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PHILIPPINE MANGROVE FOREST RESOURCES ACCOUNTING REPORT: 1992-1997[1]

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PHILIPPINE MANGROVE FOREST RESOURCES ACCOUNTING REPORT: 1992-1997[1]

ENRAP IV TECHNICAL PAPER

by

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Table of Contents

List of Tables
List Appendix Tables
List of Figures
List of Annexes

1. Inroduction 1
   1.1 Background 1
   1.2 Rationale 1
   1.3 Use Values of Mangrove 2
      1.3.1 Direct Use Value 2
      1.3.2 Indirect Use Value 2

2. NRAP-1 Forestry Accounts: Physical Accounts 2
   2.1 Method 2
   2.2 Assumptions 3
      2.2.1 Opening Area and Distribution 3
      2.2.2 Volume and Growth Rate 3
      2.2.3 Harvesting 3
      2.2.4 Conversion of Fishponds and Other Land Uses 4
   2.3 Accounts 4
      2.3.1 Old Growth Area Accounts 4
      2.3.2 Residual Area Accounts 4
      2.3.3 Old Growth Volume Accounts 5
      2.3.4 Residual Volume Accounts 5
   2.4 Summary of Results 5

3. ENRAP-4 Refinements and Update: Physical Account 5
   3.1 Method 6
   3.2 Assumptions 6
      3.2.1 Opening Area and Distribution 6
      3.2.2 Volume and Growth Rate 6
      3.2.3 Harvesting 6
      3.2.4 Conversion to Fishpond and Other Land Uses 7
   3.3 Accounts 7
      3.3.1 Old Growth Area Accounts 7
      3.3.2 Residual Area Accounts 7
      3.3.3 Old Growth Volume Accounts 8
      3.3.4 Residual Volume Accounts 8
   3.4 Discussion of Results 8
      3.4.1 Old Growth Mangrove Forests 9
      3.4.2 Residual Mangrove Forests 9

4. Economic Evaluation 9
   4.1 Stumpage Values 9
   4.2 Depreciation Estimates 10
      4.2.1 Net Price Method 10
      4.2.2 Change in Asset Value 10

5. Depreciation of Forest Resources 10
5.1 Discussion of Results 10
5.2 Summary and Trend 11

References 12

List of Tables, Appendix Tables, Figures and Annexes

Tables

1	Summary of Area Accounts for Philippine Mangrove Forests: 1970-1997
2	Philippine Mangrove Forests Dataset: 1970-1997
3	Summary of Volume Accounts for Philippine Mangrove Forests: 1970-1997
4	Philippine Mangrove Old Growth Forest Area Accounts: 1992-1997 (In hectares)
5	Philippine Mangrove Residual Forest Area Accounts: 1992-1997 (In hectares)
6	Philippine Mangrove Growth Forest Volume Accounts: 1992-1997 (In cubic meters)
7	Philippine Mangrove Residual Forest Volume Accounts: 1992-1997 (In cubic meters)
8.1	Philippine Mangrove Old Growth Forest Economic Accounts: 1992-1997 (In Constant 1994 PHP Prices)
8.2	Philippine Mangrove Old Growth Forest Economic Accounts:1992-1997 (In Nominal Prices)
9.1	Philippine Mangrove Residual Forest Economic Accounts: 1989-1997 (In Constant 1994 PHP Prices)
9.2	Philippine Mangrove Residual Forest Economic Accounts: 1989-1997 (In Nominal Prices)
10	Summary of Economic Accounts for Philippine Mangrove Forests: 1970-1997
11	Change in Asset Value: Economic Depreciation Estimates Asset Value Approach Based on Stumpage Value Mangrove Residual Forests

Appendix Tables

1	Stumpage Value Mangrove Poles and Fuelwood (at an Annual Change of 1%)

Figures

1	Mangrove Forest Area Accounts
2	Mangrove Forest Volume Accounts
3	Mangrove Forest Economic Accounts

Annexes

1	Change in Asset Value: Economic Depreciation Estimates Asset Value Approach Based on Stumpage Value (In nominal prices)
2	Change in Asset Value: Economic Depreciation Estimates Asset Value Approach Based on Stumpage Value (In Constant 1994 Prices)
3	Mangrove Residual Forests: Harvest Rate Optimization

1. *Introduction*

1.1 *Background*

Mangrove forests are the other forest type that exists in the Philippines apart from the dipterocarp forests. Among the different forest types, they are minor types compared to the dipterocarps since they occupy only an estimated 112,400 hectares - a relatively small area comprising around 2 percent of the total forest area.

However, mangroves significantly affect the lives of the people in the communities around them. They are sources of products and services, providing income and livelihood to the people. as well as affecting the ecology of the areas where they are found. Many mangrove resources are harvested for subsistence purposes. Some local communities located near mangrove areas are almost entirely dependent on mangroves for their livelihood.

Mangrove species play a significant role in the ecological stability of their ecosystem and other outlying ecosystems. The ecological significance of mangrove forests and their roles and functions in the overall ecosystem are being given increased recognition. This forest type is one of the most diverse communities in the coastal areas, providing near-shore nutrient enrichment for small mammals, birds, reptiles, amphibians, and other aquatic and marine species. Mangrove forests also serve as natural coastal defense to soil erosion and protection to tidal waves and storm along coastal sites.

Mangroves once covered almost all of the coastal areas of the Philippines. There was even a legend that Manila was named after a mangrove species "nilad" that abound on the coast of Manila Bay. But today, it is quite rare to find them anywhere in the country.

During the twentieth century, mangroves declined substantially between 400,000 and 500,000 hectares in 1920 to less than 115,000 hectares in 1997. The rapid reduction of mangrove forests can be attributed to the conversion of mangrove swamps into brackish water ponds. About 80-90 percent of fishpond areas was once covered with mangrove. Cutting of mangrove for fuelwood, charcoal making and construction is probably the second most pervasive intrusion on the resource. The conversion of the mangrove areas into fishponds may just have been the final step in the process of destruction that began with the over-harvesting of mangrove for fuelwood.

To properly evaluate the different management strategies for mangroves, it is crucial that the uses and values of mangroves be identified and estimated. The accounting of mangrove forests will serve as a tool in the policy- and decision-making on the sustainable development of mangrove resources. Specifically, these resources are accounted to:

a. reflect the changes in mangrove forests brought about by economic growth;
b. provide a measure of performance to all stakeholders; and
c. generate information needed to formulate congruent economic and environmental policies.

1.2 *Rationale*

The ecosystem functions of mangrove are very important, but difficult to evaluate in economic terms. The economic value of these functions is only recognized when depletion of the mangrove resources has occurred. Likewise, government regulations governing the utilization.

development and management of mangrove resources have affected the economic valuation of these resources.

The assessment of mangroves has typically focused almost entirely on the different productive uses of mangroves, while ignoring the other productive uses such as the traditional activities and the environmental functions and services provided by mangroves. The economic value of many mangrove components escapes traditional economic analysis because they do not have market prices. The valuation of these non-marketed good and services requires a number of assumptions and additional research efforts.

This paper attempts to refine and update the NRAP I Forestry Accounts: physical accounts for old growth and residual mangrove forests in terms of area, stock and economic values. Likewise, the previous mangrove forests policies and strategies adopted by the government are evaluated to come up with recommendations on appropriate programs/strategies to address the identified problems and issues.

1.3 Use Values of Mangrove

1.3.1 Direct Use Value

Direct use values are the values derived from the direct use or interaction with mangroves' resources and services. Direct use values include consumptive uses of mangrove resources and non-consumptive uses of mangrove services. Direct use value may involve commercial and non-commercial activities.

Direct use values of mangrove resources and services are relatively straightforward to measure. usually involving the market value of production gains. However, the use of prices alone will normally underestimate benefits, as they do not account for local consumer surplus.

1.3.2 Indirect Use Value

Indirect use values are indirect support and protection provided to economic activity and property by the mangroves' natural functions, or regulatory environmental services.

Since environmental functions are rarely exchanged in markets, measurement of indirect use values typically entails the use of non-market valuation techniques.

2. NRAP-1 Forestry Accounts: Physical Accounts

2.1 Method

The NRAP-1 accounting structure for mangrove forests followed the basic accounting identity used by Repetto (1989) wherein the opening stock plus all growth, increase or additions less all extraction, destruction or diminution equals the closing stock. The accounting period covers 1970 to 1989 with 1972 as the benchmark year.

2.2 *Assumptions*

2.2.1 *Opening Area and Distribution*

The benchmark data used for the opening area was based on the digital analysis of LANDSAT imageries of the country's forest resources conducted by the Natural Resources Management Center (NRMC) in 1972, which is now the National Mapping and Resources Information Agency (NAMRIA).

The estimated mangrove area of 227,947 hectares was used as the 1972 benchmark data for the opening area. The opening area was based on the estimated remaining mangrove forests, approximately 95 percent of which are residual forests and only 5 percent are old growth mangroves. These old growth mangrove forests are mostly located in Palawan.

It was assumed that there is zero net stand growth and tree growth is equal to tree mortality in the old-growth mangrove forests. The area logged was assumed to be the volume of the poles and fuelwood harvested in the old growth and residual mangrove forests. For residual mangrove forests area accounts, the area logged in the old growth forests in the previous years was assumed to be converted to residual forests.

2.2.2 *Volume and Growth Rate*

For resource accounting purposes, the average volume stock used in this study on the old growth mangrove forests was 132.3 cubic meters (cu m) per hectare, whereas the average volume on the residual mangrove forests was 33 cu m per hectare. These estimates were based on the average volume gathered from ground inventories conducted in various provinces during the period 1981-1985 by the National Mangrove Committee.

The growth rates of bakauan (*Rhizophora* spp.), a major mangrove species, diminishes at an accelerated rate from smaller diameter classes (Brown and Fischer 1920). Bakauan seedlings grow at 14.9 percent for the five-centimeter diameter class and slow down to 3.4 percent; for the ten-centimeter diameter class, 2.6 percent; for the 15-centimeter diameter, 1.9 percent and for the 20-centimeter diameter class, 1.3 percent. The study covered the cultivation of bakauan for fuelwood purposes only. The estimated growth rate used in the study was 2.037 cu m/ha/yr. based on a series of forest resource inventories conducted by the then Bureau of Forest Development, which is now the Forest Management Bureau (FMB).

2.2.3 *Harvesting*

Mangroves are sources of both forest and fishery products. Only the accounting of forest products harvested from mangroves was included in the study. The focus on forest products does not discount the importance of accounting for fishery products harvestable from mangrove forests, which are also considered valuable.

The reported forest products harvested from mangrove forests are timber, fuelwood, charcoal, nipa shingles and tanbarks, for which data are given yearly in the Philippine Forestry Statistics (PFS). Although there were reports of timber harvesting on mangrove forests in 1971 and 1972, the data on mangrove timber for these years were discarded in favor of the data on fuelwood exports (Serna, 1991).

The bulk of mangrove resources have been used for fuelwood, a marginal livelihood activity. Therefore, the accounts established for the study were based on the harvest of these forest products. Harvest for subsistence was assumed to be equivalent to the per capita fuelwood consumption of 0.5 cu m/yr. among the coastal population using fuelwood (Bennagen and Cabahug, 1992). It was estimated that in 1970 around 250,000 cu m were harvested for this fuelwood use.

2.2.4 Conversion to Fishponds and to other Land Uses

The accounts used for area converted to fishponds were the areas covered by Fishpond Lease Agreements (FLAs) reported yearly by the Bureau of Fisheries and Aquatic Resources (BFAR).

The area of old-growth mangroves converted to fishpond was computed at 5 percent of the total area covered by fishpond lease agreements issued by BFAR, while 95 percent of areas converted to fishpond used to be residual mangrove forests.

The accounts assumed that 70 percent of the mangrove area depletion is attributed to the conversion into fishponds and the rest to other land uses. The area estimated already includes illegal conversion to fishponds and other land uses.

2.3 Accounts

In accounting for the mangrove forest resources, the Repetto basic accounting structure was used, wherein the opening account plus the additions less the reductions equals the closing account during the accounting period. The difference between the additions and the reductions is the net change during the accounting period.

2.3.1 Old Growth Area Accounts

The opening area of the old growth mangrove forest was assumed at 5 percent of the LANDSAT-I data of 227,947 hectares from the Mangrove Inventory of Philippines, with 1972 as the benchmark year. There are no additions in the old growth forest because of the assumption that there is no net stand growth in old growth forest and that tree growth is equal to tree mortality.

Reductions in area accounts included area logged and converted to fishponds. Logged-area includes areas subjected to poles and fuelwood harvests. It is unfortunate that there are no studies and/or reports that can provide estimates on the harvests done in mangrove forests. On the other hand, the area of old-growth stands converted to fishponds is equivalent to the 5 percent of the total area of fishpond leases issued by BFAR.

2.3.2 Residual Area Accounts

For the residual mangrove forest, the opening area was equivalent to 95 percent of the 227,947 hectares with 1972 as the benchmark year. The area logged in the old growth mangrove forests in the previous year becomes an addition to the residual mangrove forest area for the accounting year.

The accounts for area reductions in residual mangrove forest comprise of areas converted to fishpond and other land uses. The area converted to fishpond was computed at 95 percent of

total area of fishpond leases issued by BFAR, while 70 percent of the mangrove area depletion is accounted for by areas converted into fishponds and other land uses.

2.3.3 Old Growth Volume Accounts

Using the area of the old growth in 1972, the volume account opening area is the product of the area and the old growth average stock volume as benchmark volume. No additions were made to the old growth volume because of the assumption that there is zero net stand growth and tree growth is equal to tree mortality.

Volume reductions were composed of the stocks on the logged areas and areas converted to fishponds. The stock reduction was computed by multiplying the areas logged and converted to fishpond with the average stock volume for old growth mangrove forests.

2.3.4 Residual Volume Accounts

The residual forest volume accounts additions include: a) the *net stand growth of 1970*, which is equivalent to 1970 opening area in residual forest multiplied by the assumed growth rate of 2.037 cu m/ha/yr; b) the *initial volume*, which is logged-area in previous year multiplied by an average residual forest stock volume of 33 cu m/ha; and, c) the *net stand growth of the current year*, which is equivalent to the product of the area logged in previous years and the assumed growth rate of 2.037 cu m/ha/yr.

The reductions in the volume accounts for residual mangrove forests include the volume of areas converted to fishponds and other uses multiplied by the average stock volume for residual mangrove forests, and the actual volume of extracted forest products as reported in the PFS. The volume harvested for subsistence is computed based on the assumption that the per capita fuelwood consumption among the coastal population is 0.5 cu m/yr, using as benchmark the 1970 estimate of 250,000 cu m.

2.4 Summary of Results

Based on the of NRAP-1 reports, the area accounts indicated that mangrove forests decreased from 238,164 hectares to 132,645 hectares over the 20-year accounting period or an average of 5,276 hectares annually. In volume terms, the total stock of 9.7 million cu m in 1970 has been reduced to 6.2 million cu m in 1989. Thus the stock depletion totaled 3.5 million cu m over the 20-year period or an annual drain of 177,000 cu m. This depletion represents 36 percent of the growing stock in 1970 (Bennagen and Cabahug, 1991).

3. ENRAP-4 Refinements and Update: Physical Account

The accounting method used in refining and updating mangrove forests accounts in ENRAP-4 was generally similar to the accounting method used in NRAP-1. To attune the results of NRAP-1 to the current situation, the data, assumptions and physical accounts used were verified and validated before applying them to the ENRAP-4 mangrove forests accounts refinements and update. Existing policies that have affected the valuation of mangrove resources were also considered.

The benchmark data for the ENRAP-4 accounts uses the 1988 RP-German National Forest Resources Inventory (NFRI) results with 1989 as the benchmark year. In 1994, the Japan

Forest Technical Assistance (JAFTA) carried out an inventory of the forest resources of the Philippines but this has not yet been completed.

3.1 Method

The accounting structure in ENRAP-4 also uses the basic accounting identity of Repetto. The general principle is that the opening stock less the net change in stock is equal to the closing stock. The net change in stock is the difference between the additions and the reductions in stock.

3.2 Assumptions

3.2.1 Opening Area and Distribution

The benchmark data used for the opening area was based on the results of the 1988 RP-German National Forest Resources Inventory (NFRI). Estimates based on the combination of aerial photography or satellite imageries and ground verification of the NFRI placed the remaining mangrove forests at 139,100 hectares, with 1989 as the benchmark year. The remaining mangroves are mainly along the seashores of Regions IV, IX and X constituting 85 percent of the total mangrove forests.

