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ANNEX III

CHARCOAL PRODUCTION SUBPROJECT

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CHARCOAL PRODUCTION SUBPROJECT

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ANNEX III

CHARCOAL PRODUCTION SUBPROJECT

I. BACKGROUND

The Farm Systems Development Corporation (FSDC) is responsible for implementing the Government of the Philippines (GOP) Charcoal Production Program. FSDC was initially created to provide financial and technical assistance to lowland irrigation-based farmers and small pump systems. FSDC was recently directed (under Presidential Decree 1595) to expand its client-beneficiary base in order to help improve the social and economic condition of upland farmers and seasonal farm workers.

One of the activities started under FSDC's new mandate is the Tree Resources for Energy and Enterprise (TREE) Program. Objectives of the TREE Program are: (1) to develop reliable, affordable and renewable energy resources, primarily firewood and charcoal, (2) to replace imported fossil fuels, (3) to generate employment, and (4) to improve local ecological balance. The AID-assisted Charcoal Production Subproject described in this annex will be part of the broader GOP Charcoal Production Program under the TREE Program.

The FSDC Charcoal Production Program and the AID-assisted Charcoal Production Subproject within the program are important efforts to achieve the TREE objectives. The program, in brief, entails the establishment of energy tree farms by upland farmers in all regions to serve as a resource base for local charcoal production for industrial enterprises and household use. Tree farms can range in size from 20 to 1,000 hectares, with 100 hectare modules as the basic unit in which to organize farmers for charcoal production. The charcoal produced in this subproject and FSDC's broader charcoal program will be used to meet:

- concentrated industrial demands for process heat such as ore smelting (as in Brazil, Malaysia, India and Argentina), portland cement manufacturing which has been directed to change from fuel oil to a coal or coal/charcoal mix fuel base, ceramics and sugar refineries;
- small rural industry uses such as brick and lime kilns, crop driers, blacksmith forges, commercial ovens, stoves and pottery kilns;
- rural and urban household needs.

The charcoal will also be used in the future to fuel commercially produced gasifier units adapted to irrigation pumps, rice mills, electrical generators, small ice plants, and farm and transport vehicles (see Annexes I and II).

Under the broader TREE Program, the GOP charcoal program assisted by this subproject is organized at three levels:

1. At the national level, FSDC provides loans for institutional development including training, administration, and economic development such as formation of enterprises. In addition, FSDC provides technical and management advisory services, in this case, for tree farm development, management, and charcoal production.

2. At the provincial level, FSDC provincial offices, drawing on resources from the FSDC national and area offices, will provide or facilitate: loans, institutional development, including management training; technical advisory services; and marketing assistance. FSDC provincial offices will be the primary entity providing services and other inputs directly to associations undertaking charcoal enterprises.

3. At the farm level, a Charcoal Producers Association (CPA) is responsible for the development of the tree farm, cultivation, maintenance, harvesting and charcoal production. The association is composed of farm families who are directly involved in and will benefit from the tree farm and charcoal production.

II. SUBPROJECT DESCRIPTION

A. General

The broader GOP Charcoal Program calls for approximately 200,000 hectares to be under cultivation by the Year 2000, producing approximately 1.4 million metric tons (MT) of charcoal per year. During the initial phase, 1981-1986, the program calls for the development of approximately 67 tree farms nationwide totalling approximately 77,000 hectares. To date, 21 tree farms are underway. They include 11,673 hectares, of which 1,807 hectares were planted in 1981. Charcoal will be produced in beehive kilns organized in groups throughout the tree farms to reduce wood transport costs. (See Appendix B, CPA Program Sites.)

Within the broader Charcoal Program, AID will assist in the development of approximately 21,200 hectares and up to 1,060 kilns for production of charcoal. This will be broken down into at least 212 tree farm modules for the organization and operation by CPAs nationwide. A CPA is comprised primarily of individual farmers currently occupying government land. These farmers are invited to work together for their mutual benefit in planting, operating the tree farm, and producing and selling charcoal. The associations are made up primarily of farmers who have practiced traditional slash-and-burn techniques and who have shifted cropping sites as the land was depleted. They now have the opportunity to settle in an area to pursue a more stable and secure livelihood.

The CPA tree farm organizations and operating systems, with variations for site-specific cultural and bio-physical factors are independent private enterprises. They function as follows: the tree farms will

normally range in size from 20 to 1,000 contiguous hectares, depending on land availability and local energy demand. The tree farms are divided into 100 hectare modules growing one or a number of fast-growing species, on a three-year rotation cycle. Five charcoal kilns are required for each module. Approximately 15 families (11-12 to work the tree farm and 3-4 to operate the kilns), with the same socio-economic background and almost always known to one another, are responsible for each module.1/ (A more complete description of a CPA's structure is contained in Appendix C.)

The CPAs are provided access to government land under long-term leases (an initial 25 years, automatically renewable for 25 years) and supervised credit to develop it. The long-term leases provide association members with a tenure security which will help motivate their participation. (See Appendix E; Legal Rights and Protections.) Farmers are permitted and encouraged to intercrop rice, corn and vegetables for their own use or sale. Members can also produce and sell leafmeal for their own profit where Leucaena is grown.

During the first phase of the program, FSDC provincial offices, with assistance from other sources as needed, help farmers organize their associations, license the land and prepare and plant the tree farm. During the second phase, they will train association members in charcoal production, and attendant enterprises such as leafmeal production, lumber production and cottage industries, enterprise management, and maintenance and improvement of infrastructure. The Bureau of Forest Development (BFD), the Forestry Research Institute (FORI), the Ministry of Agriculture (MA), and the National Food Authority (NFA) are prepared to provide additional assistance in tree farm development, maintenance and management, as well as marketing and skills training.

Once charcoal sales begin, the CPA will automatically deduct the amount due for the periodic loan repayments from the sales receipts, and distribute the remainder as shares to each member.

B. Charcoal Production Markets

1. Demand

An indication of the demand for charcoal in the industrial, commercial and household sectors from 1982-1991 is shown in Table A on the following page. The information is based on historical consumption and projected use of charcoal in various sectors.

The present industrial/commercial demand for charcoal is primarily from ore smelting plants (projected 210,750 MT in 1983), ceramics, bakeries (estimated 40,530 in 1983), the more than 20 large sugar

1/ In some areas, CPAs will have 20 members to increase employment generation, or to compensate for terrain conditions.

Table A[1/]
Charcoal Demand Projection
(In Thousand Metric Tons)

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Cement Industries[2/]	3.33	4.26	6.69	9.30	12.12	15.13	18.39	21.87	25.36
Smelter Plants	210.75	221.29	307.35	322.72	338.80	355.80	373.58	392.26	411.88
Hotesl & Restaurants	2.60	2.73	2.86	2.99	3.11	3.23	3.35	3.47	3.66
Bakeries	40.53	42.89	45.59	47.86	50.46	52.63	55.13	58.46	61.30
Households	315.95	321.27	326.85	332.31	337.26	342.47	346.84	352.74	358.39
Total	586.09	592.44	689.34	715.18	741.75	769.26	797.29	828.80	860.59

1/ This table does not include GOP projections for charcoal in the major program to apply gasifiers to vehicles, fishing boats, and various types of stationary applications, such as rice mills, threshers, refrigerators and electrical generation on a stand-alone basis. Projections in this program are:

1983	1984	1985	1986	1987	1988	1989	1990	1991
1020.0	1848.0	2755.0	3662.0	4569.0	5476.0	6383.0	7290.0	8197.0

2/ Assumes that 2% of projected petroleum demand will be substituted with charcoal in 1983 and 10% thereafter.

centrals/refineries (estimated 40,000 MT in 1983) and a growing demand in the cement industry (conservatively estimated at 3,330 MT in 1983, but projected to increase rapidly after cement plants are retrofitted to use coal or coal/charcoal as required by recent law).1/ Charcoal will be used increasingly in this sector as a bunker fuel and coal substitute.

Coal supply and demand were balanced from 1973 to 1980. According to the National Energy Program (1981-1986) coal supplies will increase from the present level of 300,000 MT to 3.7 million MT by 1986, and demand will grow from 300,000 MT a year to 6.9 MT by 1986. A recent World Bank and Asian Development Bank energy survey more conservatively projected a 1985 supply and demand of 2.3 million MT and 3.6 million MT, respectively. Nonetheless, a considerable gap (1.3 million MT) still remains to be filled. The government promotes the use of charcoal to fill this gap, even though currently limited by production capacity and conversion technologies.

Some examples of demand in the areas targeted as markets in this program are Mindanao, Camarines Norte, and Ilocos Norte. The Philippine Smelter Plant Corporation (PSC) in Camarines Norte is a major user of metallurgical coke as a fuel reductant. The corporation specializes in manufacturing various types of high alloy castings, such as grinding balls and mill liners.

Test data on charcoal technology operations reveal that PSC's annual blast furnace requirement is 9,975 MT of fixed carbon and 12,000 MT of charcoal. Considering the 20% in-plant losses and fines generated, the corporation needs a minimum of 15,000 MT of charcoal. However, the company's own charcoal production system can only produce 3,000 MT of charcoal annually. To operate continuously, it needs a steady and much larger charcoal supply.

Another major targeted customer is the Mabuhay Vinyl Conglomerate in Lanao and Misamis Oriental, which includes the Electric Alloy Corporation and the Maria Cristina complexes; both are industrial smelters and corrugated sheet manufacturers in Iligan City. Estimated demand for these firms, plus the smelting, porcelain and plastics companies of Cagayan de Oro City, is approximately 180,000 MT per year. A similar situation exists in Ilocos Norte where a new pig iron plant is being constructed at Pinili. The plant will have an annual charcoal requirement of 75,000 MT, approximately 50% of which will be produced outside of the plant's facilities.

In the rural industrial sector, charcoal consumption is expected to increase fairly rapidly in the future as greater charcoal avail-

1/ All cement companies are required to complete conversion this year. Of the thirteen major cement producers currently in the conversion process, eight are receiving funding assistance from the U.K. (suppliers' credits), the Manufacturers Hanover Trust of New York and the Development Bank of the Philippines, and five are financing their own conversion program.

ability at relatively lower cost enables local businesses to increase production through fuel substitution. It is conservatively estimated that a 15% charcoal demand growth will be experienced over the next five years, with brick, pottery and tile making, blacksmithing, lime production and bakeries being the major consumers.

The commercial sector will consume approximately 43,130 MT of charcoal by 1983. Currently in the Philippines, hotels and restaurants use charcoal mainly for broiling purposes while bakeries use it to fuel their ovens.

A significant demand for charcoal comes from households, largely because of its lower cost relative to such energy sources as kerosene and liquified petroleum gas (LPG). Philippine families are switching back to charcoal for at least some of their cooking, and kerosene and LPG sales have dropped off. While use of fuels in the houshold is complex with a "shadow price" existing for socially preferred fuels, and often with more than one fuel type being used per household, it is clear that the use of charcoal per se is increasingly more advantageous than LPG or other petroleum-based fuels.

It is estimated that by 1983, about 315,950 MT will be required for cooking and ironing purposes. Table B shows the historical noncommercial energy consumption of the household sector. The data were culled from a variety of primary sources of energy demand developed in recent years. The data in the table show the importance of traditional fuels such as firewood and charcoal in meeting the Philippines' demand for energy. Total noncommercial energy use of households in 1977 was close to 20.5 thousand barrels of oil equivalent divided as follows: firewood 60.2%, wood wastes 0.5%, charcoal 25.7%, coconut shells 11.9% and rice hulls 1.8%.

A report submitted by local consultants to AID, on Upland Development for Energy Production, indicates that in Regions V, VI, and VIII practically all households use charcoal for ironing and cooking purposes, and that overall household charcoal consumption is likely to increase by approximately 20% annually.

Household Charcoal Demand

	1980 (MT)	1985 (MT)
Region V	56,400	123,737
Region VI	81,200	224,515
Region VIII	18,400	32,453

Information from the Philippine Ministry of Energy shows that kerosene consumption, which is used primarily by households, declined at an average of 1.2% a year from 1973 to 1979 as kerosene prices rose and

Table B
Non-Commercial Energy Consumption of Households - 1977
(Thousand Barrels of Oil Equivalent)

		Firewood	Woodwaste	Charcoal	Coconut Shells	Rice Hulls	Others	Total
I.	Ilocos	1549.30	14.00	450.21	-	1.39	-	2014.90
II.	Cagayan Valley	286.73	0.15	154.61	0.06	-	0.01	441.56
III.	Central Luzon	1038.54	50.67	615.36	6.42	33.82	-	1744.81
IV.	National Capital Region, Metro Manila	11.45	0.18	1.18	0.06	-	-	12.87
V.	Bicol	349.82	5.94	362.76	251.06	-	-	969.58
VI.	Western Visayas	2042.82	3.58	307.30	63.70	-	-	2417.40
VII.	Central Visayas	805.79	8.85	260.70	17.45	-	-	1092.79
VIII.	Eastern Visayas	760.42	2.70	267.48	7.91	-	-	1033.51
IX.	Western Mindanao	2149.33	-	271.12	41.30	-	-	2461.75
X.	Northern Mindanao	436.12	0.03	239.45	1543.54	-	-	2219.14
XI.	Southern Mindanao	301.79	0.64	86.48	2.39	-	-	391.30
XII.	Central Mindanao	801.91	7.54	212.00	65.91	71.58	9.24	1168.18
XIII.	Southern Tagalog	1778.97	4.85	2021.70	426.42	256.24	0.54	4488.72
	Total	12312.99	99.13	5250.35	2426.22	363.03	9.79	20461.51
		60%	0.5	25.7	11.9	1.8	-	99.9

*Conversion Factors - Rice Hull - 4,000 Btu/lb.
Firewood and Woodwastes - 4,000 Btu/lb.
Coconut Shell - 8,000 Btu/lb.
Charcoal - 12,000 Btu/lb.

The foregoing heating values were used in deriving barrel-of-oil equivalents of non-commercial energy consumption, original figures of which are expressed in standard kilograms.

other fuels such as charcoal became more attractive to this particular market segment. Another indication of increased charcoal use in the household sector is the historical consumption of LPG, a middle and upper income class fuel. LPG consumption grew at 36.2% annually during the 1966-72 period and 5.2% annually after 1973. Per capita consumption increased rapidly during 1960's, its period of market introduction, and continued to inch upward from 1973 to 1979. In 1980, LPG sales showed a dramatic downward trend because of a relatively sharp price increase for LPG in February 1980.

The decline in consumption of LPG and kerosene is attributed to their price differential compared to the price of charcoal and other noncommercial energy fuels. Diagram 1 shows the historical price of charcoal, LPG and kerosene in the Philippines from 1971 to 1980.

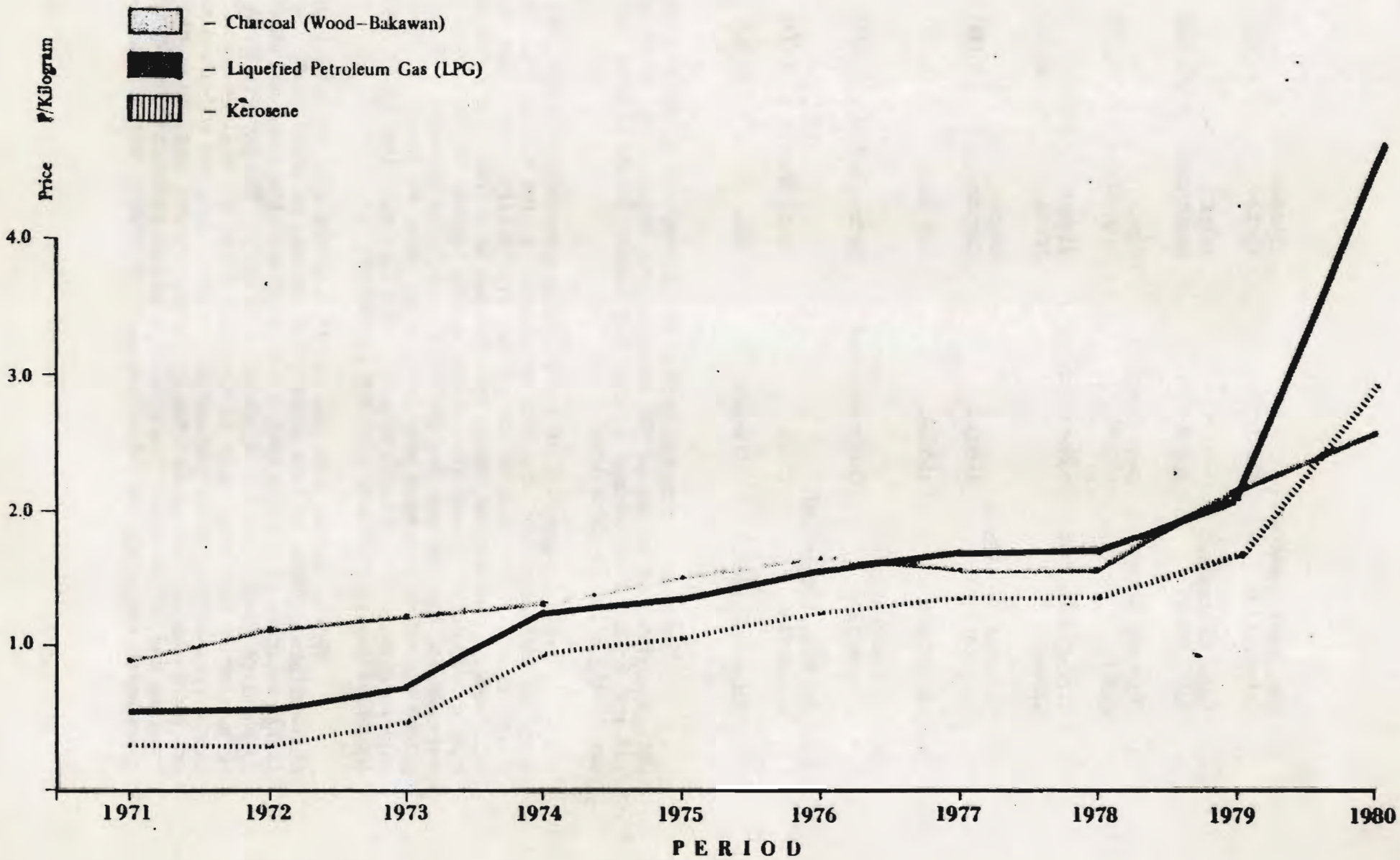
It should be pointed out that most of the fuelwood and charcoal being used to replace kerosene and LPG or to meet demand increases resulting from population or economic growth comes from existing tree stands. Programs to develop biomass energy resources, such as the Charcoal Production Program, have only recently started. In the meanwhile, the traditional ways of meeting fuelwood and charcoal demand will continue to contribute to deforestation in the Philippines.

2. Subproject Markets

The TREE Program and the AID-assisted subproject will be implemented on three levels of introductory priority corresponding to three target markets, or areas: first will be identified industries with large charcoal requirements; second will be household and middle-scale industrial users in major population centers; and the third will be pilot projects in rural areas with less certain rural markets. CPAs involved in the first two areas will also make their charcoal available to small rural enterprises and industries and household users. The industrial market in the first case will be foundries, smelters, cement plants, sugar centrals/refineries, and other industries which use, or will use, fuelwood or charcoal. Among these potential customers are:

Name of Firm/Industry	Product Utilization	Location Of Plants	Annual Requirement (MT)
1. Philippine Smelters Corporation	pig iron and foundry	Camarines Norte	15,000
2. Mabuhay Agro-Forestry Corporation	pig iron and foundry	Lanao del Norte	180,000
3. Maria Cristina Chemical Industries Incorporated	pig iron, corrugated sheets & ceramics	Lanao del norte	

Figure 2
HISTORICAL PRICES OF CHARCOAL, LPG AND KEROSENE



4.	MNR Development Corporation	pig iron	Ilocos Norte	75,000
5.	Sugar Centrals/ Refineries	sugar	eight provinces	150,000
6.	Thirteen Cement Plants	cement and/or clinkers	nine provinces	3,330
7.	Virginia Tobacco Growers	tobacco curing	Ilocos Norte	100,000
8.	Victoria Milling Corporation	alcohol	Negros Occidental	9,000
9.	La Carlota	alcohol	Neg Occ.	4,300
10.	Dubicon Ceramic Corporation	Ceramics/tiles	Metro Manila	10,000
11.	Far East Integrated Industries	tiles	Metro Manila	9,000
12.	Union Carbide	batteries	Cebu	35,000

The size of charcoal production enterprises in these areas will depend on the volume of charcoal/fuelwood requirements of these industries, and a percentage of that requirement deemed safe in terms of developing a market floor level.

Prior to approval of any of these enterprises by the FSDC Board of Administrators, the FSDC provincial or area office will conduct a market survey as a part of the project feasibility study. The study will have to demonstrate demand for charcoal as a fuel or a reductant, that an economical transport distance exists between the tree farm and end-user and the end-user has indicated a definite interest. Enterprises for which end-users have provided a letter of intent or interest will be given priority consideration. The CPAs will then enter into long-term supply contracts with the purchaser.

In the second case, the targeted market will be major population centers. These include first class cities, of which there are 26 in 17 provinces plus Metro Manila and large municipalities and other appropriate growth centers of economic activity. The project areas will be smaller in size than those in the first level and will be established on the periphery of these population centers. Targeted end-users are small- to medium-scale industries requiring process heat, households, bakeries and restaurants. The CPAs will either contract directly with an end-user (depending on volume) or sell to private charcoal whole-

salers and retailers. Once again, marketing feasibility studies will be presented to the FSDC Board of Administrators for review. Loan approval will depend upon the Board's satisfaction with study findings.

As mentioned above, CPAs producing charcoal for these markets will also be able to meet some local requirements such as; brick, lime, pottery and tile kilns, crop driers, blacksmithing, commercial ovens and stoves, and household needs.

