Sub-total		7783	4450	4450
2.2 Pigeon pea				
2.2.1 Seeds		25	0	0
2.2.2 Fertilizer		300	300	300
2.2.3 Insecticide		75	75	75
2.2.4 Labour		350	350	350
Sub-total		750	725	725
2.3 Bush sitao				
2.3.1 Seeds		1000	0	0
2.3.2 Fertilizer		700	700	700
2.3.3 Insecticide		200	200	200
2.3.4 Labour		1000	1000	1000
Sub-total		2900	1900	1900
Total Expenses		11433	7075	7075
NET RETURNS		2542	6900	6900
TOTAL EXPENSES WITHOUT LABOR		7608	3250	3250

Appendix Table A 2.4

COST-RET ANALYSIS OF ONE HECTARE UP. RICE-PEANUT

TEM		YEAR 1	YEAR 2	YEAR 3
1.O OUTPUT/REVENUE				
1.1 Yield (kg)*				
1.1.1 Upland Rice		1000	2000	2000
1.1.2 Peanuts		440	440	440
1.2 Price/kg*	Price/kg(P)			
1.2.1 Upland Rice	7	7000	14000	14000
1.2.2 Peanut	12	5280	5280	5280
		12280	19280	19280
2.0 INPUTS/EXPENSES*				
2.1 Rice				
2.1.1 Seeds		600	600	600
2.1.2 Fertilizer		500	1200	1200
2.1.3 Herbicide		100	100	100
2.1.4 Insecticide		200	400	400
2.1.5 Labour		3200	4100	4100
Sub-total		4600	6400	6400
2.2 Peanut				
2.2.1 Seeds		72	270	270
2.2.2 Fertilizer		100	100	100
2.2.3 Insecticide		100	100	100
2.2.4 Labour		1200	1260	1260
Sub-total		1472	1730	1730
Total Expenses		6072	8130	8130
3.0 NET RETURNS		6208	11150	11150
TOTAL EXPENSES WITHOUT LABOUR		1672	2770	2770

*Values used for yield, prices and inputs were obtained from the feasibility study of the project prepared by the DENR.

COST-RET ANALYSIS OF ONE HECTARE UP. RICE-PEANUT CROP WITHOUT THE PROJECT

TEM		YEAR 1	YEAR 2	YEAR 3
1.O OUTPUT/REVENUE				
1.1 Yield (kg)*				
1.1.1 Upland Rice		800	800	800
1.1.2 Peanuts		95	95	95
1.2 Price/kg*	Price/kg(P)			
1.2.1 Upland Rice	7	5600	5600	5600
1.2.2 Peanut	12	1140	1140	1140
1.3 Gross Revenue(P)		6740	6740	6740
2.0 INPUTS/EXPENSES*				
2.1 Rice				
2.1.1 Seeds		400	400	400
2.1.2 Fertilizer		0	0	0
2.1.3 Herbicide		0	0	0
2.1.4 Insecticide		0	0	0
2.1.5 Labour		1500	1500	1500
Sub-total		1900	1900	1900
2.2 Peanut				
2.2.1 Seeds		72	72	72
2.2.2 Fertilizer		0	0	0
2.2.3 Insecticide		0	0	0
2.2.4 Labour		1200	1200	1200
Sub-total		1272	1272	1272
Total Expenses		3172	3172	3172
3.0 NET RETURNS		3568	3568	3568
TOTAL EXPENSES WITHOUT LABOUR		472	472	472

Appendix Table A.3

OPERATING COSTS REFORESTATION	[1] Cost/hectare*	[2] Year 1	[3] Year 2	[4] Year 3	[5] Year 4	[6] Year 5	[7] Year 6	[8] Year 7	[9] TOTAL
No. of Hectares		350	300	300	0	0	0	0	950
ACTIVITIES									
Nursery operation	5847.08	2046478	1754124	1754124	0	0	0	0	5554726
Plantation establishment	3905.06	1366771	1171518	1171518	0	0	0	0	3709807
Maintenance and protection	1757.38	615083	527214	527214	0	0	0	0	1669511
(3 times annually)	1703.76	0	596316	511128	511128	0	0	0	1618572
	1703.76	0	0	596316	511128	511128	0	0	1618572
Infrastructure	3322.42	1162847	996726	996726	0	0	0	0	3156299
Maintenance	282.3	0	98805	84690	84690	0	0	0	268185
	282.3	0	0	98805	84690	84690	0	0	268185
Field Admin. and Sup. (30% of total cost)	5641.218	1974426.3	1692365.4	1692365.4	0	0	0	0	5359157.1
TOTALS		7165605.3	6837068.4	7432886.4	1191636	595818	0	0	23223014.1

*Source of cost/ha. were obtained from the feasibility study of the project.
Cols.2-8 = Col 1* No. of Has. developed annually.

