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# ENERGY STRATEGIES FOR SUBSISTENCE AGRICULTURE:

# GUATEMALA: A CASE STUDY

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## CONTENT

# ENERGY STRATEGIES FOR A SUBSISTENCE AGRICULTURE: GUATEMALA: A CASE STUDY

## I. General, Geographic and Economic Description.

Geography.

The Republic of Guatemala is the northernmost country of Central America; it lies among El Salvador, Honduras and Mexico.

It covers 106,360 square kilometrs being, by extension, the third in Central America.

There is a great variety of climates, in Guatemala due to the different altitudes of the two branches of the Andes Mountain Range, the Sierra Madre and Los Cuchumatanes.

The following climatic zones can be distinguished:
Hot zone: between 0 and 600 meters OSL, annual average temperature 23° to 26°C. Temperature zone: 600 to 1,800 meters OSL: there are two sub-zones: 1o. Low land between 600 and 1,200 meters OSL; with temperatures between 20° and 23°C; 2o. High land between 1,200 and 1,800 meters OSL; with temperatures between 17°and 20°C. Cold zone: more than 1,800 mts. OSL and temperatures lower to 17°C. Generally speking the lowest temperatures are registred in January due to the northern winds of the dry season. The highest temperatures are registred before the rainy season that starts in May, specially in the low lands. The dry season stretches from November to April and the rainy season from May to November.

Guatemala's Ecological Regiones.

Tropical Strip: it covers 62,000 Kms, that is 56.88% of the country's total territory, it has an annual average temperature of more than 24°C. It rises 300 mts. OSL on the Pacific Coast and 500 mts OSL on the Atlantic Coast. The Petén is included in this strip representing a great wealth in forests; within this strip are to be found very dry forests or dry tropical forests. A great amount of timber has been cut in the latter type of forest and agro-exports have been developed.

Apart from these, the humid forest of Izabal an the one in Petén have a great economic potential.

Sub-tropical strip: It covers a fourth of the country, where some parts are dry and others rainy; it stretches from the low tropical lands to 1,500 mts on the South Coast and a smaller altitude on the northern slope.

Few forests have remained in the subtropical savanna. The Association for Pine Forests can be seen along this strip, on impoverished soils and woods of wide leaves; along the rivers, and in the lowest and most humid parts. The pine woods' density is visible in the zone where the "burning" ("quema") system has not been used. Generally the soils are quite impoverished, due to the intense agricultural work of the past.

The extrahumid subtropical forest produces mos of the coffee, a very important export product.

Mountainous Tropical Strip (medium altitude). It covers 20,200 Km. of the Guatemalan High Plateau.

The weather is rather agreeable and the lands very productive, it is the most densely populated strip. Most of the soils have volcanic origin and up to the 1970's the charcoal and nitrogen cycles seemed satisfactory. But during the last three decades subsistence agriculture centred in this area has been subject to pressures of demographic growth, scarcity of cultivation land and settlements on lands of high slopes, therefore erosionable. 15% of the country's land has mountainous tropical humid forests.

Coniferus and fruit trees are found here, in small forests related to communities of small producers of subsistence agriculture.

Mountainous Tropical Strip: it is a small strip of 800 Kms that rises to 3,000 or 4,00 mts. OSL. It is the real cold zone of Guatemala.

In 1950 the lands assigned for cultivation, including lands at rest, were 1,477,000 Ha, and in 1964 2,190,532 Ha. showing an increase of 3.4%

per year. The enlargement of cultivation lands has been carried out at the expense of natural grazing lands and forests. By 1964 it was already evident that the land reserves for cultivation belonging to farms were becoming exhausted, forcing an increase in the intensity of land use.

According to the 1950 census, 44.6% of land was forest and non-agricultural lands. By 1964 the percentage had diminished to 22.8%.

Nevertheless, it is considered that 66% of the national territory, is land with agricultural potential; though the increase of this Agricultural Frontier would generate a pressure that could be damaging on the long run to the agro-forest balance.

According to the General Secretary of the National Council of Economic Planning (SGCNPE), the country was divided in the following regions: Zone 1: Western High Plateau and Southern Coast; Zone 2: East, Central Region Dry Central Region; Zone 3 Northern low lands and the Petén.

The population's distribution in these zones was as follows: 2.4 MM Hab in zone 1; 1.63 MM Hab in zone 2; 0.50 MM Hab in zone 3.

Economic regions

The economic regions of the country are divided as follows: Central Plateau: where the capital city is situated, with the greatest urban and industrial concentration. Western High Plateau: where the greatest concentration of subsistence agriculture is located. South Coast: where the economy of agro-exports is concentrated. East: with a majority of sharecroppers and a zone with economic potential on the Atlantic side. Verapaz: where great projects of infrastructure, related to the expansion of the agricultural frontier and oil production are presently developing. El Petén: scarcely inhabited zone with large forests and oil.

