An Economic Analysis of Environmental Protection and Management: An Example from the Philippines

C. E. FINNEY*
and
S. WESTERN

Hunting Technical Services Limited, Elstree Way, Boreham Wood, Herts WD6 1SB, U.K.

Summary

The island of Palawan covers some 12000 km² and is located in the southwest of the Philippines archipelago. It is a beautiful and as yet relatively unspoilt island but in recent years the social and economic pressures on its natural resources and environment have begun to mount. If present trends continue, severe environmental damage will result. In recognition of this danger, the Philippines government and the European Economic Community have commissioned the preparation of an Integrated Environmental Program (IEP) for the island, as part of an overall economic development program. Phase one of the IEP study comprised an assessment of the island's resources and present situation and the formulation of a plan for the future protection of its environment, taking due account of the need for continuing economic development.

An analysis was made of the likely economic returns from the proposed environmental protection program, using conventional benefit-cost analysis methodology. Due to the inadequate data base and the wide-ranging assumptions which had to be made, this was inevitably very approximate in nature. It was carried out in terms of the three main types of conservation activity proposed, namely land-based conservation, mangrove conservation and inshore marine conservation, and the program as a whole. The main benefits and costs were identified and, where appropriate, quantified for inclusion in the analysis.

Choice of discount rate and length of analysis period are critical factors affecting the economics of environmental protection, which essentially involves the pursuit of long-term rather than short-term gains, output in the immediate future being restricted to the level of long-term sustained yield for the benefit of future generations. Use of the high discount rates customarily applied for project analysis in countries such as the Philippines (typically, 10–15 percent) places a heavy premium on short-term gains and attributes little or no value to benefits and costs further in the future. To take account of this problem the present values of costs and benefits were calculated using low discount rates of zero and 5 percent. Though this was a necessarily crude and arbitrary method of adjustment it was considered to be a better alternative than that of following normal convention and applying the high rates of discount customarily used in the Philippines.

The analysis indicated that the various conservation activities could be expected to produce acceptable, though not spectacular, levels of economic return. Mangrove conservation would be particularly beneficial and the irrigation benefits from preserving river base flows and preventing an increase in peak floods, by means of catchment protection, would be high. The unquantifiable ecological and social benefits would also be substantial.

The Island of Palawan

Mainland Palawan is the largest of the 1768 islands forming Palawan Province, located in the south-west of the Philippines (Figure 1). The island is long and narrow, extending 425 km from north-east to south-west. It varies in width from over 40 km to little more than 5 km. Total area is some 1.2 million hectares. Most of the island consists of mountainous or hilly upland, with the mountain spine highest in the central and southern ranges, where elevations exceeding 1500 meters occur. The highest point is Mount Matalingahan (2085 m). The climate is tropical monsoonal, with rainfall concentrated in the wet season months of May to December. The driest areas are in the eastern lowlands, where annual rainfall is about 1600 mm; in the mountains it is likely to be two or three times

*Christopher Finney is Chief Economist of Hunting Technical Services Limited, UK, a major consulting firm involved in planning and implementation of agricultural development overseas, and has been with the firm since 1962. He is an agricultural economist with particular interest and experience in the fields of irrigation, livestock, farm mechanisation, general agriculture and conservation. He has worked on a wide variety of projects in numerous countries in Africa, Asia and Latin America. Mr Stanley Western is a senior soil scientist and land use planner with the same company. Since joining the firm in 1960 he has undertaken a very wide range of resource assessment and planning assignments in Asia, Africa and Latin America. He was Team Leader on the Palawan Integrated Environmental Program planning study.

BEST AVAILABLE COPY

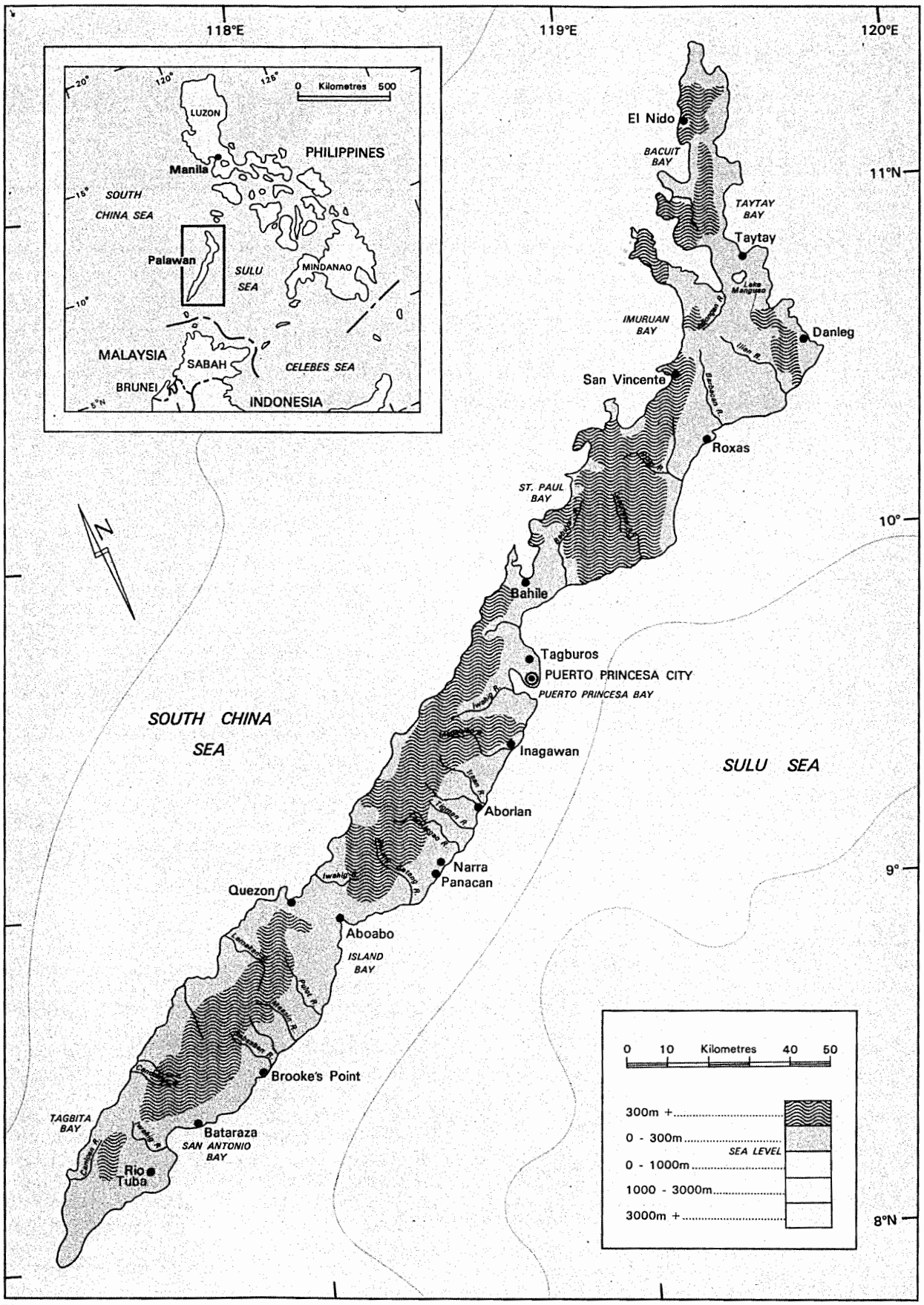
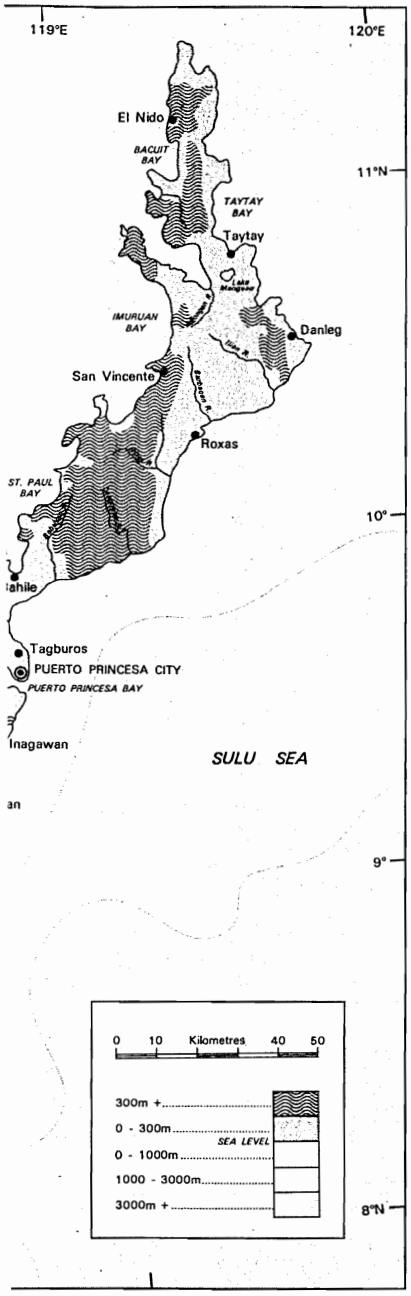


Fig. 1. Palawan and the Philippines.

BEST AVAILABLE COPY



greater. Rainfall intensity is high, although typhoons rarely occur.

The island is richly endowed with natural resources, which include cultivable land, forests and marine and mineral resources. The lowlands and lower hills are suitable for a wide range of agricultural crops. About two-thirds of the land area is still under forest and this is mainly tropical hardwood, usually of substantial commercial value. There are well-stocked fishing grounds in the adjacent seas. Mineral resources include chromite, nickel, silica, limestone, manganese, copper, iron and silver deposits and offshore oil reserves.

Palawan's flora and fauna are rich and diverse, with a considerable number of endemic species. In ecological terms the island is Bornean in character. Five of the birds endemic to Palawan are considered to be rare or endangered and one, the Peacock Pheasant, is listed in IUCN's Red Data Book covering endangered species of international importance. The only large mammals are wild pigs and dugongs - the latter is under heavy hunting pressure and numbers have been seriously reduced. Endemic mammals include the Palawan bearcat, the Palawan porcupine and the scaly anteater or pangolin. Crocodiles are present in small numbers but snakes are widespread and monitor lizards have been quite widely recorded.

The economy is based on primary production, the main activities being agriculture, commercial logging, fishing and mining. There is little manufacturing industry, and tourism, despite its potential, has not yet been developed on any scale.

The population of mainland Palawan was estimated to be 310 000 in 1983 but is rising rapidly at an annual rate of 4.6 percent. By the year 2007 it is expected to have trebled. About half the annual increase is due to immigration from other parts of the province and the Philippines. Some 75 percent of the population is Christian, mainly Roman Catholic. About 20 percent is made up of cultural minorities (aboriginals) such as the Tagbanuas, Palawans and Bataks, the remaining 5 percent being Moslems, living chiefly in the south.