Based on the PFS reports, the old growth covers approximately 5 percent of the remaining mangrove forests while 95 percent are residual forests. In the old growth forest, it is likewise assumed that there is zero net stand growth wherein tree growth is equal to tree mortality.

3.2.2 Volume and Growth Rate

The Mangrove Technical Review Committee published in 1994 the book, *Mangrove Regeneration and Management* which reported that the average volume on residual forests dominated by the *Rhizophora* species is 33 cu m per hectare, whereas the average volume on the old-growth *Rhizophora* stands is 132.3 cu m per hectare. The publication made mention that the average growth rate in natural stands is 7.5 cu m per hectare per year and for unmanaged understock stand, 3.5 cu m per hectare per year, but these were based on the Malaysian mangrove forestry inventory. Forestry experts found this to be high for the Philippines. Thus, this study opted to retain the growth rate of 2.037 cu m per hectare per year, as well as the NRAP 1 assumptions.

3.2.3 Harvesting

There have been policies issued by the Department of Environment and Natural Resources prohibiting the harvesting of fuelwood in mangrove areas. Hence, beginning in 1990, there have been no reports that monitor the cutting of poles and fuelwood in mangrove forests. But this does not mean there were no harvesting of poles and fuelwood outside fishpond leases and mangrove plantations.

The DENR issued in 1990 Administrative Order No.15 regulating the utilization, development and management of mangrove resources. Section 3 of the Order prohibits the granting of license or permit of any kind that will authorize the cutting and/or debarking of the trees for commercial purposes in areas outside the fishpond leases and mangrove plantations.

Likewise, in 1991, Republic Act No. 7161 banned the cutting of all mangrove species for fuelwood. After 1991, DENR did not issue any permit allowing the cutting of fuelwood in the mangrove forests.

This study used the assumption of NRAP-1 that the harvest for subsistence account from mangrove forest is equivalent to the per capita fuelwood consumption of 0.5 cu m per year among coastal population using fuelwood. The 1970 estimated volume of 250,000 cu m of fuelwood harvested for subsistence was utilized as benchmark data and interpolated on 1997.

3.2.4 Conversion to Fishponds and Other Land Uses

In spite of the joint Department of Agriculture (DA) and DENR Administrative Order No. 3 series of 1990, the Bureau of Fisheries and Aquatic Resources (BFAR) still grants fishpond leases to unproductive, underdeveloped and/or abandoned areas covered by and within FLAs. BFAR provided a revised list of FLAs issued from 1973 up to 1998. The revised list was used in the study to refine the NRAP-1 report using the 1988 NFRI estimate as benchmark data to reflect the actual effects of the changes of fishpond conversion on the mangrove forest accounts for this study.

3.3 Accounts

For mangrove forests accounts, additions are in the form of natural stand growth or annual increment in the standing stock of mangrove forests. Additions in the form of man-made regeneration of mangrove forests are treated separately under plantation forests accounts. Reductions are in the form of harvesting of timber, fuelwood and/or charcoal for subsistence of the residents in mangrove areas, conversion into fishponds and conversion to other land use.

3.3.1 Old Growth Area Accounts

The ENRAP-4 study used as basis the 1988 RP-German Natural Forest Resources Inventory (NFRI) figure of 139,100 hectares to compute for the old growth mangrove forest. With 1989 as the benchmark year, the opening area of the old growth mangrove forest was computed at 5 percent of the total mangrove area. Old growth areas are not increasing because it is assumed that there is no net stand growth in old growth forest and that tree growth is equal to tree mortality. Cutting in the old growth forest has been banned since 1990. The other reduction in old growth area account was the conversion to fishponds that comprise 5 percent of the total fishpond leases issued.

3.3.2 Residual Area Accounts

The opening area in the residual mangrove forest is equivalent to 95 percent of the 139,100 hectares of the estimated mangrove forest area in 1989. Mangrove plantations and reforestation programs are considered as additions in the residual area accounts. In the absence of recent data regarding these activities, a separate accounting of plantations will be done.

The area reductions in residual mangrove forests comprise of area converted to fishpond and other land uses. The residual area converted to fishpond is computed at 95 percent of the total area of fishpond leases issued by BFAR, while the area converted to other land uses is considered to be 30 percent of the depleted of mangrove forests area.

3.3.3 Old Growth Volume Accounts

The benchmark opening stock for the old growth mangrove forest is the product of the 1989 area and the average stock volume in the old growth forest. There are no additions in the old growth volume because of the assumption that there is zero net stand growth and tree growth is equal to tree mortality.

Volume reductions in old growth forest are attributed to conversion of mangrove areas into fishponds. The stock reduction is computed by multiplying the areas converted to fishpond with the average stock volume of 132.3 cu m/ha for old growth mangrove forests.

3.3.4 Residual Volume Accounts

Additions to the residual forest volume were based on the net stand growth using the 1989 opening area in residual forest and the net stand growth of the area logged from the previous years multiplied by the assumed growth rate of 2.037 cu m/ha/yr.

The reductions in the volume accounts for residual mangrove forest includes the volume of areas converted to fishponds and areas converted to other use multiplied by the average stock volume for residual mangrove forests. Another major reduction in volume account comes from the harvest of forest products for subsistence by the residents near the mangrove areas. This was computed based on the assumption of per capita annual fuelwood consumption of 0.5 cu m among coastal population, which was interpolated from the NRAP-1 benchmark volume using the 1970 estimate of 250,000 cu m.

3.4 Discussion of Results

The Philippine mangrove forests have significantly dwindled at an average of 3,500 hectares annually (**Table 1**). From an estimated area of 220,650 hectares in 1970, it declined to only about 128,650 hectares in 1997. The annual rate of decrease was registered at around 4,250 hectares during the period 1970-1979. The reduction was higher during the 1980-1989 period at 4,560 hectares annually.

The conversion of approximately 71,200 hectares (**Table 2, column 5**) of mangrove swamps into brackishwater ponds from 1970 to 1997 was the principal factor behind the loss of the Philippine mangrove forests. For the same period, around 7,845 hectares of mangrove forests have been subjected to cutting for fuelwood, charcoal and construction materials.

The depletion of mangrove forests proceeded at a slower rate from 1990 to 1997 at about 1,230 hectares annually. This coincided with the prohibition of the granting and/or renewal of mangrove timber license and/or permit of any kind that authorizes the cutting and/or debarking of trees for commercial purposes (**Table 2, columns 3 and 4**).

With the issuance of DENR Administrative Order No. 90-15 and Republic Act No. 7161, the government started to regulate the utilization, development and management of mangrove resources.

In volume terms, from a total stock of 8.3 million cu m in 1970, mangrove forest resources have been reduced to 4.5 million cu m in 1997 (**Table 3**). The stock depletion for the accounting period totaled 3.8 million cu m or an estimated average annual drain of 158,100 cu m. The highest depletion occurred during the period 1980-1989 with a reduction of approximately

193,400 cu m annually. The lowest was an annual exhaustion of 90,000 cu m registered between 1990-1997. It was noted that there was an exceptionally large depreciation during 1970-1974 with an estimated volume 235,400 cu m. This depreciation was largely due to the substantial recorded harvests of mangrove timber and fuelwood as reported in the PFS (**Table 2, columns 2, 3 and 4**).

Tables 4 and 5 present the year-to-year area accounts of old growth mangrove forests and residual mangrove forests, respectively, while the volume accounts for old growth mangrove forests and residual mangrove forests are shown in **Tables 6 and 7** respectively. For the accounting period (1992-1997) of this study, mangrove forest areas have been reduced at a rate of 985 hectares per year with an annual volume depreciation of 94,700 cu m.

The PFS estimated the change of mangrove area using the following equation as derived by the RP-German NFRI Project:

$$\text{Area for year T} = (\text{1988 Mangrove Area} \times \text{Change Factor})^{T-1988}$$

where:

1988 Mangrove Area	=	139,100 hectares
Change Factor	=	0.994
Current year	=	T

3.4.1 Old Growth Mangrove Forests

The area accounts indicate that old growth mangrove forests decreased from 6,794 hectares in 1992 to 6,635 hectares in 1997 at an average rate of about 35 hectares annually (Table 4). In volume terms, from a total stock of 898,820 cu m in 1992, it has been reduced to 877,850 cu m in 1997 (**Table 6**). The total stock depletion for the period 1992 – 1997 was estimated at 21,240 cu m or an average depreciation of around 4,650 cu m per year.

3.4.2 Residual Mangrove Forests

The area covered by residual mangrove forests in 1992 was 127,770 hectares dropping to 123,500 hectares in 1997 (**Table 5**). The decrease was only 4,270 hectares or an average change of 950 hectares per year. The stock in 1989 was 4.36 million cu m, and was reduced to 3.81 million cu m in 1997 with an annual decrease of 90,100 cu m (**Table 7**).

4. Economic Evaluation

4.1 Stumpage Values

For purposes of valuing the physical accounts, the stumpage value of the standing mangrove wood resources was estimated using the Asian Development Bank (ADB) feasibility study on mangrove development. The forest edge price less the production cost and margin for profit will result to the stumpage value of the resource.

4.2 *Depreciation Estimates*

4.2.1 *Net Price Method*

Net prices were applied on the physical account tables for the various resources with a modification allowed for the difference in prices at the beginning and at the end of the same accounting year. This procedure implies that the depreciation numbers derived through the net price method are reflective more of physical depreciation/appreciation rather than of any price effects.

Tables 8.1 and 9.1 show the depreciation of mangrove resources from 1992 to 1997 using constant 1994 prices for old-growth and residual mangrove forest, respectively. On the other hand, an appreciation of the value of the resources was observed during the same period using the current prices as indicated in **Tables 8.2 and 9.2** for old-growth and residual mangrove forests respectively.

4.2.2 *Change in Asset Value*

The economic appreciation/depreciation of residual mangrove timber resources is estimated using the asset value approach. This approach looks into changes in the future stream of harvest which are then converted into changes in the present value of stumpage at the beginning and at the end of each year using a social discount rate of 8 percent (**Annexes 1 and 2**). Since a cutting ban on said resources have been in effect since 1992, said valuation represents its option value. This means that the mangrove timber values may only be realized once said ban is lifted. The valuation may also be interpreted as the foregone benefits under such policy.

An economic cutting cycle of 35 years under the seed tree method of management was adopted. The cutting cycle was based on an optimization model (**Annex 3**) which determined the cutting cycle that would yield the highest discounted values taking into consideration changes in stumpage values, physical growth of the mangrove forests, annual cutting area and price elasticity. The seed tree management, which involves leaving 30 percent of the total stock density per hectare as sources of seedlings for natural regeneration, was adopted as it results in higher timber volumes within a shorter period of time as compared to clear cutting.

5. *Depreciation of Forest Resources*

5.1 *Discussion of Results*

Using the net price method, the values in nominal prices of old growth mangrove forest resources appreciated from PhP282 million in 1992 to 291 million in 1997. Employing the constant 1994 prices, the value of old growth mangrove resources depreciated from PhP326 million in 1989 to PhP233 million in 1997 (**Table 8.1 and 8.2**).

For residual mangrove forest, the value likewise appreciated from PhP1.29 billion in 1992 to PhP1.32 billion in 1997 at nominal prices. But in constant 1994 prices, the value depreciated from PhP1.50 billion in 1992 to PhP1.06 billion in 1997 (**Table 9.1 and 9.2**). Refer to **Table 10** for a summary of the economic accounts using the net price method.

Another approach used to determine the economic depreciation of mangrove forest was the Asset Value Approach. **Table 11** shows the results of the change in asset value of mangrove

timber resources from 1992 to 1997. At current prices, there was an appreciation of the economic value of the mangrove resources. Depreciation in asset value was observed, however, the stumpage values of the mangrove resources are expressed in constant 1994 prices. Said values decreased from PhP33.18 million in 1992 to PhP12.28 million in 1997 or by an annual average decline of 17.61 percent.

The informal use for subsistence purposes of the mangrove forest resources continuously caused the decline of its stock. Although the value of the resources appreciates using the nominal prices, it is not reflective of the true value of the resources, hence the application of the constant 1994 price which shows the gradual decrease of the asset value as the stocks diminish.

5.2 Summary and Trends

Figures 1, 2 and 3 show the year-to-year trend of the mangrove forest area, volume and economic accounts. The prohibitions on the commercial cutting and/or harvesting of mangroves resulted in a minimal depreciation of these stocks from 1992 to 1997. The conversion of the area to fishponds and other uses, and the harvest of fuelwood for subsistence purposes brought about the reductions in mangrove forest resources.

REFERENCES

Bann, Camille. *The Economic Valuation of Mangroves: A Manual for Researchers*. Economy and Environment Program for Southeast Asia. 1998.

Bennagen (Ibid.)

Bennagen, E.C. and Cabahug, D.M., NRAP-1 Technical Report No. 2: Mangrove Forest Resources Accounting, Quezon City, 1991.

Brown, H. and Fischer, A.F., 1920. Minor Products of Philippine Forests, Manila, Bureau of Printing.

DENR. 1990. Master Plan for Forestry Development

Forest Management Bureau. 1997. Philippine Forestry Statistics.

Serna, C.B. 1991. Personal Communication.

Zamora, P.M. 1990. Report on Mangrove Forest Component of the Master Plan for Forestry Development. Quezon City.

Table 1
Summary of Area Accounts for Philippine Mangrove Forests: 1970 - 1997

Year	Opening Area	Area Aditions	Area Reduction	Net Change in Area	Closing Area
1970	226,743.43	2,112.00	8,204.90	(6,092.90)	220,650.53
1971	220,650.53	2,992.84	6,966.45	(3,973.61)	216,676.93
1972	216,676.93	2,283.47	4,806.97	(2,523.50)	214,153.43
1973	214,153.43	1,071.01	777.25	293.76	214,447.19
1974	214,447.19	341.06	3,638.17	(3,297.11)	211,150.08
1975	211,150.08	339.17	3,664.68	(3,325.51)	207,824.57
1976	207,824.57	123.87	5,843.56	(5,719.69)	202,104.88
1977	202,104.88	100.70	6,768.84	(6,668.13)	195,436.74
1978	195,436.74	138.97	4,930.33	(4,791.36)	190,645.39
1979	190,645.39	149.04	6,605.61	(6,456.57)	184,188.82
1980	184,188.82	56.39	8,633.06	(8,576.67)	175,612.15
1981	175,612.15	147.03	6,941.30	(6,794.27)	168,817.88
1982	168,817.88	40.28	5,167.55	(5,127.27)	163,690.61
1983	163,690.61	59.42	4,947.13	(4,887.71)	158,802.90
1984	158,802.90	-	4,719.35	(4,719.35)	154,083.55
1985	154,083.55	-	4,110.43	(4,110.43)	149,973.12
1986	149,973.12	5.67	3,272.17	(3,266.50)	146,706.62
1987	146,706.62	-	6,046.69	(6,046.69)	140,659.94
1988	140,659.94	-	1,559.94	(1,559.94)	139,100.00
1989	139,100.00	-	547.68	(547.68)	138,552.32
1990	138,552.32	-	1,980.46	(1,980.46)	136,571.86
1991	136,571.86	-	2,008.42	(2,008.42)	134,563.44
1992 - 1997					
1992	134,563.44	-	1,116.68	(1,116.68)	133,446.76
1993	133,446.76	-	755.79	(755.79)	132,690.98
1994	132,690.98	-	307.01	(307.01)	132,383.96
1995	132,383.96	-	42.77	(42.77)	132,341.19
1996	132,341.19	-	2,238.77	(2,238.77)	130,102.42
1997	130,102.42	-	1,450.07	(1,450.07)	128,652.35
Ave. (92-97)	132,688.13	-	985.18	(985.18)	131,602.94

10 -year Period	Average Change
1970 - 1997	**(3,503.25)**
1970 - 1979	(4,255.46)
1980 - 1989	(4,563.65)
1990 - 1997	(1,237.50)

5-year Period	Average Change
1970 - 1974	(3,118.67)
1975 - 1979	(5,392.25)
1980 - 1984	(6,021.05)
1985 - 1989	(3,106.25)
1990 - 1994	(1,233.67)
1995 - 1997	(1,243.87)