The third case will involve establishing pilot projects in rural areas with less certain markets. These pilot projects will be on a scale of 20 to 100 or more hectares, and will focus on less defined markets such as agricultural use, small rural industries and rural household needs in small urban centers and villages, and surrounding rural areas. While many of the projects in this category will address the needs of a general area, some will be developed to meet specific needs such as fuel for gasifiers in feedmills and ricemills, boats and refrigeration in the Ministry of Natural Resources/FSDC coastal development program, and for National Electrification Administration gasifier-rated electrical generating plants in remote areas.

The pilot projects will enable FSDC to try different organizational, operating and marketing approaches to help it identify a variety of approaches to different situations, and to improve project and program implementation *per se*. This will also permit FSDC to test the viability of different approaches in expanding its broader program.

C. Tree Farms

Tree farms for the Charcoal Production Program and this subproject vary in size from 200 to 1,000 hectares depending on land availability and existing or potential markets. The land is made available by the Bureau of Forest Development (BFD) from denuded lands under its jurisdiction. In terms of topography and elevation, it can be in the rainfed plains to the rolling hills, and into the lower mountains.

For illustrative purposes, the production system of a 500-hectare model energy farm is described below. The model uses *Leucaena leucocephala* (ipil-ipil)[1/] as the fast-rotation species providing the conti-

1/ Two points must be made here: (1) the Giant *Leucaena* is currently, and will probably prevail as, the most commonly used species in the first phase of this program. It is easily planted and established, well adapted to most of the islands, is fast growing and nitrogen fixing, and provides both a marketable fuelwood and foliage. *Leucaena* was introduced into the Philippines about four centuries ago and currently grows in mixed stands on perhaps 300,000 hectares, and has developed no economic pests in this time; (2) while Giant *Leucaena* is used for this narrative, several other fast-growing species are and will be used, preferably nitrogen fixing, as required to meet specific site conditions. Among these are: *Acacia auriculaeformis*; *Albizia falcataria*; *Casuarina equisetifolia*; and some others such as *Gmelina* and *Eucalyptus* if necessary.

nuous wood supply. Good drainage is required and the elevation should be below 500 meters. A year-round water source is necessary to support nursery operations. Rainfall within the range of 2,000 to 2,500 mm per year is optimal and soil pH should be within the range of 5.5 to 8.5. Other species will also be used depending on local conditions.

The illustrative tree farm is divided into five modules of 100 hectares each for operation by CPA members. Approximately 15 families from the area share responsibility for the development and operation of each 100 hectare module. One of the first tasks of the CPA upon being organized is to refine a calendar of work activities and responsibilities. The calendar is a schedule of activities to guide members in their daily tasks, both for tree farm development and kiln construction. (See Appendix D: CPA Module Production Calendar.) Each module is developed within three years, one-third of the area in each year. The road or trail system for the tree farm is developed as the land is being prepared for planting. The kilns will normally be constructed during the second year.

In the case of ipil-ipil varieties, seeds (sometimes seedlings) are planted at one-meter intervals totaling 10,000 trees per hectare. Direct seeding can be done in upland planting using a simple wooden stake. The ideal time for planting is at the start of the wet season to ensure good germination. During the first year, two or three weedings are required.

Tree harvests will start after three years of growth. Harvesting patterns will normally be scheduled several days each week to provide a continuous year-round supply. This schedule differs from conventional wood harvesting systems which tend to be seasonal and spread out over long rotations. After the first cutting, coppices grow from the stumps and new trunks can be harvested every three years. Where other tree species are involved, different cultural practices will be employed to maximize yields.

After harvesting, the wood will be cut and stacked along the road and trailways to dry for approximately 80 days, then transported to nearby kilns for conversion to charcoal. The charcoal will be picked up by contract purchasers. As consumers use charcoal daily, the assurance of a steady supply is an important aspect of this subproject. The assurance of a contracted market provides the impetus for the CPA members to carry out production routinely.

One hectare of tree farm planted on average soils, at 10,000 ipil-ipil trees and managed on a three-year rotation cycle, can readily produce around 125 cubic meters of wood per harvest.[1/] This equates to approximately 75 metric tons (MT) per harvest. One kiln can accommodate approximately 41 cubic meters of feedstock per charge or about 820 cubic

1/ See Annex I, Appendix A, Page 2 for derivation of production estimates.

meters per year.1/. This volume is roughly the amount of wood produced on 20 hectares of sustained yield operations.2/ Therefore, tree farms can range in size from 20 hectares required to supply one beehive kiln up to as many as 1,000 hectares to feed 50 kilns located throughout a tree farm and run by several associations.3/

In order to finance development of the tree farm, the CPAs are granted a loan of approximately ₱3,500 per hectare, plus ₱100,000 for every 5 kilns. The loan is both in cash and in-kind, and is administered by FSDC; incremental releases are made in accordance with materials required and scheduled accomplishments. These accomplishments are evaluated by the FSDC provincial or area offices. The loan provides funds for seeds, tools, fertilizer where necessary, simple road or trail construction, and for labor performed during the tree farm development phase, up to the first harvest and sale. For additional income, the farmers are encouraged to interplant annual crops, as they did before, such as rice, corn or vegetables while the trees are still young. Farmers are also encouraged to have backyard gardens and livestock, and produce ipil-ipil leafmeal for feed or sale.

D. Charcoal Production Process4/

Carbonization is a process of heating wood at certain temperatures with little or no air. As heating begins, the wood simply dries. As the temperature rises, the material structure of the wood begins to decompose, yielding some organic chemicals and leaving a residue of pure carbon.

1/ Assuming that each kiln will be charged, emptied and re-charged 20 times/yr. (41 cu m/charge x 20 charges = 820 cu m). It is estimated that 12 days will be required to complete each production cycle (charge-empty-recharge) thus 20 cycles x 12 days = 240 working days/yr. This allows ample time for clean-up, maintenance, and other contingencies.

2/ Tree farm yields are conservatively estimated at 25 MT ha/yr. Using an average specific gravity factor of 0.60, this tonnage is the equivalent of 41 cubic meters (m^3)/ha/yr. 25 MT ÷ 0.60 = 41.7 m^3 (rounded off to 41 m^3).

3/ The number of kilns required per tree farm is sensitive to: (a) Management - more efficient operation through experience could reduce the number of days required for each production cycle, resulting in more time available for more charges/kiln/year. Growths that are greater than the 25 MT/ha/yr, as used in our calculation, will be absorbed by increased availability of kiln time as a result of improved operations; and (b) Yield - if yields exceed 75 MT/ha harvest, the number of charges/yr. can be increased or more kilns may be constructed.

4/ See Appendix F for summary of carbonization process.

In preparing for this Charcoal Program, FSDC studied and considered several types of kilns in service in various countries, including the Brazilian, Victorian, Kenyan and the Kaunlaran kilns. It decided on the Brazilian beehive brick kiln because it is simple to construct, reliable, rugged and easily operated and maintained; see Figure 1. Following the illustrative case, kilns will be built in groups, 5 per 100 ha. module, distributed throughout the tree farm. The kilns will have capacities of approximately 41 M^3 of wood, producing 7.2 MT of charcoal each, per cycle. On the average, conversion to charcoal will yield approximately 45% by volume of the original raw material.

Wood is delivered to a marshalling yard adjacent to the kilns, cut in lengths of 1.3 m, and stacked to air dry for approximately 10 more days to bring the moisture content down to approximately 30%. The kiln is then loaded.

Care is taken to stack tightly and charge the maximum amount of material into the kiln. At the ignition opening, kindling is added to facilitate ignition. Finally, the doors are bricked up, all portholes and openings are left open and hot coals are introduced through the central opening in the dome, as the carbonization process must proceed from top to bottom. As soon as the fire has caught, the central opening, the emergency outlet portholes and ports located in the dome are plugged. After the stacks (side chimneys, see Figure 1) start smoking, the combustion air inflow is limited through inlet portholes and is drawn by the draft from stacks expelling the carbonized gases.

Initially the heat in the kiln dries the wood, and then carbonization proceeds from top to bottom and also horizontally. The kiln operator controls carbonization by observing the color of smoke coming from the stacks. At the end of carbonization, the smoke becomes colorless and air inlet portholes are closed one after another. The stacks will continue to issue smoke for some time after portholes have been plugged. (To ensure a more complete burn, and to prevent development of gas pressure in the kiln, stacks should not be closed too soon.) The stacks are then closed and carbonization is terminated.

The kiln is brushed over several times with clay slurry to close all openings, leaks or cracks to prevent air from penetrating the kiln and rekindling the fire, and then cooled. Kilns are not opened until sufficiently cool to avoid spontaneous combustion. The kiln is then opened and, if the operator detects fire from the smell of issuing gases, he sprays available water to extinguish any flames or glowing coals. After complete ventilation, the kiln is unloaded manually, and the well-carbonized, solid chunks are set aside and incompletely carbonized pieces are reloaded in the next batch.

The discharged charcoal is heaped and stored in low, loose piles that permit thorough aeration (curing) in outside air in order to avoid spontaneous combustion before being transported.

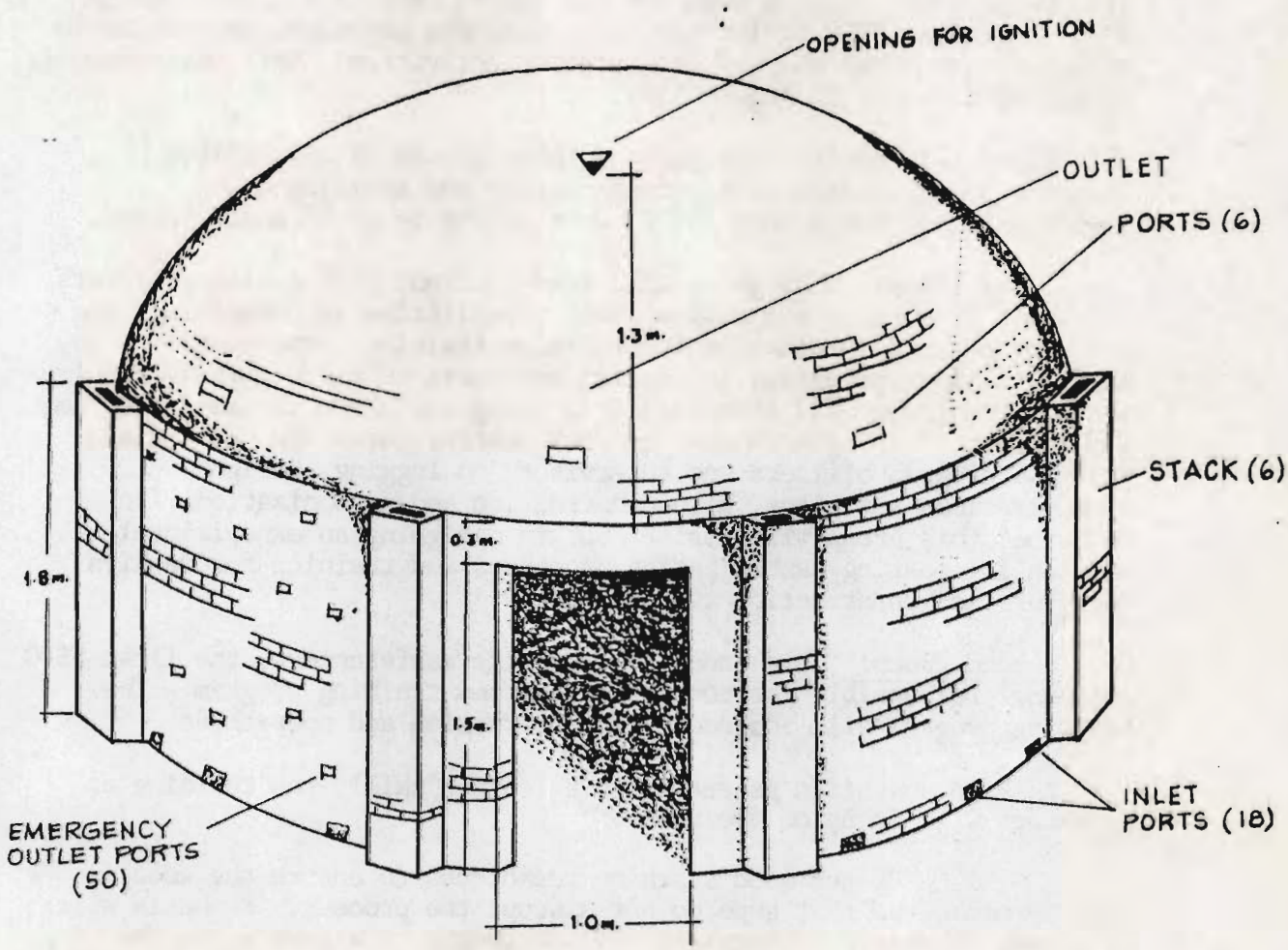


Figure 1
BEEHIVE KILN

After unloading, the bottom of the kiln is swept clean. All airports and stacks are opened and carbonized residues cleared away. The floor must be kept level and ditches provided to drain surface water away from the kiln.

Training

Negotiations are underway with the major Brazilian charcoal producer, Florestal Acesita, to provide assistance in designing and developing a training program for the FSDC charcoal program. This assistance will be provided under a separate ESF funded project (Project Design Fund) to assist FSDC in further developing its technical capability to implement its rural energy/reforestation activities. This assistance is scheduled to start in August 1982.

Florestal Acesita will provide three groups of specialists (logging, kiln construction and operations and training and communications) for a total of 22 work months in an 18 month period.

First Group: This group will study current FSDC training efforts and visit tree farms and assess local capabilities in harvesting, logging and charcoal production to determine training requirements. They will also visit potential industrial consumers to discuss their requirements. The group will then assist in designing a new training program, and conduct training sessions for FSDC central, area and provincial charcoal program officers and supervisors on logging, design considerations for kilns, kiln construction and carbonization. In addition, this group will assist FSDC in designing an experimental station for testing carbonization processes and training future kiln operators and construction supervisors.

Second group: This group will provide assistance to the first FSDC personnel responsible for conducting the new training program. The training program will include kiln construction and operations.

As kiln operation generally is a learned skill, the training of operators will focus on two areas:

1. Proper wood stacking techniques to ensure the wood is tightly packed so that gaps do not disrupt the process. Emphasis will be placed on safety. Operators will be taught to always leave the exhaust stacks open after a burn is completed and the air inlet ports closed. This safety factor will prevent gas pressure from developing in the kilns. Operators will also be taught the importance of fully ventillating a kiln before entering.

2. Maintaining proper burning conditions by operating air inlet and exhaust ports. Operators will be taught smoke and temperature observation techniques in order to optimize production.

3. The more technical aspects, such as bricking the doors brushing slurry, opening and closing portals, entering kilns and removing and stacking charcoal will require less training.

Third Group: This group will conduct a training evaluation of FSDC's training program and charcoal production operations after one year of starting the new training program, and recommend necessary changes.

E. AID Participation

AID's participation in the GOP Charcoal Program and specifically in the Charcoal Production Subproject of the Rural Energy Development Project will facilitate funding for the development of approximately 212 tree farm modules, averaging 100 hectares each for a total of 21,200 hectares plus the requisite number of kilns, estimated at up to 1,060 kilns for charcoal production. This subproject is in keeping with several major objectives of the Mission assistance strategy: (1) the development of indigenous energy resources, (2) providing gainful employment and improving the economic condition of the upland unemployed/underemployed,and (3) addressing environmental degradation.

Total Subproject Costs

	Source		
	AID/AID	GOP	Total
A. AID Funding			
1. Tree Farms (212 modules)	9,720		9,720
2. Kilns (1,060)	2,650		2,650
B. FSDC Contribution			
1. Program Management		1,654	1,654
2. Cost Escalation		3,365	3,365
Total	12,370	5,019	17,389

Additionally, but financed under a separate ESF technical assistance project (Project Design Fund (PDF)), the MAC Secretariat and AID will be providing assistance to FSDC to further develop its technical capability to implement reforestation and charcoal production activities. This technical assistance includes: applied research to develop and modify tree farm models which are appropriate to site-specific variables (including: species selection and seed/seedling development; yield response; pest and diseases advisory services; transport system review; fuelwood production cost analyses; cogeneration possibilities; potential uses of wood biomass derived energy; training of field personnel; advisory services in improved charcoal production and high energy capture conversion systems; an information dissemination program; and limited commodities; e.g. vehicles, tools and training aids).

These services, to start by August 1982, will be carried out by Filipino and American professionals. While the consultants' services

will be nationwide, they will focus their efforts on the tree farms supported under this subproject.

Additionally, two other key areas of assistance are being provided under the above assistance project: First, three Filipino trainees were sent to Brazil for two weeks in Spring 1982 for on-site study and training on Brazilian kiln construction and operation and pyrolysis techniques. The GOP is arranging for Brazilian technical consultants to come to the Philippines in the Summer of 1982 to assist in further designing and developing training programs, to advise field personnel and to critique and advise on kiln construction and operations. The S&T/EY's "Bioenergy Systems and Technology Project" has been assisting the Mission in this regard. Second, short-term consultants, either Filipino or American, will be hired from AID assistance to help FSDC further refine its technical and marketing survey and feasibility methodology. They will also help FSDC produce a manual for conducting these studies.

III. DETAILED SUBPROJECT ANALYSIS.

A. Technical Feasibility

1. Tree Farm

Tree farm and kiln operations will be run similarly whether the charcoal will be marketed to large industrial users, population centers or the smaller pilot activities.

The subproject combines two technologies: forestry and charcoal making. The lengthy technical discussion on tree farm technologies in the wood-fired power plant subproject (Annex I) and in the subproject description above provide much of the needed technical information for this subproject. Following is a short summary of the technologies involved: There are only a few examples of large tree farms harvested on a continuous sustained yield basis as proposed here. There are, however, many thousands of hectares of existing ipil-ipil both in the Philippines and elsewhere. Other fast-growing species are being tried and farmers are encouraged to intercrop and mix plantation stands where appropriate. As of October 1981, FSDC has organized 21 CPAs and planted about 1,807 hectares of trees for charcoal production. These plantings were made in June 1981.

Enough data and research results are available from other programs to assume a growth of 25 MT per hectare a year is a conservative production estimate for most sites. There are adequate data on coppicing which indicate that second growth yields are up to 30% higher than first growth. This will be carefully monitored throughout the program. Of an estimated 300,000 hectares of ipil-ipil in the Philippines, no known pests or diseases of a serious nature have been observed which might threaten yields.

In general, FSDC and the CPAs have experienced few problems with current clearing, planting and cultivation regimes. From a technical point of view, there is good evidence that tree farms may even produce more wood than estimated above. Excess wood would be converted to additional charcoal if required or allowed to grow to timber size.

The large technical assistance project associated with this Rural Energy Development Project will help provide FSDC with the capacity to perform additional applied research and analysis which is identified as implementation proceeds.

Tree farming technologies presented in the project description are considered sound.

2. Charcoal Production

a. Process

The production system proposed for this project, and based on the beehive kiln, is not new. It is a proven system that has been used continuously on a large scale in Brazil since the mid-1930s, a period of over 40 years, as well as in several other countries. Brazil chose this system after trying many different alternatives because, among other reasons, the level of skills required for construction and operation is readily attainable through informal training. Training unlettered rural farmers to become charcoal kiln operators has proven feasible in Brazil and elsewhere. The same experience is expected in the Philippines.

Charcoal making is already practiced throughout the Philippines and charcoal can be purchased in any public market. Small-scale rural charcoal production is usually accomplished by the pit method or in worn-out 50-gallon (200 liter) drums. Some larger producers in selected areas have introduced beehives and more sophisticated methods. The critical factors to good charcoal production are careful control of air and attention to the changing color of smoke given out during the process. Operating the Brazilian beehive kiln requires the same skills. This improved kiln design, however, provides better methods for controlling air, which reduces the failure factor, and produces larger quantities of charcoal.

In view of the proven kiln design, the level of skills required and indigenous experience in the Philippines, there is ample evidence to conclude that charcoal production is technically feasible under this subproject.

An important factor for successful operations will be thorough training of the kiln operators. In this regard expertise will be provided under the separate Project Design Fund Project. Three charcoal project supervisors have been sent to Brazil for on-site study of kiln construction, operations and maintenance techniques. Brazilian

technical advisors will come to the Philippines to assist in further developing a complete kiln construction and operations training course for the program. FSDC is also receiving advisory services from the Forest Products Research and Industries Development Commission (FORPRIDECOM), and the U.P. College of Forestry at Los Banos. FORPRIDECOM has extensive experience in charcoal production and has already assisted several large corporations engaged in this business.

In addition, personnel from two Japanese/Filipino charcoal production projects have supplied FSDC with extensive information and advice on kiln design and operations, and on tree farm problems experienced because of soil acidity and elevation effects. In fact, initial kiln design for the FSDC program and the first pilot kilns in Bohol and Bicol are being constructed with assistance, including training, from the Japanese/Filipino Kawasaki group. These assistance sources should help further assure the implementation of sound technology and practices and, therefore, the technical feasibility of this project.

The technology required for charcoal conversion is available and adaptable, and the use of the beehive kiln is considered technically feasible.

b. Tree Farm Output

In this subproject, the trees are expected to grow at a rate of 25 MT/ha/yr, and the yield at the end of 3 years will be 75 MT/ha (25 MT/ha/yr x 3 years). Each CPA module (100 ha) will be harvested on a three-year cycle, one-third of a module (33+ ha) per harvest.

The yield from each 33+ hectares is 2500 MT/yr (33+ ha x 75 MT/ha/harvest). Using a conversion efficiency from wood to charcoal of 28.8%, the output from the module is 720 tons of charcoal (2500 MT/yr x 0.288 = 720 MT/yr). (The effect of conversion efficiency on charcoal production is shown in Table C.)