In addition to its considerable socio-economic potential, Palawan has a special asset in its outstanding natural beauty (Figs. 2 and 3). It has excellent beaches, a profusion of coral reefs, a remarkable underground river, extensive forests, lakes and waterfalls, and rich and varied and sometimes unique forms of wildlife, all set in landscapes which are often of outstanding beauty. Many of these places are at present quite inaccessible, especially in the wet season, and remain almost completely unspoiled.

These landscapes, coupled with the rich natural fauna and flora which they support, offer considerable attractions for foreign tourists and visitors from other parts of the Philippines and for local people. The scientific value of Palawan's wild plant and animal life is great; a large number of endemic species occur and

Fig. 2. Palawan coastal scene, with typical fishing boats.

new ones are still being discovered. Most depend, directly or indirectly, on the forests for their survival as, indeed, does the well-being of Palawan and its people in the longer term. Most of Palawan's higher uplands are still forested but the lower hills and plains have been cleared. Although the most vulnerable parts of the island's environment are still intact, they are being increasingly attacked and exposed by the incursion of shifting cultivation, or 'kaingin', and in certain areas they have been degraded by damaging logging and mining activities.

River courses and run-off slopes are short and their gradients steep. Consequently, once the protective forest has gone, the fierce rainfall accelerates erosion. Soil removal and gullying destroy the upland's forest-bearing capacity and any agricultural potential. River regimes are changed by the reduced natural water storage and increasingly rapid rainfall run-off, so that previously perennial rivers and streams become seasonal, alternating between floods and zero flow. Irrigation from such rivers is impossible and existing schemes have to be abandoned. Groundwater recharge is also reduced by rapid run-off. The floods destroy crops on lowlands and cover good agricultural soils with coarse debris of gravels and cobbles.

Fig. 3. Palawan coastal scene.

Best Available Document

Settlements dependent on the streams and rivers are left without a reliable water supply and at the same time are threatened by flood destruction. Finer sediment transported by the rivers is carried out to sea, where it eventually kills the coral and impoverishes fishing grounds. As yet, these processes of environmental degradation are only just beginning to threaten Palawan. The introduction by the Government of the Philippines of integrated development and environmental projects is a timely intervention, which it is hoped will stimulate Palawan's economic development whilst safeguarding its natural beauty and ecological heritage.

Palawan's present situation is marked by low agricultural productivity, upland agriculture that destabilizes the physical environment, limited markets, a weak industrial sector, inadequate infrastructure, uncertainty of land tenure, and weak rural institutions and credit systems. In order to combat these problems and remedy the general low level of development in Palawan, the Government of the Philippines established the Palawan Integrated Area Development Project (PIADP) on 18th January, 1979. This is the fifth development project mounted by the National Council on Integrated Area Development (NACIAD) and the first to include a specific environmental component, the Integrated Environmental Program (IEP). The aim of the integrated area development approach is to promote multi-sectoral development in a unified rather than piecemeal manner.

PIADP comprises 14 components grouped under six main headings: Agricultural Development, Transport Development, Health Facilities and Services, Land Classification and Titling, Environmental and Project Benefit Monitoring and Evaluation, and Project Management. PIADP coordinates the activities of the different Government agencies directly responsible for implementation of the project components.

The Integrated Environmental Program (IEP) is funded by the European Economic Community (EEC). Phase I of IEP began in February 1983 and ended in October 1983. Phase II began in late 1984 and will last for 15 months.

The Integrated Environmental Plan

General

The rapid acceleration of development in recent years poses grave environmental dangers in a tropical situation such as that of Palawan, where climatic factors, allied to the particular topography of the island, result in a natural environment peculiarly sensitive to major change. Without control of such change, environmental degradation can be rapid, far-reaching and, in many respects, irreversible. The avoidance of such dangers, while developing natural resources for the maximum sustainable benefit, is the goal of the Integrated Environmental Plan.

The Integrated Environmental Program (IEP) prepared the Plan during Phase I. During Phase II the Plan is being refined and implementation is being initiated. Medium and long-term implementation will be undertaken by a Palawan Environmental Secretariat (PES), integrated within the Government at local, provincial and national levels.

Ecological zones

An important part of the early planning work was the division of the island into ecological zones. The concept of zonation was developed in Phase I to facilitate an environmental planning and management approach based on the correct allocation of land use for a given type of land. Such allocation should be primarily influenced by (a) the inherent physical characteristics of the land and (b) the present socio-economic condition of the land.

Since physical characteristics will not change on any large scale as a result of development practices, they form a fairly rigid framework for the first level of zonation in mainland Palawan. Five zones were defined on this basis and, as would be expected, these correlate with the pedogeomorphic units. It was also necessary to define a sixth zone, comprising those parts of the sea adjacent to mainland Palawan which are likely to be directly affected by activities on the island. The six zones, the locations and areas of which are shown in Figure 4, are as follows:

- The Inshore Marine Zone; here fishing is the main activity, with some coral and shell collection and a limited amount of tourism.
- The Mangrove Zone (46 000 ha), found on only a few stretches of the coast. Mangrove swamp is reputed to be one of the richest ecological units on earth, and the importance of this zone to Palawan is certainly much greater than its total area would suggest. Fishing, charcoal and other wood collection, and fish ponds are the main forms of land use.
- The Lowland Zone (163 000 ha), concentrated mainly on the eastern side of the island south of Puerto Princesa, the capital. Here most of the natural forest has been cleared for settled agriculture. The zone is the island's main producer of rice, the staple diet.
- The Low Hills Zone (201 000 ha), most of which has been cleared for kaingin. Only 15 percent of the area is still under productive forest.
- The Steep Hills Zone (216 000 ha), in which slopes are generally too steep for settled farming without terracing. Most of this zone is still forested, although about one fifth is under kaingin.
- The Mountain Zone (524 000 ha), occupying some 45 percent of Palawan's total land area. This has little economic potential and almost all is still under forest.

These zones are not simply geographical. Under

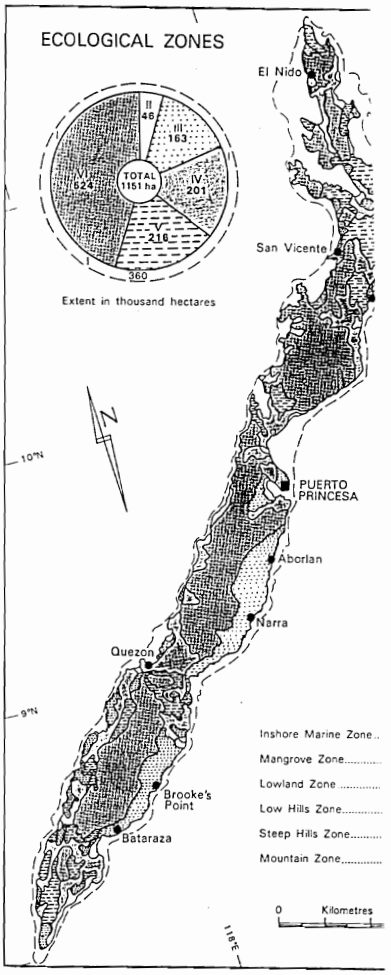


Fig. 4. The Ecological Zones of Palawan.

natural conditions the undisturbed flora ar would correlate broadly with these physical to form natural ecological units or groups Man's ability to override nature has resulte ruption or complete change of large parts ecological units, notably in the Lowland a Hills Zones.

Man's influence on the present conditior land is one of the main factors in the subdiv zones into sub-zones. Thus present land use p

Volume 6, Number 1, 45–61 (1986)

Best Available Document

Integrated Environmental Program (IEP) pre- the Plan during Phase I. During Phase II the s being refined and implementation is being :d. Medium and long-term implementation will ertaken by a Palawan Environmental Secretar- :S), integrated within the Government at local, cial and national levels.

ical zones

portant part of the early planning work was the n of the island into ecological zones. The con- zonation was developed in Phase I to facilitate vironmental planning and management ap- ı based on the correct allocation of land use for n type of land. Such allocation should be pri- influenced by (a) the inherent physical charac- :s of the land and (b) the present socio-economic ion of the land.

:e physical characteristics will not change on rge scale as a result of development practices, ›rm a fairly rigid framework for the first level of on in mainland Palawan. Five zones were de- ›n this basis and, as would be expected, these ıte with the pedogeomorphic units. It was also ary to define a sixth zone, comprising those ›f the sea adjacent to mainland Palawan which :ely to be directly affected by activities on the . The six zones, the locations and areas of which own in Figure 4, are as follows:

e Inshore Marine Zone; here fishing is the main :ivity, with some coral and shell collection and a ıited amount of tourism.

e Mangrove Zone (46 000 ha), found on only a / stretches of the coast. Mangrove swamp is ›uted to be one of the richest ecological units on :th, and the importance of this zone to Palawan :ertainly much greater than its total area would ggest. Fishing, charcoal and other wood collec- n, and fish ponds are the main forms of land use.

e Lowland Zone (163 000 ha), concentrated ıinly on the eastern side of the island south of ıerto Princesa, the capital. Here most of the tural forest has been cleared for settled agricul- :e. The zone is the island's main producer of rice, : staple diet.

e Low Hills Zone (201 000 ha), most of which s been cleared for kaingin. Only 15 percent of : area is still under productive forest.

ıe Steep Hills Zone (216 000 ha), in which slopes : generally too steep for settled farming without 'racing. Most of this zone is still forested, al- ›ugh about one fifth is under kaingin.

ıe Mountain Zone (524 000 ha), occupying some percent of Palawan's total land area. This has :le economic potential and almost all is still der forest.

:se zones are not simply geographical. Under natural conditions the undisturbed flora and fauna would correlate broadly with these physical divisions to form natural ecological units or groups of units. Man's ability to override nature has resulted in disruption or complete change of large parts of these ecological units, notably in the Lowland and Low Hills Zones.

Man's influence on the present condition of the land is one of the main factors in the subdivision of zones into sub-zones. Thus present land use provided the basis for delineating sub-zones. The influence of other factors, especially climate, in separating productive and non-productive forest is also important. Altogether 20 sub-zones were recognised, the main basis for sub-division being whether the land is still forested, has been cleared for kaingin (Figure 5) or is now under settled cultivation. They represent either natural ecological divisions in which vegetation remains in, or close to, the climax state or, more often, successional or degradation departures from the climax state under the influence of man.

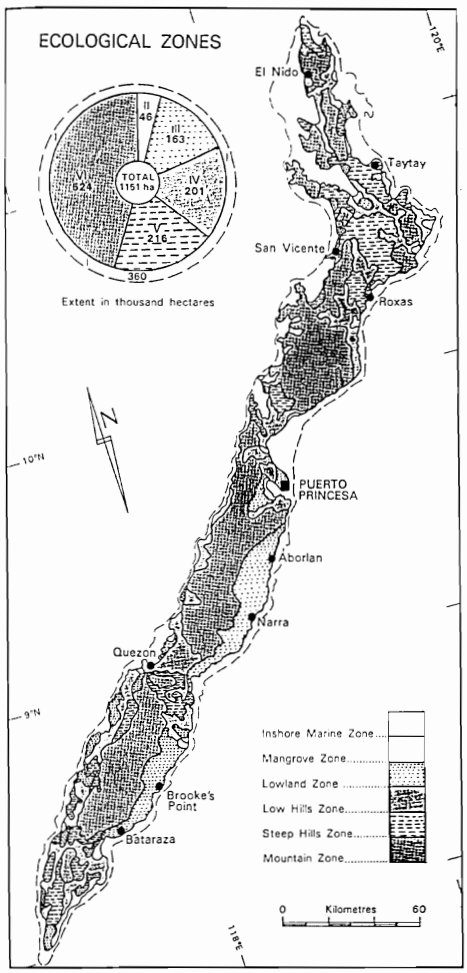


Fig. 4. The Ecological Zones of Palawan.