Table 2
Philippine Mangrove Forest Dataset: 1970 - 1997

YEAR	FUELWOOD EXPORT (CU.M.)	FUELWOOD PRODUCTION (CU.M.)	CHARCOAL PRODUCTION (CU.M.)	FISHPOND LEASE (HAS.)	STUMPAGE VALUE				ppp	constant 1994 price	MANGROVE AREA (PFS)		
					OLD GROWTH		RESIDUAL				TOTAL (HAS.)	OLD GROWTH (HAS.)	RESIDUAL (HAS.)
					NOMINAL	CONSTANT	NOMINAL	CONSTANT					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1970	297,189.00	151,037	9,730	3,704.00	279.34	5,819.58	144.35	3,007.29	20.83	4.80	288,035.00	14,264.00	273,771.00
1971	226,749.00	118,000	6,833	3,328.00	270.24	4,659.31	140.94	2,430.00	17.24	5.80	286,650.00	14,213.00	272,437.00
1972	106,351.00	68,000	2,308	2,655.00	249.47	3,838.00	126.74	1,949.85	15.38	6.50	284,211.00	13,906.00	270,305.00
1973	33,867.00	7,000	3,000	309.98	221.78	2,957.07	124.25	1,656.67	13.33	7.50	233,955.00	12,154.00	221,801.00
1974	33,680.00	15,015	4,000	2,344.46	260.50	2,631.31	146.63	1,481.11	10.10	9.90	232,097.00	11,872.00	220,225.00
1975	12,300.00	9,000	12,000	2,516.32	245.79	2,318.77	182.32	1,720.00	9.43	10.60	254,016.00	12,662.00	241,354.00
1976	10,000.00	8,000	41,000	4,081.22	190.88	1,631.45	150.73	1,288.29	8.55	11.70	228,472.00	11,308.00	217,164.00
1977	13,800.00	23,188	3,000	4,711.58	206.35	1,599.61	156.10	1,210.08	7.75	12.90	249,138.00	12,048.00	237,090.00
1978	14,800.00	2,553	3,000	3,397.87	268.12	1,942.90	194.49	1,409.35	7.25	13.80	246,699.00	11,741.00	234,958.00
1979	5,600.00	16,443	5,000	4,654.26	220.90	1,372.05	188.42	1,170.31	6.21	16.10	245,000.00	12,000.00	233,000.00
1980	14,600.00	13,644	2,000	6,030.68	285.65	1,511.38	219.58	1,161.80	5.29	18.90	241,821.00	11,127.00	230,694.00
1981	4,000.00	244	28,000	4,904.28	304.24	1,364.30	273.92	1,228.34	4.48	22.30	239,382.00	10,820.00	228,562.00
1982	5,900.00	14,632	2,000	3,630.14	338.89	1,394.61	280.68	1,155.06	4.12	24.30	211,513.00	10,513.00	201,000.00
1983	-	9,400	30,000	3,515.73	281.90	1,105.49	310.49	1,217.61	3.92	25.50	234,504.00	10,206.00	224,298.00
1984	-	71,000	53,000	3,353.85	285.45	761.20	351.33	936.88	2.67	37.50	232,065.00	9,899.00	222,166.00
1985	563.00	62,000	36,000	2,917.09	288.99	625.52	251.01	543.31	2.16	46.20	218,111.08	9,629.13	208,481.94
1986	-	25,000	29,000	2,325.40	292.54	635.96	229.11	498.07	2.17	46.00	214,478.64	9,399.65	205,078.99
1987	-	15,400	29,000	4,297.14	296.08	624.64	259.38	547.22	2.11	47.40	143,522.00	6,289.94	137,232.06
1988	-	16,200	3,000	1,108.58	299.63	563.21	259.77	488.29	1.88	53.20	139,100.00	6,096.14	133,003.86
1989	-	9,400	1,000	389.21	303.17	511.25	198.72	335.11	1.69	59.30	135,700.00	5,947.13	129,752.87
1990	-	-	-	1,407.43	306.72	457.11	267.80	399.11	1.49	67.10	132,500.00	5,806.89	126,693.11
1991	-	-	-	1,427.30	310.26	390.26	299.75	377.04	1.26	79.50	129,200.00	5,662.27	123,537.73
1992	-	-	-	793.58	313.81	363.63	307.70	356.55	1.16	86.30	126,300.00	5,535.17	120,764.83
1993	-	-	-	537.11	317.35	343.82	315.66	341.99	1.08	92.30	123,400.00	5,408.08	117,991.92
1994	-	-	-	**218.18**	**320.90**	**320.90**	**323.62**	**323.62**	**1.00**	**100.00**	120,500.00	5,280.98	115,219.02
1995	-	-	-	30.40	324.44	300.41	331.57	307.01	0.93	108.00	117,700.00	5,158.27	112,541.73
1996	-	-	-	1,591.01	327.99	278.43	339.53	288.23	0.85	117.80	115,100.00	5,044.33	110,055.67
1997	-	-	-	1,030.50	331.53	265.65	347.49	278.44	0.80	124.80	112,400.00	4,926.00	107,474.00

ASSUMPTIONS:1988 FRI Inventory		
Benchmark Area	139,100.00	hectares
Stock Volume (OG)	132.30	cu.m./ha.
Stock Volume (R)	33.00	cu.m./ha.
Growth Rate	2.037	cum/ha/yr

Table 3
Summary of Volume Accounts for Philippine Mangrove Forests: 1970 - 1997

Year	Opening Volume	Volume Aditions	Volume Reduction	Net Change in Volume	Closing Volume
1970	8,962,364.35	499,222.34	1,157,874.96	(658,652.62)	8,303,711.73
1971	8,303,711.73	534,386.47	980,081.23	(445,694.76)	7,858,016.97
1972	7,858,016.97	515,628.85	683,489.38	(167,860.53)	7,690,156.44
1973	7,690,156.44	477,799.07	353,442.01	124,357.06	7,814,513.49
1974	7,814,513.49	454,405.46	483,695.92	(29,290.46)	7,785,223.04
1975	7,785,223.04	455,034.22	476,142.41	(21,108.19)	7,764,114.84
1976	7,764,114.84	448,181.40	617,879.15	(169,697.75)	7,594,417.09
1977	7,594,417.09	447,622.18	618,325.64	(170,703.45)	7,423,713.64
1978	7,423,713.64	449,168.11	519,718.39	(70,550.28)	7,353,163.36
1979	7,353,163.36	449,804.04	612,933.64	(163,129.60)	7,190,033.76
1980	7,190,033.76	446,861.51	693,452.84	(246,591.32)	6,943,442.44
1981	6,943,442.44	450,151.95	656,281.36	(206,129.41)	6,737,313.03
1982	6,737,313.03	446,711.34	580,026.36	(133,315.02)	6,603,998.02
1983	6,603,998.02	447,463.79	622,037.42	(174,573.63)	6,429,424.39
1984	6,429,424.39	445,503.07	793,430.26	(347,927.19)	6,081,497.20
1985	6,081,497.20	445,503.07	730,548.65	(285,045.58)	5,796,451.61
1986	5,796,451.61	445,701.72	622,516.96	(176,815.25)	5,619,636.37
1987	5,619,636.37	445,514.62	716,120.55	(270,605.93)	5,349,030.43
1988	5,349,030.43	445,514.62	513,613.55	(68,098.93)	5,280,931.50
1989	5,280,931.50	445,514.62	471,166.12	(25,651.50)	5,255,280.00
1990	5,255,280.00	445,514.62	515,183.75	(69,669.13)	5,185,610.87
1991	5,185,610.87	445,514.62	529,047.32	(83,532.70)	5,102,078.16
1992 - 1997					
1992	5,102,078.16	445,514.62	509,688.58	(64,173.96)	5,037,904.20
1993	5,037,904.20	445,514.62	510,103.51	(64,588.93)	4,973,315.27
1994	4,973,315.27	445,514.62	507,702.92	(62,188.30)	4,911,126.98
1995	4,911,126.98	445,514.62	512,448.82	(66,934.20)	4,844,192.77
1996	4,844,192.77	445,514.62	607,480.99	(161,966.37)	4,682,226.40
1997	4,682,226.40	445,514.62	593,916.17	(148,401.55)	4,533,824.85
Ave. (92-97)	4,925,140.63	445,514.62	540,223.50	(94,708.89)	4,830,431.75

10-year Period	Average Change
1970 - 1997	**(158,162.12)**
1970 - 1979	(177,233.06)
1980 - 1989	(193,475.38)
1990 - 1997	(90,181.89)
5-year Period	**Average Change**
1970 - 1974	(235,428.26)
1975 - 1979	(119,037.85)
1980 - 1984	(221,707.31)
1985 - 1989	(165,243.44)
1990 - 1994	(68,830.60)
1995 - 1997	(125,767.37)

Philippine Mangrove Old Growth Forest Area Accounts: 1992-1997 (In hectares)

Year	Opening Area	ADDITIONS		REDUCTIONS			Net Change	Closing Area	PFS Figures 2/	Discrepancy	
		Net Stand Growth	Total Additions	Logged Area 1/	Converted Fishpond	Total Reductions				Statistical	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1992	6,793.80	-	-	-	39.68	39.68	(39.68)	6,754.12	5,535.17	1,218.95	22.02%
1993	6,754.12	-	-	-	26.86	26.86	(26.86)	6,727.27	5,408.08	1,319.19	24.39%
1994	6,727.27	-	-	-	10.91	10.91	(10.91)	6,716.36	5,280.98	1,435.37	27.18%
1995	6,716.36	-	-	-	1.52	1.52	(1.52)	6,714.84	5,158.27	1,556.57	30.18%
1996	6,714.84	-	-	-	79.55	79.55	(79.55)	6,635.29	5,044.33	1,590.96	31.54%
1997	6,635.29	-	-	-	51.53	51.53	(51.53)	6,583.76	4,926.00	1,657.77	33.65%

OLD-GROWTH MANGROVE (Area Account)

(1) Year.
(2) Benchmark opening area is 5% of 139,100 hectares mangrove area reported in the 1988 RP-German NFRI study.
(3) Net stand growth is zero (0) in old-growth forest where tree-growth equals tree mortality.
(4) Sum of additions.
(5) Logged area for poles and piles and for fuelwood.
1/ There is no known study that gives estimates on areas harvested of poles and piles and/or fuelwood in mangrove areas.
(6) 5% of the total area of Fishpond lease issued by BFAR.
(7) Sum of reductions.
(8) Total additions less total reductions.
(9) Opening area plus net change in area.
(10) Philippine Forestry Statistics (PFS) reports.
2/ Estimates from PFS did not take into consideration DAO 90-15 prohibiting the cutting of trees for commercial purposes.
(11) Computed closing area less PFS area.
(12) Percentage difference of computed closing area and PFS area.
n.d.a. - no data available
n.a. - not applicable

Table 5

Philippine Mangrove Residual Forest Area Accounts: 1992-1997 (In hectares)

Year	Opening Area	ADDITIONS		REDUCTIONS			Net Change	Closing Area	PFS Figures	Discrepancy	
		Old-growth Area Logged	Total Additions	Converted Fishpond	Converted Other Uses	Total Reductions				Statistical	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1992	127,769.64	-	-	753.90	323.10	1,077.01	(1,077.01)	126,692.64	120,764.83	5,927.81	4.91%
1993	126,692.64	-	-	510.25	218.68	728.93	(728.93)	125,963.71	117,991.92	7,971.79	6.76%
1994	125,963.71	-	-	207.27	88.83	296.10	(296.10)	125,667.60	115,219.02	10,448.59	9.07%
1995	125,667.60	-	-	28.88	12.38	41.25	(41.25)	125,626.35	112,541.73	13,084.63	11.63%
1996	125,626.35	-	-	1,511.46	647.77	2,159.22	(2,159.22)	123,467.13	110,055.67	13,411.46	12.19%
1997	123,467.13	-	-	978.98	419.56	1,398.54	(1,398.54)	122,068.59	107,474.00	14,594.59	13.58%

RESIDUAL MANGROVE (Area Accounts)

(1) Year.
(2) Benchmark opening area is 95% of 139,100 hectares mangrove area reported in the 1988 RP-German NFRI study.
(3) Assumed that area logged in the old-growth mangrove forests in previous year becomes residual fores area.
(4) Sum of additions.
(5) 95% of the total area of fishpond lease issued by BFAR.
(6) 30% of the total area converted based on Zamora (1990).
(7) Sum of reductions.
(8) Total additions less total reductions.
(9) Opening area plus net change in area.
(10) Philippine Forestry Statistics (PFS) reports.
(11) Computed closing area less PFS area.
(12) Percentage difference of computed closing area and PFS area.
n.d.a. - no data available
n.a. - not applicable

Table 6

Philippine Mangrove Old Ggrowth Forest Volume Accounts: 1992-1997 (In cubic meters)

Year	Opening Stock	ADDITIONS		REDUCTIONS			Net Change	Closing Stock	PFS Figures	Discrepancy		Density per Hectare (cu.m./ha.)	
		Net Stand Growth	Total Additions	Logged Area Stock [1/]	Converted Fishpond	Total Reductions				Statistical	Percent	Computed	PFS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1992	898,820.08	-	-	-	5,249.55	5,249.55	(5,249.55)	893,570.53	n.d.a.	n.a.	n.a.	132.30	n.a.
1993	893,570.53	-	-	-	3,552.96	3,552.96	(3,552.96)	890,017.58	n.d.a.	n.a.	n.a.	132.30	n.a.
1994	890,017.58	-	-	-	1,443.26	1,443.26	(1,443.26)	888,574.31	n.d.a.	n.a.	n.a.	132.30	n.a.
1995	888,574.31	-	-	-	201.07	201.07	(201.07)	888,373.24	n.d.a.	n.a.	n.a.	132.30	n.a.
1996	888,373.24	-	-	-	10,524.50	10,524.50	(10,524.50)	877,848.74	n.d.a.	n.a.	n.a.	132.30	n.a.
1997	877,848.74	-	-	-	6,816.79	6,816.79	(6,816.79)	871,031.95	n.d.a.	n.a.	n.a.	132.30	n.a.

OLD-GROWTH MANGROVE (Volume Account)

(1) Year.
(2) Assumed volume of 132.3 cu.m./ha. in old-growth mangrove forest.
(3) Net stand growth is zero (0) in old-growth forest where tree-growth equals tree mortality.
(4) Sum of additions.
(5) Logged area multiplied by 132.3 cu.m./ha.
1/ Harvesting in mangrove areas was banned effective 1990.
(6) Converted fishpond multiplied by 132.3 cu.m./ha.
(7) Sum of reductions.
(8) Total additions less total reductions.
(9) Opening area plus net change in area.
(10) Philippine Forestry Statistics (PFS) reports.
(11) Computed closing volume less PFS volume.
(12) Percentage difference of computed closing volume and PFS volume.
(13) Computed density per hectare.
(14) PFS Density per hectare.
n.d.a. - no data available
n.a. - not applicable

Table 7

Philippine Mangrove Residual Forest Volume Accounts: 1992-1997 (In cubic meters)

Year	ADDITIONS					REDUCTIONS					Net Change	Closing Stock	PFS Figures	Discrepancy		Density per Hectare (cu.m./ha.)	
	Opening Stock	NSG 1970	Logged Over Stock[1] Initial	Logged Over Stock[1] Current Year	Total Additions	Harvested w/ Permit	Harvested Subsistence	Converted Fishpond	Converted Other Uses	Total Reductions				Statistical	Percent	Computed	PFS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1992	4,203,258.08	425,224.20	-	20,290.42	445,514.62	-	468,897.86	24,878.82	10,662.35	504,439.03	(58,924.41)	4,144,333.67	n.d.a.	n.a.	n.a.	32.71	n.a.
1993	4,144,333.67	425,224.20	-	20,290.42	445,514.62	-	482,495.90	16,838.28	7,216.41	506,550.59	(61,035.97)	4,083,297.70	n.d.a.	n.a.	n.a.	32.42	n.a.
1994	4,083,297.70	425,224.20	-	20,290.42	445,514.62	-	496,488.28	6,839.96	2,931.41	506,259.65	(60,745.03)	4,022,552.66	n.d.a.	n.a.	n.a.	32.01	n.a.
1995	4,022,552.66	425,224.20	-	20,290.42	445,514.62	-	510,886.44	952.91	408.39	512,247.75	(66,733.13)	3,955,819.53	n.d.a.	n.a.	n.a.	31.49	n.a.
1996	3,955,819.53	425,224.20	-	20,290.42	445,514.62	-	525,702.15	49,878.03	21,376.30	596,956.48	(151,441.87)	3,804,377.66	n.d.a.	n.a.	n.a.	30.81	n.a.
1997	3,804,377.66	425,224.20	-	20,290.42	445,514.62	-	540,947.51	32,306.31	13,845.56	587,099.38	(141,584.77)	3,662,792.90	n.d.a.	n.a.	n.a.	30.01	n.a.