The population distribution in these areas in 1979 (see table 2) shows that 41% is concentrated in the High Western Plateau and 20% in the East, which are the two most densely populated regions and where subsistence agriculture predominates.

Population and growth.

Guatemala is the most populated country in Central America; a comparison of the results of the 1950 and 1964 Census, shows that the population grew from 2,790,868 to 4,284,473 inhabitants with an annual geometrical rate of 3.1%. This high rate of growth was due to the diminishing mortality rate which decressed from 21.8 per thousand in 1950 to 17.2 per thousand in 1963, changing the demographic density from 26 to 39 inhabitants per square Km. Nevertheless, the rural density was of 136 inhabitants per square Km. of cultived land which was slightly higher than the one in El Salvador at the time.

By 1979, the total population was estimated at 6,811 inhabitants, that is, 64 inhabitants per square Km; and the rural population in 4,330,000 the rate of growth being of 2.8%.

Economy.

Guatemala's economy is the largest in Central America. In 1979 the GDP was of 6,886 millions of Quetzales (Q=$), with the largest industrial sector (488.4 millions of G.) in Central America. The GDP grew firefold in 10 years, increasing the National Income Per Cápita to 888 Q. in 1979.

The agricultural sector is the most important, representing more than 25% of the GDP and is the country's major source of exports. The most important exports are: coffee (243 million of Quetzales in 1976), sugar (110 million in 1976), cotton (84 million in 1976), banana (41 million in 1976), meat (21 million in 1976) and processed agricultural products (13 million in 1976).

Agro-export production is developed in big agricultural farms on the Pacific's South Coast and to a lesser degree on the Atlantic Coast.

On the Central High Plateau and on the East, a subsistence agriculture basic the farming population of the country is developing. Basic foofstuffs, corn, beans and rice, are grown here.

In the last years the mineral sector has become important. Nickel has begun to be exploited for exportation; also oil, which has reached

thousand barrels/day, which justifies the oil-line which has been built from the oil-wells to the main Caribbean Port, Puerto Barrios.

Through the Central American Common Market, there has been a quick increase in the manufacturing sector, especially in food processing, clothing, footwear, textiles, chemical products and non-metal minerals. Many of these industries are affiliated to multinational enterprises.

Nevertheless, two thirds of hte industrial labour is engaged in small industries with low productivity.

Balance of payments.

From 1973 to 1979 Guatemala's external trade greatly imroved, maily due to high coffe, sugar, and cardamom prices at the time. Nevertheless, the rise of oil prices mily affected the balance of trade of the country. In the last few years, though, Guatemala keeps a reserve of currency that allows to expect a solvency of its external economy. In the last two years, strong drains of capital, due to the high external interest rates and the political events of the region have somehow modified this perspective.

Guatemalan exports still depend heavily on agro-exports, especially coffee, which still represents 33% of export income.

The Guatemalan manufacturing sector has greatly benefited form the Central American Common Market, having diversified, thanks to it, its exports. The recent difficulties of the CACM, have affected the rate of growth of these exportations both for political reasons as well as tariffs.

Tourism, which is also a growing source of foreign exchange, has decreassed in the last year. All these facts lead to believe, that in the coming years the balance of payments figures could deteriorate if the above-mentioned tendencies continue.

Energy sources.

The energy sources in Guatemala are: hydroelectric, geothermic, aeolian, solar and of biomass. (See tables 12, 13, fig. 27).

Hydroelectric sources.

Though belatedly, Guatemala is beginning to recognize its hydroelectric potential. Since 1952 there was the awareness of the need to develop hydroelectricity, but differen obstacles postponed the decision to do so took 23 years with all that this implies in terms of costs.

Presently, ambitious plans which contemplate 390 MW of hydroelectric capacity are being developed on the short run and for the year 2,000 there are plans for plants with a hydroelectrical capacity of more than 3,600 MW. The total thoretical capacity being of 10,900 MW. A series of bulding problems and rising costos have retarded the goals of such programs but it is hoped that by 1983.

Geothermical sources.

It is still in the primary exploratory stage both in Zunil as well as in Moyuta. The INDE (acronym for National Institute of Electrification) plans to install a 55 MW plant by 1981.

Oil.

Up to now Guatemala is the only Central country with known and published reserves. The probable reserves reach a total of 20 million barrels and the proven ones 10.3 million. The present production of 8,000 barrels per day is drawn out from not deep creataceous layers.

Guatemala has only one refinery, south of the country, with a capacity of 15,200 barreles per day. There are projects form private enterprises for expoiting gas which up to now is burnt.

Solar and Aeolian energy.

On the south coast the average monthly solar insulation is 0.35 $Kw/m^2$ and in the north 0.21 $Kw/m^2$.

Forest reserves.

Estimated in 1977 at 41.1%.

Effect of the rising prices of oil.

The swift rise in oil prices, had an impact over the cost structure, prices and balance of payments. Besides it negatively affected the

expansion of GDP.