The proposed Integrated Environmental Plan

The structure of the proposed Plan consists of an integrated series of programs and projects extrapolated over a ten-year period, the objectives being to:

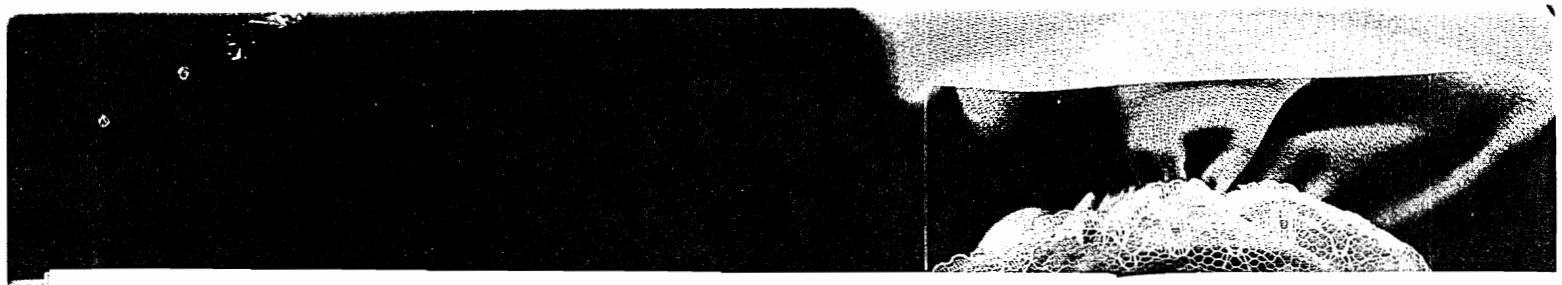
- Stabilise the environment, within the ten-year period;
- Develop Palawan's natural resources to the fullest extent consistent within sound long-term management concepts;
- Conserve Palawan's unique or special landscapes and wildlife, with benefits to science, tourism and recreation;
- Accommodate the expected increased population in ways consistent with maintaining a stable environment;
- Create the optimum conditions for health, employment and income generation.

The central core of the Plan is the maintenance of forest in the steeper uplands, which are not suited to settled farming, the eventual replacement of the destructive kaingin system by settled farming and the conservation of the coastal mangroves. Specific plan components include:

(a) Measures to stabilise the environment, including:
- Protection of forest on the steeper uplands;
- Better regulation of commercial logging;

Fig. 5. Recent forest clearance for 'kaingin' (shifting cultivation) with maize in foreground.

Best Available Document



- Improved and accelerated land classification of forest lands to improve regulation or control of settlement within them;
- Protective management of the coastal mangroves, so important to inshore fisheries;
- Measures to introduce stable systems of agriculture in already occupied areas (including increased emphasis on the present Upland Stabilisation Program (USP));
- Special studies and remedial programs for endangered catchments, especially in the south-east;
- Final selection and establishment of National Parks and Reserves, both terrestrial and marine, to protect Palawan's unique wildlife and to encourage tourism.

(b) Development activities aimed at improving or maximising settlement and production in environmentally sound locations so as to act as magnets attracting settlement - thus relieving pressure on environmentally vulnerable areas. These activities would include physical elements such as roads and water supplies and social elements such as education and health. Special emphasis would be placed on:

- Developing stable farming systems in the Low Hills Zone;
- Intensifying agriculture and settlement in the Lowland Zone;
- Accelerated land classification and titling in both these zones;
- Developing the full potential for irrigation.

(c) Developing a mechanism for plan implementation, involving:

- Setting up the Provincial Environmental Staff (PES) and the Environmental Monitoring and Evaluation System (EMES);
- Strengthening key agencies involved in Plan implementation, especially the Bureau of Forest Development (BFD) and those agencies responsible for marine resources development and regulation;
- Developing local awareness of environmental problems.

Approach and Methodology for the Economic Analysis of the Proposed Plan

Introduction

The analysis of the economic benefits and costs of the environmental protection program for mainland Palawan contained in the Integrated Environmental Plan was based on a comparison of the Plan's anticipated results with those of the 'present trends' scenario, which represents the 'without protection' situation and hence provides a baseline for comparison. The analysis was preliminary in nature and inevitably very approximate. The existing data base was insufficient to enable more detailed analysis to be carried out; the quality of information available on the resources and present situation on Palawan is very variable. In addition, accurate predictions of the consequences of future environmental trends in terms of soil erosion, agriculture, river flows, siltation of coral reefs and other aspects are notoriously difficult to make. Few comprehensive economic assessments of this type of protection have been undertaken anywhere in the Tropics, partly for this reason.

In the analysis all costs and benefits were valued at 1983 constant prices and thus excluded the effects of future inflation. The analysis was made at economic rather than financial or market prices, in order to assess the values of the costs and benefits to the island and the national economy as a whole. The approach to the environmental economic analysis evolved for Palawan is best discussed in terms of the four main issues:

- Benefit categories and valuation
- Development costs and benefits
- Allocation of costs and benefits between Plan components
- Discount rates and analysis period.

Benefit Categories and Valuation

Environmental protection for Palawan would produce both direct ('internal') and indirect ('external') benefits. These can be divided, in turn, into quantifiable and unquantifiable. Many environmental goods and services are not easily priced; in Palawan these include outdoor recreational amenities, outstanding scenic, cultural and scientific resources, and key natural functions of the forest ecosystems. In addition, planning in Palawan is a multiple-objective exercise including major objectives which are non-economic, such as promoting social equity, health, and long-term quality of life. Various attempts to establish sound principles for quantifying these 'externalities' have been made in recent years but, as in-depth reviews by Hufschmidt and Lyman (1982) and O'Riordan and Turner (1983) show, results have been unconvincing.

The main benefits would take the following forms:—

- Sustained forest production
- Sustained fisheries production
- Rained and irrigated agricultural production
- Various ecological benefits, such as the preservation of ecosystems, flora and fauna
- Various social benefits, such as the maintenance of the island's capacity to support its population at an adequate standard of living
- Prevention of the increase in flood damage which would take place in the absence of effective catchment control
- Continued growth in tourism, due to the maintenance of Palawan's natural beauty and other attractions.

This list includes both direct and indire
- in many cases it is difficult to draw the lir
the two categories. The distinction betwee
able and non-quantifiable is more importar
cated above, realistic valuation of s
ecological benefits is extremely difficult, e
there is a good data base - this is not t
Palawan. Such benefits were, therefore, nc
in the economic analysis. Values for the
forms of benefits were included, albeit in fair
imate fashion, due to the limited data avai

Development Costs and Benefits

Another problem in economic assessment
stems from its necessary integration with
primarily development rather than envi
protection activities; these comprise the s
components of mining, urban and industri
improved transport communications (ro
and airports), and tourism (including natu
vation), plus the considerable agricultura
ment envisaged. The latter would in
improvement of rainfed and irrigated lowla
ture, the widespread establishment of stabl
ing in the Low Hills Zone, and some a
development in the Steep Hills Zone.

The approach initially considered for tl
was to estimate all the quantifiable benefits
of the components involved in the Integrate
mental Plan. These estimates would, there
included not only the direct benefits fror
mental protection but also what could be
indirect development benefits, such as th
returns from the various agricultural co
These benefits are likely to be very large: fo
the Plan calls for the establishment by the y
98 000 ha of stable hill farming and 7500 h
forestry, as an alternative to present trenc
increasingly widespread and intensive kai
agricultural development could provide
turns of some Pesos 150 million (US$ 13.6
1983 prices. These figures would dwarf thos
environmental protection benefits and wou
result in an analysis of an agricultural de
project with a significant environmental ele
er than of the environmental protectior
itself.

Mining, urban and industrial growth, anc
transport communications all represent s
development activities for which the Plar
regulation by means of Environmental Im
ments. In view of the economic and social i
of most such developments, regulation wou
istic only in cases of extreme or unwarrante
mental threat, as for instance if the n
beaches of Imuruan Bay were to be exploite
In all such site-specific cases the aim woul
be to minimize damaging impacts. The

nt situation on Palawan is very variable. In ion, accurate predictions of the consequences of : environmental trends in terms of soil erosion, ılture, river flows, siltation of coral reefs and aspects are notoriously difficult to make. Few rehensive economic assessments of this type of :tion have been undertaken anywhere in the cs, partly for this reason.

he analysis all costs and benefits were valued at :onstant prices and thus excluded the effects of inflation. The analysis was made at economic than financial or market prices, in order to the values of the costs and benefits to the island ıe national economy as a whole. The approach environmental economic analysis evolved for an is best discussed in terms of the four main

ıefit categories and valuation
velopment costs and benefits
ocation of costs and benefits between Plan nponents
:count rates and analysis period.

· *Categories and Valuation*

nmental protection for Palawan would proth direct ('internal') and indirect ('external') s. These can be divided, in turn, into quantifiıd unquantifiable. Many environmental goods rvices are not easily priced; in Palawan these : outdoor recreational amenities, outstanding cultural and scientific resources, and key naınctions of the forest ecosystems. In addition, ıg in Palawan is a multiple-objective exercise ng major objectives which are non-economic, promoting social equity, health, and long-term of life. Various attempts to establish sound les for quantifying these 'externalities' have ade in recent years but, as in-depth reviews by midt and Lyman (1982) and O'Riordan and (1983) show, results have been unconvincing. main benefits would take the following –

ained forest production
ained fisheries production
ıed and irrigated agricultural production
ous ecological benefits, such as the preserva- of ecosystems, flora and fauna
ous social benefits, such as the maintenance of sland's capacity to support its population at dequate standard of living
ention of the increase in flood damage which ld take place in the absence of effective catch- : control
:inued growth in tourism, due to the mainten- of Palawan's natural beauty and other attrac-

This list includes both direct and indirect benefits – in many cases it is difficult to draw the line between the two categories. The distinction between quantifiable and non-quantifiable is more important. As indicated above, realistic valuation of social and ecological benefits is extremely difficult, even where there is a good data base – this is not the case in Palawan. Such benefits were, therefore, not included in the economic analysis. Values for the other five forms of benefits were included, albeit in fairly approximate fashion, due to the limited data available.