RESIDUAL MANGROVE (Volume Accounts)

(1) Year.
(2) Assumed volume of 33 cu m./ha. in residual mangrove forest.
(3) 1989 opening area in residual forest multiplied by the assumed growth rate of 2.037 cu.m /ha./year.
(4) Logged-area in the old-growth forest multiplied by an average residual forest volume of 33 cu.m./ha.
(5) Cumulative logged-area multiplied by the assumed growth rate of 2.037 cu.m./ha./year
" There is no known study that monitors the estimated volume of harvested of poles and/or fuelwood in mangrove areas.
(6) Sum of additions.
(7) Production report of fuelwood, adjusted to 100% for under reporting.
(8) Assumed per capita fuelwood consumption of 0.5 cu.m /year among coastal population (ENRAP-I Study).
(9) Area converted to fishpond multiplied by average residual forest volume of 33 cu.m./ha.
(10) Area converted to other uses multiplied by average residual forest volume of 33 cu.m./ha.
(11) Sum of reductions
(12) Total additions less total reductions
(13) Opening volume plus net change in volume.
(14) Philippine Forestry Statistics (PFS) reports.
(15) Computed closing volume less PFS volume.
(16) Percentage difference of computed closing volume and PFS volume.
(17) Computed density per hectare.
(18) PFS density per hectare.
n.d.a. - no data available
n.a. - not applicable

Table 8.1

Philippine Mangrove Old Growth Forest Economic Accounts: 1992 - 1997 (In constant 1994 PhP prices)

Year	Opening Value	ADDITIONS		REDUCTIONS			Net Change	Closing Value
		Net Stand Growth	Total Additions	Logged Area 1/ Value	Converted Fishpond	Total Reductions		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1992	326,835,145.49	-	-	-	1,908,877.34	1,908,877.34	(1,908,877.34)	324,926,268.14
1993	307,231,429.14	-	-	-	1,221,593.79	1,221,593.79	(1,221,593.79)	306,009,835.35
1994	285,606,640.43	-	-	-	463,143.42	463,143.42	(463,143.42)	285,143,497.01
1995	266,934,305.63	-	-	-	60,402.78	60,402.78	(60,402.78)	266,873,902.85
1996	247,349,354.91	-	-	-	2,930,332.83	2,930,332.83	(2,930,332.83)	244,419,022.08
1997	233,199,673.52	-	-	-	1,810,872.63	1,810,872.63	(1,810,872.63)	231,388,800.89

Table 8.2

Philippine Mangrove Old Growth Forest Economic Accounts: 1992 - 1997 (In nominal prices)

Year	Opening Value	ADDITIONS		REDUCTIONS			Net Change	Closing Value
		Net Stand Growth	Total Additions	Logged Area 1/ Value	Converted Fishpond	Total Reductions		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1992	282,058,730.55	-	-	-	1,647,361.15	1,647,361.15	(1,647,361.15)	280,411,369.41
1993	283,574,609.10	-	-	-	1,127,531.07	1,127,531.07	(1,127,531.07)	282,447,078.03
1994	285,606,640.43	-	-	-	463,143.42	463,143.42	(463,143.42)	285,143,497.01
1995	288,289,050.08	-	-	-	65,235.00	65,235.00	(65,235.00)	288,223,815.08
1996	291,377,540.09	-	-	-	3,451,932.08	3,451,932.08	(3,451,932.08)	287,925,608.01
1997	291,033,192.55	-	-	-	2,259,969.04	2,259,969.04	(2,259,969.04)	288,773,223.51

Table 9.1

Philippine Mangrove Residual Forest Economic Accounts: 1989 - 1997 (In constant 1994 PhP prices)

Year	Opening Value	ADDITIONS			REDUCTIONS					Net Change	Closing Value
		NSG 1989	Logged Over Stock[1]	Total Additions	Harvested w/ Permit	Harvested Subsistence	Converted Fishpond	Converted Other Uses	Total Reductions		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1992	1,498,658,761.61	151,612,381.95	-	158,846,868.74	-	167,184,093.21	8,870,466.04	3,801,628.30	179,856,187.55	(21,009,318.82)	1,477,649,442.79
1993	1,417,335,173.47	145,423,911.41	-	152,363,103.00	-	165,010,461.67	5,758,582.09	2,467,963.75	173,237,007.50	(20,873,904.50)	1,396,461,268.97
1994	1,321,436,800.93	137,611,054.85	-	144,177,440.42	-	160,673,537.87	2,213,547.43	948,663.18	163,835,748.48	(19,658,308.05)	1,301,778,492.88
1995	1,234,960,913.47	130,547,765.94	-	136,777,112.62	-	156,846,868.23	292,553.61	125,380.12	157,264,801.95	(20,487,689.33)	1,214,473,224.14
1996	1,140,169,274.66	122,560,587.29	-	128,408,809.83	-	151,520,925.90	14,376,136.85	6,161,201.51	172,058,264.26	(43,649,454.42)	1,096,519,820.24
1997	1,059,281,405.80	118,398,362.54	-	124,047,976.23	-	150,620,072.73	8,995,288.14	3,855,123.49	163,470,484.35	(39,422,508.12)	1,019,858,897.68

Table 9.2

Philippine Mangrove Residual Forest Economic Accounts: 1989 - 1997 (In nominal prices)

Year	Opening Value	ADDITIONS			REDUCTIONS					Net Change	Closing Value
		NSG 1989	Logged Over Stock[1]	Total Additions	Harvested w/ Permit	Harvested Subsistence	Converted Fishpond	Converted Other Uses	Total Reductions		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1992	1,293,342,511.27	130,841,485.62	-	137,084,847.72	-	144,279,872.44	7,655,212.19	3,280,805.22	155,215,889.86	(18,131,042.14)	1,275,211,469.13
1993	1,308,200,365.11	134,226,270.23	-	140,631,144.07	-	152,304,656.12	5,315,171.27	2,277,930.54	159,897,757.93	(19,266,613.85)	1,288,933,751.26
1994	1,321,436,800.93	137,611,054.85	-	144,177,440.42	-	160,673,537.87	2,213,547.43	948,663.18	163,835,748.48	(19,658,308.05)	1,301,778,492.88
1995	1,333,757,786.55	140,991,587.22	-	147,719,281.63	-	169,394,617.69	315,957.89	135,410.53	169,845,986.11	(22,126,704.47)	1,311,631,082.08
1996	1,343,119,405.55	144,376,371.83	-	151,265,577.98	-	178,491,650.71	16,935,089.21	7,257,895.38	202,684,635.29	(51,419,057.31)	1,291,700,348.24
1997	1,321,983,194.44	147,761,156.45	-	154,811,874.34	-	187,973,850.77	11,226,119.59	4,811,194.11	204,011,164.47	(49,199,290.14)	1,272,783,904.31

Table 10
Summary of Economic Accounts for Philippine Mangrove Forests: 1970 - 1997

Year	Opening Value	Value Aditions	Value Reductions	Net Change in Value	Closing Value
1970	10,021,705,945.69	1,501,307,187.89	4,664,508,905.00	(3,163,201,717.11)	6,858,504,228.58
1971	6,858,504,228.58	1,298,559,128.19	3,104,157,829.11	(1,805,598,700.92)	5,052,905,527.66
1972	5,052,905,527.66	1,005,396,922.68	1,633,400,962.84	(628,004,040.16)	4,424,901,487.51
1973	4,424,901,487.51	791,553,788.78	646,878,617.34	144,675,171.44	4,569,576,658.95
1974	4,569,576,658.95	673,024,980.54	785,858,180.23	(112,833,199.68)	4,456,743,459.26
1975	4,456,743,459.26	782,658,851.70	838,744,258.16	(56,085,406.46)	4,400,658,052.80
1976	4,400,658,052.80	577,387,880.56	809,844,380.09	(232,456,499.53)	4,168,201,553.28
1977	4,168,201,553.28	541,657,540.67	767,524,654.32	(225,867,113.65)	3,942,334,439.63
1978	3,942,334,439.63	633,034,099.89	754,977,324.19	(121,943,224.30)	3,820,391,215.32
1979	3,820,391,215.32	526,410,414.99	725,039,026.22	(198,628,611.24)	3,621,762,604.08
1980	3,621,762,604.08	519,163,231.98	826,398,381.36	(307,235,149.38)	3,314,527,454.70
1981	3,314,527,454.70	552,940,006.20	811,272,686.31	(258,332,680.11)	3,056,194,774.59
1982	3,056,194,774.59	515,979,175.93	677,601,610.27	(161,622,434.34)	2,894,572,340.25
1983	2,894,572,340.25	544,835,424.05	754,790,173.76	(209,954,749.71)	2,684,617,590.54
1984	2,684,617,590.54	417,382,914.41	739,451,354.70	(322,068,440.29)	2,362,549,150.25
1985	2,362,549,150.25	242,047,024.06	398,563,611.16	(156,516,587.10)	2,206,032,563.15
1986	2,206,032,563.15	221,988,522.53	312,175,159.99	(90,186,637.47)	2,115,845,925.69
1987	2,115,845,925.69	243,792,365.85	394,072,926.14	(150,280,560.29)	1,965,565,365.40
1988	1,965,565,365.40	217,540,097.96	251,341,534.85	(33,801,436.89)	1,931,763,928.51
1989	1,931,763,928.51	149,296,230.58	158,345,789.19	(9,049,558.61)	1,922,714,369.90
1990	1,922,714,369.90	177,807,473.16	206,152,847.38	(28,345,374.22)	1,894,368,995.68
1991	1,894,368,995.68	167,978,624.54	199,598,949.93	(31,620,325.39)	1,862,748,670.29
1992 - 1997					
1992	1,862,748,670.29	168,846,868.74	181,765,064.90	(22,918,196.16)	1,839,830,474.13
1993	1,839,830,474.13	152,363,103.00	174,458,601.29	(22,095,498.29)	1,817,734,975.84
1994	1,817,734,975.84	144,177,440.42	164,298,891.90	(20,121,451.47)	1,797,613,524.37
1995	1,797,613,524.37	136,777,112.62	157,325,204.73	(20,548,092.11)	1,777,065,432.26
1996	1,777,065,432.26	128,408,809.83	174,988,597.09	(46,579,787.25)	1,730,485,645.01
1997	1,730,485,645.01	124,047,976.23	165,281,356.99	(41,233,380.75)	1,689,252,264.26
Ave. (92-97)	1,804,246,463.65	140,770,218.48	169,666,286.15	(28,916,067.67)	1,775,330,395.98

10-year Period	Average Change
1970 - 1997	**(297,587,631.48)**
1970 - 1979	(639,994,334.16)
1980 - 1989	(169,904,823.42)
1990 - 1997	(29,182,763.21)
5-year Period	**Average Change**
1970 - 1974	(1,112,992,497.29)
1975 - 1979	(166,996,171.04)
1980 - 1984	(251,842,690.77)
1985 - 1989	(87,966,956.07)
1990 - 1994	(25,020,169.11)
1995 - 1997	(36,120,420.04)

Table 11
Change in Asset Value: Economic Depreciation Estimates
Asset Value Approach Based on Stumpage Value Mangrove Residual Forests

PERIOD			Change in Asset Value		Percentage Change
			Nominal Prices (Million Pesos)	*Constant 1994 Prices* (Million Pesos)	*Constant 1994 Prices*
1992	-	1993	9.37	33.18	-
1993	-	1994	9.46	31.00	-6.57%
1994	-	1995	9.55	27.33	-11.84%
1995	-	1996	9.65	23.03	-15.74%
1996	-	1997	9.75	16.93	-26.46%
1997	-	1998	9.84	12.28	-27.46%
				Average	**-17.61%**

Appendix Table 1
Stumpage Value Mangrove Poles and Fuelwood
(at an Annual Change of 1%)

		NOMINAL PRICES			CONSTANT 1994 PRICES			
T	Year	POLES	FUELWOOD	TOTAL	cpi	POLES	FUELWOOD	TOTAL
	1990	870.98	267.80	1,138.78	0.671	584.431	179.694	764.12
	1991	879.69	270.48	1,150.17	0.795	699.357	215.030	914.39
0	1992	888.49	273.18	1,161.67	0.863	766.768	235.757	1,002.52
1	1993	897.38	275.91	1,173.29	0.923	828.278	254.669	1,082.95
2	1994	906.35	278.67	1,185.02	1.000	906.350	278.674	1,185.02
3	1995	915.41	281.46	1,196.87	1.080	988.647	303.977	1,292.62
4	1996	924.57	284.28	1,208.84	1.178	1,089.141	334.876	1,424.02
5	1997	933.81	287.12	1,220.93	1.248	1,165.399	358.323	1,523.72
6	1998	943.15	289.99	1,233.14		1,177.053	361.906	1,538.96
7	1999	952.58	292.89	1,245.47		1,188.824	365.525	1,554.35
8	2000	962.11	295.82	1,257.93		1,200.712	369.181	1,569.89
9	2001	971.73	298.78	1,270.51		1,212.719	372.872	1,585.59
10	2002	981.45	301.76	1,283.21		1,224.846	376.601	1,601.45
11	2003	991.26	304.78	1,296.04		1,237.095	380.367	1,617.46
12	2004	1,001.17	307.83	1,309.00		1,249.465	384.171	1,633.64
13	2005	1,011.19	310.91	1,322.09		1,261.960	388.013	1,649.97
14	2006	1,021.30	314.02	1,335.31		1,274.580	391.893	1,666.47
15	2007	1,031.51	317.16	1,348.67		1,287.326	395.812	1,683.14
16	2008	1,041.83	320.33	1,362.15		1,300.199	399.770	1,699.97
17	2009	1,052.24	323.53	1,375.78		1,313.201	403.767	1,716.97
18	2010	1,062.77	326.77	1,389.53		1,326.333	407.805	1,734.14
19	2011	1,073.39	330.03	1,403.43		1,339.596	411.883	1,751.48
20	2012	1,084.13	333.33	1,417.46		1,352.992	416.002	1,768.99
21	2013	1,094.97	336.67	1,431.64		1,366.522	420.162	1,786.68
22	2014	1,105.92	340.03	1,445.95		1,380.187	424.364	1,804.55
23	2015	1,116.98	343.44	1,460.41		1,393.989	428.607	1,822.60
24	2016	1,128.15	346.87	1,475.02		1,407.929	432.893	1,840.82
25	2017	1,139.43	350.34	1,489.77		1,422.008	437.222	1,859.23
26	2018	1,150.82	353.84	1,504.67		1,436.228	441.594	1,877.82
27	2019	1,162.33	357.38	1,519.71		1,450.591	446.010	1,896.60
28	2020	1,173.96	360.95	1,534.91		1,465.097	450.471	1,915.57
29	2021	1,185.70	364.56	1,550.26		1,479.748	454.975	1,934.72
30	2022	1,197.55	368.21	1,565.76		1,494.545	459.525	1,954.07
31	2023	1,209.53	371.89	1,581.42		1,509.490	464.120	1,973.61
32	2024	1,221.62	375.61	1,597.23		1,524.585	468.761	1,993.35
33	2025	1,233.84	379.37	1,613.21		1,539.831	473.449	2,013.28
34	2026	1,246.18	383.16	1,629.34		1,555.230	478.184	2,033.41
35	2027	1,258.64	386.99	1,645.63		1,570.782	482.965	2,053.75

continued

Appendix Table 1 (continued)