Appendix Table A.4

OPERATING COSTS AGROFORESTRY

	Cost/Hectare*	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	TOTAL
REFORESTATION	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
No. of Hectares		600	450	450	0	0	0	0	1500
ACTIVITIES									
Nursery Operation	5847.08	3508248	2631186	2631186	0	0	0	0	8770620
Plantation Establishment	3905.06	2343036	1757277	1757277	0	0	0	0	5857590
Maintenance and protection	1757.38	1054428	790821	790821	0	0	0	0	2636070
(3 times annually)	1703.76	0	1022256	766692	766692	0	0	0	2555640
	1703.76	0	0	1022256	766692	766692	0	0	2555640
Infrastructure	3322.42	1993452	1495089	1495089	0	0	0	0	4983630
Maintenance	282.3	0	169380	127035	127035	0	0	0	423450
	282.3	0	0	169380	127035	139738.5	0	0	436153.5
Field Admin. and Sup. (30% of total cost)	5641.218	3384730.8	2538548.1	2538548.1	0	0	0	0	8461827
SUBTOTAL		12283894.8	10404557.1	11298284.1	1787454	906430.5	0	0	36680620.5
SHADE TREES AND FRUIT TREES									
No. of Hectares		0	250	250	250	250	0	0	1000
Nursery Operation	5847.08	0	1461770	1461770	1461770	1461770	0	0	5847080
Maintenance and Protection	1703.76	0	0	425940	425940	425940	468534	0	1746354
(twice annually)	1703.76	0	0	0	425940	425940	468534	515387.4	1835801.4
Infrastructure	3322.42	0	830605	830605	830605	830605	0	0	3322420
Maintenance	282.3	0	0	70575	70575	70575	77632.5	0	289357.5
	282.3	0	0	0	70575	70575	77632.5	85395.75	304178.25
Field Admin. and Sup. (30% of total cost)	8 3942.486	0	985621.5	985621.5	985621.5	985621.5	0	0	3942486
SUBTOTAL		0	3277996.5	3774511.5	4271026.5	4271026.5	1092333	600783.15	17287677.15
HEDGEROWS SPECIES AND FRUIT TREES									
No. of Hectares		0	170	150	150	100	0	0	570
Cost of Seeds	300	0	51000	45000	45000	30000	0	0	171000
Establishment Cost	1000	0	170000	150000	150000	100000	0	0	570000
Cost of Fruit Trees	1050	0	178500	157500	157500	105000	0	0	598500
Field Admin. and Sup. (30% of total cost)	705	0	119850	105750	105750	70500	0	0	401850
SUBTOTAL		0	519350	458250	458250	305500	0	0	1741350
TOTAL COST OF AGROFORESTRY		12283894.8	14201903.6	15531045.6	6516730.5	5482957	1092333	600783.15	55709647.65

*Source of cost/hectare were obtained from the feasibility study of the project.
Cols 2 to 8 = Col. 1*No. of Has. developed annually

Appendix Table A.5

PROJECT MANAGEMENT COSTS*

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	TOTAL
Personnel Cost	1488000	1488000	1488000	1488000	1488000	1636800	1800480	10877280
Electric facilities	60000	0	0	0	0	0	0	60000
Water system	25000	0	0	0	0	0	0	25000
Equipment, furnitures & fixtures	726200	0	0	0	0	0	0	726200
Office building and dormitory	1000000	0	0	0	0	0	0	1000000
MOE	324000	324000	324000	324000	324000	356400	392040	2368440
Other costs (Orientation)	490000	0	0	0	0	0	0	490000
TOTALS	4113200	1812000	1812000	1812000	1812000	1993200	2192520	15546920

SOCIAL DEVELOPMENT COSTS*

	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Personnel Services	500000	500000	500000	300000	300000	2100000
MOE	200000	200000	200000	100000	100000	800000
Training	200000	150000	100000	0	0	450000
Others	80000	80000	50000	50000	50000	310000
Contingency	20000	20000	20000	50000	50000	160000
TOTALS	1000000	950000	870000	500000	500000	3820000

*Streams of costs were taken from the project feasibility study.