Development Costs and Benefits

Another problem in economic assessment of the Plan stems from its necessary integration with what are primarily development rather than environmental protection activities; these comprise the supra-zonal components of mining, urban and industrial growth, improved transport communications (roads, ports and airports), and tourism (including nature conservation), plus the considerable agricultural development envisaged. The latter would include the improvement of rainfed and irrigated lowland agriculture, the widespread establishment of stable hill farming in the Low Hills Zone, and some agroforestry development in the Steep Hills Zone.

The approach initially considered for the analysis was to estimate all the quantifiable benefits and costs of the components involved in the Integrated Environmental Plan. These estimates would, therefore, have included not only the direct benefits from environmental protection but also what could be termed the indirect development benefits, such as the net crop returns from the various agricultural components. These benefits are likely to be very large: for example, the Plan calls for the establishment by the year 2007 of 98 000 ha of stable hill farming and 7500 ha of agroforestry, as an alternative to present trends towards increasingly widespread and intensive kaingin. This agricultural development could provide annual returns of some Pesos 150 million (US$ 13.6 million) at 1983 prices. These figures would dwarf those for direct environmental protection benefits and would in effect result in an analysis of an agricultural development project with a significant environmental element, rather than of the environmental protection program itself.

Mining, urban and industrial growth, and improved transport communications all represent site-specific development activities for which the Plan demands regulation by means of Environmental Impact Statements. In view of the economic and social importance of most such developments, regulation would be realistic only in cases of extreme or unwarranted environmental threat, as for instance if the magnificent beaches of Imuruan Bay were to be exploited for silica. In all such site-specific cases the aim would generally be to minimize damaging impacts. The costs and benefits of doing this would have to be assessed on a case-by-case basis and would in most cases be minor, having little effect on the overall economic analysis of the Plan.

A further difficulty with including related development costs and benefits is that few of the major development components have reached even the feasibility study stage. This means that only very provisional figures are available and that there are numerous uncertainties and unknowns.

As a result of these considerations, it was decided to modify the analysis approach in order to provide what was actually required, namely an economic assessment of environmental protection for Palawan. Exclusion of the overall economic impact of the complete, fully integrated development and environmental programs represent a lowest bounds situation, in that returns to the various development inputs are certain to at least equal, and generally to considerably exceed, the returns calculated here for the Environmental Plan.

Allocation of Costs and Benefits within the Plan

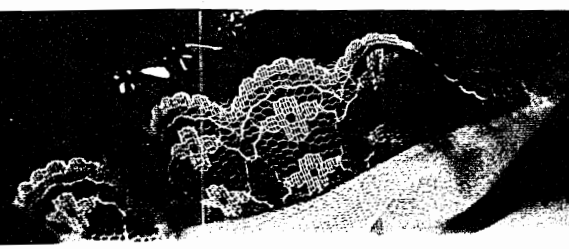
Analysis was carried out in terms of the three main groupings of the components proposed by the Plan:

— Land-based protection
— Mangrove conservation
— Inshore marine conservation

Land-based protection activities included in the analysis were sustained commercial logging (rather than short-term over-exploitation), reforestation and rehabilitation, forest preservation, and associated catchment protection work. The major development activities, notably the various forms of rainfed agriculture, were omitted, as noted above, except that the direct effects of forest and catchment protection on irrigation, tourism and other economic aspects were taken into account.

Although it would be desirable to assess the justification of these three main protection components separately as well as together, this was made difficult by the fact that certain benefits would be derived from two or more components. A complete economic analysis of each component separately was thus not feasible. Instead, the approach adopted was as follows:

(1) The capital and recurrent costs of each component were estimated.
(2) Benefits were divided into two types, 'separable' (i.e. attributable to only one component) and 'common' (attributable to two or more components) and the values of each form of benefit were estimated item by item. Marine conservation, for example, produces both types.
(3) For land-based and mangrove conservation a comparison of costs and separable benefits was



then made, to see whether their implementation might be economically justifiable even if the common benefits are not taken into account. A similar analysis could not be undertaken for marine conservation because all its benefits are common. This analysis gives some indication of the economic value of going ahead with a component even if the other two were postponed, cancelled or reduced in scale.

(4) An assessment of the overall costs and benefits, both separable and common, of the proposed Environmental Plan was then made.

Discount rates and analysis period

Benefit - cost analysis is the normal method used to assess the economic justification of development and conservation programs. It involves the estimation of a program's or project's future economic benefits and capital and recurrent costs for each year of the analysis period, to create the year-by-year 'cash flow', and then the discounting of these sums to calculate the Net Present Value (NPV) and the Internal Rate of Return (IRR).

NPV (sometimes termed 'Present Worth') is a measure of the net value of a program (i.e. its total benefits minus its total costs) as seen from the point in time at which its expenditure starts (i.e. the present), after taking account of the fact that money earned or invested now has a higher value to an individual, community or nation than the equivalent earned or invested some time in the future. Faced with the choice of two investments of equal amounts, one of which would start yielding an annual benefit or income after one year and the other of which would start yielding the same levels of benefit after only, say, 10 years, one would obviously opt for the former.

Benefit - cost analysis enables this time factor to be taken fully into account, by means of a method calling 'discounting'. All future values are converted to their present value (their value at the start of the program; i.e. normally the present time) using a specific discount rate chosen by the analyst. For the purposes of explanation, a discount rate can be considered to be the same as an interest rate and in most cases is based on the opportunity cost of capital in the national economy; that is, the average real return, excluding the future effects of inflation, that can be earned by investing money in favourable enterprises or projects anywhere in the economy.

Discount factors to be applied to the year-by-year program benefits and costs can be obtained from published tables and are multiplied by the particular benefit or cost value in any year to calculate its present value. Taking interest rates (i.e. discount rates) of 5 percent and 10 percent as an example the discount factors for certain future years in a project's life would be as follows:

	DISCOUNT FACTORS	
Year after start of project	5 percent interest rate	10 percent interest rate
1	0.9524	0.9091
5	0.7835	0.6209
10	0.6139	0.3855
20	0.3769	0.1486

These factors are reciprocals of the compound interest rate factors. They illustrate how the timing of benefits and costs over a project's life is taken properly into account by the discounting process. Assuming an opportunity cost of capital of 10 percent, a sum of £1,000 spent or earned in the first year of a project's life would be worth £909 (£1,000 × 0.9091) in present day terms (i.e. at the start of the project) whereas the same sum spent or earned in 20 years would be worth only £149 (£1,000 × 0.1486). This huge difference allows for the fact that £1,000 received or spent in Year 1 could be invested elsewhere and could earn interest at the rate of 10 percent per annum from then on, whereas with the same level of benefit received only in Year 20, 19 years interest would be missed.

The above example also illustrates the effect that choice of discount rate has on NPVs. If a rate of 5 percent rather than 10 percent were assumed, the present value of a future sum would be substantially greater. Because the return that can be obtained from the use of capital is less, so the income foregone by receiving money later rather than earlier is correspondingly reduced. Carrying the argument to its extreme, if the opportunity cost of capital were zero (i.e. average returns on capital investment were negligible) the present value of a given sum would be the same as in any year in the future, the discount factor being 1.0.

The NPV gives the sum of a project's discounted benefits minus discounted costs over the total project life or analysis period, at the particular discount rate applied. In some cases separate NPVs may be calculated at two or more different discount rates, to see the effect of varying discount rate assumptions.

The IRR is also calculated by means of discounting over a project's life and is a measurement of the overall return on capital employed. It is calculated by discounting year-by-year benefits and costs at various discount rates, the IRR being that discount rate at which the total present value of benefits equals the total present value of costs.

So far, discount rates have been considered as being based on the opportunity cost of capital. This is often also taken as representing the 'social rate of time preference', the premium that is attributed by society to income now rather than at some time in the future.

In principle, the richer the country, the m
are willing and able to forego present inc
of income in the future, and thus the lo
rate of time preference. As the concludi
in the final Section of this paper indica
there may sometimes be a case for assu
rate of time preference different from th
cost of capital, especially in the case
conservation.

The above discussion demonstrates th
of the choice of discount rate in pro
Length of analysis period is also impor
the greater the number of years incl
analysis, the larger the total benefits ove
project life. Both points are particularly
the case of the economics of environment
The fundamental objective of conservati
tect the environment for the use of future
by restricting exploitation of a resour
which can be sustained indefinitely witho
damage. This implies the pursuit of lon
than short-term gains. In the case of r
sources such as forests or fish stocks th
choice to be made between over-explo
high levels of output (benefit) for a limite
then little or no production for a consi
thereafter, and exploitation on a sustaine
In the latter situation output will tend t
the immediate future but higher in the l

The opportunity cost of capital in deve
tries such as the Philippines, where capit
supply and there are many opportunit
profitably, is generally considered to
high, in the 10–15 percent per annum ra
as representing also the social rate of tim
these high rates place a heavy premium
the present and immediate future.

Use of such high discount rates thus fa
term rather than longer-term gains an
exploitation rather than sustained yields.
Palawan's forest resources, for example,
comparison between over-exploitation
tained yield policy, using these convent
discount rates, would show that the best
extract all the island's commercial timbe
possible, even though this would result i
production in the longer term. The re
forestry benefits obtained in the longer
have little or no present value when disc
10–15 percent are applied.

Taken to its logical extreme, a policy b
principles would be absurd. All resourc
exploited as rapidly as possible, without r
future, and there would be little or nothin
the population once the resources had bee
Economic activity would be devoted en
interests of the present generation, at th

an example the discount factors for certain future years n a project's life would be as follows:

Year after start of project	DISCOUNT FACTORS 5 percent interest rate	10 percent interest rate
1	0.9524	0.9091
5	0.7835	0.6209
10	0.6139	0.3855
20	0.3769	0.1486

These factors are reciprocals of the compound nterest rate factors. They illustrate how the timing of benefits and costs over a project's life is taken properly nto account by the discounting process. Assuming an opportunity cost of capital of 10 percent, a sum of :1,000 spent or earned in the first year of a project's ife would be worth £909 (£1,000 × 0.9091) in present lay terms (i.e. at the start of the project) whereas the ame sum spent or earned in 20 years would be worth nly £149 (£1,000 × 0.1486). This huge difference al-ows for the fact that £1,000 received or spent in Year 1 ould be invested elsewhere and could earn interest at e rate of 10 percent per annum from then on, hereas with the same level of benefit received only in ear 20, 19 years interest would be missed.

The above example also illustrates the effect that hoice of discount rate has on NPVs. If a rate of 5 ercent rather than 10 percent were assumed, the resent value of a future sum would be substantially reater. Because the return that can be obtained from e use of capital is less, so the income foregone by ceiving money later rather than earlier is corre-ondingly reduced. Carrying the argument to its treme, if the opportunity cost of capital were zero e. average returns on capital investment were negli-le) the present value of a given sum would be the me as in any year in the future, the discount factor ing 1.0.

The NPV gives the sum of a project's discounted nefits minus discounted costs over the total project e or analysis period, at the particular discount rate plied. In some cases separate NPVs may be calcu-ted at two or more different discount rates, to see the ect of varying discount rate assumptions.