T	Year	NOMINAL PRICES			CONSTANT 1994 PRICES			
		POLES	FUELWOOD	TOTAL	cpi	POLES	FUELWOOD	TOTAL
36	2028	1,271.23	390.86	1,662.09		1,586.490	487.795	2,074.28
37	2029	1,283.94	394.77	1,678.71		1,602.355	492.673	2,095.03
38	2030	1,296.78	398.72	1,695.49		1,618.378	497.600	2,115.98
39	2031	1,309.75	402.70	1,712.45		1,634.562	502.576	2,137.14
40	2032	1,322.84	406.73	1,729.57		1,650.907	507.601	2,158.51
41	2033	1,336.07	410.80	1,746.87		1,667.417	512.677	2,180.09
42	2034	1,349.43	414.91	1,764.34		1,684.091	517.804	2,201.89
43	2035	1,362.93	419.06	1,781.98		1,700.932	522.982	2,223.91
44	2036	1,376.56	423.25	1,799.80		1,717.941	528.212	2,246.15
45	2037	1,390.32	427.48	1,817.80		1,735.120	533.494	2,268.61
46	2038	1,404.22	431.75	1,835.98		1,752.472	538.829	2,291.30
47	2039	1,418.27	436.07	1,854.34		1,769.996	544.217	2,314.21
48	2040	1,432.45	440.43	1,872.88		1,787.696	549.660	2,337.36
49	2041	1,446.77	444.84	1,891.61		1,805.573	555.156	2,360.73
50	2042	1,461.24	449.29	1,910.53		1,823.629	560.708	2,384.34
51	2043	1,475.85	453.78	1,929.63		1,841.865	566.315	2,408.18
52	2044	1,490.61	458.32	1,948.93		1,860.284	571.978	2,432.26
53	2045	1,505.52	462.90	1,968.42		1,878.887	577.698	2,456.58
54	2046	1,520.57	467.53	1,988.10		1,897.676	583.475	2,481.15
55	2047	1,535.78	472.20	2,007.98		1,916.652	589.310	2,505.96
56	2048	1,551.14	476.93	2,028.06		1,935.819	595.203	2,531.02
57	2049	1,566.65	481.69	2,048.34		1,955.177	601.155	2,556.33
58	2050	1,582.31	486.51	2,068.83		1,974.729	607.166	2,581.89
59	2051	1,598.14	491.38	2,089.51		1,994.476	613.238	2,607.71
60	2052	1,614.12	496.29	2,110.41		2,014.421	619.370	2,633.79
61	2053	1,630.26	501.25	2,131.51		2,034.565	625.564	2,660.13
62	2054	1,646.56	506.27	2,152.83		2,054.911	631.820	2,686.73
63	2055	1,663.03	511.33	2,174.36		2,075.460	638.138	2,713.60
64	2056	1,679.66	516.44	2,196.10		2,096.214	644.519	2,740.73
65	2057	1,696.46	521.61	2,218.06		2,117.177	650.964	2,768.14
66	2058	1,713.42	526.82	2,240.24		2,138.348	657.474	2,795.82
67	2059	1,730.55	532.09	2,262.64		2,159.732	664.049	2,823.78
68	2060	1,747.86	537.41	2,285.27		2,181.329	670.689	2,852.02
69	2061	1,765.34	542.79	2,308.12		2,203.142	677.396	2,880.54
70	2062	1,782.99	548.21	2,331.21		2,225.174	684.170	2,909.34
71	2063	1,800.82	553.70	2,354.52		2,247.426	691.012	2,938.44
72	2064	1,818.83	559.23	2,378.06		2,269.900	697.922	2,967.82
73	2065	1,837.02	564.82	2,401.84		2,292.599	704.901	2,997.50
74	2066	1,855.39	570.47	2,425.86		2,315.525	711.950	3,027.47
75	2067	1,873.94	576.18	2,450.12		2,338.680	719.070	3,057.75

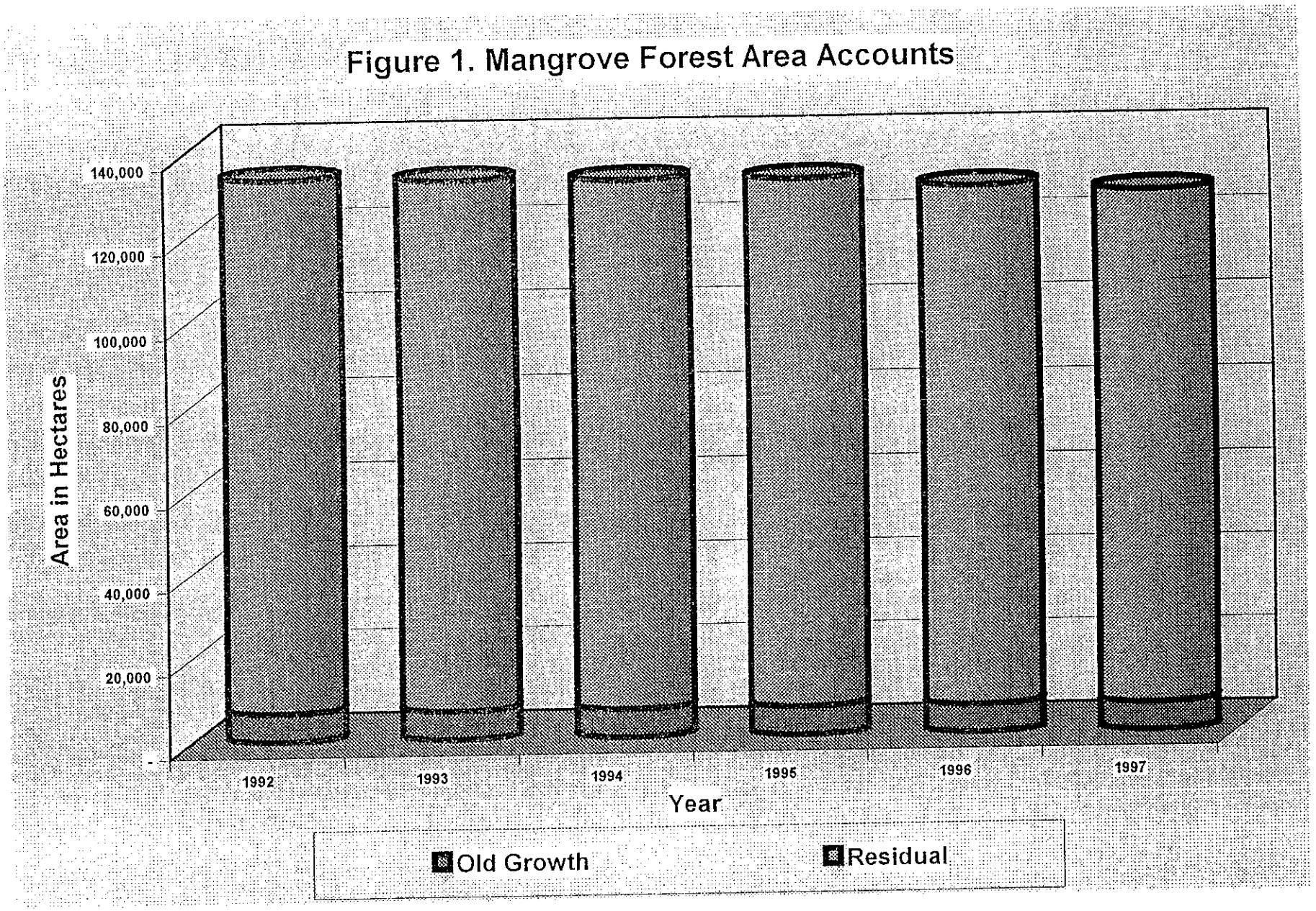


Figure 1. Mangrove Forest Area Accounts
Area in Hectares
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
1992
1993
1994
1995
1996
1997
Year
Old Growth
Residual

Figure 2. Mangrove Forest Volume Accounts

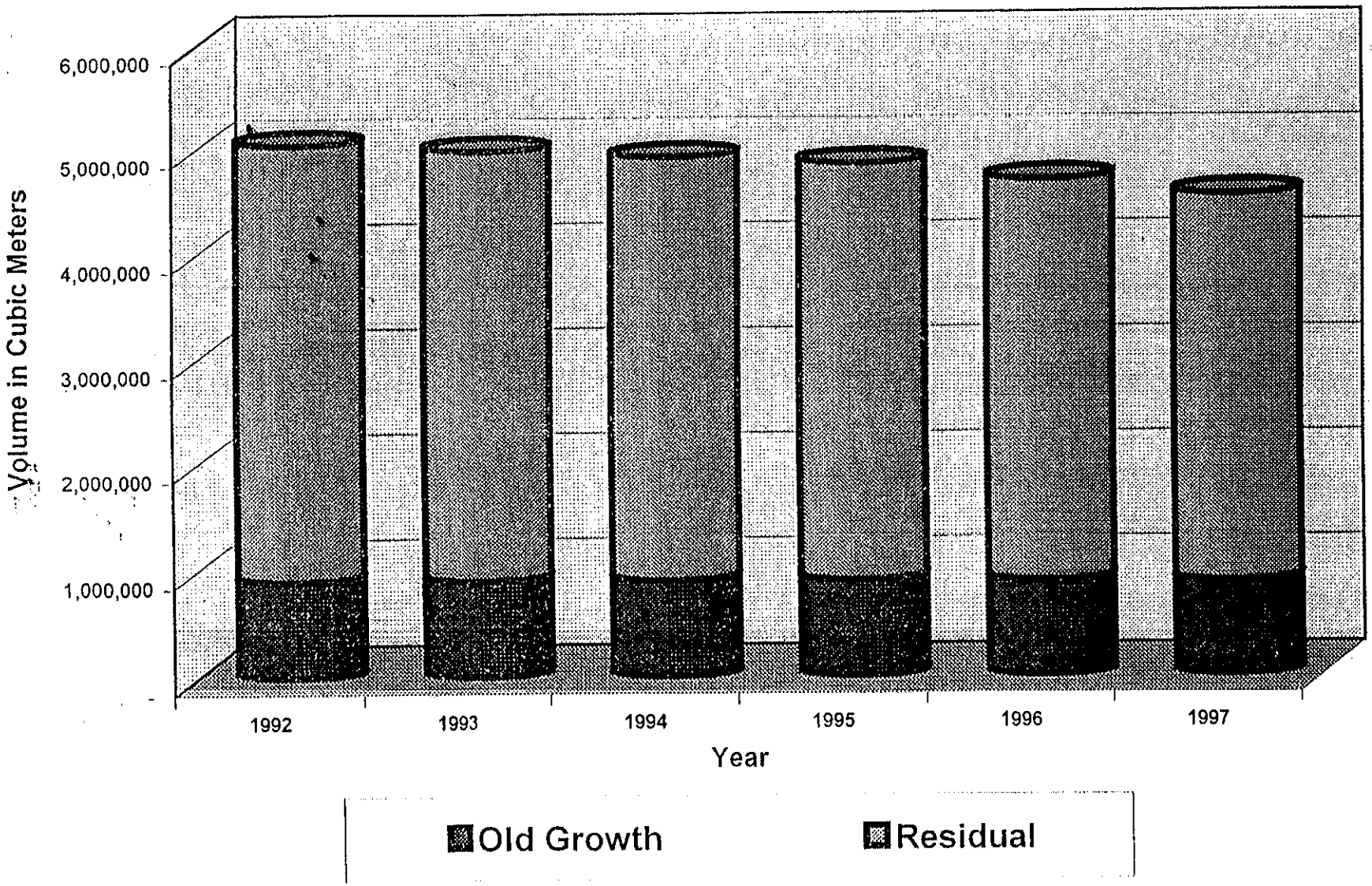
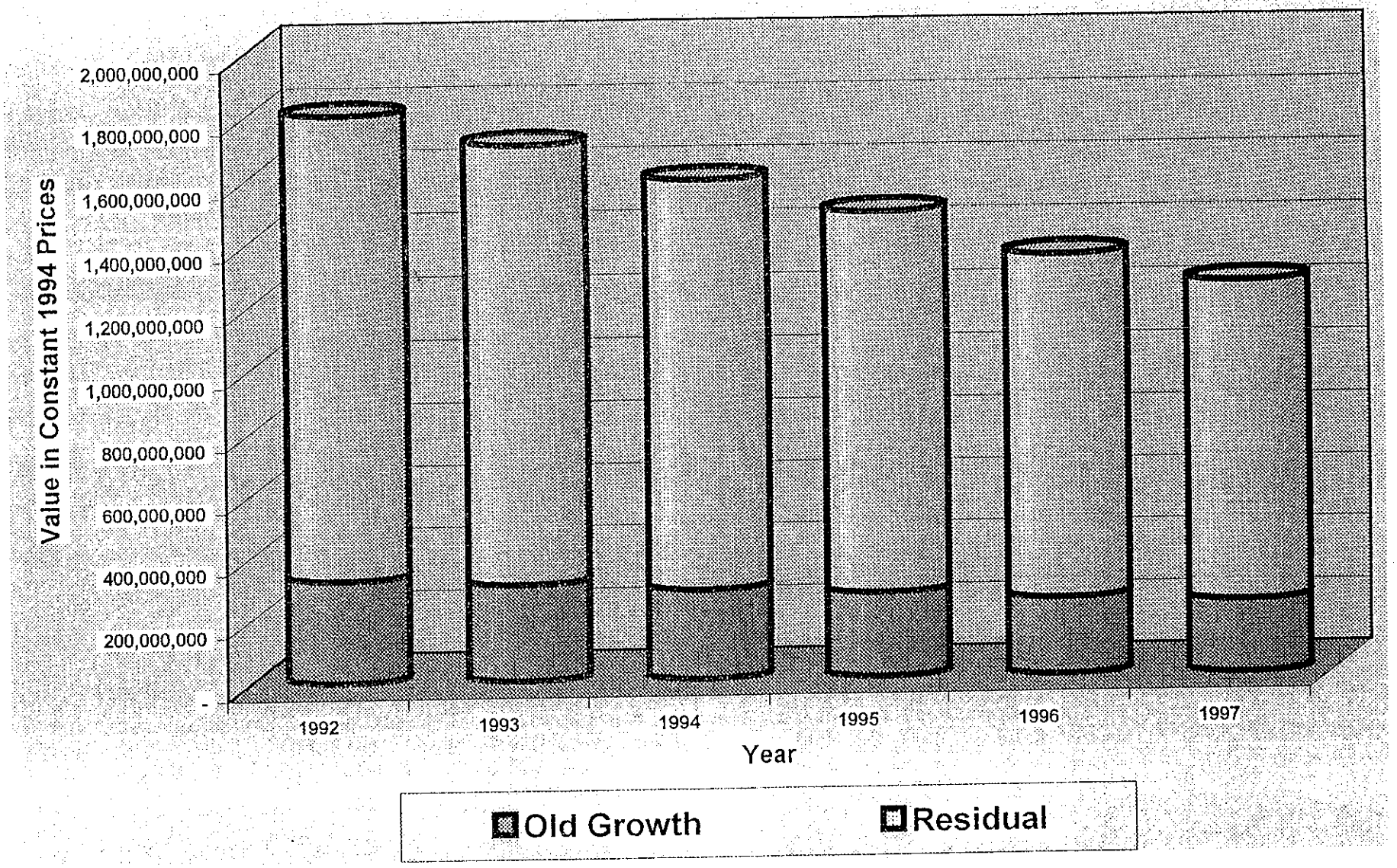


Figure 3. Mangrove Forest Economic Accounts



Annex 1

Change in Asset Value: Economic Depreciation Estimates Asset Value Approach Based on Stumpage Value

(In nominal prices)