Such an increase substantially modified the estimates of the 1974 "Operative Plan" of the National Ministry of Planning. The foreign exchange flow to cover for imports of fuel and lubricants was much higher than originally planned.

The inflationary impact in households resulted in an additional 3.4% increase in the cost of living; the present inflationary rate is 11%. Within the productive sector, the industries most affected by rising costs due to higher oil prices are transport, whose costs have risen 2.6% and electricity 6%; other industries which have been hit are nickel and cement production. Most of the electricity in Guatemala is still generated by thermoelectric plants. The impact of oil prices on small industries and subistence agriculture has been more severe, with increases in prices estimated at 8%, plus the inflation rate of 11%.

In 1979, 11.4 million barrels were imported (50% crude, 50% derivatives) with a value of 250 MMQ, a bit more than the value of coffee exports at high prices. It is estimated than in 1982 the price of oil imports will be approximately 700 MMQ.

The perspectives for economic growth in Guatemala, in spite of the negative factors already mentioned, are still favorable. Guatemala's economy has low external debt and has a potential for increasing agro-exports. If the restrictive tendencies of the industrialized countries and the decrease in demand, due to the worl economic crisis continue it is probable that this potential will go to waste.

There have been large public and private investments to develop energy sources in the past few years, around 7.1 thousand MMQ. Nevertheless, the ripening of these investments has been slowed down, especially in what concerns hydroelectric energy and have considerably increased the ratio of the country's debt/servicing, which rose from 1.9% in 1975 to 7% in 1981.

The strategic goal is to develop oil production in order to substitute a third of its present level of imports, apart from substituting oil as the main generator of electricity by 1983, through the setting up the hydroelectrical projects of the Chixoy River; which will supply 270 MW to the country's electrical system.

Out of the 7.1 thousand million MMW, investment 1.9 MM will be invested by the public sector from 1979 to 1982 and 5.2 MM by the private sector. Nevertheless, this depends on the trust that investors may have in the political and social stability of Guatemala for the next 5 years.

Political events in the central american area, especially Salvador's civil war, as well as the increase of a convulsive social situation in Guatemala, add a pesimistic note to the analysis of Guatemala's economic growth.

From an optimistic point of view, the low foreign debt, the important agricultural potential, the increase of the internal energy production and strong investments, give way to thinking that the GDP annual growth will be of 6.7% in Guatemala, during the next decade. The pessimist view point forecasts that during the next five years a social crisis of great repercussions may ripen, leading the country's economy to situations similar to those at El Salvador at the moment, with GDP rates of growth lower to the ones of population growth.

## CHAPTER 2. THE RURAL SUBSISTENCE SECTOR

### Definition.

By subsistence sector we mean that in which the amount of cultivated land is worked by the family, or a certain amount of labor is used.

In this sense, subsistence agriculture in Guatemala has the following classification:

"Minifundio": Exploitation of small extensions that can not absorb the working capacity of a rural family, estimating that two adult laborers work most of the year in its exploitation, with a technology which corresponds to a "minifundista" region. Since their normal labor capacity can not be absorbed, farmers look for work in the large agro-export farms of the South and North Coast, thus complementing their income.

Family Farms: Those that can absorb the normal labor capacity of a rural family. At the national average level it is estimated that the family farms are between 10 and 64 "manzanas" (7 and 45 ha.).

NUMBER OF FARMS AND AREA

In the 1950 Census the subsistence agricultural lands represented 97.8 of the farms, in 1964 98%. Nevertheless in 1950 they had 27.8% of the land and in 1964 36.6%.

In subsistence agriculture the "minifundio" is the most important landholding in numerical terms.

The agricultural Census of 1950 showed a total of 74,259 microfarms (21.3% of the farms in the census); 233,804 subfamily farms (67%). Therefore in the "minifundio" category a total of 308,073 units was registered, representing 88.3% of the agricultural exploitation.

The microfarms area was of 40,822 "manzanas" (28,575 ha.) which represents 0.8% of the total. The subfamily farms area was of 720,794 "manzanas" (504,556 ha.) that is 13.6% of the total. The area covered by the "minifundios" was, therefore of 761,616 "manzanas" (533,131 ha.) (14.4% of the total).

The agricultural Census of 1964 registered 85,083 microfarms (20.4%); and 279,796 subfamily farms (67.0%). Therefore, in the "minifundio" category 364,879 units were registered, representing 87.4% of the farms' total.

The microfarms area was of 46,683 "manzanas" (32,677 ha.) equivalent to 1.0% of the total. The subfamily farms area was of 896,933 "manzanas" (627,853 ha.) that is 17.7% of the total. The "minifundios" area was, therefore, 916,616 "manzanas" (641,631 ha.) (18.7% of the total).