The IRR is also calculated by means of discounting er a project's life and is a measurement of the erall return on capital employed. It is calculated by scounting year-by-year benefits and costs at various scount rates, the IRR being that discount rate at ich the total present value of benefits equals the al present value of costs.

So far, discount rates have been considered as being sed on the opportunity cost of capital. This is often o taken as representing the 'social rate of time ference', the premium that is attributed by society income now rather than at some time in the future.

In principle, the richer the country, the more its people are willing and able to forego present income in favour of income in the future, and thus the lower the social rate of time preference. As the concluding discussion in the final Section of this paper indicates, however, there may sometimes be a case for assuming a social rate of time preference different from the opportunity cost of capital, especially in the case of resource conservation.

The above discussion demonstrates the importance of the choice of discount rate in project analysis. Length of analysis period is also important, because the greater the number of years included in the analysis, the larger the total benefits over the assumed project life. Both points are particularly important in the case of the economics of environmental protection. The fundamental objective of conservation is to protect the environment for the use of future generations, by restricting exploitation of a resource to a level which can be sustained indefinitely without permanent damage. This implies the pursuit of long-term rather than short-term gains. In the case of renewable resources such as forests or fish stocks there is often a choice to be made between over-exploitation, with high levels of output (benefit) for a limited period and then little or no production for a considerable time thereafter, and exploitation on a sustained yield basis. In the latter situation output will tend to be lower in the immediate future but higher in the longer term.

The opportunity cost of capital in developing countries such as the Philippines, where capital is in short supply and there are many opportunities to use it profitably, is generally considered to be relatively high, in the 10–15 percent per annum range. If taken as representing also the social rate of time preference these high rates place a heavy premium on income in the present and immediate future.

Use of such high discount rates thus favours short-term rather than longer-term gains and thus over-exploitation rather than sustained yields. In the case of Palawan's forest resources, for example, an economic comparison between over-exploitation and a sustained yield policy, using these conventionally high discount rates, would show that the best policy is to extract all the island's commercial timber as soon as possible, even though this would result in little or no production in the longer term. The reason is that forestry benefits obtained in the longer term would have little or no present value when discount rates of 10–15 percent are applied.

Taken to its logical extreme, a policy based on such principles would be absurd. All resources would be exploited as rapidly as possible, without regard to the future, and there would be little or nothing to support the population once the resources had been exhausted. Economic activity would be devoted entirely to the interests of the present generation, at the expense of future generations. This is neither desirable nor sensible.

It might be argued that part of the income generated by maximizing production in the short term would be used to invest in other activities (e.g. manufacturing industry) which would help to support the population in the future. In the case of Palawan it is difficult to see this happening on a large scale; the island's economy can be expected to continue to depend on its natural resources for the foreseeable future. If this is so, conventional economic analysis based on the use of the high discount rates customarily applied in the Philippines is inappropriate for the assessment of the IEP environmental protection program. In most cases it will show that conservation is not economically justified and that the best thing is to exploit all the resources as rapidly as possible, even though this is clearly not in the best long-term interests of the local population.

An alternative approach was, therefore, adopted for the IEP economic analysis. From the viewpoint of analyzing conservation costs and benefits the basic problem is that the normal discount rates of 10–15 percent place insufficient value on longer-term benefits and costs. The simplest way of correcting this fault is to apply lower discount rates, thereby increasing the relative importance of longer-term benefits and costs in the analysis. Since there is no recognized basis from which to derive an exact figure for this modified discount rate, two rates, zero percent and 5 percent, representing what was considered to be a reasonable range of values, were used.

A discount rate of zero implies that future income is considered to be just as important as present income and that the maintenance of the resource base for the use of future generations is accorded a high priority. In view of Palawan's rapidly increasing population and finite resource base this is not an unreasonable assumption. On the other hand, it also implies that very low returns on capital are acceptable, which, given the generally high returns to capital in the country's economy (possibly 10–15 percent) is probably over-stating the case. The other discount rate, 5 percent, gives more weight to returns on capital rather than only on maintenance of the resource base and might be considered to represent a reasonable compromise between the two parameters: the opportunity cost of capital and the need to protect future incomes and living standards.

The use of these low discount rates also implicitly takes account of the fact that the real prices or values of certain products or benefits affected by conservation measures will rise with time, as population and demand increase against a more or less fixed resource base. The best examples of this relate to marine fisheries, commercial timber production and general amenity.

Costs of Environmental Protection

Land-based and Mangrove Protection Costs

The land-based and mangrove components were grouped together for costing purposes, because mangrove conservation would be undertaken by the Bureau of Forest Development (BFD), which would also be responsible for most of the land-based protection activities. Land-based and mangrove components protection included:

(i) the capital and recurrent costs of strengthening BFD in order to enable it to perform its duties effectively and to implement its parts of the environmental protection program.
(ii) capital costs of reforestation and forest rehabilitation.
(iii) demarcation and other capital costs of forest preservation.

In 1983 BFD had an estimated 43 professional staff and less than 150 other staff, to cover the 780 000 ha of forest and mangrove on Palawan. With only four vehicles, a general shortage of equipment and inadequate office space and facilities, and this limited complement of staff, it would clearly be unable to provide the desired control over forest utilisation. A vital part of the IEP, therefore, would be a substantial strengthening of the BFD.

It was proposed that staff numbers should be increased by about 170, especially forest guards, office facilities should be greatly improved, additional motor transport, boats and equipment should be purchased and a Provincial BFD coordination office should be set up. The total costs of this strengthening program at 1983 prices were estimated to be:—

	Pesos Million*
Capital Cost	2.31
Recurrent Costs (per annum)	2.65

* The exchange rate applied was US $1.0 = 11.0 Pesos.

It should be noted that all the costs and benefits quoted are in terms of 1983 prices. Inflation in the Philippines has been high since 1983 and, due to the resultant price increases, the benefit and cost values used in the analysis given are now somewhat out of date in terms of today's prices.

Given the crucial importance of forestry to Palawan's economy and physical environment, these costs are not excessive. Not all would be chargeable to the environmental protection program, because some expansion of BFD's staffing and capability was due to take place anyway. For analysis purposes, two thirds of the costs were assumed to be chargeable to the Plan.

The basic purpose of reforestation and rehabilitation would be to protect damaged catchments by restoring their vegetative cover. An average capital cost of Pesos 1000/ha was assumed; this allowed for the heavy maintenance expenditure required in the first one or two years, to establish the trees and plants properly. Maintenance thereafter would be relatively inexpensive. The area currently requiring reforestation and rehabilitation was estimated to be some 40 800 ha, so total capital costs would be Pesos 40.8 million.

Forest preservation would involve the setting-aside of forest reserves in which the only form of exploitation permitted would be the harvesting of minor forest products. Provision of the staff, equipment and facilities needed for the policing of these reserves would be covered under the BFD strengthening program. The only other substantial costs would be the demarcation of the reserves. As an approximate estimate the overall cost of demarcation, including that for national parks, was taken to be Pesos 1500 per 1000 ha of preserved forest. On this basis the total capital cost of preservation of an estimated 331 000 ha of forest would be Pesos 496000.

Marine Conservation Costs

The costs of marine conservation would include:

— The capital and recurrent costs of strengthening the Bureau of Fisheries and Aquatic Resources (BFAR) in order to enable it to carry out its responsibilities more effectively and to implement its parts of the environmental protection plan.
— Those establishment and operation costs of the three proposed marine parks which would not be already covered under the general budget for strengthening BFAR. These costs would not be very large; as a rough estimate a sum of Pesos 0.25 million was allowed. Recurrent costs other than those already included in the estimates for BFAR strengthening are likely to be negligible.

In 1983 BFAR staffing and facilities were completely inadequate and a major expansion was required even without any conservation program. Professional BFAR fisheries staff numbered less than twelve and the Bureau had no boats. A major expansion in staffing, transport, office facilities, equipment and other facilities was proposed, with capital expenditure of Pesos 2.15 million and an increase in BFAR recurrent costs of Pesos 2.42 million per annum. Since much of this expenditure would be incurred for fisheries development (rather than conservation) and deep-sea rather than inshore marine conservation, only one third of the increased costs were included in the analysis.

Other Environmental Protection Costs

Most of the direct environmental protection measures would be carried out by BFD and BFAR, but environmental protection staff would also be needed for

certain other agencies which are involved
indirectly with the island's physical envir
its use and protection. It was envisaged th
organizations would have one Environme
each. Their recurrent costs were estimated
150 000 per annum; capital expenditure
negligible.

Total Costs

The total estimated capital and recurre
environmental protection as proposed by
shown in Table 1. Total capital cost would
million, of which Pesos 43.8 million woul
able against the Plan. Virtually all the capi
ture for the Environmental Plan wo
reforestation and rehabilitation. Stren
BFD and BFAR would not require a
investment but would raise their recurrer
stantially, by some Pesos 5.6 million pe
which Pesos 3.1 million was attributed tc

As noted earlier, cost (and benefit) figu

TABLE 1
Estimated Capital and Recurrent Direct Costs o
Mainland Palawan (Pesos million, at 1983 prices).
specific) development impacts; e.g. mining.

Item	(
CAPITAL COSTS	
Land-based & mangrove conservation:	
Strengthening of BFD	
Reforestation & Rehabilitation	
Forest preservation	
Marine Conservation:	
Strengthening of BFAR	
Development of marine parks	
Other items	N
Total:	
RECURRENT COSTS	
Land-based and mangrove conservation	
Strengthening of BFD	
Reforestation & Rehabilitation	
Marine Conservation:	
Strengthening of BFAR	
Other items	
Total:	

·ring their vegetative cover. An average capital of Pesos 1000/ha was assumed; this allowed for ıeavy maintenance expenditure required in the ɔne or two years, to establish the trees and plants erly. Maintenance thereafter would be relatively ɔensive. The area currently requiring reforestation 'ehabilitation was estimated to be some 40800 ha, tal capital costs would be Pesos 40.8 million.

rest preservation would involve the setting-aside 'est reserves in which the only form of exploita- permitted would be the harvesting of minor products. Provision of the staff, equipment and ies needed for the policing of these reserves ɪ be covered under the BFD strengthening pro- . The only other substantial costs would be the rcation of the reserves. As an approximate esti- the overall cost of demarcation, including that ıtional parks, was taken to be Pesos 1500 per ıa of preserved forest. On this basis the total ıl cost of preservation of an estimated 331000 ha est would be Pesos 496000.

ıe Conservation Costs

osts of marine conservation would include:

ıe capital and recurrent costs of strengthening ɜ Bureau of Fisheries and Aquatic Resources FAR) in order to enable it to carry out its ıponsibilities more effectively and to implement parts of the environmental protection plan.

ıose establishment and operation costs of the 'ee proposed marine parks which would not be eady covered under the general budget for engthening BFAR. These costs would not be ·y large; as a rough estimate a sum of Pesos 0.25 llion was allowed. Recurrent costs other than ɔse already included in the estimates for BFAR ɜngthening are likely to be negligible.