MANGROVE RESIDUAL FORESTS

time (t)	Year	Nominal SV (P)	Harvest (M cu.m.)	Vn (SV X Harvest)	$(1+r)^t$	V_{1992}	V_{1993}	V_{1994}	V_{1995}	V_{1996}	V_{1997}	V_{1998}
0	1992	1,161.67	0.06	65.51	1.00	65.51						
1	1993	1,173.29	0.06	66.17	1.08	61.27	66.17					
2	1994	1,185.02	0.06	66.83	1.17	57.30	61.88	66.83				
3	1995	1,196.87	0.06	67.50	1.26	53.58	57.87	62.50	67.50			
4	1996	1,208.84	0.06	68.17	1.36	50.11	54.12	58.45	63.12	68.17		
5	1997	1,220.93	0.06	68.86	1.47	46.86	50.61	54.66	59.03	63.75	68.86	
6	1998	1,233.14	0.06	69.54	1.59	43.82	47.33	51.12	55.21	59.62	64.39	69.54
7	1999	1,245.47	0.06	70.24	1.71	40.98	44.26	47.80	51.63	55.76	60.22	65.04
8	2000	1,257.93	0.06	70.94	1.85	38.33	41.39	44.71	48.28	52.14	56.32	60.82
9	2001	1,270.51	0.06	71.65	2.00	35.84	38.71	41.81	45.15	48.76	52.67	56.88
10	2002	1,283.21	0.06	72.37	2.16	33.52	36.20	39.10	42.23	45.60	49.25	53.19
11	2003	1,296.04	0.06	73.09	2.33	31.35	33.86	36.56	39.49	42.65	46.06	49.74
12	2004	1,309.00	0.06	73.82	2.52	29.32	31.66	34.19	36.93	39.88	43.07	46.52
13	2005	1,322.09	0.06	74.56	2.72	27.42	29.61	31.98	34.54	37.30	40.28	43.51
14	2006	1,335.31	0.06	75.31	2.94	25.64	27.69	29.91	32.30	34.88	37.67	40.69
15	2007	1,348.67	0.06	76.06	3.17	23.98	25.90	27.97	30.20	32.62	35.23	38.05
16	2008	1,362.15	0.06	76.82	3.43	22.42	24.22	26.15	28.25	30.51	32.95	35.58
17	2009	1,375.78	0.06	77.59	3.70	20.97	22.65	24.46	26.42	28.53	30.81	33.28
18	2010	1,389.53	0.06	78.36	4.00	19.61	21.18	22.87	24.70	26.68	28.81	31.12
19	2011	1,403.43	0.06	79.15	4.32	18.34	19.81	21.39	23.10	24.95	26.95	29.10
20	2012	1,417.46	0.06	79.94	4.66	17.15	18.52	20.00	21.60	23.33	25.20	27.22
21	2013	1,431.64	0.06	80.74	5.03	16.04	17.32	18.71	20.20	21.82	23.57	25.45
22	2014	1,445.95	0.06	81.55	5.44	15.00	16.20	17.50	18.90	20.41	22.04	23.80
23	2015	1,460.41	0.06	82.36	5.87	14.03	15.15	16.36	17.67	19.08	20.61	22.26
24	2016	1,475.02	0.06	83.18	6.34	13.12	14.17	15.30	16.53	17.85	19.27	20.82
25	2017	1,489.77	0.06	84.02	6.85	12.27	13.25	14.31	15.45	16.69	18.03	19.47
26	2018	1,504.67	0.06	84.86	7.40	11.47	12.39	13.38	14.45	15.61	16.86	18.21
27	2019	1,519.71	0.06	85.71	7.99	10.73	11.59	12.51	13.52	14.60	15.76	17.03
28	2020	1,534.91	0.06	86.56	8.63	10.03	10.84	11.70	12.64	13.65	14.74	15.92
29	2021	1,550.26	0.06	87.43	9.32	9.38	10.13	10.94	11.82	12.77	13.79	14.89

continued

Annex 1 (continued)

time (t)	Year	Nominal SV (P)	Harvest (M cu.m.)	Vn (SV X Harvest)	$(1+r)^t$	V_{1992}	V_{1993}	V_{1994}	V_{1995}	V_{1996}	V_{1997}	V_{1998}
30	2022	1,565.76	0.06	88.30	10.06	8.78	9.48	10.24	11.05	11.94	12.89	13.93
31	2023	1,581.42	0.06	89.19	10.87	8.21	8.86	9.57	10.34	11.16	12.06	13.02
32	2024	1,597.23	0.06	90.08	11.74	7.67	8.29	8.95	9.67	10.44	11.28	12.18
33	2025	1,613.21	0.06	90.98	12.68	7.18	7.75	8.37	9.04	9.76	10.55	11.39
34	2026	1,629.34	0.06	91.89	13.69	6.71	7.25	7.83	8.46	9.13	9.86	10.65
35	2027	1,645.63	0.06	92.81	14.79	6.28	6.78	7.32	7.91	8.54	9.22	9.96
36	2028	1,662.09	0.06	93.73	15.97	5.87	6.34	6.85	7.39	7.99	8.63	9.32
37	2029	1,678.71	0.06	94.67	17.25	5.49	5.93	6.40	6.92	7.47	8.07	8.71
38	2030	1,695.49	0.06	95.62	18.63	5.13	5.54	5.99	6.47	6.98	7.54	8.15
39	2031	1,712.45	0.06	96.57	20.12	4.80	5.19	5.60	6.05	6.53	7.05	7.62
40	2032	1,729.57	0.06	97.54	21.72	4.49	4.85	5.24	5.66	6.11	6.60	7.12
41	2033	1,746.87	0.06	98.52	23.46	4.20	4.53	4.90	5.29	5.71	6.17	6.66
42	2034	1,764.34	0.06	99.50	25.34	3.93	4.24	4.58	4.95	5.34	5.77	6.23
43	2035	1,781.98	0.06	100.50	27.37	3.67	3.97	4.28	4.63	5.00	5.40	5.83
44	2036	1,799.80	0.06	101.50	29.56	3.43	3.71	4.01	4.33	4.67	5.05	5.45
45	2037	1,817.80	0.06	102.52	31.92	3.21	3.47	3.75	4.05	4.37	4.72	5.10
46	2038	1,835.98	0.06	103.54	34.47	3.00	3.24	3.50	3.78	4.09	4.41	4.77
47	2039	1,854.34	0.06	104.58	37.23	2.81	3.03	3.28	3.54	3.82	4.13	4.46
48	2040	1,872.88	0.06	105.62	40.21	2.63	2.84	3.06	3.31	3.57	3.86	4.17
49	2041	1,891.61	0.06	106.68	43.43	2.46	2.65	2.87	3.09	3.34	3.61	3.90
50	2042	1,910.53	0.06	107.75	46.90	2.30	2.48	2.68	2.89	3.13	3.38	3.65
51	2043	1,929.63	0.06	108.82	50.65	2.15	2.32	2.51	2.71	2.92	3.16	3.41
52	2044	1,948.93	0.06	109.91	54.71	2.01	2.17	2.34	2.53	2.73	2.95	3.19
53	2045	1,968.42	0.06	111.01	59.08	1.88	2.03	2.19	2.37	2.56	2.76	2.98
54	2046	1,988.10	0.06	112.12	63.81	1.76	1.90	2.05	2.21	2.39	2.58	2.79
55	2047	2,007.98	0.06	113.24	68.91	1.64	1.77	1.92	2.07	2.24	2.41	2.61

continued

Annex 1 (continued)

time (t)	Year	Nominal SV (P)	Harvest (M cu.m.)	Vn (SV X Harvest)	$(1+r)^t$	V_{1992}	V_{1993}	V_{1994}	V_{1995}	V_{1996}	V_{1997}	V_{1998}
56	2048	2,028.06	0.06	114.37	74.43	1.54	1.66	1.79	1.94	2.09	2.26	2.44
57	2049	2,048.34	0.06	115.52	80.38	1.44	1.55	1.68	1.81	1.96	2.11	2.28
58	2050	2,068.83	0.06	116.67	86.81	1.34	1.45	1.57	1.69	1.83	1.97	2.13
59	2051	2,089.51	0.06	117.84	93.76	1.26	1.36	1.47	1.58	1.71	1.85	1.99
60	2052	2,110.41	0.06	119.02	101.26	1.18	1.27	1.37	1.48	1.60	1.73	1.87
61	2053	2,131.51	0.06	120.21	109.36	1.10	1.19	1.28	1.38	1.50	1.62	1.74
62	2054	2,152.83	0.06	121.41	118.11	1.03	1.11	1.20	1.29	1.40	1.51	1.63
63	2055	2,174.36	0.06	122.62	127.55	0.96	1.04	1.12	1.21	1.31	1.41	1.53
64	2056	2,196.10	0.06	123.85	137.76	0.90	0.97	1.05	1.13	1.22	1.32	1.43
65	2057	2,218.06	0.06	125.09	148.78	0.84	0.91	0.98	1.06	1.14	1.24	1.33
66	2058	2,240.24	0.06	126.34	160.68	0.79	0.85	0.92	0.99	1.07	1.16	1.25
67	2059	2,262.64	0.06	127.60	173.54	0.74	0.79	0.86	0.93	1.00	1.08	1.17
68	2060	2,285.27	0.06	128.88	187.42	0.69	0.74	0.80	0.87	0.94	1.01	1.09
69	2061	2,308.12	0.06	130.17	202.41	0.64	0.69	0.75	0.81	0.87	0.94	1.02
70	2062	2,331.21	0.06	131.47	218.61		0.65	0.70	0.76	0.82	0.88	0.95
71	2063	2,354.52	0.06	132.78	236.09			0.66	0.71	0.77	0.83	0.89
72	2064	2,378.06	0.06	134.11	254.98				0.66	0.72	0.77	0.83
73	2065	2,401.84	0.06	135.45	275.38					0.67	0.72	0.78
74	2066	2,425.86	0.06	136.81	297.41						0.68	0.73
75	2067	2,450.12	0.06	138.18	321.20							0.68
			TOTAL	1,442.54								

Present value of future stream of benefit	*1,001.50*	*1,010.87*				
Change in AV: V_{1993}-V_{1992}	***9.37***	*1,011.51*	*1,020.97*			
Change in AV: V_{1994}-V_{1993}		***9.46***	*1,021.63*	*1,031.18*		
Change in AV: V_{1995}-V_{1994}			***9.56***	*1,031.85*	*1,041.50*	
Change in AV: V_{1996}-V_{1995}				***9.65***	*1,042.16*	*1,051.91*
Change in AV: V_{1997}-V_{1996}					***9.76***	*1,052.59*	*1,062.43*
Change in AV: V_{1998}-V_{1997}						***9.84***	*1,063.11*

Where r = 8%

Annex 2

Change in Asset Value: Economic Depreciation Estimates Asset Value Approach Based on Stumpage Value

(in Constant 1994 Prices)

MANGROVE RESIDUAL FORESTS

time (t)	Year	Constant SV (P)	Harvest (M cu.m.)	Vn (SV X Harvest)	$(1+r)^t$	V_{1992}	V_{1993}	V_{1994}	V_{1995}	V_{1996}	V_{1997}	V_{1998}
0	1992	1,002.52	0.06	56.54	1.00	56.54						
1	1993	1,082.95	0.06	61.07	1.08	56.55	61.07					
2	1994	1,185.02	0.06	66.83	1.17	57.30	61.88	66.83				
3	1995	1,292.62	0.06	72.90	1.26	57.87	62.50	67.50	72.90			
4	1996	1,424.02	0.06	80.31	1.36	59.03	63.75	68.85	74.36	80.31		
5	1997	1,523.72	0.06	85.93	1.47	58.48	63.16	68.22	73.67	79.57	85.93	
6	1998	1,538.96	0.06	86.79	1.59	54.69	59.07	63.79	68.90	74.41	80.36	86.79
7	1999	1,554.35	0.06	87.66	1.71	51.15	55.24	59.66	64.43	69.59	75.15	81.17
8	2000	1,569.89	0.06	88.54	1.85	47.83	51.66	55.79	60.26	65.08	70.28	75.90
9	2001	1,585.59	0.06	89.42	2.00	44.73	48.31	52.18	56.35	60.86	65.73	70.98
10	2002	1,601.45	0.06	90.31	2.16	41.83	45.18	48.79	52.70	56.91	61.47	66.38
11	2003	1,617.46	0.06	91.22	2.33	39.12	42.25	45.63	49.28	53.22	57.48	62.08
12	2004	1,633.64	0.06	92.13	2.52	36.59	39.51	42.67	46.09	49.77	53.76	58.06
13	2005	1,649.97	0.06	93.05	2.72	34.21	36.95	39.91	43.10	46.55	50.27	54.29
14	2006	[illegible]	0.06	93.98	2.94	32.00	34.56	37.32	40.31	43.53	47.01	50.78
15	2007	[illegible]	0.06	94.92	3.17	29.92	32.32	34.90	37.69	40.71	43.97	47.48
16	2008	1,699.97	0.06	95.87	3.43	27.98	30.22	32.64	35.25	38.07	41.12	44.41
17	2009	1,716.97	0.06	96.83	3.70	26.17	28.26	30.52	32.97	35.60	38.45	41.53
18	2010	1,734.14	0.06	97.80	4.00	24.47	26.43	28.55	30.83	33.30	35.96	38.84
19	2011	1,751.48	0.06	98.78	4.32	22.89	24.72	26.70	28.83	31.14	33.63	36.32
20	2012	1,768.99	0.06	99.76	4.66	21.40	23.12	24.97	26.96	29.12	31.45	33.97
21	2013	1,786.68	0.06	100.76	5.03	20.02	21.62	23.35	25.22	27.23	29.41	31.76
22	2014	1,804.55	0.06	101.77	5.44	18.72	20.22	21.83	23.58	25.47	27.50	29.71
23	2015	1,822.60	0.06	102.79	5.87	17.51	18.91	20.42	22.05	23.82	25.72	27.78
24	2016	1,840.82	0.06	103.81	6.34	16.37	17.68	19.10	20.62	22.27	24.06	25.98
25	2017	1,859.23	0.06	104.85	6.85	15.31	16.54	17.86	19.29	20.83	22.50	24.30
26	2018	1,877.82	0.06	105.90	7.40	14.32	15.46	16.70	18.04	19.48	21.04	22.72
27	2019	1,896.60	0.06	106.96	7.99	13.39	14.46	15.62	16.87	18.22	19.67	21.25
28	2020	1,915.57	0.06	108.03	8.63	12.52	13.52	14.61	15.77	17.04	18.40	19.87
29	2021	1,934.72	0.06	109.11	9.32	11.71	12.65	13.66	14.75	15.93	17.21	18.58

continued

Annex 2 (continued)

time (t)	Year	Constant SV (P)	Harvest (M cu.m.)	Vn (SV X Harvest)	$(1+r)^t$	V_{1992}	V_{1993}	V_{1994}	V_{1995}	V_{1996}	V_{1997}	V_{1998}
30	2022	1,954.07	0.06	110.20	10.06	10.95	11.83	12.77	13.80	14.90	16.09	17.38
31	2023	1,973.61	0.06	111.30	10.87	10.24	11.06	11.95	12.90	13.93	15.05	16.25
32	2024	1,993.35	0.06	112.42	11.74	9.58	10.34	11.17	12.07	13.03	14.07	15.20
33	2025	2,013.28	0.06	113.54	12.68	8.96	9.67	10.45	11.28	12.19	13.16	14.21
34	2026	2,033.41	0.06	114.68	13.69	8.38	9.05	9.77	10.55	11.40	12.31	13.29
35	2027	2,053.75	0.06	115.82	14.79	7.83	8.46	9.14	9.87	10.66	11.51	12.43
36	2028	2,074.28	0.06	116.98	15.97	7.33	7.91	8.54	9.23	9.97	10.76	11.63
37	2029	2,095.03	0.06	118.15	17.25	6.85	7.40	7.99	8.63	9.32	10.07	10.87
38	2030	2,115.98	0.06	119.33	18.63	6.41	6.92	7.47	8.07	8.72	9.41	10.17
39	2031	2,137.14	0.06	120.53	20.12	5.99	6.47	6.99	7.55	8.15	8.80	9.51
40	2032	2,158.51	0.06	121.73	21.72	5.60	6.05	6.54	7.06	7.62	8.23	8.89
41	2033	2,180.09	0.06	122.95	23.46	5.24	5.66	6.11	6.60	7.13	7.70	8.32
42	2034	2,201.89	0.06	124.18	25.34	4.90	5.29	5.72	6.17	6.67	7.20	7.78
43	2035	2,223.91	0.06	125.42	27.37	4.58	4.95	5.35	5.77	6.24	6.73	7.27
44	2036	2,246.15	0.06	126.67	29.56	4.29	4.63	5.00	5.40	5.83	6.30	6.80
45	2037	2,268.61	0.06	127.94	31.92	4.01	4.33	4.68	5.05	5.45	5.89	6.36
46	2038	2,291.30	0.06	129.22	34.47	3.75	4.05	4.37	4.72	5.10	5.51	5.95
47	2039	2,314.21	0.06	130.51	37.23	3.51	3.79	4.09	4.42	4.77	5.15	5.56
48	2040	2,337.36	0.06	131.82	40.21	3.28	3.54	3.82	4.13	4.46	4.82	5.20
49	2041	2,360.73	0.06	133.13	43.43	3.07	3.31	3.58	3.86	4.17	4.50	4.86
50	2042	2,384.34	0.06	134.47	46.90	2.87	3.10	3.34	3.61	3.90	4.21	4.55
51	2043	2,408.18	0.06	135.81	50.65	2.68	2.90	3.13	3.38	3.65	3.94	4.25
52	2044	2,432.26	0.06	137.17	54.71	2.51	2.71	2.92	3.16	3.41	3.68	3.98
53	2045	2,456.58	0.06	138.54	59.08	2.34	2.53	2.74	2.95	3.19	3.45	3.72
54	2046	2,481.15	0.06	139.93	63.81	2.19	2.37	2.56	2.76	2.98	3.22	3.48
55	2047	2,505.96	0.06	141.33	68.91	2.05	2.21	2.39	2.58	2.79	3.01	3.25
56	2048	2,531.02	0.06	142.74	74.43	1.92	2.07	2.24	2.42	2.61	2.82	3.04
57	2049	2,556.33	0.06	144.17	80.38	1.79	1.94	2.09	2.26	2.44	2.64	2.85
58	2050	2,581.89	0.06	145.61	86.81	1.68	1.81	1.96	2.11	2.28	2.46	2.66
59	2051	2,607.71	0.06	147.06	93.76	1.57	1.69	1.83	1.98	2.13	2.30	2.49
60	2052	2,633.79	0.06	148.53	101.26	1.47	1.58	1.71	1.85	2.00	2.16	2.33
61	2053	2,660.13	0.06	150.02	109.36	1.37	1.48	1.60	1.73	1.87	2.02	2.18
62	2054	2,686.73	0.06	151.52	118.11	1.28	1.39	1.50	1.62	1.75	1.89	2.04
63	2055	2,713.60	0.06	153.04	127.55	1.20	1.30	1.40	1.51	1.63	1.76	1.90
64	2056	2,740.73	0.06	154.57	137.76	1.12	1.21	1.31	1.41	1.53	1.65	1.78