The kilns are rated at 7.20 MT of charcoal per cycle (charge) and are scheduled to operate 20 cycles/year. Thus each of the module's five kilns can produce 144 tons of charcoal/year, and the five produce a total of 720 MT of charcoal per year:

$$\frac{720 \text{ MT charcoal/year}}{144 \frac{\text{MT charcoal}}{\text{kiln-year}}} = 5 \text{ kilns}$$

Using these factors, the illustrative 500 hectare tree farm will have 25 kilns and will produce 3,600 MT of charcoal per year.

Table C. Effect of Conversion Efficiency in Charcoal Production

Input		Output	Efficiency
MT	M^3	MT	(%)
25	41.7	6.25	25.0
25	41.7	7.0	28.0
25	41.7	7.5	30.0

B. Economic Feasibility: Analysis I

An economic feasibility analysis of the charcoal production subproject was undertaken through the costing of the fuel cycle being considered, the costs associated with its use in various end-uses, and a comparison with alternative energy sources including kerosene and bunker oil.

The charcoal production program is designed to provide fuel substitutes for a wide range of end-uses, such as steel and cement manufacture, bakeries and domestic cooking. The program will support activities for the complete fuel cycle from reforestation and harvesting through charcoal production for particular end-users.

The charcoal subproject will grow its own feedstock on energy tree farms as described in Section II, above. As with the wood-fired power plant subproject, this subproject has significant employment and rural income generation advantages. Table 1, (all economic tables appear in Appendix G) presents the estimated economic costs of producing "raw" energy on a 500 hectare tree farm and unskilled labor is a major component of the raw fuel costs which amount to $0.74/MBTU using a 20% capital recovery factor and a peso/dollar exchange rate of ₱8 = $1. Total costs in this subproject are partially derived from the price of charcoal, thus influencing the farmer's margin. Consequently, while economic costs of raw energy are the same in both programs, the composition of costs is different; the farmer's margin being significantly greater in the charcoal program than in the power plant program. The charcoal program's annual costs, particularly for unskilled labor, are a larger relative share of total cost. In an analysis which places zero or low economic shadow value on rural unskilled labor, the effective economic cost of raw energy produced under the charcoal program would be lower.

The raw energy cost at tree farm landing of $0.74/MBTU compares quite favorably with international energy prices of crude oil at $5.60/MBTU (equivalent to $34 p. bbl.). But, as with the refining of crude oil, the raw energy must undergo additional stages which dramatically increase its costs. At standard economic parameters, the effective conversion cost of charcoal is $0.52/MBTU, but larger costs are associated with the conversion losses and the program's conservative thermal efficiency is 40%.

To produce 1 MBTU of charcoal, 2.5 MBTU of raw energy fuelwood must be introduced into a kiln, hence the feedstock costs are $1.85/MBTU (based on fuelwood at $0.74/MBTU) and the total costs are $2.44/MBTU; Table 2. It is this cost, combined with transport and end-use modification costs, that should be compared with internationally priced refined products, whether they be at the high end such as kerosene at $8.80/MBTU (used for cooking) or $5.60/MBTU for heavy fuel oil (used in many industrial applications).

It is also important to note, however, that the estimate of $2.44/MBTU for charcoal is conservative. It is based on experience in Brazil and elsewhere that shows that even without the construction of more expensive kilns the thermal efficiency could be 50% or higher. At 50% efficiency, the effective economic cost of charcoal would be reduced to $2.07/MBTU. Also, it is anticipated that the capital cost of the kiln will be further reduced through increased production based on more efficient operations as operating experience is gained.

1. Industrial Use for Charcoal

For industrial applications, such as foundries, the use of charcoal may require additional costs to retrofit existing oil-fired systems. A typical firebox/blower unit designed to replace oil burners, is assumed to cost about ₱150,000 ($28,700) with an efficiency of 80%. The effective capital cost to convert to charcoal per hour is $0.37. This expense would result in an effective total cost of $0.66/MBTU/hr to use charcoal. While the effective total cost of directly using bunker oil is only $0.57/MBTU/hr, the use of a shadow foreign exchange rate (₱10 = $1) would raise bunker oil cost by 25% resulting in an economic cost of $0.71/MBTU/hr. This is 4% more expensive than energy derived from charcoal. Additionally, less costly firebox equipment would increase the attractiveness of charcoal. The multiplier effect of purchasing indigenously produced energy, thereby recycling money spent for energy within the domestic economy, further decreases the economic cost of retrofitting investments.

2. Household Use

A significant demand for charcoal comes from households, largely because of its lower cost relative to such energy sources as kerosene or LPC. Philippine families are switching back to charcoal for at least some of their cooking, while kerosene and LPG sales have dropped off. While use of fuels in the household is complex with a "shadow price" existing for socially preferred fuels, and often with more than one fuel type being used per household, it is clear that the use of charcoal *per se* is increasingly more advantageous than LPG or other petroleum-based fuels. Purchasing a stove costing ₱700 ($87.50) and substituting charcoal for 30% of present kerosene use would give an annual effective cost of $152.92 to a household whose average annual kerosene (energy) requirement is 22 MBTU. This is much lower than the $193.60 that a household would have to spend annually if it uses kerosene to meet all of its ener-

gy requirements, Table 4. The significant price differential ($40.65/yr. or $0.11/day) has and will continue to cause energy consumption patterns in the household to shift from kerosene to charcoal.

C. Economic Feasibility: Analysis II

A standard economic feasibility analysis was conducted on the charcoal subproject comparing the estimated costs of tree farm development and annual operations and maintenance with the value of the imported bunker oil equivalent, in terms of Btu, expected to be replaced by charcoal in various production processes. To the extent charcoal can also replace higher cost kerosene, the benefits to the economy will be even greater than estimated here.

Shadow prices were used to approximate the lower opportunity cost of unskilled labor (because of the high level of underemployment, especially in rural areas) than the nominal wage rate suggests, and to compensate for the current overvaluation of the peso in foreign exchange markets.

The basic analysis indicates that to the extent domestic charcoal can actually substitute for bunker fuel, as envisioned, the economic internal rate of return (IRR) of its production would be very high, here estimated as 119%, and the economic B/C ratio would be a fantastic 7.0 at a 20% rate of discount (8.3 at 25%); (Table 5).

A sensitivity analysis was conducted by simultaneously reducing benefits by 25%, to simulate a decline in imported oil prices from the current $34 to $25.50 a barrel, and raising all costs by 20%, to allow for the possible underestimation of costs. The results although slightly lower still indicated very high feasibility indicators: an IRR of 87% and a B/C ratio of 4.4 at 20% discount (5.2 at 15%); (Table 6).

A similar sensitivity run using nominal estimates only without shadow prices produced equally robust results: an IRR of 82% and a B/C ratio of 3.7 at 20% discount (and 4.3 at 25%); (Table 7).

These results imply that a wide margin for estimation error or possible price changes can be granted to this activity without seriously affecting its very high economic value to the society at large in terms of foreign exchange costs avoided. The fact that the income from the production of charcoal will accrue to under-utilized domestic factors of production, instead of to foreign producers of oil, can also be considered a benefit to the Philippine economy, in terms of both much-needed employment generation and the multiplier effects on the local economy of higher rural incomes.

D. Financial Feasibility

The charcoal subproject includes developing 21,200 hectares of tree farms at an estimated cost equivalent to $17,389,000. Of this amount,

AID will cover $12,370,000 and the GOP will cover $5,019,000. All costs will be payable in local currency. This section analyzes the costs and returns to the farmers based on five 100 hectare modules comprising a 500 hectare tree farm.

Tree farms for the charcoal program are developed in 100-hectare modules and each module will be operated by a Charcoal Producers Association (CPA), composed of between 15 to 20 members. The wood is processed in kilns, and the charcoal is sold at a common farm gate or contracted price.

Each module is developed over a period of three years. One-third of the module area is planted each year. Ipil-ipil (or other similar fast-growing species) is planted at one-meter intervals, or 10,000 trees per hectare, and harvested in three-year cycles. New trunks grow from coppices which resprout from the stumps after each harvest and as a result there are no costs incurred for replanting. New trunks are again harvested every three years. The average annual growth is estimated at 25 to 40 MT/ha/yr and Tables 3-6 (all financial tables appear in appendix H) are projected on the basis of both 25 and 40 MTs.

For illustrative purposes, Table 1 summarizes the costs of developing a 500 hectare tree farm, i.e., 5 modules and CPAs. This is considered to be an average size tree farm for the charcoal program. The development cost of each tree farm module is $82,000 including cost escalation over three years, or $410,000 per 500 hectare tree farm. This includes land preparation, planting, maintenance, silvicultural inputs, tools, road and kiln construction. Table 2 shows the annual amortization payments required to liquidate the loan for the development of 500 hectares.

Wood harvested from the tree farms will be used for charcoal production. Based on an average yield of 25 MT/ha/yr, it is estimated that 25 kilns will be required to process the output from the tree farm. Each kiln will have an average output of 7.2 MT/cycle, and will operate for 20 cycles a year. Assuming an average growth of 25 MT/ha/yr, the expected annual charcoal production per tree farm is 3600 MT from 12,500 MT of wood. The principal markets for the charcoal are industrial end-users such as ore smelters and cement plants, small rural industries, rice and feed mills, and rural and urban households.

Tables 3-6 project the flow of resources and the net income for the tree farm assuming both 25 and 40 MT growths per hectare/year. While the net income flows into the individual CPAs, the cash will be fully distributed to the members, obviating the need to prepare a balance sheet.

During the first three years of the project, CPA members will be reimbursed from loan funds for their labor provided to develop the tree farm. Their income will depend on the number of members in the CPA; we have assumed 15 and 20 members as the most reasonable range. Projections

for years 1-3 (Tables 3 and 5) indicate CPA members will receive between $375/year (₱3,000) on the low side and $750 (₱6,000) on the high side. Once sales of charcoal commence in Year 4, the income of members rises substantially. From Year 4 to Year 25, it ranges between a low of $2,875 (₱23,000) in Table 3 (years 5-12) and a high of $6,375 (₱51,000) in Table 5 (years 14-22 and 24-25). These cash distributions to members are net of all amortization payments, operating expenses and major equipment replacements. The improvement in the farmers income is dramatic when compared to the present upland farmers' average annual income of $125 to $187.

The critical element in the financial projection tables for the charcoal program is the per ton price of ₱1,000. Current prices in the Philippines range from ₱1,400 to ₱1,800. Although we believe the demand will continue to exceed supply as long as charcoal is a viable substitute for fuel oil, we have attempted to be conservative and use the ₱1,000 price.

Tables 3 and 5 show charcoal sales of ₱3,600,000 ($450,000) and ₱5,760,000 ($720,000) based on a growth of 25 and 40 MT/ha/yr, respectively. In all years, on both Tables 3 and 5, this provides revenue adequate to cover amortization payments (Years 5-12), replacements for kilns in Years 13 and 23, and operating expenses--and still produces the large cash flows to individual CPA members described above. Revenues cover projected outflows by a minimum of 2.8 times in Table 3 for years 5-12 to a maximum of 7.2 times in years 14-22 and 24-25. These same ratios are higher in Table 5 which calculates income at the same selling price but on a higher wood yield.

This charcoal program would be financially viable even if we further reduced the charcoal selling price by 50% to ₱500 per ton, approximately 1/3 of today's price. Using this price and the estimated yield of 25 MT/ha/yr, revenues would still cover outflows from between 1.4 times and 3.6 times. Net cash transfers to individual CPA members during years 4-25 would range between ₱6,840 ($845) and ₱17,320 ($2,165). The farmers also earn additional income from cash crops they will be growing and leafmeal production. Based on a leafmeal selling price of $62.50/ton in Year 1 and an average output of 2 tons/ha/yr, net returns to farmers is approximately $500 in Year 5. Although this potential income is substantial, it is not considered in this section which focuses on the financial viability of charcoal production.

E. Social Soundness Analysis

1. Beneficiaries

Direct subproject beneficiaries are the approximately 3,100 to 4,200 families who will grow fuelwood trees for conversion to charcoal. The majority of these families are landless and poor.[1/] Most of them

1/ Definition and analysis of rural poverty is presented in AID CDSS documents for years 1982, 1983, and 1984.

are doing rainfed (usually swidden or slash-and-burn) agriculture on marginal uplands; many supplement their incomes as agricultural laborers on lowland paddy fields and plantations. Numerous studies, including AID CDSS documents, have identified these farmers as among the most impoverished in rural Philippines.

Indirect beneficiaries include (a) villagers who will be hired on a part-time basis by the charcoal producers associations to assist during times of peak labor demand; (b) consumers who will benefit from lower fuel costs and greater availability; (c) unemployed and underemployed people who will obtain jobs in rural small-scale industry and manufacturing which should begin to develop and expand once charcoal production gets underway; and (d) people who become involved in the transport and sale of charcoal.

2. Socio-Cultural Feasibility

Under this subproject, groups of 15 farm families will be organized into charcoal producers associations. Each association will establish a tree farm of approximately 100 hectares and will construct five kilns for charcoal production. Beginning in the fourth year after the initial planting, the trees will be cut, dried, transported to nearby kilns, and converted to charcoal. The charcoal will be sold for manufacturing, small-scale industrial, and household use in neighboring market towns and villages. In general, organizing farmers to grow trees for charcoal production is similar to organizing farmers to grow trees for wood-fired power plants.1/ The differences in this subproject are that farmers undertake the additional task of converting the firewood to charcoal and may become involved, in some cases, in the marketing of charcoal. These two activities, charcoal production and marketing, are the main feasibility issues discussed in this section.

1/ See discussion in Section III, E, and Appendix C, of Wood-Fired Power Plants Subproject, Annex I, as well as general discussion in Section III, D, of the Summary Paper.

a. Charcoal Production

Conversion of wood into charcoal is not novel in the rural Philippines. Countless rural families are currently satisfying industrial, commercial, and household needs for charcoal. Much of the present production, however, is of poor quality and is performed without regard to environmental consequences (i.e., random cutting of trees without systematic replanting).

In this subproject, charcoal production will occur under controlled conditions and training will be provided by FSDC to three or four members of each CPA. Experience to date shows that rural farmers can easily learn the skills required to make high quality charcoal.

Project designers initially feared that combining two functions, tree growing and charcoal making, within a single association might tax the group's managerial capabilities and ultimately threaten group viability. Upon closer examination, FSDC and its consultants have concluded that although there are additional managerial requirements for charcoal making they are acceptable, and tree growing and charcoal making are complementary. The two functions are quite discrete, and there is no interference or conflict between them; different association members undertake different tasks and responsibilities can be clearly defined. Kiln operators within each CPA will be trained to handle all aspects of kiln operation and maintenance. The CPA need only apprise these operators of fuelwood availability and near-term demand for charcoal. Overall CPA managerial responsibility thus is not much different whether the end product is fuelwood or charcoal.

Charcoal production is not only a logical adjunct to tree growing, but by maintaining both functions within the same association the members stand to gain a great deal of income in terms of the added value of charcoal vis-a-vis wood. Obviously, the association could sell wood directly rather than convert it themselves to charcoal. But the selling cost spread between wood and charcoal is quite large, and this is potential income that would be lost to the association members. The members themselves understand this and are keen on retaining the charcoal making function within their associations. To date, there has been no hesitancy expressed in agreeing to the loan terms for kiln construction.

A related feasibility issue is that intragroup problems may arise between those members of the association who exclusively tree farm and the three members of each association who have been trained in making charcoal and will be primarily responsible for that activity. On the one hand, the charcoal makers may feel that they deserve a larger share of the revenue because they are, after their training, "semi-skilled workers". On the other hand, it was feared by some project designers that these people might be so involved in charcoal making they would not have sufficient time to cultivate backyard gardens, intercrop, and pursue other interests to the same degree as other association members.

In regard to the latter concern, time-study analysis of charcoal production indicates that there is a fair degree of flexibility in kiln operators' schedules, allowing them to undertake agricultural activities or pursue other interests in almost equal proportions to other association members. For example, although the burning process requires daily monitoring to ascertain that carbonization is occurring at the proper rate, the operators need only observe smoke emissions and make any required exhaust hole adjustments 3-4 times per day; operators need not be present constantly (of course, they are not present at night). Also, at the beginning and ending of each 12-day production cycle, there are likely to be a few days during which operators are free. Further, tree farm areas assigned to the kiln operators for the intercropping or other farming are likely to be adjacent to the kiln, thus facilitating their supervision of agricultural work. Finally, it is expected that association members, friends, and family members will also assist the kiln operators during times of peak demand or when agricultural or other work conflicts with kiln responsibilities.

The other concern, potential conflict between the members regarding their different skill levels and perceived status differences will remain somewhat of a question until actual operations start. It is anticipated that group solidarity based upon kinship, friendship, and working together will prevent or, at least, dampen the emergence of this problem. It is impossible to pre-judge the outcome of this issue since none of the associations already established have begun making charcoal, and potential conflict is dependent on personalities in the individual groups. Project implementors agree that intergroup status differentials warrant monitoring. To the implementors' credit, they have decided to remain flexible on the issue and allow the associations themselves to determine the best solution to the problem if it should arise.

b. Marketing

Most CPAs will be located near provincial capitals or large market towns. Before establishing tree farms, FSDC will undertake marketing feasibility studies and will assist the CPAs in obtaining long-term contracts with industrial and manufacturing concerns and other charcoal users. FSDC will also initiate advertising and promotional campaigns in CPA areas to educate potential users to the cost savings and efficiencies involved in converting from petroleum-based fuel to charcoal. While most CPAs thus should be able to begin charcoal production with firm contracts in hand, some CPAs in the more rural, pilot areas will have to engage more directly in marketing their charcoal. Generally, this will only entail making contacts with middlemen and retailers, though in some areas association members and their families might engage in selling charcoal themselves for rural household consumption. CPAs which are located in these pilot testing areas will receive special training and assistance from FSDC.

3. Spread Effects

Charcoal is already being produced by small-scale entrepreneurs, farmers, and others throughout much of the Philippines. As alternative fuels continue to escalate in price, demand for charcoal is likely to increase and more people will begin making charcoal to meet increased demand. Assured supplies by relatively large producers, as under this subproject, should encourage industrialists and manufacturers who are considering plant retrofit or are preparing to construct a new facility, to use charcoal rather than petroleum and other fuel, thus stimulating demand still further.

Current and potential small-scale producers, however, are faced with two major constraints. First, they do not have secure access to land and are thus reluctant to undertake replanting once they have cut an area. Secondly, the technology used by most of these small producers is rather primitive, resulting in too-rapid burning, poor quality charcoal and waste. More efficient technology is available, but it can be expensive.

The two constraints of course are interrelated because rural small-scale charcoal producers will not adopt new technology or undertake replanting unless they are guaranteed long-term tenure. Ironically, without tenure, it is advantageous to these charcoal makers to continue cutting the forests indiscriminately and using primitive, inefficient technology. Fortunately, Bureau of Forestry Development (BFD) officials have begun to realize that at least a partial solution to the deforestation problem is to grant long-term access rights to woodlands to villagers and upland group endeavors. Success under this subproject will encourage the BFD to continue this policy.

As for the cost of new improved technology for charcoal production, loans at moderate interest rates are becoming available through such programs as the Ministry of Human Settlements' "Livelihood" or "KKK" program and the AID-assisted Rural Service Centers Project. Again, success in this subproject should encourage the GOP to expand its loan programs for reforestation and similar activities, to enable small-scale charcoal producers (individually or in small groups) to obtain loans to adopt new technology.

4. Equity

Most direct beneficiaries of this subproject are landless squatters on government land who are currently doing rainfed agriculture, usually using slash and burn techniques. Indirect beneficiaries will include those from the same group who are not association members but will be occasionally employed as laborers on the tree farms. The project also has good potential for generating employment for other rural landless and near-landless households by providing low-cost reliable energy sources to small-scale industrial and manufacturing enterprises.

Most larger manufacturing concerns, such as cement and ore smelting firms, will not significantly increase their number of employees after converting to charcoal as their primary energy source. Small-scale rural industries and manufacturing concerns, however, are more labor intensive; furthermore, a general absence of low-cost reliable energy has often prohibited these businesses from operating at full capacity or expanding. Brickmaking, pottery, baking, tile making, and blacksmithing are likely to undergo rejuvenation and expansion once charcoal for energy is available. These and similar operations, of course, are extremely labor intensive, employing not only large numbers of full-time workers but providing part-time work during peak periods for those seeking supplemental income. All this should have a salutary effect on the two major problems facing the rural Philippines: unemployment/underemployment and disparities in income distribution.

As in the Wood-Fired Power Plant subproject, the only negative impact of this subproject is that some upland farmers will eventually be denied access to land which was previously available to them for farming. Unless equally accessible land is readily available elsewhere, these farmers are bound to feel a loss. Moreover, given the existing situation of too many people on too little land, any restriction of land will result in greater pressure on other land, with consequent shortened fallow, increased erosion, and generalized environmental degradation.

Fortunately, however, given the FSDC policy of preferring areas where population densities are low, the number of farmers denied access to lands by the establishment of tree farms should be small. Further, it is expected that a number of local indirect jobs generated by this subproject such as assisting on the tree farms during periods of peak labor demand will, in some ways, compensate for any negative effects of the subproject. It should be noted that a number of observers (e.g., Gelia Castillo) have suggested that since upland farmers are marginal, only 26% of their incomes are derived from their own farms, that the best way to improve their lot is by enhancing off-farm and non-farm employment opportunities. Employment generated by this project, beyond that provided to the direct beneficiaries, will thus in general benefit upland farmers who lose access to previously available land.

5. Women In Development

Women will benefit directly through their involvement in tree farming and agriculture (intercropping and backyard gardening). They will also benefit indirectly as consumers and employees. Most charcoal currently produced in the country is used by the household for cooking and ironing. Production of charcoal under this subproject will increase the availability of low-cost, efficient fuel for household use. Those engaged in cooking and ironing, of course, are generally women.