983 BFAR staffing and facilities were comple- adequate and a major expansion was required ·ithout any conservation program. Professional fisheries staff numbered less than twelve and ıreau had no boats. A major expansion in ɜ, transport, office facilities, equipment and acilities was proposed, with capital expenditure ɔs 2.15 million and an increase in BFAR recur- ɔsts of Pesos 2.42 million per annum. Since ɔf this expenditure would be incurred for fisher- elopment (rather than conservation) and deep- her than inshore marine conservation, only one ɔf the increased costs were included in the s.

Environmental Protection Costs

f the direct environmental protection measures ɔe carried out by BFD and BFAR, but environ- protection staff would also be needed for

certain other agencies which are involved directly or indirectly with the island's physical environment and its use and protection. It was envisaged that five other organizations would have one Environmental Officer each. Their recurrent costs were estimated to be Pesos 150000 per annum; capital expenditure would be negligible.

Total Costs

The total estimated capital and recurrent costs of environmental protection as proposed by the Plan are shown in Table 1. Total capital cost would be Pesos 46 million, of which Pesos 43.8 million would be chargeable against the Plan. Virtually all the capital expenditure for the Environmental Plan would be for reforestation and rehabilitation. Strengthening of BFD and BFAR would not require a very heavy investment but would raise their recurrent costs substantially, by some Pesos 5.6 million per annum, of which Pesos 3.1 million was attributed to the Plan.

As noted earlier, cost (and benefit) figures deliberately omitted what are primarily development rather than conservation costs (for agriculture, mining etc). Another cost not taken into account at the initial planning stage was that of the specific environmental institutions required to implement the Plan. This is the cost of Phase II of the Integrated Environmental Program (in effect a capital cost of Pesos 11 million, as it is spread over only 15 months) plus the negligible recurrent costs of maintaining the proposed Environmental Coordinator, his deputy and their office staff beyond Phase II. These costs are not sufficient to significantly affect the economic analysis of the Plan, although they will be included in future attempts at more refined analysis.

Benefits of Environmental Protection

Land-based Protection Benefits

These were divided into separable and common benefits, as noted in the Section on the *Allocation of Costs and Benefits within the Plan.*

TABLE 1
Estimated Capital and Recurrent Direct Costs of Environmental Protection for the Natural Resources of Mainland Palawan (Pesos million, at 1983 prices). Figures exclude costs of protection against supra-zonal (site-specific) development impacts; e.g. mining.

Item	Total Cost (Pesos)	Chargeable to Environmental Protection	Total Cost of Environmental Protection
CAPITAL COSTS			
Land-based & mangrove conservation:			
Strengthening of BFD	2.31	Two thirds	1.53
Reforestation & Rehabilitation	40.80	100%	40.80
Forest preservation	0.50	100%	0.50
	43.61		42.84
Marine Conservation:			
Strengthening of BFAR	2.15	One third	0.72
Development of marine parks	0.25	100%	0.25
	2.40		0.97
Other items	Negligible		Negligible
Total:	46.01		43.81
RECURRENT COSTS			
Land-based and mangrove conservation			
Strengthening of BFD	2.67	Two thirds	1.78
Reforestation & Rehabilitation	0.51	100%	0.51
	3.18		2.29
Marine Conservation:			
Strengthening of BFAR	2.42	One third	0.80
Other items	0.15	100%	0.15
Total:	5.75		3.24

Separable benefits were assessed under:

- Improved agricultural returns, especially from irrigated rice
- Forestry production
- Reduction of flood damage to infrastructure

Common benefits included:

- Fisheries production
- Tourism

(a) Improved Agricultural Returns

Environmental protection as proposed for the Environmental Plan would protect the vitally important upland river catchments, thus maintaining present hydrological regimes. Table 2 indicates the hydrological changes to be expected if catchments continue to deteriorate as at present.

TABLE 2
Expected hydrological effects of no catchment protection in Palawan (situation in the year 2007).

	Movement	Percent
Total runoff (i.e. quantities of water)		
— Dry season	Down	65
— Wet season	Up	20
Peak flows	Up	200
Short-term flood flows	Up	50–100
Base flows (i.e. the flows in the wet season in between rainstorms etc)	Down	30–80

The direct agricultural benefits of avoiding these hydrological changes by appropriate catchment protection would include some saving of rainfed crop land which might otherwise be eroded away or buried by coarse flood sediments, but the major benefit by far would accrue from averting the large-scale loss of present and planned irrigated rice land, due to changes in water availability. It was estimated that by the year 2007 worthwhile irrigation on about half the projected total irrigated area of 36 000 ha would no longer be feasible, as a result of the hydrological changes shown in Table 2. At the same time, on much of the remaining 18 000 ha rice yields would be reduced by the lower and less reliable base flows, while maintenance, repair and construction costs would all increase significantly.

The total value of benefits from preventing these adverse effects by environmental protection were estimated to reach Pesos 80 million per annum by the year 2007. Development of the 18 000 ha of additional irrigation would of course require a very heavy investment; this was taken into account in the analysis. The breakdown of the Pesos 80 million annual benefit was as follows:

	Pesos million per annum in the year 2007
Prevention of adverse effect on the 18 000 ha of land assumed to be irrigated even in the 'without environmental protection' situation:	
— Prevention of increase in irrigation maintenance costs	4.5
— Prevention of reduction in yields and net returns from irrigated rice	17.1
	21.6

	Pesos million per annum in the year 2007
Irrigation development of the additional 18 000 ha, due to catchment protection	
Increase in net returns from rice cultivation*	67.4
Minus: irrigation operation and maintenance costs	-9.0
Total	58.4
Total irrigation benefits before allowance for irrigation capital costs	80.0

(i.e. the replacement of rainfed cropping by irrigated cropping).

On those steep lands where kaingin would be replaced by forestry rather than stable systems of agriculture the changeover from kaingin to forestry would result in a direct loss of crop output. The assumption made is that this would apply to the estimated 1 300 kaingin families in the Mountains Zone, the resultant annual loss of crop net returns being Pesos 2.2 million.

(b) Forestry Production

Forestry production would comprise the timber output from the commercial logging concessions, the collection of minor forest products and future timber production from reforested areas. Only the first of these was included in the analysis, the other two being not very significant in overall terms.

If present trends continue, with no better control over commercial logging than at present, the annual cut can be expected to exceed the estimated sustainable yield of about, say, 1 m^3/ha per annum by a wide margin, for two main reasons. First, the extraction rate per hectare would be well above the desirable level, because many loggers would cut more of the smaller (and younger) trees than permitted. Second, the cutting cycle would be shorter (25 years has been assumed), a larger forest area being logged each year than is desirable.

Due to these two factors, production per hectare of forest under Present Trends (i.e. without the Plan) would be much higher during the first cycle but much lower thereafter. Based on the assumptions made and on World Bank price projections for tropical hardwoods, and allowing for timber extraction costs, the commercial forest returns with and without the Plan

are estimated to be as follows, in Pesos n
annum:

	Mid-1980s	*2006*	*20(*
Without Plan	396	434*	
With Plan	198	325	
Conservation benefit	−198	−109	

*It is assumed that all the area available for a first c
exhausted by this date and that yields from subsequer
Without Plan situation would be much lower.

In the case of forestry, therefore, environm
tection would involve a sacrifice of income i
and medium term in order to maintain
production in the long-term future.

One point that enhances the forestry bene
sustained yield policy is that future returns
timber are likely to be substantially higher
rent levels in real terms, due to the long-ter
trend in world tropical hardwood prices.
powerful argument in favour of conse
island's timber resources for long-term sust
duction. As can be seen from the figu
commercial logging is a very important p
island's economy (Figure 6).

(c) Reduction of Damage to Infrastructure

In the absence of environmental protectio
increase in infrastructural damage that w
would be the destruction or damage to b
roads caused by the higher and more frec
floods resulting from lack of catchment
Estimates indicate that for roads and b
benefits from adequate catchment protectio
of damage and repair costs avoided, might t
Pesos 9 million per annum, of which Peso
would be for increased bridge maintenance
figure does not allow for the economic c
traffic disruption caused by road and brid
Existing data are insufficient to enable such
ment to be made.

(d) Fisheries Production

Fisheries benefits would result primarily fr
marine and mangrove conservation rather
land-based conservation measures, but
would also contribute by reducing siltation
waters and thus protecting coral reefs and
breeding grounds. As noted, common bene
improved fisheries production cannot be
for the separate forms of environmental pr

(e) Tourism Benefits

Tourism is another common benefit share
based and marine conservation. It is just b

lows:

	Pesos million per annum in the year 2007
ion of adverse effect on the 18 000 ha of sumed to be irrigated even in the 'without mental protection' situation:	
'revention of increase in irrigation aintenance costs	4.5
revention of reduction in yields and et returns from irrigated rice	17.1
	21.6

	Pesos million per annum in the year 2007
on development of the additional ia, due to catchment protection	
: in net returns from rice cultivation*	67.4
irrigation operation and maintenance costs	-9.0
	58.4
rigation benefits before allowance for n capital costs	80.0

replacement of rainfed cropping by irrigated cropping).

those steep lands where kaingin would be d by forestry rather than stable systems of ture the changeover from kaingin to forestry result in a direct loss of crop output. The ption made is that this would apply to the ted 1 300 kaingin families in the Mountains the resultant annual loss of crop net returns Pesos 2.2 million.

orestry Production

ry production would comprise the timber out- om the commercial logging concessions, the on of minor forest products and future timber tion from reforested areas. Only the first of as included in the analysis, the other two being y significant in overall terms.

esent trends continue, with no better control ommercial logging than at present, the annual be expected to exceed the estimated sustain- eld of about, say, 1 m^3/ha per annum by a wide , for two main reasons. First, the extraction r hectare would be well above the desirable ecause many loggers would cut more of the (and younger) trees than permitted. Second, ting cycle would be shorter (25 years has been d), a larger forest area being logged each year desirable.

to these two factors, production per hectare of nder Present Trends (i.e. without the Plan) e much higher during the first cycle but much hereafter. Based on the assumptions made and rld Bank price projections for tropical hard- and allowing for timber extraction costs, the rcial forest returns with and without the Plan

are estimated to be as follows, in Pesos million per annum:

	Mid-1980s	*2006*	*2007 onwards*
Without Plan	396	434*	34
With Plan	198	325	325
Conservation benefit	−198	−109	+291

*It is assumed that all the area available for a first cut would be exhausted by this date and that yields from subsequent cuts in the Without Plan situation would be much lower.

In the case of forestry, therefore, environmental protection would involve a sacrifice of income in the short and medium term in order to maintain levels of production in the long-term future.

One point that enhances the forestry benefits from a sustained yield policy is that future returns per m^3 of timber are likely to be substantially higher than current levels in real terms, due to the long-term upward trend in world tropical hardwood prices. This is a powerful argument in favour of conserving the island's timber resources for long-term sustained production. As can be seen from the figures above, commercial logging is a very important part of the island's economy (Figure 6).