Appendix Table A.6

ON SITE BENEFITS
BENEFITS FROM REFORESTATION COMPONENT (950 HECTARES)

[1] YEAR	[2] BENEFITS/HA. NO. OF TREES	[3] VALUE/TREE		[4] FAST GROW SPECIES	[5] TOTAL
			No.ofHas	475	475
8	100	450		21375000	21375000
9	100	450		21375000	21375000
10	100	450		21375000	21375000
11	100	450		21375000	21375000
12	100	450		21375000	21375000
13	100	450		21375000	21375000
14	100	450		21375000	21375000
15	100	450		21375000	21375000
16	100	450		21375000	21375000
17	100	450		21375000	21375000
18	100	450		21375000	21375000
19	100	450		21375000	21375000
20	100	450		21375000	21375000
21	100	620		29450000	29450000
22	100	620		29450000	29450000
23	100	620		29450000	29450000
24	100	620		29450000	29450000
25	100	620		29450000	29450000
26	100	620		29450000	29450000
27	100	620		29450000	29450000
28	100	620		29450000	29450000
29	100	620		29450000	29450000
30	100	620		29450000	29450000
TOTALS				572375000	572375000

*Calculated no. of trees/ha. & cost of tree/yr. was based on DENRs Watershed Project Development Manual.
Cols 4 = Col2*Col3*No. of Has.

Appendix Table A.7

BENEFITS FROM AGROFORESTRY COMPONENT (3070 Hectares)

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
			BENEFITS/HECTARE		REFORESTATION				
YEAR	NO.TREES	VALUE/ TREE	SHADE SP.	HERB SP.	FAST GROW SP.	PREMIUM SP.	FRUIT TRE	HEDGES/ FRUIT TREES	TOTAL
HECTARES					750	750	1000	570	3070
4			750	500	0	0	750000	285000	1035000
5			1500	1400	0	0	1500000	798000	2298000
6			2500	2300	0	0	2500000	1311000	3811000
7			4000	4500	0	0	4000000	2565000	6565000
8	100	450	4000	4500	33750000	0	4000000	2565000	40315000
9	100	450	4000	4500	33750000	0	4000000	2565000	40315000
10	100	450	4000	4500	33750000	0	4000000	2565000	40315000
11	100	450	4000	4500	33750000	0	4000000	2565000	40315000
12	100	450	4000	4500	33750000	0	4000000	2565000	40315000
13	100	450	4000	4500	33750000	0	4000000	2565000	40315000
14	100	450	4000	4500	33750000	0	4000000	2565000	40315000
15	100	450	4000	4500	33750000	0	4000000	2565000	40315000
16	100	450	4000	4500	33750000	0	4000000	2565000	40315000
17	100	450	4000	4500	33750000	0	4000000	2565000	40315000
18	100	450	4000	4500	33750000	0	4000000	2565000	40315000
19	100	450	4000	4500	33750000	0	4000000	2565000	40315000
20	100	450	4000	4500	33750000	0	4000000	2565000	40315000
21	100	620	4000	4500	46500000	0	4000000	2565000	53065000
22	100	620	4000	4500	46500000	0	4000000	2565000	53065000
23	100	620	4000	4500	46500000	0	4000000	2565000	53065000
24	100	620	4000	4500	46500000	0	4000000	2565000	53065000
25	100	620	4000	4500	46500000	0	4000000	2565000	53065000
26	100	620	4000	4500	46500000	0	4000000	2565000	53065000
27	100	620	4000	4500	46500000	0	4000000	2565000	53065000
28	100	620	4000	4500	46500000	0	4000000	2565000	53065000
29	100	620	4000	4500	46500000	0	4000000	2565000	53065000
30	100	620	4000	4500	0	46500000	4000000	2565000	53065000
TOTALS					857250000	46500000	100750000	63954000	1068454000

*Calculated no. of trees & cost/yr was based on the DENRs Watershed Development Manual.
Cols 5&6 = Col1*Col2*No.ofHas. On 30th year the derived benefits is for premium species.
Cols 7&8 = Col3*No. of Has.