As mentioned in the previous section, charcoal can serve as a dependable low-cost energy source in small-scale rural industries and manufacturing concerns. Most of these businesses are labor-intensive

and often employ women, e.g., in pottery making, baking, handicrafts. Provision of charcoal for the development and expansion of these types of small businesses should result in increased employment opportunities for rural women seeking to supplement their household incomes.

F. Environmental Impact Analysis (EIA)

This subproject involves extensive reforestation activities throughout the Philippines (subproject goals call for reforestation of approximately 21,200 hectares, while the broader program calls for 250,000 hectares by the year 2000), and the manufacture of charcoal in the reforested areas. Current program plans call for 5 beehive kilns per 100 hectares.

Employment generation is one obvious impact which can be expected, and current slash-and-burn farmers will provide the labor force. As the large majority of the work force will come from people already occupying or living near the tree farm areas, no great influx of workers, creating new demands on housing, food and public services and facilities is expected.

The areas to be reforested under this program have been largely denuded by shifting cultivators; in some cases following loggers. The reforestation effort will improve microclimatic conditions and assist in reducing erosion and stabilizing the soil. In addition, preference is given to tree species which are nitrogen-fixing, thereby improving soil conditions. While the growing trees will extract other nutrients from the soil, the overall biological impact is expected to be positive. The program per se is considered a very positive improvement over current negative uses of the areas to be reforested.

The energy tree farms developed in this program will ultimately be harvested to supply wood for charcoal production. The manufacture of charcoal in beehive kilns, however, is expected to have minimal impacts on the environment. Before kiln construction can proceed, each CPA must apply for a permit to operate with the National Pollution Control Commission (NPCC); (See Appendix J). The application includes an analysis of a facility's pollution potential and a description of control measures employed, or justification for not employing control measures. Upon review and approval of the NPCC, the kilns are constructed.

Impacts on the air quality in the vicinity of the kilns can be reduced considerably by using proper siting criteria, and by designing for maximum ventilation. Impacts on the water quality of the area will be negligible. The solid wastes (fines) generated in the charcoaling process can be densified or briquetted.

In order to prevent health and safety hazards, sufficient exhaust time must be made available before stacks are closed to avoid gas build up, and charcoal should be screened for removal of fines prior to storage. Cracks in the kiln should be promptly repaired, since the intrusion of air will prevent proper cooling from taking place. In addition, the

kiln should be thoroughly ventilated before anyone is allowed to enter it. This procedure should be practiced in order to prevent inhalation of relatively high concentrations of poisonous gases that may be present in the kiln.

The use of proper siting criteria and solid engineering principles can mitigate any potential adverse effects on land use, as well as biological resources. Overall, this program will have significantly positive effects on the environment of currently denuded and eroding uplands.

The complete EIA for tree farm development and charcoal production is contained in Appendix J.

G. Administrative Feasibility

This project is implemented by FSDC, one of the most successful agencies in the Philippine Government dealing with small farmers. In its six years of existence, FSDC-sponsored farmers associations have grown from less than a hundred to more than 2,054 associations representing 107,390 farmers nationwide. FSDC has developed a multi-tiered administrative organization which provides loans, training and technical assistance to farmers to enable them to organize, operate, maintain and manage their own associations. Under FSDC's decentralized administration considerable authority is delegated to area and provincial offices. FSDC prefers to make authority available where implementing actions take place, i.e., in the field.

In 1979, FSDC was directed to expand its irrigation activities to develop the uplands and improve the well-being of upland farmers. The uplands program calls for the extension and replication of FSDC sponsored Integrated Services Associations 1/ to introduce improved agricultural methods and technical packages in the uplands. Included as a part of this effort is the Charcoal Production Program with its focus on livelihood through reforestation projects. The same association loan, training and technical assistance systems from the earlier programs are repeated in the FSDC Charcoal Program, with assistance designed to meet the new program focus, i.e., energy tree farms and charcoal production. As in other FSDC efforts, training and technical assistance will be periodically updated as required by new needs, or to introduce new technologies or methods.

FSDC has shown real competence in starting new programs with few effects on its on-going efforts. FSDC views the new programs as opportunities to increase livelihood and to provide its personnel with new managerial experience, thus improving its overall efforts. As for membership, FSDC has experienced few constraints in recruiting the necessary farmer-members for the associations--the program's incentives are more than adequate to attract the requisite numbers.

1/ The administrative achievements, organization and management procedures of FSDC and its farmers associations are described in PP: Small Farmer Systems II (492-0333).

The program is administered by implementing entities at the national, provincial and project levels as follows:

At FSDC headquarters the TREE Program Office (TPO) is responsible for overall program development, relations with other agencies to promote communications and foster support, and providing management and technical assistance to area offices. The Office is composed of three sections; technical (agricultural and engineering), financial and institutional; and is headed by a coordinator and a deputy who direct and supervise the operations of the program and internal administration of the group.

Under the Technical Staff Section are the Agricultural and Engineering Units. The agricultural unit is responsible for collecting information relating to silviculture and charcoal production, and disseminating it to the field. This unit also conducts agricultural studies including crop production, cropping patterns, yield projections and soil classification, and prepares production schemes. The engineering unit reviews, evaluates and revises (in coordination with the area office) the design plans and estimates of charcoal kilns and road networks. The unit also monitors, evaluates and sometimes supervises kiln construction at the sites.

The Financial Section reviews and evaluates (in coordination with the area office) financial and economic feasibility studies of charcoal production projects and facilitates presentation of all feasible projects for approval. This section also coordinates with area offices and provincial offices to verify the validity of economic and financial studies prepared for proposed projects. During project implementation this section provides projects with financial management guidance and monitoring. Budgetary requirements and financial schemes are also prepared by this section.

The Institutional Section designs and conducts training programs and assesses and evaluates the effectiveness of the CPAs. The section also conducts management and program operations studies and establishes linkage with other agencies. The formulation of project implementation policies and guidelines is also performed by this section.

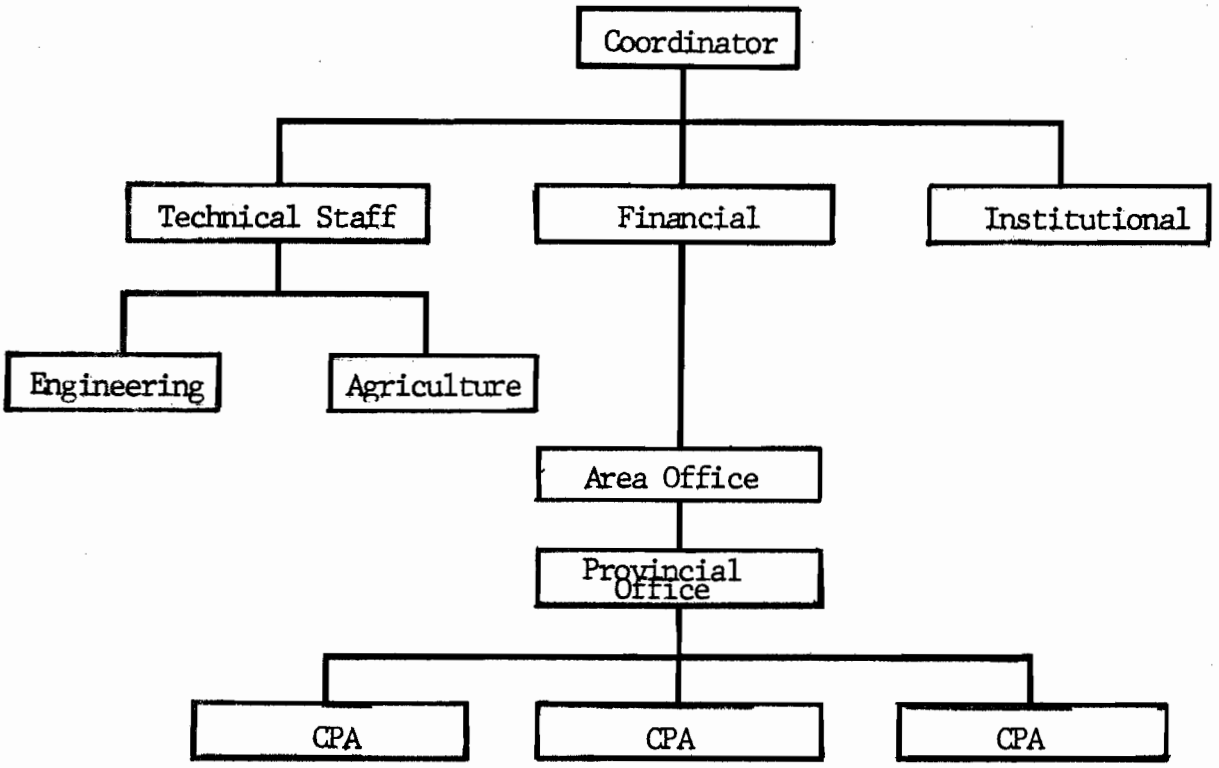


Figure 3
Organizational Structure
FSDC Charcoal Program

Requests and necessary documentation from Area Offices for leasing lands are reviewed by the TREE Program Office and forwarded to MNR/BFD for granting leases. After leases are granted, the FSDC Board of Administrators reviews and evaluates the technical and marketing feasibility studies prepared for a specific site, and the CPA loan request. Upon approval, the Board notifies the area office to proceed with the project. General guidelines and policies for project implementation have also been established by the central office.

In addition, the TPO provides or arranges for technical and managerial advice as needed from consultants and other GOP agencies, such as:

- MNR and BFD for policy information and advisory services, technical support on agro-forest development and land access;

- The Bureau of Soils (BS) for soil analysis and soil management services for tree-based intercrops and other services as may be required later;

- The National Food Authority (NFA) and Ministry of Human Settlements (MHS) for entrepreneurial and marketing advice.

At the provincial level, the FSDC provincial office assumes responsibility for the program. The typical provincial office is staffed by 7 to 12 field officers (depending on the number of projects in the province) who specialize in agriculture, mechanics and engineering, forestry and management. It identifies project sites and assists in organizing CPAs. It conducts baseline demand and marketing surveys and prepares feasibility studies. It coordinates with local BFD offices to assist in surveying and mapping the tree farm area and to provide access clearance to the CPA. The provincial office forwards resolutions drafted by the CPA, project site evaluations and feasibility studies (technical, marketing, economic and social) to the FSDC area office for review. If they meet evaluation requirements they are endorsed and forwarded to FSDC's Board of Administrators for final approval. In all these efforts, the provincial office receives guidance and assistance as required from the area office.

During project implementation the provincial office provides technical support to the CPAs (either directly or by arrangement with FSDC headquarters, the area office, other agencies or consultants), and monitors and evaluates activities and project progress. Finally, the provincial office is also responsible for collecting loans and remitting them to FSDC headquarters. The provincial office is assisted in the training and technical activities by the provincial KAISA, a federation representative of rural associations. It serves as the focal point to varied interests, attitudes, resources, and skills which can be brought together to serve the CPAs' needs.

At the project level, activities are carried out and managed by the Charcoal Producers Association (CPA). The association is composed of upland farmers and interested unemployed local residents (preference is given to existing slash-and-burn farmers) and their families. The assocation is incorporated and registered with FSDC. Member activities include clearing and planting, maintenance of trees, harvesting, transport, charcoaling and marketing. The farm family is the basic organizational unit for tree production, transport and charcoaling activities. Coordination of tree farm and charcoal production activities is assumed by functional leaders appointed from each group.

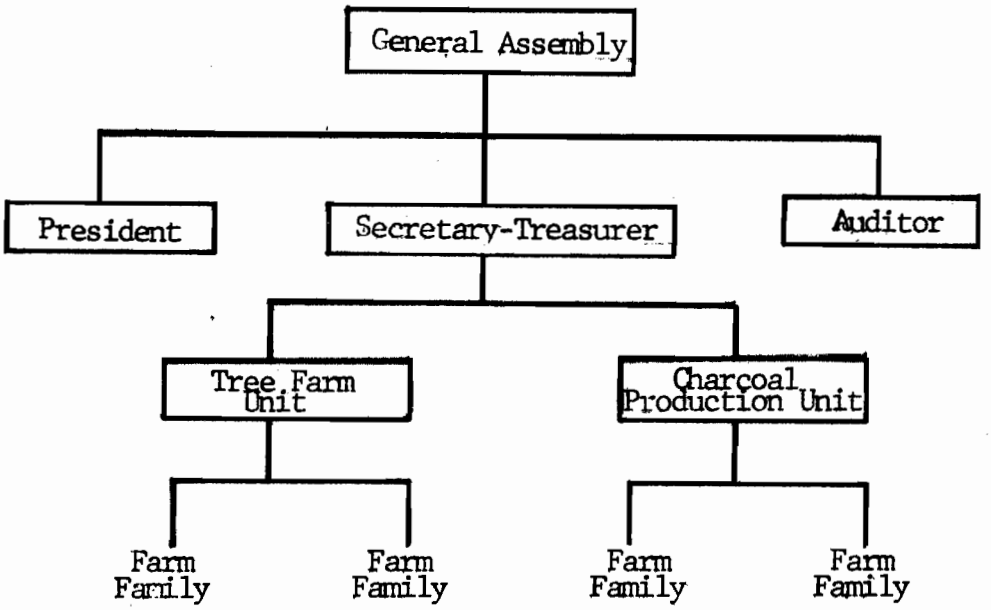


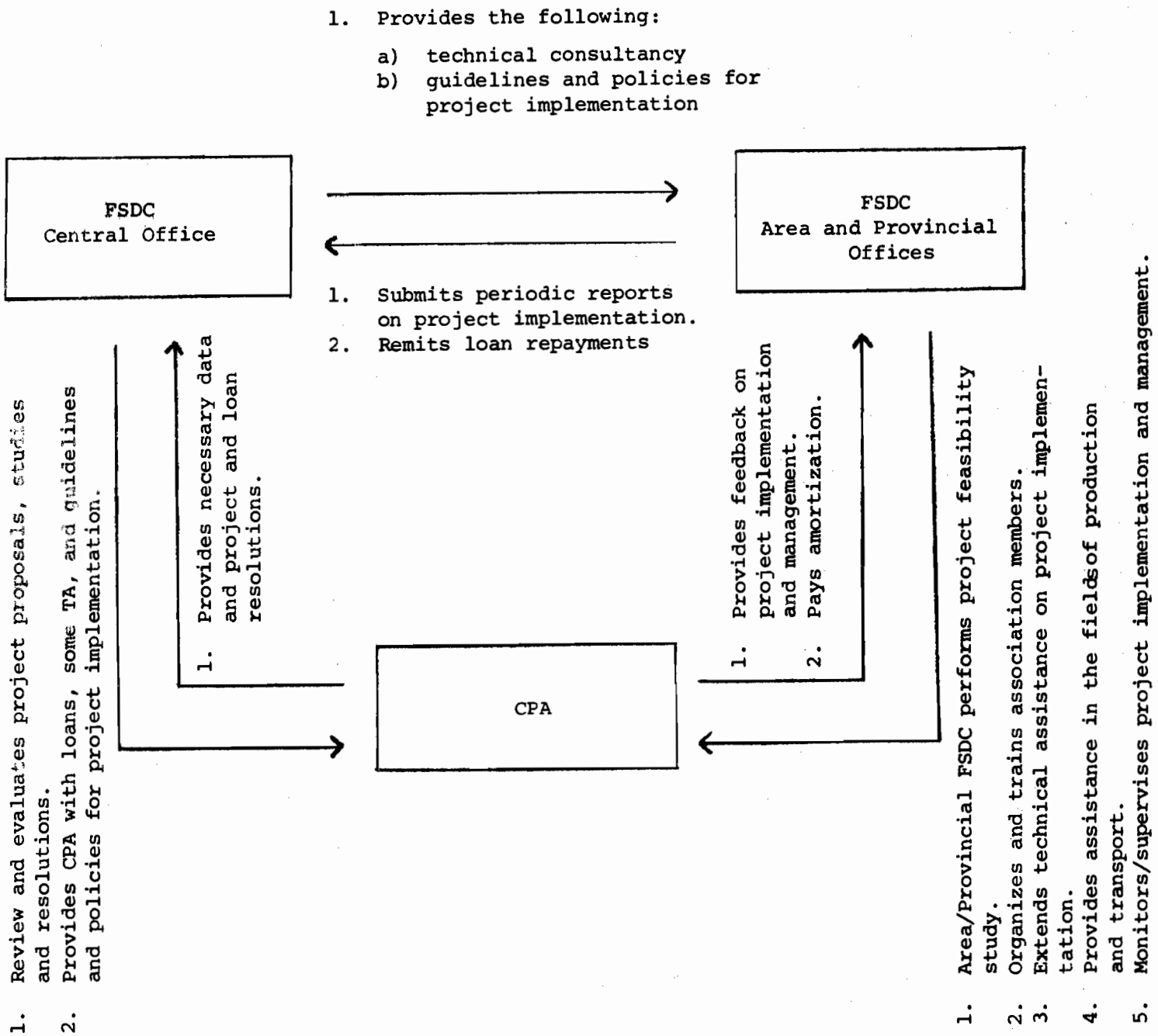
Figure 4
Organizational Structure
Charcoal Producers Association

The CPA General Assembly is represented by all family heads. It performs all decisions and policy making for the association including the formulation/revision of rules and policies governing the association. All matters affecting the association move through the assembly for action/resolution.

The Executive Board sees that all policies and decisions of the association are implemented. It is answerable to the assembly for all decisions it undertakes.

The association organization and support system described above is, as stated earlier, a replication and extension of an established operating system which has received high praise in AID evaluations and from other assistance agencies.

SUPPORT AND OPERATIONS LOOP



IV. FINANCIAL PLAN

This section presents the financial plan for the Charcoal Production Subproject focusing on funding obligations and disbursements. Overall economic and financial analyses of the subproject at the farmer, association and national levels are covered in Section III, B, C and D: Economic and Financial Feasibility.

A. Project Obligations

($000)

	Years 1	2	3	4	5	6	Total
AID	2,000	5,370	5,000	-	-	-	12,370

B. Disbursements Schedule

All costs in this subproject will be local currency. The proposed $12.370 million AID grant as well as the $5.019 million FSDC contribution will be disbursed over a six year period, following a six year planting schedule. Shown below is a projected disbursement schedule.

($000)

	Years 1	2	3	4	5	6	Total
a. AID Funds Tree farm development and Kilns	1,050	2,376	2,976	2,976	1,984	1,008	12,370
b. FSDC Funds Program Management and Cost Escalations	426	972	1,207	1,207	805	402	5,019
Total	1,476	3,348	4,183	4,183	2,789	1,410	17,389

The AID grant funds will cover 71% of the total costs of developing approximately 21,200 hectares of tree farms basically divided into 100 hectare modules. These costs include clearing, planting, maintenance, silvicultural inputs, tools, roads and charcoal production facilities. The remaining 29%, covering program management costs and cost escalations, will be financed by FSDC.

V. IMPLEMENTATION PLAN 1/

This section covers implementation considerations for the charcoal subproject. Administrative feasibility is discussed in Section III.

A. Grant Implementation Schedule

	Project Month
Obligation	0
Conditions Precedent Met	3
First Disbursements	3
Evaluation	18
Charcoal Production Begins	36
Impact Evaluation	60

B. Subproject Implementation Schedule

The following is the schedule for tree farm development and kiln construction.

Schedule for Charcoal Tree Farm Development Hectares and Kiln Construction

	Project Year 1	2	3	4	5	6
	1,767	1,766	1,766			
		1,767	1,766	1,766		
			1,767	1,766	1,766	
				1,767	1,766	1,770
Total Ha/Year	1,767	3,533	5,299	5,299	3,532	1,770
Cumulative Ha.	1,767	5,300	10,599	15,898	19,430	21,200
Kilns		265	265	265	265	
Cumulative		265	530	795	1,060	

1/ Relationships between and responsibilities of granting and implementing agencies, and the disbursement system are discussed in the Summary section to this Project Paper.

C. Project Management System

The GOP will be the grantee and the executing agency will be the MAC Secretariat at MHS. The FSDC will be the implementing agency.

More specifically, the Secretariat will deposit funds in favor of FSDC with the Philippine National Bank. FSDC will then be responsible for lending funds to the CPAs in order to proceed with tree farm development and kiln construction. Detailed loan procedures and conditions are presented in Appendix I, Loan Plan.

The responsible person for this project at the MAC Secretariat will be the Livelihood Support Fund Officer.

AID will assist the MAC Secretariat and FSDC in project implementation to the extent desired and feasible, to monitor the project, provide necessary AID approvals, and participate in progress assessments as well as final project evaluation. FSDC will submit a final implementation plan to the Secretariat and AID as a condition precedent.

D. Procurement Procedures

Under this subproject, FSDC will purchase hand tools, fertilizer and seeds for tree planting and bricks, mortar and other materials for kiln construction. All items are expected to be indigenous goods and/or shelf items. FSDC will use its own procurement procedures, which have been reviewed by AID in previous projects.

APPENDICES

TABLE OF ASSUMPTIONS

Assumptions Used in the Charcoal Program

A. Price of charcoal per ton - $125 = ₱1,000

B. Leucaena yield/harvest

Yield = growth per ha. per year x no. of years
Yield/Ha. = 25 MT/ha/yr x 3 yrs = 75 MT/ha/harvest

C. Yield of a 100-hectare module

75 MT/ha x 33.33 has. = 2,500 MT
at specific gravity of 0.60
2,500 MT ÷ 0.60 = 4,166 cu. m.
25 MT/ha/yr ÷ 0.60 = 41 cu. m.