An average "minifundista" family has 6 members, having manual labor of 2 men/year with a total availability of 600 days/man. If the available land average is 2 ha. per "minifundio", it becomes clear that is impossible to have the whole family working during the whole year. According to a poll by CIDA, the "minifundistas" of the high lands generally use less than 110 days of work per parcel, this figure goes down to 60 or 70 days in the most impoverished areas of Totonicapán and Sololá. Comparatively labor in the "minifundios" of the coast seemed higher in the cases studied, being up to 128 days for the farmer and his family; this is explained by better climatic conditions and more favourable soils, plus the fact that the size of the parcels is larger.

Some estimates state that 3 ha. is the minimum a rural family needs for ubsistence with no other important sources of income, provided that soil erosion does not increase and that fertilizers will not prove too costly for the family's economy.

TENDENCIES OF CROPS

In a poll by IIESO-USAC, the main agricultural products of subsistence agriculture are: corn, 48.7% of which is grown in microfarms, 55.9% in family farms and 32.7% in family farms. Beans 6.5% of which are grown in microfarms, 6.9% in subfamily and 4.9% in family farms. Vegetables: 26.3% in microfarms, 13.8 in subfamily and 8.3 in family farms; and roots, especially potato and manioc 1.5% grown in microfarms, 5.6% in subfamily and 0.35% in family farms seasonal commercial crops; 1.75% in microfarms, 3.66% in subfamily and 2.63% in family farms; permanent commercial crops (coffee, cardamon, achote): 9.8% microfarms, 7.6% in subfamily and 41% in family farms.

In livestock production, the subsistence sector production of bovine cattle was 125.7 MQ in microfarms, 365.7 MQ in the subfamily farms and 215.4 MQ in the family farms. Porcine production: 241.2 MQ in microfarms, 622.1 MQ in subfamily and 95.6 MQ in the family farms. Pultry production 450.5 MQ in microfarms, 1,300.2 MQ in subfamily and 185.4 MQ in family farms. Apart from this other activities are developed with sheep, rabbits and bees.

Only the subfamily farms have track animals because in the microfarms there is no place for pasture and cattle sheds, nor the economic means to buy them.

As far as agricultural capital is concerned, family farms have the greatest investment (36% especially in installations for improving coffee production.

In the microfarms, the capital consists of traditional and rudimentary tools and utensils, (machetes, hoes, axes and files). In the subfamily farms agricultural installations predominate. There is little investment in track animals, being a mere 2.49% of the agricultural capital of the region. Animal traction has not been adecuately promoted nor disseminated.

Capital yields from microfarms are between 20-30 Q; in the between 30-50 Q in subfamily farms; and between 100-200 Q in family farms.

LAND TENURE:

The ratio of exploited areas and the rest of the territory of the High Plateau, where subsistence agriculture prevails, is 38%.

According to the 1964 Census, at a national level, 20% of the exploitations were microfarms, in the Western High Plateau 47.7% and 29.5% in the Northwestern High Plateau.

In 1964, 1% of the agricultural land belonged to those exploitations, in which 85,000 families worked, representing a million and a half people, that is 11 persons per "manzana", the average exploitation per "manzana" is 0.54. The subfamily farms had in 1964 17.6% of the land, in which 279,796 families worked, representing a million and a half people. The average area was of 3.1 "manzanas" of exploitation and 1.7 persons per "manzana". In 1978 in the Northwestern region, subfamily exploitations represented 57.9% of the total, being 30% of the area. The family farms represented 10.5% of all the agricultural units and 18.8% of the total land, 43,600 families depend on them, that is 218,000 persons. The average area is of 24.6 "manzanas" per farm and 0.26 persons per "manzana".

Recent polls in the Northwestern High Plateau show a tendency of the average area of subsistence agricultural units to decrease in size and of the multifamily units to increase.

AVERAGE SIZE OF FARMS

| | Northwestern High Plateau | |
|---|---|---|
| | 1964 | 1978 |
| Microfarms | 0.59 | 0.57 |
| Subfamily farms | 3.55 | 3.31 |
| Family farms | 20.45 | 18.85 |
| Multifamily farms | 196.30 | 262.84 |

There are different forms of land tenure in microfarms: communally hired, lands colonies, sharecropping, etc.; in the subfamily farms land owning and usufruct rights are predominant; in family farms lands are privately and communally owned.

FAMILY, MEN AND WOMEN ROLES:

In the family, men are basically in charge of the following tasks: clearing the land, preparing it for sowing and harvesting; fetching fuel wood, especially the one found in sites; some community jobs; small industry (pottery, wood furnitur, limestone, bakery), house building and husbandry of track animals.

Women are in charge of bringing water, cooking, rearing of children,. house chores, harvesting, sometimes sowing, especially vegetable sowing, selling in the market, handicrafts (weaving, wicker-work) they fetch fuelwood from nearby places generally dry branches and small pieces of wood; they also take care of small domestic animals.

The family as a whole participates in the organization of celebrations, small commercial and educational activities and the storing of grains.