(c) Reduction of Damage to Infrastructure

In the absence of environmental protection the main increase in infrastructural damage that would occur would be the destruction or damage to bridges and roads caused by the higher and more frequent flash floods resulting from lack of catchment protection. Estimates indicate that for roads and bridges the benefits from adequate catchment protection, in terms of damage and repair costs avoided, might total about Pesos 9 million per annum, of which Pesos 8 million would be for increased bridge maintenance costs. This figure does not allow for the economic costs of the traffic disruption caused by road and bridge failures. Existing data are insufficient to enable such an assessment to be made.

(d) Fisheries Production

Fisheries benefits would result primarily from inshore marine and mangrove conservation rather than from land-based conservation measures, but the latter would also contribute by reducing siltation in inshore waters and thus protecting coral reefs and other fish breeding grounds. As noted, common benefits such as improved fisheries production cannot be quantified for the separate forms of environmental protection.

(e) Tourism Benefits

Tourism is another common benefit shared by land-based and marine conservation. It is just beginning to take off in Palawan but is not yet a very significant component of the island's economy. In comparison with other parts of the Philippines, Palawan is not particularly accessible. To become a successful tourist area it must therefore be able to offer something extra that other places do not have. At present it has that necessary something extra, namely beautiful and relatively unspoilt beaches, coral reefs and inland scenery. If, through the lack of an adequate conservation policy, it loses these advantages the prospects for tourism are not promising.

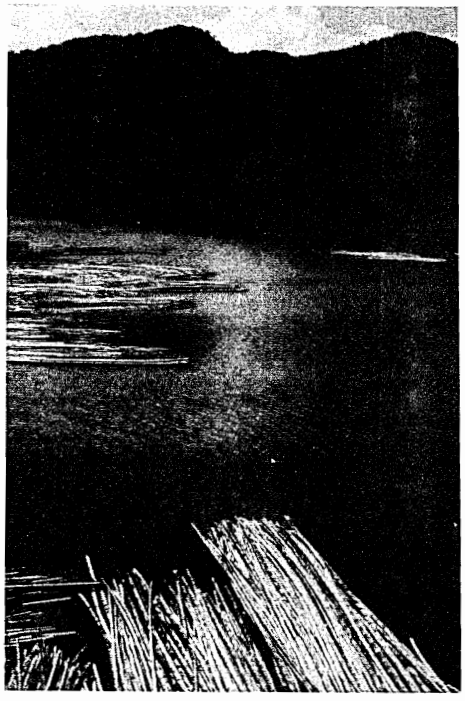
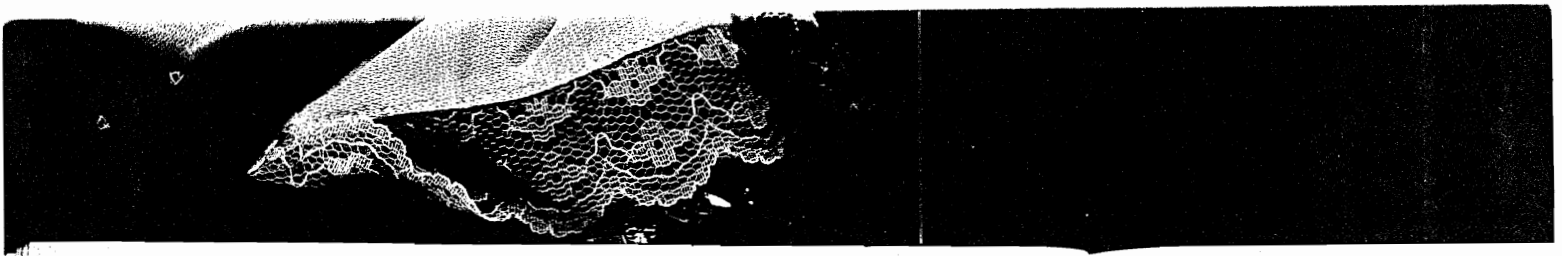


Fig. 6. Bamboo logs awaiting processing for export, Palawan.

It was assumed that returns from the foreign tourist trade might eventually fall to only half the level that would prevail if Palawan's physical environment were protected, the reduction being Pesos 6.6 million by the year 2007. This was based on the 1982/83 figures of some 2000 tourist visitors per annum, spending some US $175 over their average stay of three days, of which one third would be profit (i.e. 1982/83 total net return would be US $117 000), and an assumed 10 percent annual growth rate of tourist numbers and income if the island's environment were properly protected.

13



Mangrove Conservation Benefits

Mangroves are a very valuable natural resource. They are a major 'nursing' ground for and produce substantial catches of fish, crustaceans and shellfish; are a significant source of building timber, charcoal and other forest products; protect adjacent coral reefs from silt deposition by coastal rivers; and protect the coast from storm damage. Loss of the island's mangrove forests would have severe economic and other consequences, especially in relation to the comparatively small proportion of the island's area that they occupy (46 000 ha at present). If present trends continue, it is estimated that an extra 14 600 ha of mangrove forest would be destroyed over the next 25 years. This clearance process would produce high immediate returns per hectare in the form of timber and charcoal, returns thereafter being low, especially as much of the cleared area would be lost to the sea. Conservation of these 14 600 ha would result in long-term sustained production of timber, charcoal, fish, crustaceans and shellfish, estimated to give total net returns of some Pesos 36.7 million per annum, of which about two thirds would be from fisheries in the mangrove areas and one third would be from timber, charcoal and other forest products.

Net returns without the Plan were calculated to be substantially higher initially (Pesos 50 million in 1985) but would decline progressively to a very low level (Pesos 4.5 million per annum) by the year 2007, with the crossover point coming in 1995. Moreover, the return of Pesos 36.7 million per annum with the Plan takes no account of the mangrove area's very substantial value as a nursing ground for inshore marine fish species.

Inshore Marine Conservation Benefits

The tangible benefits of inshore marine conservation consist essentially of increased returns to fisheries and tourism. Both are common benefits: improved fisheries would be contributed to by land-based and mangrove conservation, while land-based environmental protection would also encourage tourism. Consequently, neither the following estimate of increased fisheries production nor the previous calculation of improved tourism returns could be used for separate economic analysis of inshore marine conservation. Impact on fisheries was calculated under this heading because inshore marine conservation would be the major environmental factor influencing increased fisheries returns under the Plan.

The conservation measures proposed would benefit fish production in the Inshore Marine zone through effective control of fishing and the protection of coral reefs, which are important breeding/'nursing' zones. Based on BFAR data, with appropriate adjustments, the present total annual catch was estimated to be 56 000 tonnes. The average landed price of fish was assumed to be Pesos 5/kg, of which half would be accounted for by fishing and related costs, the net return thus being Pesos 2.5/kg. With the paucity of existing data on fish stocks it was not possible to judge whether or not the inshore marine fish resources are being under- or over-exploited at present. BFAR's view was that the northern Palawan waters are overfished whereas those in southern Palawan are underfished. Broadly, therefore, the system seems to be in reasonable balance and the present level of exploitation may not be too far from the sustainable yield.

The great uncertainty is what would happen to fish production in the future, in the absence of effective conservation. Experience with, for example, the herring industry of the North Sea, in Northwest Europe, and tuna fishing in the Mediterranean suggests that overfishing can reduce production to negligible levels. On the other hand, these industries employed highly sophisticated capital-intensive technology (e.g. sonar equipment) and would have been able to catch a much larger proportion of the available stocks than would be possible with the less advanced technology likely to be used in the Palawan area even in the future. Another factor is that the Palawan fish stocks contain a smaller proportion of shoaling species like herring, which are the easiest to fish out.

In the absence of firm evidence, the assumption made was that over the next 24 years (i.e. to 2007) inshore marine fish production would progressively decline to 50 per cent of today's level (i.e. to 28 000 tonnes). This implies an annual rate of decline of about 3 per cent. Under this assumption the annual benefit from preventing this decline would reach Pesos 70 million by the year 2007. The causes of the decline would be a combination of inadequate control of fishing methods and the degradation of the mangrove and coral ecosystems.

Economic Analysis of Environmental Protection

Benefit-cost analyses were undertaken for the following:

- Land-based protection, comparing its costs with its separable benefits
- Mangrove conservation, similarly
- The Integrated Environmental Plan as a whole.

Land-based Protection

The proposed land-based environmental protection activities would involve the following costs and separable benefits:

- Costs: The strengthening of BFD
  Reforestation and forest rehabilitation
  Forest preservation
  Loss of kaingin crop production from the Mountains Zone
- Separable benefits: Irrigated agriculture
  Forestry
  Reduction of damage
  frastructure

Other common benefits, which could not b
cated between the three conservation comp
(land-based, marine and mangrove) but which
be partly attributable to land-based protecti
cluded tourism and inshore marine fisherie
following analysis therefore represents a lower t
assessment of land-based environmental prote

Based on the net cash flows prepared for t
year analysis period the net present values (NP
percent and 5 percent discount rates and the i
rate of return (IRR) were as follows:

NPV at 0 percent	Pesos 26332
5 percent	714
Internal rate of return	6.1

The large difference between the two NPVs illu
the importance of the choice of discount rate
economic results.

The internal rate of return from land-based
vation was thus estimated to be about 6 p
Bearing in mind the earlier discussion of di
rates, this is considered to be an adequate
especially as it does not take account of the co
production benefits of the stable hill farmi
agro-forestry components. It is reasonable to
the crop production benefits from such devel
to be sufficient to give an IRR of at least the san
of 6 percent, if not more. Furthermore, the a
does not attempt to include the many import
unquantifiable ecological and social benefits.

Forestry and irrigation are by far the most
tant factors determining the level of economic
Irrigation benefits are expected to be very lar
returns from commercial logging would also
high.

Mangrove Conservation Analysis

The only direct cost of mangrove conservation
be that proportion of the costs of strengthenin
which are attributable to mangrove protectio
ing one third as a reasonable estimate the capit
would be Pesos 0.5 million, incurred over tw
and the recurrent costs would be Pesos 0.6 mi

The main conservation cost would be the
one of foregoing present income in favour
future, by not destroying the mangroves and
ing the high immediate returns from mangrove
and charcoal which accrue from clearing the
The analysis, which was concerned solely w
14 600 ha of mangroves which would be de
between now and 2007 if a conservation poli

Best Available Document

14

ımed to be Pesos 5/kg, of which half would be ›unted for by fishing and related costs, the net rn thus being Pesos 2.5/kg. With the paucity of ting data on fish stocks it was not possible to judge ther or not the inshore marine fish resources are g under- or over-exploited at present. BFAR's · was that the northern Palawan waters are over-:d whereas those in southern Palawan are under-:d. Broadly, therefore, the system seems to be in ɔnable balance and the present level of exploita- may not be too far from the sustainable yield.