D. Feedstock requirement/year

1 kiln requires 41 cu.m. of feedstock/charge

41 cu.m./charge x 20 charges/year = 820 cu. m./year

E. No. of kilns needed per 100-hectare module

$$= \frac{\text{Total harvest/year}}{\text{feedstock requirement/year}}$$

$$= \frac{\text{4,166 cu. m./year}}{\text{820 cu. m./year}}$$

= 5 kilns

F. Average kiln charges per year - 20

G. Average output per charge per kiln - 7.2 MT

H. Average charcoal production per 100-hectare module

7.2 MT charcoal/charge x 20 charges/year x 5 kilns = 720 MT/year

I. Annual charcoal production per 500 hectares

7.2 MT charcoal/charge x 20 charges/year x 25 kilns = 3,600 MT/year

TABLES: CPA PROGRAM SITES BY REGION/ISLAND AND PROJECTED PROGRAM GROWTH

Table 1

Number of Tree Farm Sites and ARea by Region by Year

Province	Region	1982 No. of Sites	1982 Area (Ha.)	1983 No. of Sites	1983 Area (Ha.)	1984 No. of Sites	1984 Area (Ha.)	1985 No. of Sites	1985 Area (Ha.)	1986 No. of Sites	1986 Area (Ha.)	1987 No. of Sites	1987 Area (Ha.)	1988 No. of Sites	1988 Area (Ha.)	1989 No. of Sites	1989 Area (Ha.)	1990 No. of Sites	1990 Area (Ha.)	1991 No. of Sites	1991 Area (Ha.)	Total No. of Sites	Total Area (Ha.)
	1	-	-	3	1624	3	1500	4	2000	4	2000	6	3000	4	2000	4	1833	4	2000	4	2000	36	17957
	2	-	-	1	500	3	1500	3	1500	4	2201	4	1833	4	2000	4	2000	4	2166	3	1500	30	15200
	3	-	-	3	1500	3	1500	5	2500	4	2000	4	2000	4	2000	4	2000	4	2000	3	1500	34	17000
	4	-	-	4	2000	4	2000	6	3000	5	2500	6	3000	5	2334	5	2500	4	2000	4	2000	43	21334
	5	4	1742	1	500	2	1000	4	2000	6	3000	4	2000	4	2000	4	2000	4	2000	4	2000	37	18242
	6	1	587	2	1000	2	1000	5	2500	4	2000	4	2000	4	2000	4	2000	3	1500	3	1500	32	16087
	7	-	-	1	500	2	1035	3	1534	3	1500	3	1500	3	1500	3	1500	4	2000	3	1500	25	12569
	8	-	-	-	-	3	1500	5	2500	2	1000	4	2000	4	2000	4	2000	3	1500	3	1500	28	14000
	9	3	1500	-	-	-	-	3	1500	3	1500	4	2000	4	2000	4	2000	4	2000	4	2000	29	14500
	10	3	1500	2	1000	3	1500	-	-	3	1500	4	2000	4	2000	4	2000	3	1500	3	1500	29	14500
	11	-	-	2	1000	3	1500	5	2500	4	2000	3	1500	3	1500	3	1500	3	1500	3	1500	29	14500
	12	3	1599	1	500	2	1000	-	-	4	2000	4	2000	4	2000	4	2000	3	1500	3	1500	28	14099
Total		14	6938	20	10124	30	15035	43	21534	46	23201	50	24833	47	23334	47	23333	43	21666	40	20000	380	189998
Cumulative			6938		17062		32097		53631		76832		101665		124999		148332		169998		189998		

Table 2
Number of Charcoal Kiln by Region by Year

Region	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Total
1	-	-	81	75	100	100	150	100	92	100	798
2	-	-	25	75	75	10	92	100	100	108	685
3	-	-	75	75	125	101	100	100	100	100	776
4	-	87	100	100	150	125	150	117	125	100	1054
5	-	80	25	50	100	150	100	100	100	100	755
6	-	-	50	50	125	100	100	100	100	75	700
7	-	-	25	52	77	75	75	75	75	100	554
8	-	-	-	75	125	50	100	100	100	75	625
9	-	75	-	-	75	75	100	100	100	100	625
10	-	75	50	75	-	75	100	100	100	75	650
11	-	-	50	75	125	100	100	75	75	75	675
12	-	80	25	50	-	100	75	100	100	75	605
Total		347	506	752	1077	1161	1242	1167	1192	1083	8527
Cumulative		347	853	1665	2682	3843	5085	6252	7444	8527	

CHARCOAL PRODUCERS ASSOCIATION

The TREE Program is implemented at the project level by the Charcoal Producers Association (CPA). The CPA is initially organized with the assistance of a TREE Program Project Supervisor from FSDC and a representative of the FSDC provincial office. The CPAs are small and have simple organizational and management systems to promote and enable maximum member participation in management.

Organizing a CPA: Priority for membership in CPAs is given to slash-and-burn cultivators who occupy a project site and other unemployed/underemployed laborers in the community or neighboring area. In both cases, physical ability to work and willingness of individuals to accept project terms and conditions take primary consideration. Based on these criteria for membership, candidates are recruited, screened, and ultimately organized by the TREE Project Supervisor.

Pre-organizational training is conducted by the FSDC provincial office to prepare the groundwork for organizing an association. Documentary requirements such as articles of incorporation, constitution, by-laws, and application for loans are drafted. During the actual organizational process, each of these steps must be approved in a vote of the full membership. This is followed by on-the-job training of members. The FSDC area and provincial offices provide training on essential aspects of the program:

1. Institutional development to manage and lead the affairs of the association. Including developing skills on administrative procedures and details, processes for handling disputes and grievances, and communications networks within and outside of the association.

2. Technical skills to develop/construct and maintain the tree farm and charcoal kilns. Including cultural requirements of various fast-growing species, specific cash crops and orchard plants, and processing and marketing charcoal.

3. Financial training including understanding the schemes of amortization payment and the technical competence to operate basic standardized accounting, budgeting, and auditing systems for the association and the member families. (See Figure 1 for support and operations loop.)

Institutional Features: The association is a legal, corporate entity duly registered with the FSDC. The CPA holds the land lease for the membership and is capable of entering into contracts and other legal activities such as loan and services negotiation and acquisition. Any net earnings arising from the operations of the association belong to the members and are distributed equally to them as active participants in the program. Each member is entitled to one vote and has an equal and mutual responsibility to finance the operation and maintenance of the association.

The association is organized on a contiguous or semi-contiguous area suitable for energy tree farms. Contiguity of farm areas facilitates management and supervision of the project and its members and technology transfer.

The program promotes the evolution of the associations into self-reliant groups. Initially, outside resources will be called on to equip farmer-members, but as their skills improve through experience and on-the-job training, the need for outside assistance will lessen and ultimately disappear.

Finally, the association seeks to broaden its range of services and benefits by practicing the FSDC farm family approach. Under this practice, the farmer's dependents are tapped to enhance family participation in the project and, more importantly, to provide added income to family members during peak labor periods.

Structure of CPA: The general membership of the association consists of two production groups: the tree farm and the charcoal manufacturing groups. The tree farmers are responsible for developing the energy plantation while the latter construct, operate, and maintain the charcoal kilns. Each group has an appointed functional leader; see Figure 2.

There are three organizational substructures which comprise an association. These are:

1. General Assembly

Composed of all family heads, the assembly is responsible for formulation of rules, regulations and policies governing the association, and general decision-making concerning actions to be taken by the group.

2. Executive Board

The executive board is composed of three members: president, secretary-treasurer and auditor. It ensures that all by-laws policies and decisions are implemented and adhered to. It is answerable to the assembly for whatever decisions it may arrive at and activities it may undertake.

In addition, each individual member of the board has individual functions: the president is responsible for management and production operations and entrepreneurial and institutional undertakings. The secretary-treasurer maintains all records and coordinates all financial activities/transactions and acts in behalf of the president in case of the latter's absence or disability. The auditor audits all funds, and conducts inventory control of the association's property.

3. Farm Family

The farm family is the basic unit of the association and project. It is responsible for wood production, transport, and charcoal production.

The farmer works in and oversees all activities in these areas (depending on the production groups to which he belongs), while the family members assist in implementing all decisions/plans of the association and immediate work responsibilities of the family.

Figures 1 and 2 below, diagram the Charcoal Program's intraorganizational support and operations loop, and a CPA's organizational structure.

Figure 1

SUPPORT AND OPERATIONS LOOP

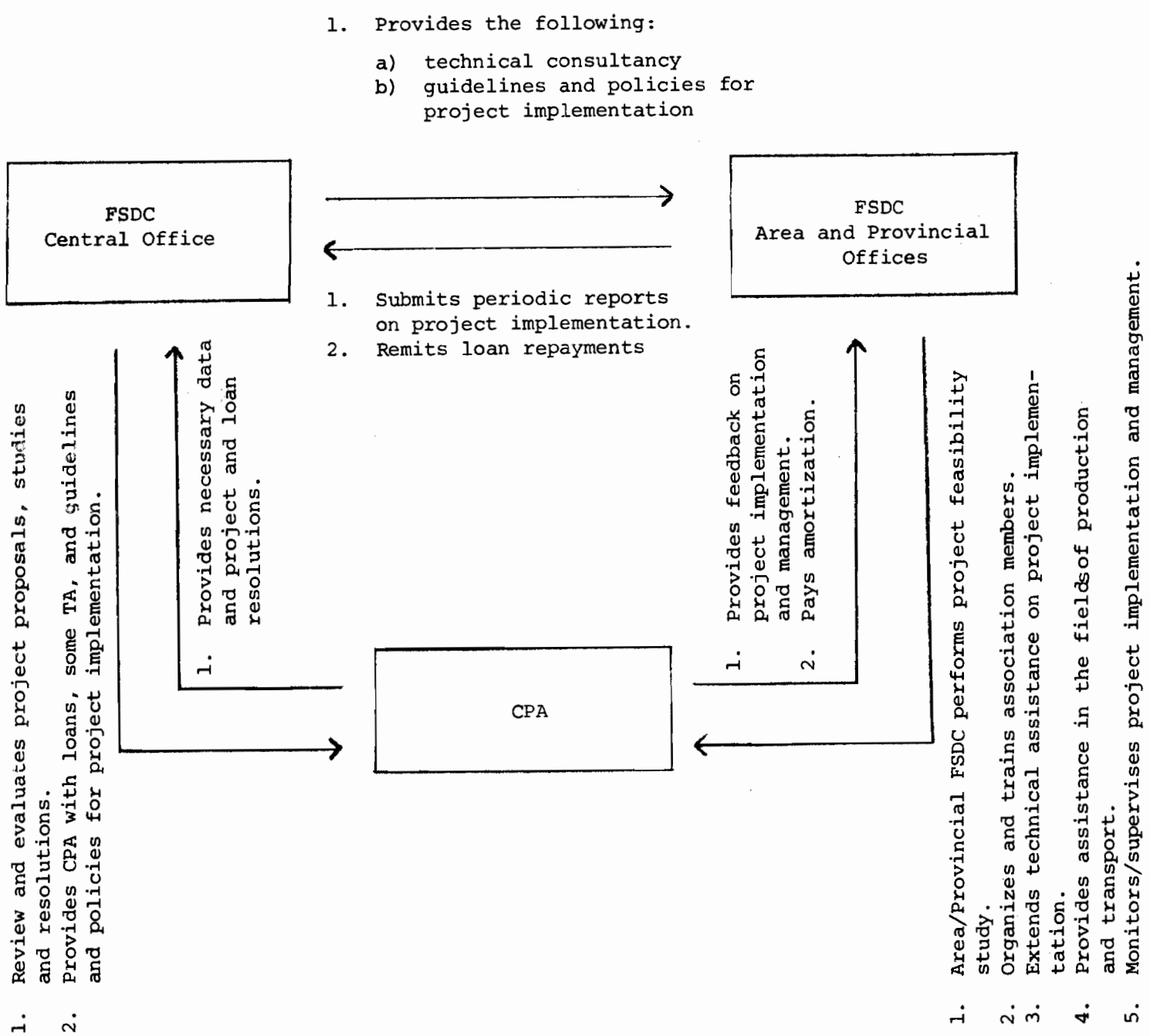
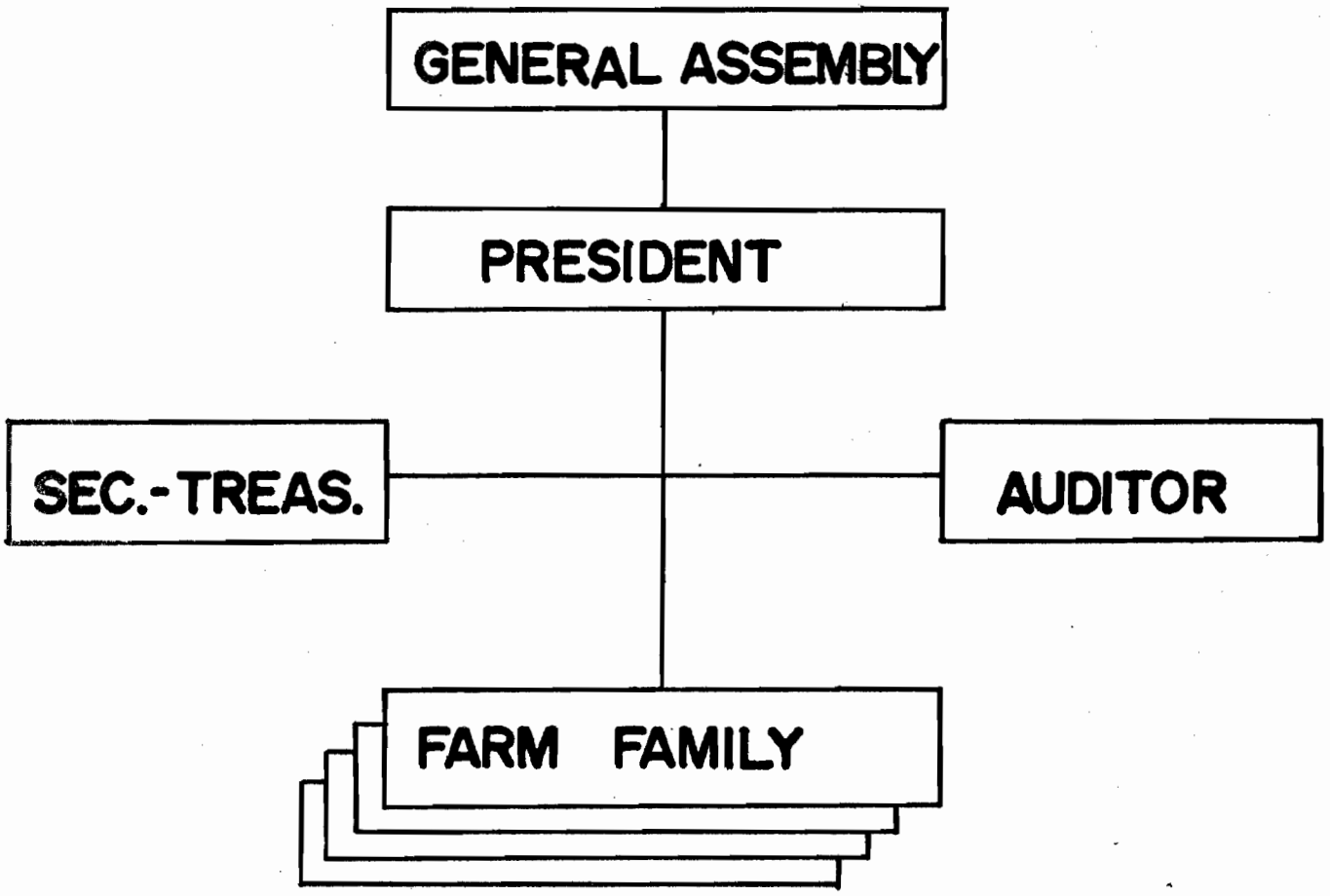


Figure 2

ORGANIZATIONAL STRUCTURE OF THE CHARCOAL PRODUCERS ASSOCIATION



CPA MODULE PRODUCTION CALENDAR

The production calendar is a scheduled table of activities prepared by the CPA to guide members in daily tasks. The calendar is composed of two sections; one for tree farm development, and the other for charcoal production.

The tree farm production calendar includes all activities related to crop development, i.e., clearing, staking, planting, weeding and care and maintenance to be performed during the first year on one-third of a module. During the second and third years the maintenance activities, primarily weeding, are repeated except as changes are necessary as shown by experience or new techniques. Also during the second year, the kilns are constructed. At the end of the calendar the harvest is scheduled. The calendar is repeated for each of the remaining two-thirds of a module. The calendar is developed specifically for each module of a tree farm and considers climatic conditions, soil types, material needs and labor requirements from members' families for the various activities.

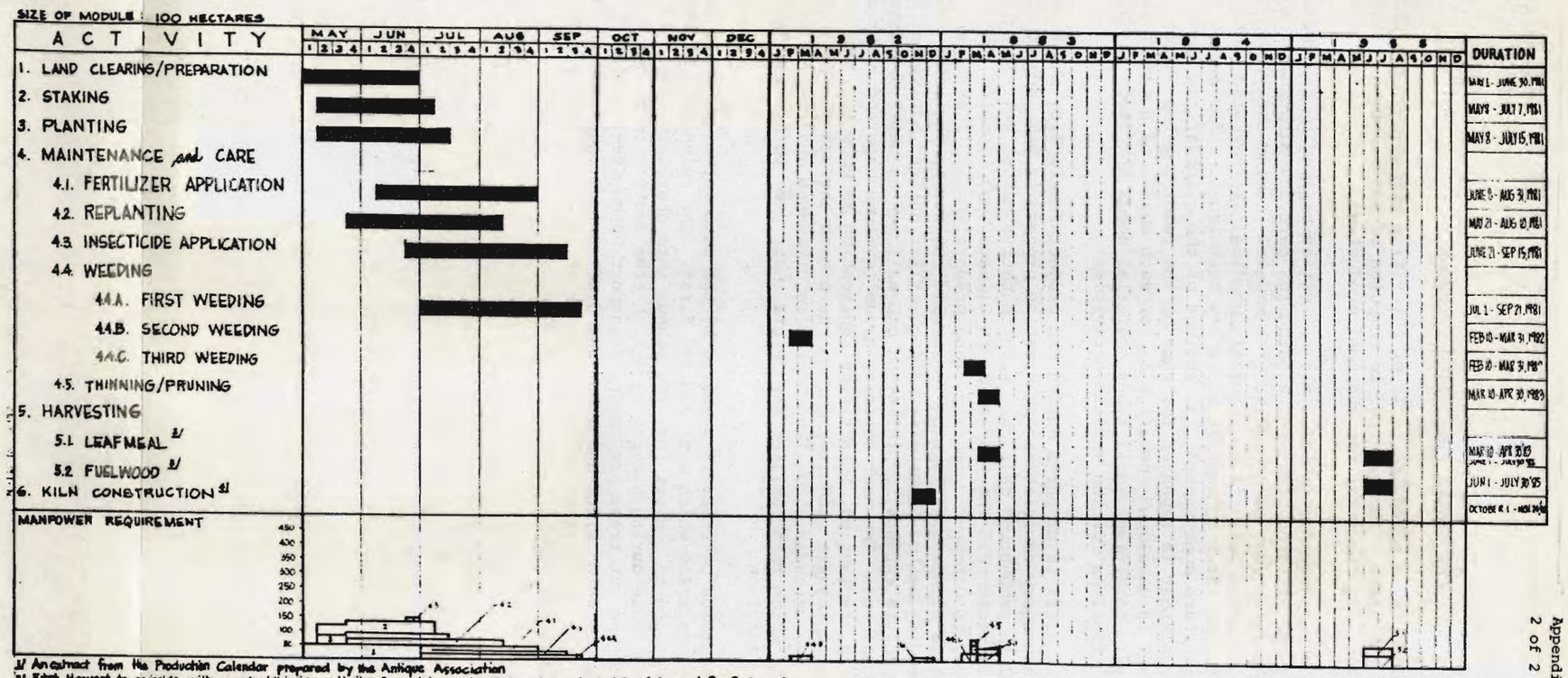
The initial calendar draft is prepared during the project feasibility stage and refined after the necessary association organization procedures have been completed. An example of a module production calendar, with tentative dates, for the Mablad, Antique tree farm is attached. The project is in Climate Type I, which has a rainy season from May to October. Clearing, land preparation and staking are started a month before planting. Planting is carried out during the rainy season using the direct seeding method, thus eliminating earlier nursery activities for this module. The process extends for three-and one-half months until one-third of the module is completed. The next activity group involves care and maintenance, including fertilizing, replanting, insecticide application as necessary and weeding. Thinning and pruning are conducted during the nineth through eleventh months. The bottom half of the calendar shows labor force requirements and clearly identifies slack days in which farm families may devote their time to other endeavors, such as cash crop production.

The charcoaling production calendar is prepared by the association prior to harvesting, and focuses on areas which were planted first. The calendar will cover all activities undertaken to convert the tree stands into charcoal. These include: Time and Manpower schedule during harvesting--which tree section to be cut and to which stockpile area the cut trees are taken; Transport Schedule--identifying which stockpiles supply which kilns and labor and draft animal requirements for transport; and a Firing Schedule--establishing an order in which kilns are loaded, fired, unloaded and maintained.

ENERGY PLANTATION PRODUCTION CALENDAR 1/

MABLAD, BARBASA, ANTIQUE TREE PROJECT

SIZE OF MODULE : 100 HECTARES



1/ An extract from the Production Calendar prepared by the Antique Association
2/ First Harvest to coincide with pruning/thinning activity. Second harvest will depend on actual date of harvest for fuelwood
3/ Tentative date. Actual harvest will depend on maturity and details of activity to be reflected on harvesting calendar
4/ Fire Kiln

LEGAL RIGHTS AND PROTECTIONS OF THE CHARCOAL PRODUCERS ASSOCIATIONS

This document is appended to the Project Paper in order to address the legal aspects of the questions raised in paragraphs 2 D(2) and (by extension) 3A of 1981 State cable 317473 which approved the PID for this Project.

The referenced paragraphs requested, among other things, a review of the legal rights and protections of the farmers associations with particular reference to their rights to lease and hold lands for tree farming use.

Such a review had already been performed prior to receiving State 317473, and the conclusion therefrom remains valid; i.e., the farmers associations do have legal rights and protections which are sustainable by the judicial courts of the Philippines and which appear adequate for purposes of AID financing requirements.