Due to influence of mass-media, transport and ecudation of younger generations, there is a tendency to leave the community, to look for non-agricultural jobs in order to acquire certain economic independence. This is especially true in the case of young people.

CHANGES IN THE RURAL SUBSISTENCE SECTOR:

Due to the growing economic gap between urban and rural areas, subsistence agriculture in the last few decades has suffered a severe deteriorating process. The prices of foodstuffs are less remuneratory for this sector, while the prices of industrialized and commercial products in the rural area increase constantly, (salt, sugar, fertilizers, clothing, plastics, construction materials, agricultural tools, shoes, domestic items); transportation is especially costly due to the increase in fuel prices.

Until recently, the minimum wage in the rural area was of 1.20 Q and after massive strikes in the South Coast of the country, these wages were increased to 3.20 Q/day. The consequence of the rise in salaries has been that labor in the large farms in the South Coast has been made redundant to compensate for the new increase in salaries, which is the first in 22 years.

Pressure over the land has become a national problem due to the lack of available land for culture. The agricultural frontier has been extended to the North. Many families have migrated to those lands trying to make them arable. Nonetheless, this migration shift

has not absorbed the great existent deficit, especially in the High Plateau and the East.

All these reasons have contributed to the exodus from country to city, which was increased with the earthquake of February 1976, when the subsistence farmers were severly damaged. In the city these migrants find menial permanent jobs, with great difficulty anlarging the already large underployment sector.

This exodus towards the cities, takes the form of a staircase: from the villages to the small towns, from these to larger towns, from here to smaller cities and from these to the capital. An increasing percentage of people that do not find jobs in the capital have started to migrate to foreign countries, mainly the United States.

The microfarms are practically on the verge of atomization and their growth is in detriment of the family and subfamily farms, especially those pertaining to the communities. Generally the average of the "minifundio" area has diminished.

The "minifundio" and the "latifundio" coexist in an economic symbiosis. The small "minifundio" farmers from the labor reserve of the big farms oft he South Coast which need, in times of increased agricultural activities important quantities of efficient and cheap labor. The wages in these farms give migrant "minifundista" families the small income which allows them to buy the industrial products they need.

In the large farms where mechanization is already possible, and due to high export prices of products, such as cotton, sugarcane and livestock, daily wages are considerably higher than in the more traditional farms, especially devoted to coffee. All these tendencies are rapidly leading to a proletarization of the migrant farmer, manifested through labor demands, trade-unionization salary claims, etc.

# CHAPTER 3. ENERGY USE IN THE SUBSISTENCE RURAL SECTOR

## Firewood

Firewood is the most important national energy resource. It represents 84% (or 60% depending on the method of calculation) of primary energy production, out of which 77% is consumed by the residential and commercial sector. Firewood is the main fuel used for cooking by 80% of the population. Besides it is used in small industries and commercial enterprises.

Out of this percentage 66% use only firewood, 14% use Kerosene or propane gas too, of the remaining 20%, 12% use propane gas, 7% Kerosene and 1% charcoal.

In urban areas, families using firewood represent 42% and in rural areas 95%. So most of the subsistence agriculture farmers use firewood as the main source of fuel.

The annual growth of forests in Guatemala in 1979 was estimated at 5.2 million of cubic meters (MMmc) per year, as compared with an annual use of 12.9 MMmc. per year.

The present rate of deforestation is approximately of 3% per year. The deficit is of 7.7 solid MMmc and a forest stock of 254 MMmc.

Thus if firewood consumption keeps rising at the present rate, indirect ratio to the population growth, and no policy for firewood savins is developed, Guatemala's forests may virtually disappear by 1988, excluding Petén. By then firewood would have to be substituted by electricity, propane gas and/or kerosene. But electricity and propane gas are realtively expensive in relation to the purchasing power of the subsistence agriculture sector, at least for the next 20 years.

That is why, kerosene is the most feasible possibility, but this, for the time being, would put a burden the balance of trade by increasing the oil imports.

30 years ago firewood supplied 3/4 of the total energy used in Guatemala. With urbanization and industrialization, the consumption of oil products has swiftly increased to an annual rate of 11%, becoming the predominant source of energy in all sectors, excluding the residential one. Nonetheless, in spite of the increasing importance of oil, fuelwood is still providing more than 50% of the total energy consumed in Guatemala during 1979.

A poll taken by William G. Mathews and Associates Ltd. under contract with the General Secretary of the National Council of Economic Planning, estimated that 80% of the Guatemalan families cook with firewood, of which 66% use only wood and 14% complement it with propane-gas or kerosene. The estimated volume of domestic consumption of wood was of 9.3 MMmc.

| FUEL | NATURAL UNITS | ENERGY EQUIVALENT (MJ) |
|---|---|---|
| Firewood | 1,650 lbs. s,h. | 13,530 |
| Kerosene | 14 gal. | 1,855 |
| Propane | 75 Lbs. | 1,580 |

30% of the rural families already use kerosene for illumination purposes, but this percentage has decreased due to the expansion of electric service, especially in the CentralRegion, Central High Plateau and the South Coast zone near the cities.