Appendix Table A.8

BENEFITS FROM AGRICULTURAL CROPS

Parameters:		UR/C Ben(P)*	Hectares	SwtPota,Pea,BshStao Ben(P)	Hectares	Rice/ Peanut Ben(P)	Hectares	Rice/Mungo Ben(P)	Has.
	Year 2	12745.6	50	21476.5	50	8540	50	24200	50
	Year 3	20319.4	100	23700	100	8967	100	32350	100
	Year 4	20319.4	150	23700	150	8967	150	34100	150

YEAR	UR&C	SwtPota,pea BshStao	Rice&Peanut	Rice/Mung	TOTAL
1					
2	637280	1073825	427000	1210000	3348105
3	2669220	3443825	1323700	4445000	11881745
4	3685190	4628825	1772050	6325000	16411065
5	3685190	4628825	1772050	6325000	16411065
6	3685190	4628825	1772050	6325000	16411065
7	3685190	4628825	1772050	6325000	16411065
8	3685190	4628825	1772050	6325000	16411065
9	3685190	4628825	1772050	6325000	16411065
10	3685190	4628825	1772050	6325000	16411065
11	3685190	4628825	1772050	6325000	16411065
12	3685190	4628825	1772050	6325000	16411065
13	3685190	4628825	1772050	6325000	16411065
14	3685190	4628825	1772050	6325000	16411065
15	3685190	4628825	1772050	6325000	16411065
16	3685190	4628825	1772050	6325000	16411065
17	3685190	4628825	1772050	6325000	16411065
18	3685190	4628825	1772050	6325000	16411065
19	3685190	4628825	1772050	6325000	16411065
20	3685190	4628825	1772050	6325000	16411065
21	3685190	4628825	1772050	6325000	16411065
22	3685190	4628825	1772050	6325000	16411065
23	3685190	4628825	1772050	6325000	16411065
24	3685190	4628825	1772050	6325000	16411065
25	3685190	4628825	1772050	6325000	16411065
26	3685190	4628825	1772050	6325000	16411065
27	3685190	4628825	1772050	6325000	16411065
28	3685190	4628825	1772050	6325000	16411065
29	3685190	4628825	1772050	6325000	16411065
30	3685190	4628825	1772050	6325000	16411065
TOTALS	102806630	129495925	49596050	176430000	458328605

Col.1,2,3, & 4 = Annual benefits*Area.

Appendix Table A.9

OFF SITE BENEFITS FROM INCREASED WATER YIELD

Parameters:

Water yield projectn (domestic use)	21560140
Price/cu.m.	2.5
Projected irrigable area (hectares)	4000
Average yield/ha.(tons)	3.5
Water yield (without project)	4842517
Price/ton(pesos)	7000
Irrigable area (without project)	2280
Ave. yield/ha.(without project)	24

YEAR [1]	DOMESTIC/COMMERCIAL USE [2]	IRRIGATION [3]	TOTAL [4]
0			
1			
2			
3			
4	33762500	98000000	131762500
5	46971460	98000000	144971460
6	48184682.5	98000000	146184683
7	49527475	98000000	147527475
8	51545970	98000000	149545970
9	52381500	98000000	150381500
10	53900350	98000000	151900350
11	53900350	98000000	151900350
12	53900350	98000000	151900350
13	53900350	98000000	151900350
14	53900350	98000000	151900350
15	53900350	98000000	151900350
16	53900350	98000000	151900350
17	53900350	98000000	151900350
18	53900350	98000000	151900350
19	53900350	98000000	151900350
20	53900350	98000000	151900350
21	53900350	98000000	151900350
22	53900350	98000000	151900350
23	53900350	98000000	151900350
24	53900350	98000000	151900350
25	53900350	98000000	151900350
26	53900350	98000000	151900350
27	53900350	98000000	151900350
28	53900350	98000000	151900350
29	53900350	98000000	151900350
30	53900350	98000000	151900350
TOTALS	1414280937.5	2646000000	4060280938

Col.2 = Projected water yield for domestic use * Price/cu.m.