The Charcoal Producers Associations have been fostered and supported by the Farm Systems Development Corporation (FSDC) under its charter. FSDC was established on April 7, 1975 by Presidential Decree 681 (subsequently amended by Presidential Decree 1595). The powers granted to FSDC include the promotion of and assistance to all irrigation and other farm-based associations.

These presidential decrees also empower FSDC to organize and register farmers associations as legal corporate entities; making them legally established corporations under the laws of the Philippines and having the rights and remedies associated therewith.

FSDC has model articles of incorporation and model by-laws available to the farm groups with which they are working. These guidelines explain the requirements and responsibilities associated with incorporation. The guidelines appear to be quite adequate for the purpose they fill.

In the view of the AID Mission, the rights of the members of the associations we are assisting are established by law and may be protected by the judicial courts of the Philippines.

One of the rights of these associations is the right to lease public land in the name of the association. The Government of the Philippines responsibility for public land applicable to this discussion has been delegated to the Ministry of Natural Resources. Its Bureau of Lands administers Commonwealth Act No. 141, the Public Land Act; and its Bureau of Forest Development administers Presidential Decree No. 705, the Forestry Reform Code of the Philippines. Both laws provide for the lease of public lands (for agricultural purposes and for forestry purposes, respectively) for periods of 25 years, renewable for an additional 25 years. The provisions of each law specifically allow for such leases to be entered into with associations (corporations) of Philippine citizens.

Both the Bureau of Lands and the Bureau of Forest Development have promulgated regulations and rules applicable to leasing lands for purposes which include

the development of the type of tree farms we will be assisting. The Bureau of Lands has actually issued a "Primer" on the leasing of such lands which explains in considerable detail the steps to be taken in order to lease public land. Similary NEA and FSDC have guidelines relevant to tree farmers associations and charcoal production units, respectively, on leasing public land and on the assistance they can provide in this regard.

Further, the President has issued Executive Order 725 as the official Government policy directive encouraging and facilitating the establishment of tree farms. This executive order reiterates the provision of an initial twenty-five year lease and additionally provides for the "automatic" renewal thereof for an additional period of twenty-five years at the option of the lessor (providing the lessee has complied with the terms of the lease).

A sample lease published by the Ministry of Natural Resources is attached. Other documents, laws and decrees referred to herein are on file in the Office of the AID/Manila Regional Legal Advisor.

Republic of the Philippines
Ministry of Natural Resources
Office of the Minister
Diliman, Quezon City

INDUSTRIAL TREE PLANTATION LEASE AGREEMENT NO._____

OF

_____
(Name of Lessee)

_____
(Location of Area)

This AGREEMENT, made and entered into by and between:

The MINISTRY OF NATURAL RESOURCES, for and in behalf of the Republic of the Philippines, hereinafter referred to as the LESSOR, and_____ _____with residence and postal address at _____ hereinafter referred to as the LESSEE:

WITNESSETH, THAT:

WHEREAS, the establishment of industrial tree plantations is encouraged as Government policy to accelerate the country's reforestation efforts which shall promote ecological balance and assure an adequate wood supply to meet local and foreign demand;

WHEREAS, P.D. 705, P.D. 1559, and other existing laws, rules and regulations provide for incentives to qualified developers and operators of industrial tree plantations;

WHEREAS, the LESSOR and the LESSEE are desirous of entering into this Industrial Tree Plantation Agreement;

NOW, THEREFORE, for and in consideration of the foregoing premises, the LESSOR, as Minister of Natural Resources and by virtue of the Authority of Presidential Decree No. 705, as amended by Presidential Decree No. 1559, otherwise known as the Revised Forestry Code of the Philippines, hereby leases to the LESSEE _____hectares of public forest land covering a period of twenty-five (25) years to expire on _____, automatically renewable for another twenty-five (25) years, which land is located at Sitio/s _____

Barrio/s _____, Municipality/ties of _____ _____, Province of _____, Philippines, the description and boundaries of which are shown in the attached sketch which forms part of this Lease Agreement.

This Lease Agreement shall be for the planting of trees to supply the requirement of existing and proposed wood processing, energy plants and other related industries subject to the following terms and conditions:

1. The LESSEE agree to plant and raise in the area covered under this Lease Agreement trees for the production of saw timber, pulpwood, etc., and other crops suitable for energy generation or for other government sponsored development projects if found viable.

2. The planting of dipterocarp or primary trees of commercial value and raising of secondary crops shall be confined within the perimeter of the parcel of land described herein. The LESSEE shall conserve and preserve the monuments and other landmarks indicating corners and outlines along the boundaries and within the confines of the area covered by this Agreement.

3. The area subject of this Lease Agreement is a public forest land and does not include areas already declared as A&D lands or private lands and any such lands shall be excluded from the boundaries of the ITP leased area.

4. The LESSOR reserves the right to permit, if public interest requires the opening of such portions of the area under lease for logging, mining, and other public rights-of-way, which shall not be more than _____ meters wide; Provided, That the person or entity granted the right-of-way shall pay the LESSEE a reasonable compensation for any damage to improvements, if any, occasioned by such opening.

5. No rental shall be collected during the first ____ years from the date of issuance of the lease; Provided, That from the _____ to the _____ year, the annual rental shall be _____ per hectare; and thereafter, and until the expiration of the lease, the annual rental shall be _____ per hectare; Provided Further, That if the area be declared/certified as long denuded by the Director of Forest Development, duly approved by the Minister of Natural Resources, the LESSEE shall be entitled to exemption from payment of rentals for the full term of the Lease Agreement.

6. All operation and planting of agricultural crops, forest crops, in harmonized combination with the raising of animals, shall follow such rules and regulations that may be issued by the Bureau of Forest Development;

Provided, That precautionary measures shall be instituted to minimize surface run-off, soil erosion, and other land imbalance. Non-compliance with such rules and regulations shall be sufficient ground for the cancellation of this Lease Agreement.

7. If the LESSEE does not utilize the area leased herein for the purpose for which the lease is granted, or fails to comply with the terms and spirit hereof within one (1) year after the signing of the Agreement, then this Lease Agreement may be cancelled by the LESSOR, except for causes beyond the control of the LESSEE.

8. The LESSEE shall improve and plant at least _____ of the area herein granted within three (3) years from the execution of this Agreement; _____ of the area within five (5) years; _____ of the area within seven (7) years; and the balance of the entire area within _____; otherwise, a more realistic plan shall be submitted, giving details on budget, cash flow, and timetable of development within the capabilities of the LESSEE, subject to approval by the LESSOR; Provided, However, That the LESSEE shall always maintain the area forested, which shall be planted with trees immediately after they are cut; otherwise the LESSOR may reduce the area granted, commensurate with the capability of the LESSEE to improve and make use of the area, or cancel the lease for cause and forfeit the bond deposit.

9. As a guaranty for the faithful performance of the conditions of this Agreement, the LESSEE shall furnish or deposit a bond in the amount of _____ (₱ _____), if cash or other acceptable government securities, and an additional twenty-five percent (25%) more than the amount herein provided, if by a surety. The LESSEE agrees that the said bond shall, upon his failure to fulfill all and singular the conditions and requirements herein set forth or made part hereof, be retained and/or forfeited in favor of the Republic of the Philippines to be applied, as much as practicable, for the satisfaction of the obligations assumed hereunder; and the LESSEE further agrees that should the sureties on the bond delivered herewith or any bond delivered herewith or any bond delivered thereafter in connection with this Agreement become unsatisfactory to the LESSOR, the LESSEE shall, within thirty (30) days from receipt of notice or demand, furnish a new bond with sureties solvent and satisfactory to the LESSOR.

10. The LESSEE shall do all in his power to prevent and suppress fires in the area under this Agreement or other areas immediately adjacent thereto, and to place his employees or workers under the direction of Foresters or other authorized agents of the Director of Forest Development, whenever required for the purpose of putting out or preventing forest fires.

11. The LESSEE shall be responsible for the protection and conservation of forest growth in the area under lease and shall cooperate with the Bureau of Forest Development in the protection of forest areas immediately adjacent thereto.

12. The cutting, gathering, or protection of trees, naturally growing in the area of lease shall be regulated by the BFD. For this purpose, all dipterocarp and endangered tree species inside inadequately-stocked areas shall not be cut except when so authorized in accordance with BFD rules and regulations.

13. The LESSEE shall not assign or sub-lease the leased area or any portion thereof, neither shall the LESSEE encumber the leased area, in whole or in part, to any lending entity for the purpose of securing credit financing, without the prior approval of the LESSOR.

14. Upon expiration of this Agreement or on its termination when public interest demands, all permanent improvements on the area shall remain on the plantation, but the LESSEE shall be entitled to fair compensation for such improvements introduced by the LESSEE on the leased area in an amount to be determined by a third party appraiser mutually acceptable to both parties. The compensation for the standing trees shall be their market value at the expiration date of the lease, using the following formula, to wit:

$$V = \sum_{i=1}^{n} V_i$$

$$V_i = \frac{P_i Q_i}{(1+4)^t}$$

Where:

V	=	Total amount of compensation for standing trees
V_i	=	Value of standing trees for specific timber/wood products at the expiration date of the lease
i	=	Particular type of timber/wood products expected from the industrial tree plantation

n = Number of types of timber/wood products expected from the industrial tree plantation

P_i = Price of specific timber/wood products, based on the standing trees, the expiration date of the lease

Q_i, t = Expected harvest upon maturity of trees

t = Years to harvest from expiration date of the lease

r = Interest rate prevailing at the expiration date of the lease

The LESSEE shall be entitled to compensation for permanent infrastructure introduced by the LESSEE, based on their fair market value as of the expiration date. The LESSEE may remove the temporary or semi-permanent structures, unless the LESSOR opts to retain them by paying their fair market value as of the expiration date. The value of the improvements shall be finally determined by the appraiser mutually accepted by both parties.

15. In the event of violation by the LESSEE or his authorized agents of any provisions of P.D. 705 and P.D. 1559 governing the protection of the trees in the lease area, or of the terms and conditions of the lease agreement; and the event that after due warning by the LESSOR to the LESSEE, the latter fails within a reasonable time, which time shall not exceed three (3) months, to stop the violation referred to; or in the event that the LESSEE or his agents or other persons operating under this Lease Agreement, commit and act tending to influence a forest officer, to induce him directly or indirectly to violate existing rules and/or regulations, then this Agreement may be cancelled by the LESSOR without the right of compensation under the immediately preceding paragraph.

16. To insure normal balance of forest cover, the LESSEE shall submit a development program for the leased area for the approval of the LESSOR which shall form part of this contract upon its approval. No revision shall be made on such program without the mutual consent of both parties.

17. The LESSEE is required to submit on or before the 30th day of January of each year an annual report ot the LESSOR, showing, among others, the number of hectares developed during the year, species, planted, survival rate at the

end of the year, number and size of nurseries established, kinds of seedlings raised, and other improvements introduced during the year. Quarterly progress reports shall be submitted to the BFD during the tenure of this Agreement.

18. The LESSEE shall not unnecessarily impede, obstruct or in any manner prevent the passage of legitimate licensees, lessees, permittees and/or other forest users and the public, by virtue of the lease herein granted.

19. After the final ground survey, the boundaries of the area covered by this Industrial Tree Plantation Lease Agreement shall not be altered or modified except when public interest demands.

20. In the process of development, the LESSEE shall strictly observe and/or implement all possible measures for the protection of watersheds and the environment to the effect that:

    a. No trees in the leased area shall be cut regardless of species, if found within 20 meters from edges or rivers or creeks of at least five (5) meters in width and of public roads.

       Open, denuded, brushlands, or inadequately stocked areas along stream channels below five (5) meters in width shall be planted with trees and may be harvested if included in the duly approved industrial tree plantation development plan.

    b. The LESSEE shall protect and conserve unique, rare, and endangered trees, plants and wildlife indentified under existing laws, rules, and regulations within the leased area.

    c. The LESSEE shall plant five (5) edible fruit tree species per hectare of the area under lease, to provide aid and comfort, and food for wildlife species.

    d. There should be at least sixty (60) surviving seedlings of suitable dipterocarp species per hectare of the area after three (3) years from the start of land development.

21. In the event that there are old growth forest, mossy forest and other prohibited portion within the area subject of this Lease of Agreement which may be discovered later that same shall be subjected to ground delimitation within sixty (60) days after discovery.

22. In the event that there shall be found later forest occupants within the area subject of this Lease which were already there before inspection of the area was made, the LESSEE shall within sixty (60) days upon discovery of such occupants submit a revised Industrial Tree Plantation (ITP) development plan to government with the reduced area which plan shall include, among others, an effective scheme for the management of such forest occupants consistent with the provision of P.D. 705, as amended and other policies, rules and regulations related thereto. If such occupants were proven to have been in the area before 19 May 1975, the LESSEE shall not disturb the occupancy until further instruction from the Director of Forest Development and priority shall be given to those forest occupants in the matter of implementation.

23. Construction of permanent infrastructures that are not necessary in the development of industrial tree plantation such as houses of concrete and strong materials is not allowed under this Lease.

24. The LESSEE shall coordinate/link up the development scheme with the Kilusang Kabuhayan at Kaunlaran (KKK) program of the New Republic.

Quezon City, Philippines
_____, 19_____

For and in behalf of the
Republic of the Philippines

_____ _____
Minister of Natural Resources (LESSEE)

WITNESSES: WITNESSES:

_____ _____

_____ _____

RECOMMENDED BY:

Director
Bureau of Forest Development

REPUBLIC OF THE PHILIPPINES)
) S.S.
QUEZON CITY)

In Quezon City, this _____day of _____, 19_____, before me a Notary Public for and in the said City, personally

Name	R.C. NO.	Date of Issue	Place of Issue

_____
Minister of Natural Resources
(LESSOR)

_____
(LESSEE)

known to me and to me known to be the same persons who executed the foregoing instrument and who acknowledged to me that the same is his free act and deed.

This document is an INDUSTRIAL TREE PLANTATION LEASE AGREEMENT NO. _____covering _____parcels of public forest land, consisting of eight (8) pages and each is signed by the LESSOR and his witnesses and bears my Notarial Seal.

Witness my hand and official seal, on the date and place first above written.

NOTARY PUBLIC

Doc. No. _____;
Page No. _____;
Book No. _____;
Series of 19_____.

CHARCOAL PRODUCTION PROCESS

Carbonization is a process of heating wood at certain temperatures with little or no air. As heating begins, the wood simply dries. As the temperature rises, the material structure of the wood begins to decompose, yielding some organic chemicals and leaving a residue of pure carbon.

Below 170°C practically pure water is released. Above that temperature, wood will begin to carbonize and at 250°C partial decomposition takes place. At 250-270°C, an exothermic reaction begins and carbonization continues without requiring heat from external sources. In most charcoal production systems, process heat is normally provided from the wood-charge to be carbonized, this is the case for all kilns and kiln type furnaces. This heat must be sufficient to reduce the moisture and raise the temperature to a self-carbonizing level, plus allow for losses from kiln walls and stacks. The carbonizing temperature determines the fixed carbon and the residual volatile matter, which are interrelated. In actual operations, between 15% and 20% of the wood, depending on its moisture content (M.C.) and other factors, will be consumed as a heat source for the carbonization process.

Heat contained in the combustion gases will, before leaving the kiln, completely dry the wood and heat it until the carbonization process is self-supporting. The better the gases are conducted through the wood charge, the better their heat will be transferred to the charge, the less wood will be consumed through combustion and the higher the yield.

Yield is expressed as a percentage of wood input and is related to the type of kiln, initial moisture content, carbonization temperature and speed, the characteristics of the wood, its age, size, shape, volume of bark and the experience and skill of the kiln operator. On the average, conversion to charcoal will yield approximately 28.5% by weight or 45-55% by volume of the original raw material - air dried wood (30% M.C.).

1/ This Section draws from Brazilian techniques described in the United Nations Industrial Development Organization (UNIDO) Report, "Charcoal Ironmaking: A Technical and Economic Review of Brazilian Experience; Meyers, H.; Jennings, R.V.; November 8, 1978.

ECONOMIC TABLES

Table 1
Charcoal Program "Raw" Fuelwood Energy Cost at Landing
(500 hectare module)

	Local (Peso)	Dollar Equivalent (₱8 = US$ 1)
Annual Costs		
Unskilled labor	306,000	38,250
Skilled labor	120,000	15,000
Silvicultural inputs	173,000	21,625
Total Annual Cost	599,000	74,875
Capital Costs		Annualized Cost Capital Recovery Factor @ 20%
Roads (10-yr.life)	163,000	$ 4,860
Tools & Equipment (4-yr. life)	10,000	483
Total Capital Cost	173,000	
Total Annual Capital Cost		5,343
Farmer's Margin		21,344
Total Effective Cost		101,562
Effective cost/million BTU		$0.74

Table 2
Charcoal Conversion Costs[1/]

	Local (Peso)	Dollar Equivalent (₱8 = US$ 1)
Annual Costs		
Unskilled labor	8,560	1,070
Skilled labor	4,320	540
Total Annual Costs	12,880	1,610
Capital Costs		Annualized Cost Capital Recovery Factor @ 20%
Kiln (10-yr. life)	20,000	596
Total Effective Cost (less feedstock)	17,648	2,206
Effective Conversion Cost/Million BTU		.59
Effective Charcoal Cost Per Million BTU including Wood and Feedstock		$2.44

1/ Assumes 7.2 MT charcoal charge/year x 20 charges/year = 144 MT charcoal/year

144 MT charcoal = 3730.57 million BTU Thermal efficiency @ 40%

Table 3
Comparative Cost of Charcoal Vs Bunker Oil for Industrial End-Use

Capital Cost for Conversion of Charcoal

	Local (₱)	Foreign (₱8=$1)
Firebox/Blower	150,000	18,750
Annual capital cost of firebox		3,206 1/
Effective capital cost to convert charcoal/hr.		0.37

	Bunker Oil	Charcoal
Fuel requirement/MBTU/hr.	0.10	0.12
Cost/MBTU ($)	5.60	2.44
Cost/hr. ($)	0.57	0.29
Conversion cost to fuel ($)	-	0.37
Total Cost/MBTU/HR. ($)	0.57	0.66
Shadow Forex: ₱10 = 1($)	0.71 2/	0.58

1/ Interest rate of 15% and capital recovery factor of .171017 (15 years). Firebox/blower is assumed at 80% efficiency.

2/ A shadow foreign exchange rate of ₱10 = $1 would increase the cost of bunker oil by 24%.

Table 4
Comparative Cost of Charcoal & Kerosene for Household End-Use[1/]
(In Dollars)

	Cost (₱8 = 1)
Kerosene Stove	
Effective annual cost using kerosene	
22 MBTU x $8.80/MBTU	193.60
Charcoal Stove[2/]	
Effective annual cost using charcoal	
6.6 MBTU x $2.44/MBTU	16.1
15.4 MBTU (kerosene) x $8.80/MBTU	135.52
Capital cost/MBTU	1.33
	152.95

1/ Average annual kerosene requirement per household is 22 million BTU.

2/ At 30% charcoal substitution, the annual kerosene requirement of 22 MBTU will be provided through a combination of 6.6 MBTU of charcoal (22 MBTU x 30%) and 15.4 MBTU of kerosene (22 MBTU x 70%).

3/ Local cost of charcoal stove is ₱700. Annualized at 20% interest rate and capital recovery factor of .334380 (5 yrs.)

Table 5. Charcoal Production: Economic Benefit/Cost and Internal Rate of Return (IRR) Analysis for 500-Ha. (₱1000, 1981 Prices)

Year	Total Economic Cost 1/	Total Economic Benefit 2/	Present Value at 20% Discount Rate Costs	Present Value at 20% Discount Rate Benefits	Present Value at 15% Discount Rate Costs	Present Value at 15% Discount Rate Benefits	Net Undiscounted Benefits	P.V. of Net Benefits at 119.3% Discount Rate
1	506	-	422	-	440	-	-506	-230.7
2	503	-	349	-	380	-	-503	-104.6
3	935	-	541	-	615	-	-935	- 88.7
4	562	5800	271	16478*	321	24249*	5238	226.5
5	359	5800	144		178		5441	107.3
6	359	.	120		155		5441	48.9
7	359	.	100		135		5441	22.3
8	359	.	83		117		5441	10.2
9	251	.	49		71		5549	4.7
10	251	.	41		62		5549	2.2
11	251	.	34		54		5549	1.0
12	251	.	28		47		5549	.4
13	676	.	63		110		5124	.2
14	251	.	95*		195		5549	.2
15	251	.					5549	
.	.	.					.	
.	.	.					.	
22	251	.					5549	
23	676	.	10		27		5124	
24	251	.	3		9		5549	
25	251	5800	3		8		5549	
TOTAL	9059	127600	2356	16478	2925	24249	118541	-0.2

Benefit/Cost Ratio: At 20% Discount = 6.99
At 15% Discount = 8.29

Net Present Value: At 20% Discount = 14122
At 15% Discount = 21324

Internal Rate of Return (IRR): 119.3%

*P.V. of constant stream of benefits or costs beginning and ending in years indicated.

1/ See Table 8.

2/ Economic benefit is estimated as the annual value of the imported bunker oil equivalent, in terms of BTU, replaced by charcoal: 3600 MT charcoal annual production per 500 ha. X 25.907 MBTU/MT = 93,264 MBTU of charcoal/year. At 6.022 MBTU/barrel of bunker oil this equals 15,487 barrels. At a current price less taxes of ₱1.885/liter or ₱299.6/barrel of bunker oil, this equals an annual ₱4.640 million, or about ₱1290/MT charcoal. A foreign exchange premium (shadow price) of 25% is added (4.64 X 1.25 = 5.80). Since bunker oil is refined from crude oil in-country, the profits (revenues minus total costs) of the refineries should be deducted from the wholesale price as not representing Philippine economic costs avoided. These are rather small percentages of the wholesale price of bunker oil, however, (no more than 2%, about half of which accrues to foreign owners) so ignoring them in these calculations does not result in a significant bias.