continued

Annex 2 (continued)

time (t)	Year	Constant SV (P)	Harvest (M cu.m.)	Vn (SV X Harvest)	$(1+r)^t$	V_{1992}	V_{1993}	V_{1994}	V_{1995}	V_{1996}	V_{1997}	V_{1998}
65	2057	2,768.14	0.06	156.11	148.78	1.05	1.13	1.22	1.32	1.43	1.54	1.67
66	2058	2,795.82	0.06	157.67	160.68	0.98	1.06	1.14	1.24	1.34	1.44	1.56
67	2059	2,823.78	0.06	159.25	173.54	0.92	0.99	1.07	1.16	1.25	1.35	1.46
68	2060	2,852.02	0.06	160.84	187.42	0.86	0.93	1.00	1.08	1.17	1.26	1.36
69	2061	2,880.54	0.06	162.45	202.41	0.80	0.87	0.94	1.01	1.09	1.18	1.27
70	2062	2,909.34	0.06	164.07	218.61		0.81	0.88	0.95	1.02	1.10	1.19
71	2063	2,938.44	0.06	165.72	236.09			0.82	0.88	0.95	1.03	1.11
72	2064	2,967.82	0.06	167.37	254.98				0.83	0.89	0.96	1.04
73	2065	2,997.50	0.06	169.05	275.38					0.84	0.90	0.97
74	2066	3,027.47	0.06	170.74	297.41						0.84	0.91
75	2067	3,057.75	0.06	172.44	321.20							0.85
			TOTAL	**1,720.88**								
Present value of future stream of benefit						*1,178.02*	*1,211.20*					
Change in AV: V_{1993}-V_{1992}						***33.18***	*1,212.01*	*1,243.01*				
Change in AV: V_{1994}-V_{1993}							***31.00***	*1,243.83*	*1,271.16*			
Change in AV: V_{1995}-V_{1994}								***27.33***	*1,271.99*	*1,295.01*		
Change in AV: V_{1996}-V_{1995}									***23.03***	*1,295.85*	*1,312.78*	
Change in AV: V_{1997}-V_{1996}										***16.93***	*1,313.63*	*1,325.91*
Change in AV: V_{1998}-V_{1997}											***12.28***	*1,326.76*

Where r = 8%

Annex 3
Mangrove Residual Forests: Harvest Rate Optimization

Assumptions							
	Cutting Cycle			5			
		(1+r)t	t	CR	DV	NPVt	DEP
1997		1.00	0	247.88	247.88	1,088.81	
Total area (Million Hectares)	0.12206859	1.08	1	250.36	231.81	928.04	160.77
Stand density (cu m/ha)	33	1.17	2	252.86	216.79	751.92	176.11
Production area	100%	1.26	3	255.39	202.74	559.22	192.71
Harvestable volume	70%	1.36	4	257.94	189.60	348.56	210.65
Stumpage value (P/cu m)	1,220.93	1.47	5			118.51	230.06
Annual change, s.v.	1%	1.59	6				
		1.71	7				
Price elasticity effects:	S.V.	1.85	8				
if T< 20	36%	2.00	9				
if 20 = T <= 30	67%	2.16	10				
if T> 30	100%	2.33	11				
		2.52	12				
Discount rate	8%	2.72	13				
		2.94	14				
CR = Current revenue		3.17	15				
DV = Discounted Value of CR		3.43	16				
NPV_t = NPV_t at the beginning of the year t		3.70	17				
DEP = Depreciation		4.00	18				
Cutting Cycle	NPV in million pesos	4.32	19				
5	1,088.81	4.66	20				
10	933.82	5.03	21				
15	808.24	5.44	22				
20	1,313.58	5.87	23				
25	1,156.97	6.34	24				
30	1,027.38	6.85	25				
35	*1,372.22*	7.40	26				
40	1,236.92	7.99	27				
45	1,122.51	8.63	28				
50	1,025.09	9.32	29				
		10.06	30				
		10.87	31				
		11.74	32				
		12.68	33				
		13.69	34				
		14.79	35				
		15.97	36				
		17.25	37				
		18.63	38				
		20.12	39				
		21.72	40				
		23.46	41				
		25.34	42				
		27.37	43				
		29.56	44				
		31.92	45				
		34.47	46				
		37.23	47				
		40.21	48				
		43.43	49				
NPV-Cutting Cycles (in Million Pesos)						1,088.81	

continued

Annex 3 (continued)

Cutting Cycle				10			
Assumptions		(1+r)t	t	CR	DV	NPVt	DEP
1997		1.00	0	123.94	123.94	933.82	
Total area (Million Hectares)	0.12206859	1.08	1	125.18	115.91	884.59	49.23
Stand density (cu m/ha)	33	1.17	2	126.43	108.39	830.17	54.41
Production area	100%	1.26	3	127.69	101.37	770.16	60.02
Harvestable volume	70%	1.36	4	128.97	94.80	704.08	66.08
Stumpage value (P/cu m)	1,220.93	1.47	5	130.26	88.65	631.43	72.65
Annual change, s.v.	1%	1.59	6	131.56	82.91	551.68	79.75
		1.71	7	132.88	77.53	464.25	87.43
Price elasticity effects: S.V.		1.85	8	134.21	72.51	368.51	95.74
if T< 20	36%	2.00	9	135.55	67.81	263.78	104.73
if 20 = T <= 30	67%	2.16	10			149.34	114.45
if T> 30	100%	2.33	11				
		2.52	12				
Discount rate	8%	2.72	13				
		2.94	14				
CR = Current revenue		3.17	15				
DV = Discounted Value of CR		3.43	16				
NPV_t = NPV_t at the beginning of the year t		3.70	17				
DEP = Depreciation		4.00	18				
Cutting Cycle	NPV in million pesos	4.32	19				
5	1,088.81	4.66	20				
10	933.82	5.03	21				
15	808.24	5.44	22				
20	1,313.58	5.87	23				
25	1,156.97	6.34	24				
30	1,027.38	6.85	25				
35	*1,372.22*	7.40	26				
40	1,236.92	7.99	27				
45	1,122.51	8.63	28				
50	1,025.09	9.32	29				
		10.06	30				
		10.87	31				
		11.74	32				
		12.68	33				
		13.69	34				
		14.79	35				
		15.97	36				
		17.25	37				
		18.63	38				
		20.12	39				
		21.72	40				
		23.46	41				
		25.34	42				
		27.37	43				
		29.56	44				
		31.92	45				
		34.47	46				
		37.23	47				
		40.21	48				
		43.43	49				

NPV-Cutting Cycles (in Million Pesos) 933.82

continued

Annex 3 (continued)

Cutting Cycle	15

Assumptions

1997	
Total area (Million Hectares)	0.12206859
Stand density (cu m/ha)	33
Production area	100%
Harvestable volume	70%
Stumpage value (P/cu m)	1,220.93
Annual change, s.v.	1%
Price elasticity effects:	S.V.
if T< 20	36%
if 20 = T <= 30	67%
if T> 30	100%
Discount rate	8%

CR = Current revenue
DV = Discounted Value of CR
NPV_t = NPV_t at the beginning of the year t
DEP = Depreciation

Cutting Cycle	NPV in million pesos
5	1,088.81
10	933.82
15	808.24
20	1,313.58
25	1,156.97
30	1,027.38
35	1,372.22
40	1,236.92
45	1,122.51
50	1,025.09

(1+r)t	t	CR	DV	NPVt	DEP
1.00	0	82.63	82.63	808.24	
1.08	1	83.45	77.27	790.28	17.97
1.17	2	84.29	72.26	770.05	20.23
1.26	3	85.13	67.58	747.36	22.68
1.36	4	85.98	63.20	722.02	25.34
1.47	5	86.84	59.10	693.80	28.22
1.59	6	87.71	55.27	662.47	31.34
1.71	7	88.59	51.69	627.76	34.71
1.85	8	89.47	48.34	589.39	38.37
2.00	9	90.37	45.21	547.07	42.32
2.16	10	91.27	42.28	500.47	46.60
2.33	11	92.18	39.54	449.23	51.23
2.52	12	93.11	36.97	392.99	56.24
2.72	13	94.04	34.58	331.32	61.67
2.94	14	94.98	32.34	263.79	67.53
3.17	15			189.92	73.87
3.43	16				
3.70	17				
4.00	18				
4.32	19				
4.66	20				
5.03	21				
5.44	22				
5.87	23				
6.34	24				
6.85	25				
7.40	26				
7.99	27				
8.63	28				
9.32	29				
10.06	30				
10.87	31				
11.74	32				
12.68	33				
13.69	34				
14.79	35				
15.97	36				
17.25	37				
18.63	38				
20.12	39				
21.72	40				
23.46	41				
25.34	42				
27.37	43				
29.56	44				
31.92	45				
34.47	46				
37.23	47				
40.21	48				
43.43	49				

NPV-Cutting Cycles (in Million Pesos) 808.24

continued

Annex 3 (continued)

Cutting Cycle	20				
Assumptions	(1+r)t	t	CR	DV	NPVt	DEP
1997	1.00	0	115.33	115.33	1,313.58	
Total area (Million Hectares) 0.12206859	1.08	1	116.49	107.86	1,303.34	10.25
Stand density (cu m/ha) 33	1.17	2	117.65	100.87	1,291.12	12.22
Production area 100%	1.26	3	118.83	94.33	1,276.76	14.36
Harvestable volume 70%	1.36	4	120.02	88.21	1,260.07	16.69
Stumpage value (P/cu m) 1,220.93	1.47	5	121.22	82.50	1,240.86	19.21
Annual change, s.v. 1%	1.59	6	122.43	77.15	1,218.91	21.95
	1.71	7	123.65	72.15	1,194.00	24.91
Price elasticity effects: S.V.	1.85	8	124.89	67.47	1,165.87	28.13
if T< 20 36%	2.00	9	126.14	63.10	1,134.25	31.62
if 20 = T <= 30 67%	2.16	10	127.40	59.01	1,098.85	35.40
if T> 30 100%	2.33	11	128.67	55.19	1,059.36	39.49
	2.52	12	129.96	51.61	1,015.44	43.92
Discount rate 8%	2.72	13	131.26	48.26	966.71	48.72
	2.94	14	132.57	45.14	912.79	53.92
CR = Current revenue	3.17	15	133.90	42.21	853.24	59.55
DV = Discounted Value of CR	3.43	16	135.24	39.47	787.60	65.64
NPV_t = NPV_t at the beginning of the year t	3.70	17	136.59	36.92	715.37	72.23
DEP = Depreciation	4.00	18	137.95	34.52	636.02	79.36
Cutting Cycle NPV in million pesos	4.32	19	139.33	32.29	548.94	87.07
5 1,088.81	4.66	20			453.52	95.42
10 933.82	5.03	21				
15 808.24	5.44	22				
20 1,313.58	5.87	23				
25 1,156.97	6.34	24				
30 1,027.38	6.85	25				
35 1,372.22	7.40	26				
40 1,236.92	7.99	27				
45 1,122.51	8.63	28				
50 1,025.09	9.32	29				
	10.06	30				
	10.87	31				
	11.74	32				
	12.68	33				
	13.69	34				
	14.79	35				
	15.97	36				
	17.25	37				
	18.63	38				
	20.12	39				
	21.72	40				
	23.46	41				
	25.34	42				
	27.37	43				
	29.56	44				
	31.92	45				
	34.47	46				
	37.23	47				
	40.21	48				
	43.43	49				
NPV-Cutting Cycles (in Million Pesos)				1,313.58		

continued

Annex 3 (continued)

Cutting Cycle	25

Assumptions

1997	
Total area (Million Hectares)	0.12206859
Stand density (cu m/ha)	33
Production area	100%
Harvestable volume	70%
Stumpage value (P/cu m)	1,220.93
Annual change, s.v.	1%
Price elasticity effects:	S.V.
if T< 20	36%
if 20 = T <= 30	67%
if T> 30	100%
Discount rate	8%

CR = Current revenue
DV = Discounted Value of CR
NPV_t = NPV_t at the beginning of the year t
DEP = Depreciation

Cutting Cycle	NPV in million pesos
5	1,088.81
10	933.82
15	808.24
20	1,313.58
25	1,156.97
30	1,027.38
35	*1,372.22*
40	1,236.92
45	1,122.51
50	1,025.09

(1+r)t	t	CR	DV	NPVt	DEP
1.00	0	92.27	92.27	1,156.97	
1.08	1	93.19	86.29	1,157.26	(0.29)
1.17	2	94.12	80.69	1,156.65	0.61
1.26	3	95.06	75.46	1,155.06	1.59
1.36	4	96.01	70.57	1,152.40	2.66
1.47	5	96.97	66.00	1,148.58	3.82
1.59	6	97.94	61.72	1,143.50	5.09
1.71	7	98.92	57.72	1,137.03	6.46
1.85	8	99.91	53.98	1,129.07	7.96
2.00	9	100.91	50.48	1,119.49	9.58
2.16	10	101.92	47.21	1,108.14	11.35
2.33	11	102.94	44.15	1,094.87	13.27
2.52	12	103.97	41.29	1,079.52	15.35
2.72	13	105.01	38.61	1,061.92	17.61
2.94	14	106.06	36.11	1,041.86	20.05
3.17	15	107.12	33.77	1,019.15	22.71
3.43	16	108.19	31.58	993.57	25.59
3.70	17	109.27	29.53	964.86	28.70
4.00	18	110.36	27.62	932.78	32.08
4.32	19	111.47	25.83	897.04	35.74
4.66	20	112.58	24.15	857.34	39.70
5.03	21	113.71	22.59	813.34	44.00
5.44	22	114.85	21.12	764.70	48.64
5.87	23	115.99	19.76	711.03	53.67
6.34	24	117.15	18.48	651.92	59.11
6.85	25			586.92	65.00
7.40	26				
7.99	27				
8.63	28				
9.32	29				
10.06	30				
10.87	31				
11.74	32				
12.68	33				
13.69	34				
14.79	35				
15.97	36				
17.25	37				
18.63	38				
20.12	39				
21.72	40				
23.46	41				
25.34	42				
27.37	43				
29.56	44				
31.92	45				
34.47	46				
37.23	47				
40.21	48				
43.43	49				

NPV-Cutting Cycles (in Million Pesos) 1,156.97

continued

Annex 3 (continued)

Cutting Cycle	30

Assumptions

1997	
Total area (Million Hectares)	0.12206859
Stand density (cu m/ha)	33
Production area	100%
Harvestable volume	70%
Stumpage value (P/cu m)	1,220.93
Annual change, s.v.	1%
Price elasticity effects: S.V.	
if T< 20	36%
if 20 = T <= 30	67%
if T> 30	100%
Discount rate	8%

CR = Current revenue
DV = Discounted Value of CR
NPV_t = NPV_t at the beginning of the year t
DEP = Depreciation

Cutting Cycle	NPV in million pesos
5	1,088.81
10	933.82
15	808.24
20	1,313.58
25	1,156.97
30	1,027.38
35	*1,372.22*
40	1,236.92
45	1,122.51
50	1,025.09