The annual average use of kerosene intended for illumination is of 15 gal. per family, with a cost of 14.00 Q.

53% of all families using wood buy most of it. At the national average level this fiture is around 40-45%.

In the rural areas 79% of the families use firewood and 15% complement it with propane-gas or kerosene.

Cooking methods with firewood:

Approximately 2/3 of all families using firewood for cooking do so in open fires, be it directly on the rgound, on adobes, on

earth platforms or on top of a barrel. Only 13% of the families cook on open fires on the fround; slightly more than 20% have a stone bench with a plate.

Considering the hypothesis that firewood consumption will increase at the same ratio of 2.7% as the population firewood consumption may increase from 11.3 solid MMmc. in 1979 to 19.7 solid MMmc in the year 2000.

As firewood consumption increases, the deficit increases, and the forest stock decreases. Firewood prices will swiftly rise as the stock diminishes; thus many families will start using kerosene as a substitute as it is now done in the critical zones of Centre West and the South Coast. This situation will become generalized in 20 years time and a renewable domestic resource will have to be replaced by an imported nonrenewable one.

## CHAPTER 4. PAST AND PRESENT POLICIES

The Impact of the 1974 increase in oil prices and policies adopted.

In 1974, the most dramatic impact of the increase in oil prices was clearly reflected in the balance of trade, up to the point where of the 60 million Q. in foreign exchange currency expected for December 1973, there was a loss of 4 million Q.

It was then calculated that the cost of producing of agricutural goods would increase, due to the effect of 5% higher oil prices. It was also forecasted that the combined effect of the increase of prices would restrict the level of overall demand, diminishing the rate of expansion of the GDP by 1%.

The policies adopted were the following:

1. Restriction on gasoline sales, through prohinition and price rising.
2. Restrictions in the use of electric energy.
3. Promoting an agressive reforestation campaign in the whole country.
4. Promoting the export of geothermic resources.
5. Accelerating the development of the hydroelectrical project

of Chixoy.

6. Electric interconnection with El Salvador for better use of electric surpluses.
7. Initiation of feasibility of studies to produce fuel alcohol from sugar-cane.
8. Set up a study group on the feasibility of substituting tank trucks by oil pipe lines.

In those days the impact of the energy crisis in the rural area was not thoroughly realized. The main emphasis was on transport supplies and electric energy for urban centres.

Later on, in view of the growing difficulties of the rural areas, a program of rural electrification was designed, enlarging the coverage of the national electric system by 8.2% (fig. 3).

Nonetheless, the delays in the setting up of the operation of the projected hydroelectric plants, caused an increase in fuel consumption which at present prices equals 2.5 million Q. monthly. The decision about the interconnection with El Salvador is not final yet. All this leads us to expect a significant increase in electricity rates with the consequent problems for rural areas.

In 1980, a program of rural electrification (PER-2) was started, which tried to enlarge the system coverage in critical rural zones of the Western High Plateau.

For the first time in 1981, there was talk about the need to promote the identification, study, and development of non-conventional energy sources.

At a private level, since 1953 biogas started to be diffused, especially in the South Coast; 14 biological plants were built. Nonetheless, the existence of cheap oil at the time resulted in a lack of support, at the national level.

As a result of the February 1976 earthquake, and the reconstruction works this entailed, the spread and experiments with non-conventional energy sources began in the rural areas such as:

1. Small scale biogas digestors for rural areas.
2. Firewood-saving cookers.
3. Solar energy instruments.
4. Projects for nurseries for reforestation.
5. Development of windmills.
6. Experimenting with fuel alcohol.

The Government Forest Agency, INAFOR, is sponsoring a replanting program for the period 1978-1982. The goal was to reforest 100,000 Ha. during four years, but during the first two years of the program a total of 32,000 Ha. were reforested. Assuming that the same ratio continues during the next two years, a total of 65,000 Ha. will be reforested during the 1978-1982 period. According to the calculation made by Wilhem Mittak, such a reforestation program would result in an increase of only 3 solid MMmc. in the standing wood volume for year 2000.

In the rural subsistence sector, the most severe impact has been the restricted supply of firewood. The rural population is finding it more difficult to obtain supplies of this traditional fuel. That is why the promotion campaign of the "Lorena stove" carried out by ICADA, CEMAT, XELAC and lately INTECAP and ICAITI, have had a positive impact in arousing the interest of the rural population.

The efficienty of the different fuel-saving stoves has been proven, so has been their acceptance by rural communities (fig. 23, 24, 25). In some of them, such as San Pedro la Laguna, Sololá and other towns around Atitlán and in Cantel, Quetzaltenango, these firewood savers have already had a massive diffusion.

Nevertheless, in spite of such a success, the firewood saving stoves do not have a wide distribution. The main cause is the lack of inter-institutional coordination, in which official institutions, non-governmental and private organizations can participate in equal standing, so as to have a massive promotion of these fuel-savin stoves in all of the country's regions.