USAID/P, OD/PE, 4/6/82

Table 6. Charcoal Production: Economic B/C and IRR Sensitivity Analysis (for 500-ha.) -- with Costs Increased 20% and Benefits Reduced 25%[1/] (₱1000, 1981 Prices)

Year	Total Economic Cost + 20%	Total Economic Benefits - 25%	Present Value at 20% Discount Rate Costs	Present Value at 20% Discount Rate Benefits	Present Value at 15% Discount Rate Costs	Present Value at 15% Discount Rate Benefits	Net Economic Benefits	Net Present Value at 87.0% Rate of Discount
1	607	-	506	-	528		- 607	-325
2	604	-	419	-	457		- 604	-173
3	1122	-	649	-	738		-1122	-172
4	674	4350	325	12359*	385	18187*	3676	301
5	431	4350	173		214		3919	171
6	431	4350	144		186		3919	92
7	431	.	120		162		3919	49
8	431	.	100		141		3919	26
9	301	.	58		86		4049	14
10	301	.	49		74		4049	8
11	301	.	41		65		4049	4
12	301	.	34		56		4049	2
13	811	.	76		132		3539	1
14	301	.	113*		233*		4049	1*
15	301	.					4049	
.	.	.					.	
.	.	.					.	
22	301	.					4049	
23	811	.	12		33		3539	
24	301	.	4		11		4049	
25	301	4350	3		9		4049	
TOTAL			2826	12359	3510	18187		1

Benefit/Cost Ratio: at 20% Discount: 4.37
at 15% Discount: 5.18

Net Present Value: at 20% Discount: 9533
at 15% Discount: 14677

Internal Rate of Return (IRR): 87.0%

*PV of constant stream of costs or benefits beginning and ending in years indicated.

1/ See Table 5 for estimated economic costs and benefits.

USAID/P, OD/PE, 4/6/82

Table 7. Charcoal Production: Economic B/C and IRR Sensitivity Analysis (for 500-ha.) -- with No Shadow Prices (₱1000, 1981 Prices)

Year	Total Nominal Cost 1/	Total Nominal Benefits 2/	Present Value at 20% Discount Rate Costs	Present Value at 20% Discount Rate Benefits	Present Value at 15% Discount Rate Costs	Present Value at 15% Discount Rate Benefits	Net Nominal Benefits	Net Present Value at 82.3% Rate of Discount
1	675	-	563	-	587		- 675	-370
2	703	-	488	-	532		- 703	-212
3	1211	-	701	-	796		-1211	-200
4	914	4640	441	13183*	523	19399*	3726	337
5	609	4640	245		303		4031	200
6	609	4640	204		263		4031	110
7	609	.	170		229		4031	60
8	609	.	142		199		4031	33
9	501	.	97		142		4139	19
10	501	.	81		124		4139	10
11	501	.	67		108		4139	6
12	501	.	56		94		4139	3
13	1001	.	94		163		3639	1
14	501	.	189*		389*		4139	2*
15	501	.					4139	
.	.	.					.	
.	.	.					.	
22	501	.					4139	
23	1001	.	15		40		3639	
24	501	.	6		18		4139	
25	501	4640	5		15		4139	
TOTAL			3564	13183	4525	19399		0.01

Cost/Benefit Ratio: at 20% Discount: 3.70
at 15% Discount: 4.29

Net Present Value: at 20% Discount: 9,619
at 15% Discount: 14,874

Internal Rate of Return (IRR): 82.3%

*PV of constant stream of costs and benefits beginning and ending in years indicated.

1/ See Table 8.

2/ See Table 5 , fn. 2.

USAID/P, OD/PE, 4/6/82

Table 8. Economic Cost of Charcoal Production (500-ha.)
(₱1000, 1981 Prices)

Year	Tree Farm Development 1/			Annual Operations and Maintenance			Nominal Cost	Total Economic Costs 2/		
Year	Unskilled Labor	Other	Total	Unskilled Labor	Other 4/	Total	Total	Unskilled Labor	Other	Total
1	339	336	675				675	170	336	506
2	400	303	703				703	200	303	503
3	552	659	1211				1211	276	659	935
4	225	101	326	480	108	588	914	353	209	562
5				501	108	609	609	251	108	359
6				501	108	609	609	251	108	359
7				.	108	609	609	251	108	359
8				.	108	609	609	251	108	359
9				.	-	501	501	251	-	251
10				.	-	501	.	251	-	251
11				.	-	501	.	251	-	251
12				501	-	501	501	251	-	251
13				651 3/	350 3/	1001	1001	326	350	676
14				501	-	501	501	251	-	251
15				501	-	501	501	251	-	251
.				.	-	.	.	.	-	.
.				.	-	.	.	.	-	.
22				501	-	501	501	251	-	251
23				651 3/	350 3/	1001	1001	326	350	676
24				501	-	501	501	251	-	251
25				501	-	501	501	251	-	251
TOTAL	1516	1399	2915							

1/ Includes construction of kilns in year 3.
2/ Unskilled labor is shadow priced at -50%.
3/ Kiln reconstruction every 10 years.
4/ Includes FSDC technical supervision for first 5 years of operation.

USAID/P, OD/PE, 4/6/82

FINANCIAL TABLES

Table 1
Charcoal Program
Breakdown of Total Project Costs
At 25 MT/ha/yr Growth
(000)

PROJECT COSTS	500 Hectare Tree Farm YEAR 1	2	3	TOTAL	100 Hectare Module
A. Tree Farm Development	555	610	669	1834	367
1. Land Clearing	75	75	75	225	45
2. Planting	62	63	63	188	38
3. Maintenance and Care	169	226	285	680	136
4. Silvicultural Inputs	173	175	175	523	105
5. Tools/Equipment	10	-	-	10	2
6. Roads	49	54	54	157	31
7. Contingencies	17	17	17	51	10
B. Charcoal Development (Kilns)			500 1/	500	100
C. Program Management	120	93	99	312	62
Sub-Total	675	703	1268	2646	529
D. Cost Escalation 2/	67	148	420	635	127
Total Development Cost in Pesos	742	851	1688	3281	656
Equivalent in Dollars				410	82

1/ Amount is $800 if target yield is 40 MT/ha/yr.

2/ Assumes 10% compounded increase per year.

Table 2
Charcoal Program
Projected Resource Flow
CPA: 500 Hectare Tree Farm - 25 MT/ha/yr Yield
(₱000)

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Year 13	Years 14-22	Year 23	Years 24-25
I. Inflows									
A. Loan Funds									
1. Cash	426	457	1022						
2. Farm Supplies	249	246	246						
B. Charcoal Sales				3600	3600	3600	3600	3600	3600
Total Inflows	675	703	1268	3600	3600	3600	3600	3600	3600
II. Outflows									
A. Tree Farm Development Cost									
1. Silvicultural Inputs	173	175	175						
2. Tools and Equipment	10								
3. Roads	49	54	54						
4. Contingencies	17	17	17						
Sub-Total	249	246	246						
B. Program Management Costs	120	93	99	99					
C. Charcoal Development Costs	-	-	500	-	-	500	-	500	-
D. Operating Expenses									
1. Tree Farm Maintenance				102	123	123	123	123	123
2. Harvesting and Transportation				164	164	164	164	164	164
3. Charcoal Processing				214	214	214	214	214	214
4. FSDC Supervision Fee				108	108	-	-	-	-
E. Amortization on Loans					678				
Total Outflows	369	339	845	687	1287	1001	501	1001	501
Net Cash to CPA	306	364	423	2913	2313	2599	3099	2599	3099
Net Cash per Member									
75 Members	4	5	6	39	31	35	41	35	41
100 Members	3	3.6	4	29	23	26	31	26	31

Note: Cost escalations not included.

Table 3
Charcoal Program
500 Hectare Tree Farm
Amortization Schedule
Loan for Target Growth of 25 MT/ha/yr.
(₱000)

Amount of Loan	2646
Capitalized Interest	721
Principal	3367[1/]
Interest Rate	12%
Maturity Period	12 years
Grace Period	4 years
CRF	.201303

YEAR	AMORTIZATION	INTEREST	PRINCIPAL	BALANCE
1	678[1/]	404	274	3093
2	678	371	307	2786
3	678	334	344	2442
4	678	293	385	2057
5	678	247	431	1626
6	678	195	483	1143
7	678	137	541	602
8	678	76	602	-

[1/] If target yield is 40 MT/ha/yr, there will be additional charcoal development costs which shall increase the principal to 3,721 and annual amortization to 749.

Table 4
Charcoal Program
Projected Income Statement
CPA 500 Hectare Tree Farm - 25 MT/ha/yr Yield
(₱000)

	Years 1-3	Year 4	Years 5-12	Year 13	Years 14-22	Year 23	Years 24-25
Revenues:							
Sales		3600	3600	3600	3600	3600	3600
Expenses:							
Development Expenses[1/]		84	84	84	84	84	84
Interest Expense		-	257	-	-	-	-
Labor - Tree Farm Maintenance		102	123	123	123	123	123
Labor - Harvesting and Transp.		164	164	164	164	164	164
Labor - Charcoal Processing		214	214	214	214	214	214
FSDC Supervision Fee		108	108	-	-	-	-
Program Management Costs		99	-	-	-	-	-
Charcoal Development Costs		-	-	500	-	-	-
Sub-Total		771	950	1085	585	1085	585
Net Income in Pesos		2829	2650	2515	3015	2515	3015
Equivalent in Dollars		354	331	314	377	314	377

[1/] Development costs in years 1-3 were capitalized and amortized over 40 year life of tree farm.

Note: Cost escalations not included.

Table 5
Charcoal Program
Projected Resource Flow
CPA: 500 Hectare Tree Farm - 40 MT/ha/yr Yield
(₱000)

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Year 13	Years 14-22	Year 23	Years 24-25
I. Inflows									
A. Loan Funds									
1. Cash	426	457	1022						
2. Farm Supplies	249	245	246						
B. Charcoal Sales				5760	5760	5760	5760	5760	5760
Total Inflows	675	703	1268	5760	5760	5760	5760	5760	5760
II. Outflows									
A. Tree Farm Development Cost									
1. Silvicultural Inputs	173	175	175						
2. Tools and Equipment	10								
3. Roads	49	54	54						
4. Contingencies	17	17	17						
Sub-Total	249	246	246						
B. Program Management Costs	120	93	99	99	-	-	-	-	-
C. Charcoal Development Costs	-	-	500	-	-	800	-	800	-
D. Operating Expenses									
1. Tree Farm Maintenance				102	123	123	123	123	123
2. Harvesting and Transportation				262	262	262	262	262	262
3. Charcoal Processing				285	285	285	285	285	285
4. FSDC Supervision Fee				172	172	-	-	-	-
E. Amortization on Loans				-	749	-	-	-	-
Total Outflows	369	339	845	920	1591	1470	670	1470	670
Net Cash to CPA	306	364	423	4840	4169	4290	5090	4290	5090
Net Cash per Member									
75 Members	4	5	6	65	56	57	68	57	68
50 Members	3	3.6	4	48	42	43	51	43	51

Note: Cost escalations not included.

Table 6
Charcoal Program
Projected Income Statement
CPA: 500 Hectare Tree Farm - 40 MT/ha/yr Yield
(₱000)

	Years 1-3	Year 4	Years 5-12	Year 13	Years 14-22	Year 23	Years 24-25
Revenues:							
Sales		5760	5760	5760	5760	5760	5760
Expenses:							
Development Expenses[1/]		93	93	93	93	93	93
Interest Expense		-	284	-	-	-	-
Labor - Tree Farm Maintenance		102	123	123	123	123	123
Labor - Harvesting and Transportation		262	262	262	262	262	262
Labor - Charcoal Processing		285	285	285	285	285	285
FSDC Supervision Fee		172	172	-	-	-	-
Program Management Costs		99	-	-	-	-	-
Charcoal Development Costs		-	-	800	-	800	-
Total Expenses		1013	1219	1563	763	1563	763
Net Income in Pesos		4747	4541	4197	4997	4197	4997
Equivalent in Dollars		593	568	525	625	525	625

Note: Cost escalations not included.

[1/] Development costs in years 1-3 were capitalized and amortized over 40 year life of tree farm.

Table 7
Charcoal Sub-Project
Summarized Total Costs
(000)

	GOP	ESF	TOTAL
Tree Farm development costs (₱1834 ÷ 5 = ₱366.8/100 hectare tree farm x 212 modules)	-	77,762	77,762
Kilns (₱500 ÷ 5 = ₱100/100 hectare tree farm x 212)	-	21,200	21,200
Program management and cost escalation (₱947 ÷ 5 = 189.4/100 hectare tree farm x 212)	40,153	-	40,153
Total peso costs	40,153	98,962	139,115
Dollar equivalent	5,019	12,370	17,389

Note: All costs in local currency.

LOAN PLAN

A. General Description

Under the program, the Farm Systems Development Corporation provides a charcoal development loan to the Charcoal Producers' Association (CPA). The association in turn relends the loan to the members.

The loan consists of three credit packages, one for developing the energy farms and the second, for constructing the charcoal kilns. The loan finances 100% of the total project cost.

1. Farm development loan

The farm development loan includes the cost of labor for land preparation, planting, maintenance, harvesting and materials and tools.

The loan bears an interest rate of 12% per annum upon release with a maturity period of 12 years, has a four-year grace period and is due and payable on the fifth year of the project and every year thereafter until paid in full.

Loan disbursement covers a period of three years, which is equivalent to the growth cycle of the trees planted.

2. Charcoal development loan

The charcoal development loan includes the cost of constructing the kilns established on the tree farm and labor costs to operate the first year. The construction of the kilns are undertaken by CPA members with technical assistance from FSDC.

The loan bears an interest rate of 12% per annum upon release to the association. The release starts on the second year of farm development, when the kilns are constructed, up to the third year when the first charcoal is produced.

The loan has a two-year grace period with a maturity of seven years. Repayment covers a period of five years, starting on the fifth year of farm development.

For both loans, an extension period on the payment of the principal and interest may be granted by FSDC in cases in which the CPA fails to make payments because of force majeure.

3. Program management loan

The program management loan is a one-time loan to cover the cost of FSDC personnel services and operating expenses during project development. The loan bears a 2% interest rate, is payable in Year 5 and has no grace period.

B. Loan Releases Scheme

The Charcoal Producers Association (CPA) after evaluating project feasibility studies undertaken by the FSDC area office and the KAISA applies for the loan package. The loan application is accompanied by the following documents:

1. certificate of registration of the CPA with FSDC;

2. articles of incorporation and by-laws;

3. resolution to apply for the charcoal development loan; and

4. resolution authorizing the association's president to execute loan proceedings and sign documents for and in behalf of the association.

The loan application and accompanying documents are submitted by the association to FSDC for review, approval, and ultimately, processing and release.

Upon FSDC's release of the loan, the CPA has sole responsibility of disbursing the amount.

The president of the association acknowledges receipt of the loan and deposits the funds in an accredited local or national bank account opened for the purpose. The president's co-signatory is the secretary-treasurer.

With the assistance of the FSDC Tree Project Supervisor, the association determines its financial needs per major activity based on the production calendar prepared. This calendar is an integral product of the feasibility studies. It shows the duration and schedule of each activity including the manpower and materials requirements for the development of the energy tree farm and the kilns.

Supported by the detailed work program and financial requirements, the request for funds is presented to the general assembly for approval. When approval is secured the president, with the secretary-treasurer, seeks an assembly resolution to withdraw the specified amount of funds. The disbursement of funds is on a staggered basis as prescribed by the production calendar.

Cash disbursement vouchers are prepared by the secretary-treasurer, and duly authorized and approved by the president. Withdrawal slips are presented for confirmation to the general assembly at its next meeting.

For better financial control, the associations are required to maintain books and records for easy reference in auditing. Monthly account summaries which include operating statements, a balance sheet, and a cash flow statement are discussed during general assembly meetings.

The associations are not left untrained to deal with complex situations like this. The members are progressively trained to acquire a working knowledge of and skills to cope with the requirements of sound financial

systems. The basics of pre- and post- audit procedures are introduced, as are the simple mechanics of budgeting and accounting.

C. Collection Scheme

An amortization schedule is prepared by the association in accordance with plans and specifications made by FSDC. Payment of the amortization due is done quarterly by the association president to FSDC starting on the fifth year of project implementation. All payments are made in cash and are certified by the association's general assembly.

Funds are made available for loan repayments as follows: upon sale of the charcoal, the association automatically deducts from the receipts the amount due for loan repayment before distributing sales shares to each member.

The duty to process loan repayments falls on the secretary-treasurer of the association. Built-in measures to safeguard all funds are established. Official receipts are issued for shares distributed and corresponding entries into account books are made. An auditor periodically audits these books as a further safeguard.

ENVIRONMENTAL ASSESSMENT OF CHARCOAL PRODUCTION

INTRODUCTION

This program supports the nationwide development of tree farms for charcoal production. On an average, the tree farms will be 400-500 hectares planted with fast rotation tree species. The tree farms are split into 100-ha. modules, employing 15 farm families each. Loans are extended to the families to develop the land, i.e., seed, equipment and supplies. The modules are planted on a three-year rotation basis, one-third each year; the first harvest being in the third year with a harvest in each subsequent year. The harvested wood will be used to produce charcoal in beehive kilns. Intercropping will also be performed on the modules.

Harvesting

Harvesting will be accomplished manually using bolos, and bow saws. Because species with coppicing capabilities are being planted, the stumps will remain on site. The trees will be cut in one meter section and delivered to kiln batteries at convenient places around the tree farm: convenient to farmer and for transport, i.e., near roads.

Wood Production

The trees are expected to grow at a rate of 25 metric tons (MT) of green wood per year. The yield at the end of three years will be 75 MT/ha. Each 100-ha. module will be harvested on a four-year cycle, one third of the module per harvest. Therefore, the yield from each 33.3 ha section will be 2,500 MT/yr.

Transportation

Two modes of transportation are proposed for hauling the wood to the area where the charcoal is to be manufactured. The first one will involve the use of sleds pulled by carabao; while the second one will be based upon motor vehicles.

System Description

The production of charcoal has been practiced for centuries throughout the world. For instance, it is known that wood distillation was practiced in ancient Egypt not only to produce charcoal, but also to recover tar and pyroligneous acid. Pyroligneous acid was used in embalming.

Charcoal provided the only source of carbon for steel manufacturing and other metal smelting in the U.S. until the early 19th century. At that time, the production of chemicals such as acetic acid, methanol, and acetone in conjunction with charcoal manufacture was widely practiced. However, the introduction of coke and of synthetic methanol and acetic acid in later years resulted in a gradual reduction of the demand for charcoal.

1. Charcoal Production

Charcoal is produced by partial combustion of wood under starved air conditions at a temperature of about 400°C. The main objective of the process is to "drive off" (i.e., volatilize) certain constituents from the wood, and thereby convert it to another form of carbon.

Retort

In this program, it is proposed to manufacture charcoal, using brick beehive kilns. One size of the kiln will be used initially, namely, a kiln rated at 7.2 MT per cycle. A schematic diagram of a 7.2 MT module is presented in Figure 1. The retort has two large openings, one for loading and one for unloading. Both openings are, of course, sealed with bricks during operation. In addition, the retort has two chimneys and an opening on top for ignition.

On the basis of an expected yield of 7,500 MT of wood for each module, it is estimated that approximately 5 retorts having a rated capacity of 7.2 MT of charcoal per cycle will be required. The units will be built in strategic locations throughout the tree farm.

Mass Balance

Inputs to a typical kiln are fuel and combustion air. Outputs are charcoal and off-gases.

The attainable conversion efficiency in the use of a beehive kiln is about 28.5%. Therefore, the yield of charcoal per ton of wood should be about 185 kg. A complete coaling cycle will take an average of 12 days.

A mass balance for a beehive kiln is presented in Figure 2.

The moisture content of the wood will, of course, affect the coaling pattern. Wood that has a moisture content above 45% will involve the longest coaling cycle.

Charcoal Quality

The characteristics listed in Table 1 provide an index for general market acceptability of the finished product. For example, if the charcoal has a volatile matter greater than 24%, excessive amounts of smoke will be generated when it is used.

The chemical composition of charcoal is not greatly influenced by the species of the wood from which it was produced. However, density and structure of the wood does influence the physical properties of the resulting charcoal. In general, the use of medium-dense to dense hardwoods results in a high-quality charcoal that is not readily broken and can be handled with a minimum of dust generation.