(1+r)t	t	CR	DV	NPVt	DEP
1.00	0	76.89	76.89	1,027.38	
1.08	1	77.66	71.90	1,032.68	(5.30)
1.17	2	78.43	67.24	1,037.64	(4.96)
1.26	3	79.22	62.89	1,042.22	(4.58)
1.36	4	80.01	58.81	1,046.38	(4.16)
1.47	5	80.81	55.00	1,050.08	(3.70)
1.59	6	81.62	51.43	1,053.27	(3.20)
1.71	7	82.43	48.10	1,055.92	(2.64)
1.85	8	83.26	44.98	1,057.95	(2.04)
2.00	9	84.09	42.07	1,059.33	(1.38)
2.16	10	84.93	39.34	1,059.99	(0.65)
2.33	11	85.78	36.79	1,059.85	0.13
2.52	12	86.64	34.41	1,058.86	0.99
2.72	13	87.51	32.18	1,056.93	1.93
2.94	14	88.38	30.09	1,053.98	2.95
3.17	15	89.27	28.14	1,049.91	4.06
3.43	16	90.16	26.32	1,044.64	5.27
3.70	17	91.06	24.61	1,038.06	6.59
4.00	18	91.97	23.02	1,030.04	8.01
4.32	19	92.89	21.52	1,020.47	9.57
4.66	20	93.82	20.13	1,009.22	11.25
5.03	21	94.76	18.82	996.14	13.08
5.44	22	95.70	17.60	981.08	15.07
5.87	23	96.66	16.46	963.86	17.22
6.34	24	97.63	15.40	944.31	19.55
6.85	25	98.60	14.40	922.22	22.08
7.40	26	99.59	13.46	897.40	24.83
7.99	27	100.59	12.59	869.60	27.80
8.63	28	101.59	11.78	838.58	31.02
9.32	29	102.61	11.01	804.07	34.51
10.06	30			765.79	38.28
10.87	31				
11.74	32				
12.68	33				
13.69	34				
14.79	35				
15.97	36				
17.25	37				
18.63	38				
20.12	39				
21.72	40				
23.46	41				
25.34	42				
27.37	43				
29.56	44				
31.92	45				
34.47	46				
37.23	47				
40.21	48				
43.43	49				

NPV-Cutting Cycles (in Million Pesos) 1,027.38

continued

Annex 3 (continued)

Cutting Cycle	35

Assumptions

1997	
Total area (Million Hectares)	0.12206859
Stand density (cu m/ha)	33
Production area	100%
Harvestable volume	70%
Stumpage value (P/cu m)	1,220.93
Annual change, s.v.	1%
Price elasticity effects: S.V.	
if T< 20	36%
if 20 = T <= 30	67%
if T> 30	100%
Discount rate	8%

CR = Current revenue
DV = Discounted Value of CR
NPV_t = NPV_t at the beginning of the year t
DEP = Depreciation

Cutting Cycle	NPV in million pesos
5	1,088.81
10	933.82
15	808.24
20	1,313.58
25	1,156.97
30	1,027.38
35	*1,372.22*
40	1,236.92
45	1,122.51
50	1,025.09

(1+r)t	t	CR	DV	NPVt	DEP
1.00	0	98.36	98.36	1,372.22	
1.08	1	99.35	91.99	1,383.63	(11.41)
1.17	2	100.34	86.03	1,394.98	(11.34)
1.26	3	101.35	80.45	1,406.23	(11.26)
1.36	4	102.36	75.24	1,417.39	(11.15)
1.47	5	103.38	70.36	1,428.42	(11.03)
1.59	6	104.42	65.80	1,439.31	(10.89)
1.71	7	105.46	61.54	1,450.04	(10.73)
1.85	8	106.51	57.55	1,460.58	(10.54)
2.00	9	107.58	53.82	1,470.91	(10.33)
2.16	10	108.66	50.33	1,481.00	(10.09)
2.33	11	109.74	47.07	1,490.83	(9.82)
2.52	12	110.84	44.02	1,500.35	(9.52)
2.72	13	111.95	41.16	1,509.54	(9.19)
2.94	14	113.07	38.50	1,518.36	(8.82)
3.17	15	114.20	36.00	1,526.76	(8.40)
3.43	16	115.34	33.67	1,534.70	(7.94)
3.70	17	116.49	31.48	1,542.14	(7.44)
4.00	18	117.66	29.44	1,549.01	(6.88)
4.32	19	118.84	27.54	1,555.28	(6.26)
4.66	20	120.02	25.75	1,560.86	(5.59)
5.03	21	121.22	24.08	1,565.71	(4.85)
5.44	22	122.44	22.52	1,569.74	(4.03)
5.87	23	123.66	21.06	1,572.88	(3.14)
6.34	24	124.90	19.70	1,575.05	(2.17)
6.85	25	126.15	18.42	1,576.16	(1.11)
7.40	26	127.41	17.23	1,576.11	0.05
7.99	27	128.68	16.11	1,574.79	1.32
8.63	28	129.97	15.07	1,572.09	2.70
9.32	29	131.27	14.09	1,567.89	4.20
10.06	30	132.58	13.18	1,562.05	5.84
10.87	31	133.91	12.32	1,554.44	7.62
11.74	32	135.25	11.52	1,544.89	9.55
12.68	33	136.60	10.78	1,533.23	11.65
13.69	34	137.96	10.08	1,519.29	13.94
14.79	35			1,502.87	16.42
15.97	36				
17.25	37				
18.63	38				
20.12	39				
21.72	40				
23.46	41				
25.34	42				
27.37	43				
29.56	44				
31.92	45				
34.47	46				
37.23	47				
40.21	48				
43.43	49				

NPV-Cutting Cycles (in Million Pesos) 1,372.22

continued

Annex 3 (continued)

Cutting Cycle	40

Assumptions

1997	
Total area (Million Hectares)	0.12206859
Stand density (cu m/ha)	33
Production area	100%
Harvestable volume	70%
Stumpage value (P/cu m)	1,220.93
Annual change, s.v.	1%
Price elasticity effects: S.V.	
if T< 20	36%
if 20 = T <= 30	67%
if T> 30	100%
Discount rate	8%

CR = Current revenue
DV = Discounted Value of CR
NPV_t = NPV_t at the beginning of the year t
DEP = Depreciation

Cutting Cycle	NPV in million pesos
5	1,088.81
10	933.82
15	808.24
20	1,313.58
25	1,156.97
30	1,027.38
35	***1,372.22***
40	1,236.92
45	1,122.51
50	1,025.09

(1+r)t	t	CR	DV	NPVt	DEP
1.00	0	86.07	86.07	1,236.92	
1.08	1	86.93	80.49	1,249.80	(12.88)
1.17	2	87.80	75.27	1,262.85	(13.05)
1.26	3	88.68	70.39	1,276.08	(13.23)
1.36	4	89.56	65.83	1,289.49	(13.41)
1.47	5	90.46	61.57	1,303.09	(13.60)
1.59	6	91.36	57.57	1,316.88	(13.79)
1.71	7	92.28	53.84	1,330.86	(13.99)
1.85	8	93.20	50.35	1,345.05	(14.19)
2.00	9	94.13	47.09	1,359.46	(14.40)
2.16	10	95.07	44.04	1,374.08	(14.62)
2.33	11	96.02	41.18	1,388.93	(14.85)
2.52	12	96.98	38.51	1,404.02	(15.09)
2.72	13	97.95	36.02	1,419.36	(15.34)
2.94	14	98.93	33.68	1,434.95	(15.59)
3.17	15	99.92	31.50	1,450.82	(15.86)
3.43	16	100.92	29.46	1,466.96	(16.14)
3.70	17	101.93	27.55	1,483.39	(16.43)
4.00	18	102.95	25.76	1,500.13	(16.74)
4.32	19	103.98	24.09	1,517.19	(17.06)
4.66	20	105.02	22.53	1,534.59	(17.39)
5.03	21	106.07	21.07	1,552.33	(17.75)
5.44	22	107.13	19.71	1,570.45	(18.12)
5.87	23	108.20	18.43	1,588.95	(18.50)
6.34	24	109.28	17.23	1,607.87	(18.91)
6.85	25	110.38	16.12	1,627.21	(19.34)
7.40	26	111.48	15.07	1,647.01	(19.80)
7.99	27	112.60	14.10	1,667.29	(20.28)
8.63	28	113.72	13.18	1,688.07	(20.79)
9.32	29	114.86	12.33	1,709.40	(21.32)
10.06	30	116.01	11.53	1,731.29	(21.89)
10.87	31	117.17	10.78	1,753.79	(22.50)
11.74	32	118.34	10.08	1,776.92	(23.13)
12.68	33	119.52	9.43	1,800.73	(23.81)
13.69	34	120.72	8.82	1,825.27	(24.54)
14.79	35	121.93	8.25	1,850.57	(25.30)
15.97	36	123.14	7.71	1,876.69	(26.12)
17.25	37	124.38	7.21	1,903.68	(26.99)
18.63	38	125.62	6.74	1,931.60	(27.92)
20.12	39	126.88	6.31	1,960.51	(28.91)
21.72	40			1,990.47	(29.96)
23.46	41				
25.34	42				
27.37	43				
29.56	44				
31.92	45				
34.47	46				
37.23	47				
40.21	48				
43.43	49				

NPV-Cutting Cycles (in Million Pesos) **1,236.92**

continued

Annex 3 (continued)

Assumptions				Cutting Cycle	45		
		(1+r)t	t	CR	DV	NPVt	DEP
1997		1.00	0	76.51	76.51	1,122.51	
Total area (Million Hectares)	0.12206859	1.08	1	77.27	71.55	1,135.81	(13.30)
Stand density (cu m/ha)	33	1.17	2	78.04	66.91	1,149.40	(13.59)
Production area	100%	1.26	3	78.82	62.57	1,163.31	(13.91)
Harvestable volume	70%	1.36	4	79.61	58.52	1,177.55	(14.24)
Stumpage value (P/cu m)	1,220.93	1.47	5	80.41	54.72	1,192.14	(14.59)
Annual change, s.v.	1%	1.59	6	81.21	51.18	1,207.10	(14.96)
		1.71	7	82.02	47.86	1,222.46	(15.36)
Price elasticity effects:	S.V.	1.85	8	82.84	44.76	1,238.23	(15.77)
if T< 20	36%	2.00	9	83.67	41.86	1,254.44	(16.21)
if 20 = T <= 30	67%	2.16	10	84.51	39.14	1,271.13	(16.68)
if T> 30	100%	2.33	11	85.36	36.61	1,288.31	(17.18)
		2.52	12	86.21	34.23	1,306.02	(17.71)
Discount rate	8%	2.72	13	87.07	32.02	1,324.29	(18.27)
		2.94	14	87.94	29.94	1,343.16	(18.87)
CR = Current revenue		3.17	15	88.82	28.00	1,362.67	(19.51)
DV = Discounted Value of CR		3.43	16	89.71	26.19	1,382.87	(20.19)
NPV_t = NPV_t at the beginning of the year t		3.70	17	90.61	24.49	1,403.79	(20.92)
DEP = Depreciation		4.00	18	91.51	22.90	1,425.48	(21.70)
Cutting Cycle	NPV in million pesos	4.32	19	92.43	21.42	1,448.01	(22.53)
5	1,088.81	4.66	20	93.35	20.03	1,471.42	(23.41)
10	933.82	5.03	21	94.29	18.73	1,495.78	(24.36)
15	808.24	5.44	22	95.23	17.52	1,521.16	(25.38)
20	1,313.58	5.87	23	96.18	16.38	1,547.63	(26.46)
25	1,156.97	6.34	24	97.14	15.32	1,575.26	(27.63)
30	1,027.38	6.85	25	98.11	14.33	1,604.14	(28.88)
35	*1,372.22*	7.40	26	99.09	13.40	1,634.35	(30.22)
40	1,236.92	7.99	27	100.09	12.53	1,666.01	(31.65)
45	1,122.51	8.63	28	101.09	11.72	1,699.20	(33.19)
50	1,025.09	9.32	29	102.10	10.96	1,734.05	(34.85)
		10.06	30	103.12	10.25	1,770.68	(36.63)
		10.87	31	104.15	9.58	1,809.21	(38.54)
		11.74	32	105.19	8.96	1,849.80	(40.59)
		12.68	33	106.24	8.38	1,892.59	(42.79)
		13.69	34	107.31	7.84	1,937.76	(45.16)
		14.79	35	108.38	7.33	1,985.47	(47.72)
		15.97	36	109.46	6.86	2,035.93	(50.46)
		17.25	37	110.56	6.41	2,089.35	(53.41)
		18.63	38	111.66	6.00	2,145.94	(56.59)
		20.12	39	112.78	5.61	2,205.95	(60.01)
		21.72	40	113.91	5.24	2,269.65	(63.70)
		23.46	41	115.05	4.90	2,337.31	(67.67)
		25.34	42	116.20	4.59	2,409.25	(71.94)
		27.37	43	117.36	4.29	2,485.80	(76.54)
		29.56	44	118.53	4.01	2,567.30	(81.51)
		31.92	45			2,654.15	(86.85)
		34.47	46				
		37.23	47				
		40.21	48				
		43.43	49				
					1,122.51		

NPV-Cutting Cycles (in Million Pesos)

continued

Annex 3 (continued)

Cutting Cycle	50

Assumptions

1997	
Total area (Million Hectares)	0.12206859
Stand density (cu m/ha)	33
Production area	100%
Harvestable volume	70%
Stumpage value (P/cu m)	1,220.93
Annual change, s.v.	1%
Price elasticity effects: S.V.	
if T< 20	36%
if 20 = T <= 30	67%
if T> 30	100%
Discount rate	8%

CR = Current revenue
DV = Discounted Value of CR
NPV_t = NPV_t at the beginning of the year t
DEP = Depreciation

Cutting Cycle	NPV in million pesos
5	1,088.81
10	933.82
15	808.24
20	1,313.58
25	1,156.97
30	1,027.38
35	***1,372.22***
40	1,236.92
45	1,122.51
50	1,025.09

(1+r)t	t	CR	DV	NPVt	DEP
1.00	0	68.86	68.86	1,025.09	
1.08	1	69.54	64.39	1,038.24	(13.15)
1.17	2	70.24	60.22	1,051.75	(13.52)
1.26	3	70.94	56.32	1,065.65	(13.90)
1.36	4	71.65	52.67	1,079.97	(14.31)
1.47	5	72.37	49.25	1,094.71	(14.75)
1.59	6	73.09	46.06	1,109.92	(15.21)
1.71	7	73.82	43.07	1,125.62	(15.70)
1.85	8	74.56	40.28	1,141.85	(16.23)
2.00	9	75.31	37.67	1,158.64	(16.79)
2.16	10	76.06	35.23	1,176.02	(17.39)
2.33	11	76.82	32.95	1,194.05	(18.02)
2.52	12	77.59	30.81	1,212.75	(18.70)
2.72	13	78.36	28.81	1,232.18	(19.43)
2.94	14	79.15	26.95	1,252.39	(20.21)
3.17	15	79.94	25.20	1,273.44	(21.04)
3.43	16	80.74	23.57	1,295.37	(21.94)
3.70	17	81.55	22.04	1,318.27	(22.89)
4.00	18	82.36	20.61	1,342.18	(23.92)
4.32	19	83.18	19.27	1,367.20	(25.01)
4.66	20	84.02	18.03	1,393.39	(26.19)
5.03	21	84.86	16.86	1,420.84	(27.45)
5.44	22	85.71	15.76	1,449.65	(28.81)
5.87	23	86.56	14.74	1,479.92	(30.27)
6.34	24	87.43	13.79	1,511.75	(31.83)
6.85	25	88.30	12.89	1,545.26	(33.51)
7.40	26	89.19	12.06	1,580.58	(35.32)
7.99	27	90.08	11.28	1,617.84	(37.26)
8.63	28	90.98	10.55	1,657.19	(39.35)
9.32	29	91.89	9.86	1,698.79	(41.60)
10.06	30	92.81	9.22	1,742.81	(44.02)
10.87	31	93.73	8.63	1,789.42	(46.62)
11.74	32	94.67	8.07	1,838.84	(49.42)
12.68	33	95.62	7.54	1,891.28	(52.44)
13.69	34	96.57	7.05	1,946.96	(55.68)
14.79	35	97.54	6.60	2,006.14	(59.18)
15.97	36	98.52	6.17	2,069.10	(62.95)
17.25	37	99.50	5.77	2,136.11	(67.01)
18.63	38	100.50	5.40	2,207.49	(71.39)
20.12	39	101.50	5.05	2,283.60	(76.10)
21.72	40	102.52	4.72	2,364.78	(81.19)
23.46	41	103.54	4.41	2,451.45	(86.67)
25.34	42	104.58	4.13	2,544.03	(92.57)
27.37	43	105.62	3.86	2,642.97	(98.95)
29.56	44	106.68	3.61	2,748.79	(105.82)
31.92	45	107.75	3.38	2,862.01	(113.22)
34.47	46	108.82	3.16	2,983.23	(121.22)
37.23	47	109.91	2.95	3,113.06	(129.84)
40.21	48	111.01	2.76	3,252.20	(139.13)
43.43	49	112.12	2.58	3,401.36	(149.17)

NPV-Cutting Cycles (in Million Pesos) **1,025.09**