Guatemala has also had very valuable experiences in the field of biogas and biofertilizers production. At present, there are about 20 digestors of different designs and capacities functioning, and the national technical capacity to give a strong drive to biogas in the country is already present. (Fig. 19, 20, 21).

The main failures in this field are due, basically, to the fact the promotion and follow-up of the gas digestors have been made in an isolated and partial way. The experiences of OPINA, CEMAT, ICADA, ICAITI and Engineering Gaculty at San Carlos University of Guatemala, lead to think, that there is a basis for future coordination.

A study on the feasibility of alcohol production has already been carried out; however, no decision on this has been made public yet. The recent experience of Costa Rica could be an important reference for Guatemala. In Costa Rica a plant producing fuel alcohol with a capacity of 240 m. litres/day, has been built; and presently the use of this alcohol is being experimented in self-propelled vehicles.

The CATIE, in collaboration with INAFOR, has already detected the ciritical zones of deforestation and they are implementing a firewood production program, selecting forest species of quick growth and detecting different forest production methods with community participation. (See pgs. 120 and 121).

However, a massive diffusion of the forest program needs the ever increasing participation of the communities; a difficult requirement because of rural unrest in several areas.

Another limitation for the development of the programs of non-conventional energy sources is the lack of adequate financial menas which would support the advancement of these. Some of these technologies are new and can hardly subjects of credit, based on

conventional criteria. Besides, credits have been difficult to obtain in the last two years, due to a shortage of cash.

## CHAPTER 5. FUTURE POLICIES AND THEIR FOUNDATIONS

Subsistence agriculture in Guatemala is now going through a transition period, in which rapid changes are taking place due to the combined effects of the energy crisis, accelerated demographic growth, scarcity of land, inflation (which has affected the industrial inputs that the sector purchases), and increasing unemployment and under employment, a consequence of low agro-export prices.

In what concerns the supply of energy, the main point is that exploitation is already on an ascending curve of logarithmic type in has been entered, the consumption of forestry stocks being estimated that the year 2000 these stocks will have been practically exhausted.

The ciritical zones, in order of priority are the following:

1. Guatemala's Western High Plateau: as shown in the data about Guatemala's Central High Plateau, is the region where most of Guatemala's small subsistence farms are. Due to demographic factors, it is in this area where the firewood deficit is the highest. The northern part of this region still has forest reserves, but they are being quickly exhausted, with a 3.1% growth rate of firewood consuming families.

The High Plateau's agricultural system had maintained a balance up to the 1940's and 1950's. Since then, the problems relating to the demand for land have accumulated. The "minifundio" of the High Lands is under the pressure of forestal development and of the scarcity of lands with a slope of more than 32%. This creates a vicious circle: deforestation; erosion of fertile soil; diminishing returns; decrease of agricultural income; growing need for chemical fertilizers subsidies; growing increasing indebtedness of agricultural economy. To all these difficulties, one should add the increase of trees attacked by Dendroctonus (pine

weevil); it largely affected big areas planted with native coniferus. It is precisely here that firewood has become scarce.

2. East: This region, formed by family and subfamily units, is also a critical zone in relation to energy endowment. Climatic factors affect an important part of this zone, drought being the most serious problem. Besides, deforestation due to growth of the consuming population is also important. The exodus from this region to the capital city is proportionally the most widespread in the country. However, the economic and forestry potential of Izabal, Northeastwards of the region, is an important reserve, although it is being very rapidly exhausted due to wood exports.

3. Central Plateau: The metropolis is located here. The forest deficit is important. According to studies between 20-30% of the rural-urban population of the Central Plateau still consume firewood. The expansion of the electric system has rapidly replaced the use of kerosene in rural families.

4. South-Coast: This region, where the most important agro-exports farms are located, is the most deforested of the country and it is estimated that the forest stock, if the present rate of consumption continues, will only last 8-10 years. Small population centres are usually located within large farms and the land where houses are belongs to the farms as well. This fact hinders families from any small investment in house improvements. The exhuberant vegetation may prevent the realization of the energy crisis in this region.

## POLICIES TO BE IMPLEMENTED

Energy policies for the subsistence sector, in Guatemala, have not been systematized. There are no specific programs, nor a delimitation of priorities. There are disperese activities of different government and private institutions, but their coordination is probably the first necessary step that should be taken.

The present reforestation program has been limited to the

distribution of forest species in plastic bags to be sown by the receivers. But there is no follow-up whatsoever.

Because of the strategic importance of the energy problem in the subsistence area, such policies should betaken at the highest level and implemented by the intermediate levels of official institutions with active participation of non-government, private and community organizations.