Col.3 = Irrigable area*Ave.yield*Price of rice/ton

Appendix Table A.12
(WITH ZERO VALUE ON TREES)

ECONOMIC ANALYSIS OF THE INTEGRATED REHABILITATION AND MANAGEMENT OF MAASIN WATERSHED

Parameter:
Discount Rate 0.12

	C O S T S						TOTAL	BENEFITS WITH PROJECT						BENEFITS WITHOUT PROJE				NET	NET CASH	DNCF
	REFORES	AGROFO	AGRICRO	ANR	SOCIALD	PROMGT	COSTS	REFORES	AGROFO	AGRICRO	DOMESTI	IRRIGN	TOTAL	AGRCRO	DOMESTI	IRRIGN	TOTAL	CHANGE	FLOW	
YEAR																				
0																				
1	7165605	12283895	0	2565990	1000000	4113200	27128690						0	4446850			4446850	-4446850	-31575540	-28192447
2	6837068	14201904	777700	2423513	950000	1812000	27002185			3348105			3348105	4446850			4446850	-1098745	-28100930	-22401889
3	7432886	15531046	1232900	2509380	870000	1812000	29388212			11881745			11881745	4446850			4446850	7434895	-21953317	-15625937
4	1191636	6516731	1849350	660480	500000	1812000	12530197		1035000	16411065	33762500	98000000	149208565	4446850	12106293	19152000	35705143	113503423	100973226	64170311
5	595818	5482957	2034285	256000	500000	1812000	10681060		2298000	16411065	46971460	98000000	163680525	4446850	12106293	19152000	35705143	127975383	117294323	66555949
6	0	1092333	2237714	0	0	1993200	5323246.5		3811000	16411065	48184683	98000000	166406748	4446850	12106293	19152000	35705143	130701605	125378359	63520578
7	0	600783.2	2461485	0	0	2192520	3062268		6565000	16411065	49527475	98000000	170503540	4446850	12106293	19152000	35705143	134798398	131736130	59590735
8	0	0	2707633	0	0	0	2707633.3	0	6565000	16411065	51545970	98000000	172522035	4446850	12106293	19152000	35705143	136816893	134109259	54164480
9	0	0	2978397	0	0	0	2978396.7	0	6565000	16411065	52381500	98000000	173357565	4446850	12106293	19152000	35705143	137652423	134674026	48564804
10	0	0	3276236	0	0	0	3276236.3	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	135895036	43754565
11	0	0	3603860	0	0	0	3603860	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	135567413	38972392
12	0	0	3964246	0	0	0	3964246	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	135207027	34704276
13	0	0	4360671	0	0	0	4360670.6	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	134810602	30895111
14	0	0	4796738	0	0	0	4796737.6	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	134374535	27495692
15	0	0	5276411	0	0	0	5276411.4	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	133894861	24462091
16	0	0	5804053	0	0	0	5804052.5	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	133367220	21755083
17	0	0	6384458	0	0	0	6384457.8	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	132786815	19339648
18	0	0	7022904	0	0	0	7022903.5	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	132148369	17184520
19	0	0	7725194	0	0	0	7725193.9	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	131446079	15261781
20	0	0	8497713	0	0	0	8497713.3	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	130673559	13546505
21	0	0	9347485	0	0	0	9347484.6	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	129823788	12016439
22	0	0	10282233	0	0	0	10282233	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	128889039	10651714
23	0	0	11310456	0	0	0	11310456	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	127860816	9434588.2
24	0	0	12441502	0	0	0	12441502	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	126729770	8349223.8
25	0	0	13685652	0	0	0	13685652	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	125485620	7381479.1
26	0	0	15054217	0	0	0	15054217	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	124117055	6518728.2
27	0	0	16559639	0	0	0	16559639	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	122611633	5749698.4
28	0	0	18215603	0	0	0	18215603	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	120955669	5064325.3
29	0	0	20037163	0	0	0	20037163	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	119134109	4453623.1
30	0	0	22040880	0	0	0	22040880	0	6565000	16411065	53900350	98000000	174876415	4446850	12106293	19152000	35705143	139171273	117130393	3909569.3
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