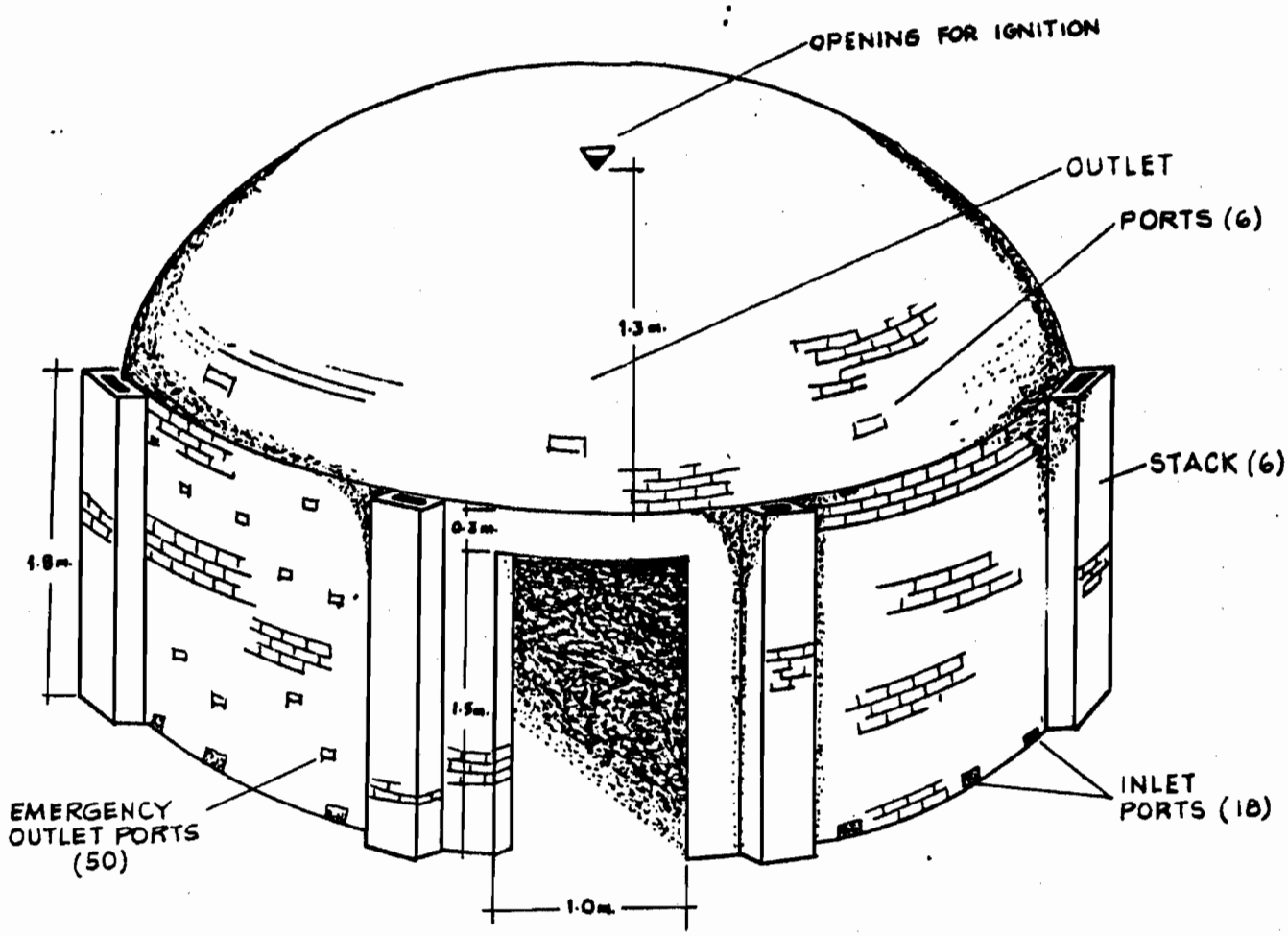
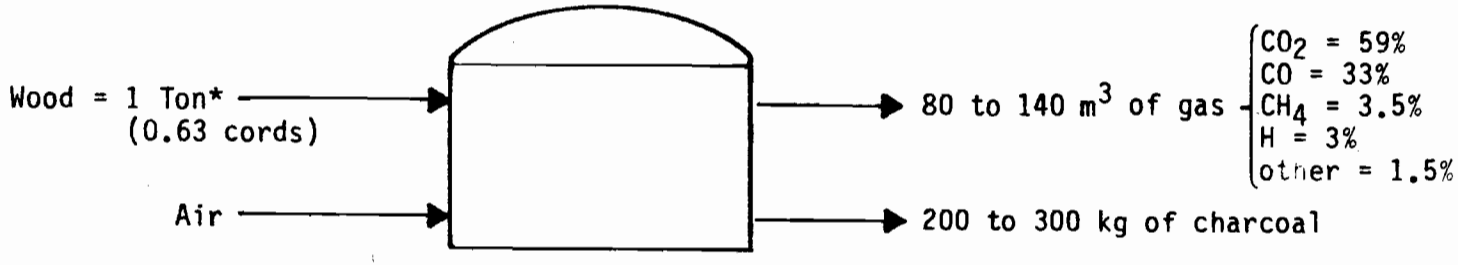


Figure 1
BEEHIVE KILN



*1 cord ≈ 1590 kg (average)

Figure 2. Mass Balance for Charcoal Production.

Table 1

General Characteristics of Charcoal

Parameter	Concentration (percent)
Moisture Content	2 to 4
Volatile Matter	18 to 23
Fixed Carbon	74 to 81
Ash	1 to 4

Emissions

Emissions from charcoal manufacturing installations include gaseous and solid (particulate) products. A discussion of each of the emissions follows:

Air

Because they depend upon the type and characteristics of the wood as well as upon the operating conditions of the kiln (e.g., temperature, air flow), the quantity and composition of the gaseous emissions can fluctuate considerably. Volumes of 80 to 140 cu. m. of gas per ton of wood have been reported.

The gas is composed primarily of CO_2, CO and CH_4.

Because of the nature of the fuel as well as of the design and operating conditions of the retort, concentrations of NO_x and SO_x are expected to be very low.

Specific data on particulate matter in the off-gases are not readily available. However, the concentration of particulates in the gases will fluctuate. During the initial stages of combustion, the concentrations will be relatively high, and a visible plume will be the result. As the coaling process continues, the concentration eventually decreases until it reaches a negligible level.

Solid Waste

The production of charcoal generates certain amounts of "fines" or "dust" which will be formed into briquettes and used by CPA members and sold.

POTENTIAL ENVIRONMENTAL IMPACTS

A discussion on specific potential environmental impacts that may result from the implementation of this program follows:

In the discussion and analysis, it is assumed that the energy plantations and charcoal manufacturing projects will be developed on marginal, government-owned lands that currently are denuded.

Earth Resources

Inasmuch as the projects will be located on denuded lands, the tree farms will have a beneficial effect on earth resources. Furthermore, reforestation will result in a substantial reduction of siltation of waterways and soil erosion.

Construction of the kilns will not require excavation or major soil displacement that could lead to the development of hazardous conditions.

Air Quality

There are two potential sources of air pollutants in this project: (1) the kilns, and (2) motor vehicles used in transporting the finished product.

The production of charcoal can generate relatively large quantities of gases. In sufficiently high concentrations, the gases can be toxic and explosive. Carbon monoxide, methane, and hydrogen are the components of main concern in the gaseous stream.

Carbon monoxide (CO) is formed when insufficient oxygen is present during combustion. (This is the condition that must be maintained in the production of charcoal). The major pathological effect of CO is its interference with oxygen transport by the red blood cells and the dissociation of oxyhemoglobin.

Methane and hydrogen, although non-toxic, are explosive at certain concentrations.

CO is disippated to non-toxic levels when mixed with sufficient quantities of clean air. It is further absorbed by the leaves of growing plants. Therefore the existence of nearby tree plantations, plus proper design, adequate ventilation and locating kilns away from housing areas will minimize the possibility of adverse environmental impacts.

Water Quality

The production of charcoal in beehive kilns does not involve the use of substantial amounts of water. Therefore, the process should not have a significant impact on the aqueous environment.

Solid Waste

Initial estimates indicate that the average tree farm (approx. 500 ha) will be capable of generating about 3,600 tons of charcoal per year. The processing and handling involved can lead to the generation of a certain amount of fines. Depending upon the quality of the wood, the fines can amount to approximately 5% of the total weight, or about 175 tons per year. This material does not necessarily have to be considered a waste and hence require disposal.

Biological Resources

The production of charcoal as proposed in this program may cause certain impacts on the biological resources near each of the project sites.

Air emissions combined with increased human and vehicular activity may adversely affect the wildlife and vegetation. However, this is unlikely, since the projects will be carried out on denuded lands. On the contrary, the net effect will be a beneficial one.

Noise

Noise is expected to be generated during manual harvesting and collection of the wood. The transport of the finished product and also result in some noise generation.

The transportation of the charcoal to the market place or points for distribution will require the use of trucks. However, it is expected that one trip per day should be sufficient for the collection of the daily output. Therefore, any impact on the surrounding area would be minimal.

Land Use/Socio-economics

Land use patterns and/or zoning regulations are not expected to be affected by this project. Plantations and the charcoal manufacturing installations will be sited on marginal lands.

The implementation of this project will provide employment and a source of income to approximately 50 families per average tree farm. In addition, another 25 families will be employed in charcoal production. Additional revenues will be generated from intercropping (i.e., vegetables). Consequently, the projects will have a very beneficial impact on the socio-economic development of the area.

Natural Resources

The production of charcoal through the use of energy tree farms certainly will have a positive effect on the natural resources in the vicinity of the projects, as well as on those of the country as a whole.

Each 500-ha tree farm is expected to produce approximately 3,600 tons of charcoal per year. This is equivalent to about 93×10^9 Btu or approximately 15,500 barrels of oil annually.

Health and Safety

The health and safety hazards are due mainly to the occupational components of the projects. The hazards can be related to fires, explosions, and toxic gases.

Proper precautions must be taken when storing charcoal. Even though the material is stable when properly cooled, charcoal can be very hazardous when stored otherwise. In addition, charcoal can be ignited through other sources of fire.

A common cause of fire is the storing of "hot" charcoal. This type of charcoal consists of hot or in some cases actively burning pieces. Spontaneous combustion can also be a source of fires, particularly when large quantities of tightly packed masses of charcoal fines are present.

If the fines are not discarded, they should be "conditioned" for about five days and stored separately from "lump" charcoal.

Relatively large amounts of heat are given off during the conversion of wood to charcoal. In particular, high temperatures and large quantities of gas can be generated when dry wood is processed. Such conditions can increase the possibilities for explosions.

Care must be taken during ignition. Fuels that have a low flash point, such as gasoline, should never be used when ignition is carried out by means of the "closed door" method.

Explosions may also be caused by the ignition of mixtures of hydrogen or methane and air.

MITIGATION MEASURES

Impacts on the air quality of the area in the vicinity of the kilns can be reduced considerably by using proper siting criteria, and by designing for maximum ventilation. The feasibility of collecting and using the by-products to recover chemicals such as acetone, methyl alcohol, turpentine, etc., should be investigated.

Impacts on the water quality of the area will be negligible.

The solid waste (fines) generated in the process can be densified or briquetted.

The use of proper siting criteria and sound engineering principles can mitigate any potential adverse effects on land use, as well as biological resources. Kilns, for instance should not be located in the vicinity of houses.

Certain precautionary measures should be taken in charcoal manufacture. In order to prevent kiln fires and explosions, the moisture content of the wood should be maintained between 30 and 40%. This can be accomplished by preventing direct exposure to sunlight. Freshly discharged charcoal should be stored in the open and away from conditioned charcoal for at least 24 hours. The charcoal should be properly ventilated and protected from the rain. It is suggested that the charcoal be screened for removal of fines prior to storage. Dust masks should be worn while handling charcoal in confined areas. Cracks in the kiln should be promptly repaired, since the intrusion of air will prevent proper cooling from taking place.

In addition, the kiln should be thoroughly ventilated before anyone is allowed to enter it. This procedure should be practiced in order to prevent inhalation of relatively high concentrations of poisonous gases that may be present in the kiln.

2. Tree Farm

The tree farms in the Charcoal Production Program will be developed nationwide on denuded uplands which are either fallow grasslands or under slash-and-burn cultivation. Because of the nationwide distribution of the program, a single environmental assessment is presented which covers the program's activities and impacts in general. Nonethe-

less, the examination is based on extensive Philippine experience in assessing the environmental effects of uplands development projects per se, and particularly with reforestation whether for timber or pulp purposes, watershed management or energy tree farms.

Table 1 shows the influence on the environment resulting from tree farm development activities in this program. The time frame of these influences, their onset and duration, are also shown. These influences are individually assessed as favorable or adverse in varying degrees of importance as perceived by the team. Finally, measures which can mitigate or correct adverse influences are suggested.

On the whole, the change from the present vegetation and land use to energy tree farm development using ipil-ipil and other fast-growing species, will have a predominantly positive impact on the environment. Whatever negative influences result from this change are outweighed by the significant positive influences and can be easily corrected.

The highly adverse impacts indicated in Table 1 are expected to be of short-term duration. One, which is the increase in soil erosion because of soil disturbance during site preparation, cultivation, and road construction, is common to all plantation development projects. This adverse impact takes effect during the immediately following rainy season, but only for the first season as vegetation development and soil stabilization quickly follow. Another, the influx of pests like rats because of the concentration of available food provided by the new plants, is also common among reforestation species. This is critical mainly during the early stages of the first growing season, and can be mitigated by proper cultural practices.

It is also believed by some that the heavy rainfall, the allellopathic effect of ipil-ipil on the underbrush, and the rapid decomposition of ipil-ipil litter would tend to induce sheet erosion in the long term. However, this is counteracted by effective rainfall interception by the canopy and increased infiltration resulting from the interweaving root system of the plants. The negative and positive effects would therefore tend to balance each other and the total effect would be of minor consequence compared to soil erosion in degraded grasslands.

Another consideration is continual biomass harvest. The harvesting process in itself will have only minor influence, especially if done during the dry season, since the nature of the product would require only the use of manual, animal-powered, or cable transport methods. Moreover, the duration of its impact is quite short as ipil-ipil stumps coppice well and quickly. The rotation of four years should not cause much drain in soil nutrients since the plant produces organic matter especially nitrogen.

Other adverse impacts are of relatively less significance. Many of these, such as loss of genetic diversity, increased susceptibility to diseases, and short-term increase in siltation of creeks, are again common to tree farm development activities.

The highly favorable impacts of tree farm development on the bio-physical

environment, on the other hand, are of long-term duration. One is improved microclimatic conditions such as stabilized soil temperature and moisture due to the higher and close ipil-ipil canopy structure. Another is the increase in primary biomass especially wood resulting from the reforestation of degraded areas with fast-growing trees.

Other highly favorable impacts include the vegetational change from Imperata-Themeda or Chromolaena-dominated grasslands to tree farms with consequent change of vegetational structure to that of close-canopy, open understory type; increased soil fertility; stabilization of water flow with improved infiltration, drainage, and aquifer recharge; and decreased run-off because of the more effective rainfall interception provided by the canopy.

The net result in the interplay of the long-term favorable impacts and the predominantly short-term adverse impacts would be the considerable improvement of the bio-physical environment from a grassland or savannah type to a forest type. These conclusions hold for the Charcoal Program's tree farm sites nationwide, and, in fact, in other similar sites in the country as well which can support ipil-ipil or other forest species. Whether the resulting forest plantation is used for charcoal production, wood-fired power generation or simply fuelwood production, its beneficial effects are the same.

Table 2
Environmental Impacts of Tree Farms for Charcoal Production

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
A. Physical Environment						
1. Run-off	a) Overall reduction of run-off due to interception of rainfall, impedance of surface, and increased infiltration	Presence of ipil-ipil canopy cover, organic matter and deeper root system	M*	L*	HF*	Positive impact
2. Erosion	a) Net reduction of soil erosion from less run-off and raindrop impact	Presence of ipil-ipil canopy cover, organic litter, and interweaving root system	M	L	F	Positive impact. Any activities that may cause soil disturbance should be conducted during the dry season whenever possible.
3. Soil Fertility	a) Increased soil fertility	N-fixing capability of ipil-ipil and increased organic matter	M	L	HF	Positive impact
4. Water Quality	a) Increased siltation of creeks and rivers due to increased erosion during certain periods of time.	Soil disturbance as a result of clearing, planting and construction of infrastructure	I	L	A	Conduct activities which may cause soil disturbance during the dry season

*Symbols

Onset
I = Immediate
M = Medium term (about 4-5 years)
L = Long term (5 and above)

Duration
S = Short term
M = Medium term
L = Long term

Relative Weight
HF = Highly favorable impact
F = Favorable impact
A = Adverse impact
HA = Highly adverse impact

Environmental Impacts of Tree Farms for Charcoal Production

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
	b) Stabilization of flow with improved infiltration, drainage and aquifer recharge	Improved canopy cover, organic litter/matter on soil and deeper inter-weaving root system	M	L	HF	Positive impact
	c) Generation of wood wastes	Harvesting will generate wastes which may reach water systems	L	L	A	Develop program for use of wood waste as kindling or composting
5. Microclimate	Improved and stabilized soil temperature and moisture, humidity and wind movement	Higher and close canopy structure of ipil-ipil and the windbreak effect of its rigid stems	M	L	HF	Positive impact
6. Air quality	Net improvement of the air quality of the area due to increased oxygen and reduction of dust	Concentrated tree growth	I	L	HF	Positive impact
B. Biological Environment						
1. Primary Productivity	a) Loss of some savannah and secondary forest trees within the plantation area	Site preparation, clearing for road, transport systems and kiln batteries	I	L	A	Extension campaigns to emphasize importance of remaining trees; careful planning so that construction activities will veer away from forested areas
	b) Increased primary biomass especially wood	Reforestation of formerly denuded areas with fast growing ipil-ipil and other trees	M	L	HF	Positive impact

Environmental Impacts of Tree Farms for Charcoal Production

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
2. Succession	a) Vegetational change from *Imperata* - *Themeda* or *Chromolaena* dominated grasslands to pure plantations of ipil-ipil with consequent change of vegetation structure to close canopy, open understory type	Dominance by faster and taller growing ipil-ipil through shading, general improvement of soil structure and fertility and protection from fire	M	L	HF	Positive impact
	b) Change in animal population from predominantly grassland/savannah types to forest type	Transformation of their habitat	L	L	F	Positive impact
3. Genetic Resources	Loss of genetic diversity and also probably the flexibility to adapt to environmental changes	Simplification of vegetative cover to a dominant species which is ipil-ipil	M	L	A	Intercrop other species with ipil-ipil and plant belts of mixed species
4. Pest Occurrence	a) Increase of insect pests especially that of *Araecerus fasciculatus* which usually attacks giant ipil-ipil pods	Monoculture/concentration of the insect pest's food source	M	L	A	Monitor pest occurrence and perform necessary pest management strategy

Environmental Impacts of Tree Farms for Charcoal Production

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
	b) Potential influx of vertebrate pests like rats (i.e. Rattus mindanensis, Rattus exulans querati)	Young shoots of ipil-ipil are food for these rats	I	M	A	Clear area where young ipil-ipil are planted and growing
5. Aquatic Resources	Possible degradation of aquatic resources (i.e. fish) due to siltation.	Planting and construction activities, wood harvesting increased local demand for planting and domestic needs (See 4a, 4c & 4d)	I,M	L	A	Strict implementation of erosion control measure

Republic of the Philippines
Ministry of Human Settlements
PAMBANSANG KOMISYON SA PAGSUGPO SA POLUSYON
(National Pollution Control Commission)
772 Pedro Gil St., cor. Taft Avenue
Ermita, Manila

Attachment 1

APPLICATION FOR PERMIT TO OPERATE (P/O)
for Air Pollution Sources and Control Facilities
(IMPORTANT: Read carefully the INSTRUCTIONS at the back hereof before accomplishing this form)

TYPE: ☐ New ☐ Renewal ☐ Change of Ownership

1. Name and Position of Applicant:
2. Name of Firm/Establishment:
3. Office Address: Tel. No.:
4. Plant Address: Tel. No.:
5. Capitalization: Authorized: ₱ Paid-up: ₱
6. Name of Pollution Control Officer*: Tel. No.:
7. General Nature of Business:
8. List of Air Pollution Source Equipment (APSE) and/or Air Pollution Control Facility(ies) (APCF)
(Use additional sheet if necessary)

Description of APSE/APCF (e.g. furnace with baghouse, boiler with multicyclone, etc.)	Date Installed APSE	Date Installed APCF
a.		
b.		
c.		
d.		

9. Total Cost of all APCF (including construction/installation) covered in this application: ₱
10. Maintenance and Operating Costs of APCF in Item 9:
   (a) Power: ₱ (c) Replacement Parts: ₱
   (b) Labor: ₱ (d) Others (specify) : ₱
11. Have you submitted all the required "SUPPORTING DOCUMENTS" indicated at the back?
   ☐ yes ☐ partially ☐ no

If YES, submit only this accomplished application form and indicate in the transmittal letter that no modifications were made in the previously submitted documents.

If PARTIALLY or NO, submit lacking or all documents, respectively. Indicate the partially submitted documents in the transmittal letter. (Please refer to Item 2 in INSTRUCTIONS at the back.)

Certified correct:

Applicant's Signature

	O.R. No.	Date
Filing Fee: ₱50.00		
Permit Fee: ₱		

*Please refer to Item 1 of "SUPPORTING DOCUMENTS" at the back hereof.

INSTRUCTIONS FOR FILING P/O APPLICATION

1. This form shall be fully accomplished and the required documents shall be complete; otherwise application will be returned.

2. Application and required documents shall be submitted in duplicate copies for firms located in Luzon and triplicate copies for firms located in Visayas and Mindanao, and shall be accompanied by a letter of transmittal addressed to the NPCC Commissioner.

SUPPORTING DOCUMENTS

1. Copy of the appointment/designation of the Pollution Control Officer (PCO) of the plant together with his biodata. Appointment of a full-time PCO is mandatory for industrial establishments with capitalization of one million pesos and above, while those with less than one million capitalization may designate a PCO on a part-time basis. (NPCC Memorandum Circular No. 02, series of 1981; implementing guidelines of LOI No. 588 dated 19 August 1977.)

2. Break-down of the cost (including construction/installation) of each APCF covered in this application.

3. Engineer's Report: To be prepared by PCO, professional mechanical engineer (PME) or chemical engineer (CHE) depending on the nature of APSE/APCF.

   a) Flowsheet and description of the manufacturing process including a list of the raw material(s) and finished product(s) with their corresponding amount/price used/produced.

   b) List of the APSE with their corresponding APCF (if provided) and description of their operation. If APSE is not provided with APCF, include justification for the non-installation of APCF, indicating the type and quantities of air pollution generated by the APSE.

4. Plan and elevation drawings with complete specifications of the APSE/APCF (50cm x 90cm)signed and sealed by a PME or CHE or both depending on the nature of the APSE/APCF. The plans shall clearly show the connection of the APCF to the APSE (if applicable).

5. Vicinity Map of plant; Plant and Machinery Layout showing connection of APSE and APCF (if applicable).

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