ıe great uncertainty is what would happen to fish luction in the future, in the absence of effective ervation. Experience with, for example, the her- industry of the North Sea, in Northwest Europe, tuna fishing in the Mediterranean suggests that fishing can reduce production to negligible levels. he other hand, these industries employed highly isticated capital-intensive technology (e.g. sonar ɔment) and would have been able to catch a much r proportion of the available stocks than would ›ssible with the less advanced technology likely to sed in the Palawan area even in the future. her factor is that the Palawan fish stocks contain aller proportion of shoaling species like herring, h are the easiest to fish out.

the absence of firm evidence, the assumption : was that over the next 24 years (i.e. to 2007) ›re marine fish production would progressively ıe to 50 per cent of today's level (i.e. to 28 000 :s). This implies an annual rate of decline of t 3 per cent. Under this assumption the annual ıt from preventing this decline would reach Pesos illion by the year 2007. The causes of the decline d be a combination of inadequate control of g methods and the degradation of the mangrove :oral ecosystems.

›mic Analysis of Environmental Protection

ıt-cost analyses were undertaken for the follow-

ınd-based protection, comparing its costs with separable benefits
angrove conservation, similarly
ıe Integrated Environmental Plan as a whole.

›based Protection

roposed land-based environmental protection ies would involve the following costs and separ- enefits:

sts: The strengthening of BFD
Reforestation and forest rehabilitation
Forest preservation
Loss of kaingin crop production from the Mountains Zone

— Separable benefits: Irrigated agriculture
Forestry
Reduction of damage to infrastructure

Other common benefits, which could not be allocated between the three conservation components (land-based, marine and mangrove) but which would be partly attributable to land-based protection, included tourism and inshore marine fisheries. The following analysis therefore represents a lower bounds assessment of land-based environmental protection.

Based on the net cash flows prepared for the 100 year analysis period the net present values (NPV) at 0 percent and 5 percent discount rates and the internal rate of return (IRR) were as follows:

NPV at 0 percent	Pesos 26 332 million
5 percent	714 million
Internal rate of return	6.1 percent

The large difference between the two NPVs illustrates the importance of the choice of discount rate for the economic results.

The internal rate of return from land-based conservation was thus estimated to be about 6 percent. Bearing in mind the earlier discussion of discount rates, this is considered to be an adequate return, especially as it does not take account of the costs and production benefits of the stable hill farming and agro-forestry components. It is reasonable to expect the crop production benefits from such development to be sufficient to give an IRR of at least the same level of 6 percent, if not more. Furthermore, the analysis does not attempt to include the many important but unquantifiable ecological and social benefits.

Forestry and irrigation are by far the most important factors determining the level of economic returns. Irrigation benefits are expected to be very large and returns from commercial logging would also be very high.

Mangrove Conservation Analysis

The only direct cost of mangrove conservation would be that proportion of the costs of strengthening BFD which are attributable to mangrove protection. Taking one third as a reasonable estimate the capital costs would be Pesos 0.5 million, incurred over two years, and the recurrent costs would be Pesos 0.6 million.

The main conservation cost would be the indirect one of foregoing present income in favour of the future, by not destroying the mangroves and obtaining the high immediate returns from mangrove, timber and charcoal which accrue from clearing the forest. The analysis, which was concerned solely with the 14 600 ha of mangroves which would be destroyed between now and 2007 if a conservation policy were not implemented, gave the following results:

	Net Present Values
Discount rate: 0 percent	Pesos 2373 million
5 percent	Pesos 150 million
Internal rate of return:	8.7 percent

With an internal rate of return of about 9 percent and allowing for the very large benefits to inshore marine fisheries in general (these are not included in this analysis), conservation of the island's mangrove forests clearly merits a very high priority. Moreover, it does not require heavy expenditure. The main requirement is the preparation of a soundly-based conservation program and its effective enforcement.

Analysis of the Overall Integrated Environmental Plan

For the analysis of the Palawan environmental protection program as a whole the benefits from inshore marine fisheries and tourism had to be added to those from land-based and mangrove conservation, and the marine conservation and other costs had to be included. Table 3 shows the year-by-year costs and benefits. For ease of calculation, benefits were taken to remain constant from Year 24 (2007) onwards.

The results of the economic analysis were as follows:

	Net Present Values
Discount rate: 0 per cent	Pesos 33 356 million
5 percent	Pesos 1384 million
Internal rate of return:	7.0 percent

Even with certain institutional costs omitted, the internal rate of return of 7 percent for the Plan is essentially a lower bounds figure, in that it ignores certain directly related development returns and various unquantified benefits. Given that it represents a lower bounds estimate, the analysis clearly justified implementation of the Plan on economic grounds.

Moreover, it would also provide very substantial social and ecological benefits. It would help to ensure that the anticipated three-fold increase in Palawan's population over the next 25 years could be successfully absorbed, while providing at least a doubling in incomes and living standards for the rural sector. The uncertainties and poor returns of kaingin farming would no longer threaten the rural communities of the Low Hills Zone. The tiny minority remaining in the steeper upland areas would follow acceptable and dependable livelihoods based on agro-forestry and other forms of social forestry. A major source of benefit would be the increase from the present 154 000 to 395 000 people involved in settled lowland agriculture. Some 233 000 people would be involved in stable agricultural and agro-forestry pursuits in the upland zones, nearly all of them in the Low Hills Zone. These would derive from the present kainginero population

TABLE 3
Economic Costs and Benefits of the Palawan Integrated Environmental Plan (Pesos million/annum at 1983 prices)[1].

Year	Land-based Protection Net Cash Flow	Mangrove[2] Conservation Net Cash Flow	Marine Conservation		Tourism Benefits	Net Cash[3] flow
			Benefits	Costs		
1	(1)	(16)	—	1	—	(18)
2	(201)	(16)	3	2	—	(216)
3	(195)	(15)	6	2	—	(206)
4	(191)	(15)	9	2	1	(198)
5	(184)	(14)	12	2	1	(185)
6	(175)	(14)	15	2	1	(173)
7	(183)	(13)	18	2	1	(179)
8	(174)	(13)	21	2	2	(166)
9	(157)	(12)	24	2	2	(145)
10	(149)	(12)	28	2	2	(133)
11	(140)	(11)	31	2	2	(120)
12	(131)	(10)	35	2	2	(106)
13	(124)	(10)	38	2	3	(97)
14	(114)	(9)	41	2	3	(81)
15	(107)	(8)	44	2	3	(70)
16	(98)	(8)	47	2	3	(58)
17	(89)	(7)	50	2	4	(44)
18	(81)	(7)	53	2	4	(33)
19	(72)	(6)	56	2	4	(20)
20	(64)	(6)	58	2	4	(10)
21	(56)	(5)	61	2	5	3
22	(50)	(5)	64	2	5	12
23	(42)	(4)	67	2	5	24
24–100	376	12	70	2	6	462

Notes: (1) Figures in brackets are negative values.
(2) Including only the timber and charcoal benefits, not the fisheries.
(3) This net cash flow is calculated by adding together the land-based protection and mangrove conservation net cash flows and the marine conservation and tourism benefits and then deducting the marine conservation costs.

of about 85 000, added to by natural increase and immigration.

The main ecological benefits would be:

- Retention of the many and varied forest ecosystems.
- Preservation of the mangrove ecosystem.
- Protection of the complex inshore element of the marine ecosystem, including the vitally important coral reefs.
- Survival of many species of flora and fauna within these different ecosystems, which would otherwise disappear; in the case of Palawan's many endemic species this would mean extinction.
- Maintenance of the island's unspoilt natural beauty.

Discussion

The economic analysis described above was necessarily very approximate in nature, due to the scarcity of reliable data and the difficulties involved in making projections of future trends with and without environmental protection. Nevertheless, it proved to be a very useful exercise for the formulation of the Plan and should also be of assistance to the Government and donor agencies in their appraisal of the Plan. Perhaps its most important contribution will concern the relative priorities which should be given to different forms of environmental protection. It is clear, for example, that mangrove conservation merits particularly high priority, because its costs are low whereas the benefits within both the mangrove zone itself and for inshore fisheries in general would be very substantial.

From the methodological viewpoint the most significant point emerging from the analysis is the vital importance of choice of discount rate. With their emphasis on the medium and long term rather than short term, most conservation activities are unlikely to appear economically justifiable if the high economic discount rates customarily used for project analysis in developing countries are applied. One possible way out of this difficulty would be to base discount rates on social rates of time preference rather than opportunity costs of capital. It could be argued that even in low-income countries the social rate of time preference with regard to choosing between resource over-exploitation and resource conservation for the future is much lower than is often assumed. When faced with the choice between destroying a resource for the sake of a few years of plenty or maintaining it at a lower level of exploitation for the benefit of future generations, many may choose the latter. If so, this would argue for the use of relatively low discount rates for the analysis of conservation programs.

References

Hufschmidt, M. M., and Lyman, E. L., (eds.) (1982
Approaches to Natural Resource and Environme
Analysis. Natural Resources and the Environment
lume 5. Tycooly International Publicity Limited, I
O'Riordan, T., and Turner, R. K. (1983) *An Annotate*

Plan (Pesos million/annum at 1983 prices)[1].

Conservation Costs	Tourism Benefits	Net Cash[3] flow
1	—	(18)
2	—	(216)
2	—	(206)
2	1	(198)
2	1	(185)
2	1	(173)
2	1	(179)
2	2	(166)
2	2	(145)
2	2	(133)
2	2	(120)
2	2	(106)
2	3	(97)
2	3	(81)
2	3	(70)
2	3	(58)
2	4	(44)
2	4	(33)
2	4	(20)
2	4	(10)
2	5	3
2	5	12
2	5	24
2	6	462

ies.
sed protection and mangrove conservation net cash
ıen deducting the marine conservation costs.

ıost important contribution will concern the rela- priorities which should be given to different forms nvironmental protection. It is clear, for example, mangrove conservation merits particularly high rity, because its costs are low whereas the benefits in both the mangrove zone itself and for inshore ries in general would be very substantial.

'om the methodological viewpoint the most signi- t point emerging from the analysis is the vital ›rtance of choice of discount rate. With their ıasis on the medium and long term rather than : term, most conservation activities are unlikely to ar economically justifiable if the high economic unt rates customarily used for project analysis in oping countries are applied. One possible way ›f this difficulty would be to base discount rates ›cial rates of time preference rather than oppor- / costs of capital. It could be argued that even in ncome countries the social rate of time preference :egard to choosing between resource over-exploi- ı and resource conservation for the future is lower than is often assumed. When faced with ıoice between destroying a resource for the sake ew years of plenty or maintaining it at a lower of exploitation for the benefit of future genera- many may choose the latter. If so, this would for the use of relatively low discount rates for ıalysis of conservation programs.

References

Hufschmidt, M. M., and Lyman, E. L., (eds.) (1982) *Economic Approaches to Natural Resource and Environmental Quality Analysis.* Natural Resources and the Environment Series, Volume 5. Tycooly International Publicity Limited, Dublin.

O'Riordan, T., and Turner, R. K. (1983) *An Annotated Reader in Environmental Planning and Management,* Urban and Regional Planning Series, Volume 30, Pergamon Press, Oxford, U.K.

Further particulars relating to this paper may be found in: Hunting Technical Services Limited, in association with Sir M. MacDonald and Partners and PMDSI, Manila: PIADP Integrated Environmental Program, Final Report, October 1983.