The critical energy matters would be the following:

1. Institutional coordination and restructuring.
2. Training of staff; compiling statistical data to obtain detailed energy balances.
3. Setting-up specific energy programs for the subsistence sector.
4. Priority to the more economical use of firewood and the spread of efficient firewood stoves.
5. Increasing the use of new energy resources: biogas, solar, mini-power stations, methanol, mini-alcohol plants, track animals, aeolic, etc.; evaluating and reassessing energy potential.
6. Backing-up the formation fo rural energy units with demonstrative character.
7. Creation of rotating funds to spread these technologies.
8. Massive educational and informative programs.
9. Incentives for commercial application of new technologies.
10. Support to institutions already spreading new technology, as well as exchanges of experiences in order to give technological assistance.
11. Increase the number of forest units of the new kind: communal forest units, firewood production farm units; agro-forest units, and natural vegetation units, especially in the critical zones.
12. Enlargement of the coverage of the national electrical system to rural areas.

General speaking, we could say that the components for a self-sufficient energy policy would be the following:

Components of Self-Sufficient Energy

| I Supply | II Finance | III Institutions |
|---|---|---|
| Demand<br>Preservation<br>and Efficiency<br>Energy<br>Taxes and<br>Allowances | Properties and<br>Control<br>Investment<br>Balance of Trade | Regulations<br>Management<br>Staff Training<br>Compilation and<br>Application of<br>Statistical Data |
| IV Infrastructure<br>Equipment and<br>Labor Supply<br>Other Sercices | V Economic<br>Social<br>Regional, and<br>Environmental<br>Impacts | VI Follow-up<br>Coordination<br>Evaluation<br>Research and<br>Foreign Relations |

The main restrictions are then the following:

1. Lack of coordination which should be dynamic and flexible and at the same time integrate all the interested sectors.

2. Lack of financial resources to implement programs of study, experimentation, evaluation, and massive diffusion and promotion.

3. Clear definition of priorities and energy strategies for the subsistence area.

For different reasons, the magnitude of this rural energy problem is less defined and the pressures to solve the problem are less important for legislators than oil problems. On the other hand, although the general parameters are know, the quantitative, reliable and specific data are scarce. On the other, the organization of active programs is more difficutl, given the organizational frame-work to solve the problem.

Appart from this the infrastructure projects, such as the building of hydroelectric plants, are more concrete efforts and more manageable. The attraction of strengthening the "modern" ur-ban and industrialized sectors of the economy, also contributes to keep the attention away from the rural energy problems. If the relative political advantages of satisfying the urban and industrial/ commercial electoral districts are added, it is easily understood why the accelerated efforts to satisfy the rural energt needs take a secondary priority.

The recommendations for a design of future strategies would be the following:

a) To support the existing networks, working in energy matters for rural areas, for example:

- Latin America Energy Organization (OLADE) which coordinates the efforts of the institutions in the energy sector and has already made a recount of resources and needs and has begun to train national staff.

- Networks of O N G, such as the Coordiantion Committee of Adequate Technology for Latin America (COCOP), the Latin American Association of Development Organizations (ALOP) the International Network of Adequate Technology (TRANET), etc.

- Research networks such as: Bioenergt Association, Applied Microbiology, Forestry, Science etc.

- Supporting the Information and Documentation Centres on energy sources for the rural areas.

b) Financial and technical assistance to the national focal points once they are defined and to the official institutions which colaborate with them.

- The Ministry of Mining, Hydrocarbons and Nuclear Energy which is the main institution for energy matters in Guatemala.

- The Energy Office of the General Secretariat of the National Council of Economical Planning, which is in charge of coordinating and promoting the use of new energy sources.

- The National Reconstruction Committee which as a result of the 1976 earthquake, and of reconstruction works in the rural areas, has demonstrated a dynamic style of coordination with non-government and private organizations that work directly with the grassroots.

- The National Gorestry Institute which, thanks to the treaty with promoting forest units which allow a better use of national forests.

- The Technical Institute of Training and Productivity (INTECAP), which trains middle and operative staff.

c) Support for the Scientific and Technological Institutions that conduct relevant research on aspects relating to energy sources for rural areas (See chart p. 122).

## CHAPTER 6. INTERNATIONAL AGENCIES AND ENERGY COOPERATION FOR RURAL AREAS

The difficult coordinating experience which has emerged world-wide on the critical problems od development such as: environment, concerns, the role of women, the role of children, of science and technology, etc. lead to think that this should be the first element to be regarded by international agencies, the development of programs with no local justification should be avoided. The problem this generates is translated into duplicating efforts and in the worst cases in inter-institutional rivalry which may block the dynamism of the programs international agencies are trying to support.

It is clear, that all this, in spite of having a very precise technical dimension has also important political elements. In this sense it is necessary to obtain an equilibrium in the contribution, combining the support of official isntitutions with non-governmental institutions, research centres with diffusion groups at grassroot level, general-balance activities with concrete local programs, etc.

Maybe the basic criterion on which to evaluate a program is finding out if it has reached grassroot level and if it has generated energy self-sufficiently program self-management.

The energy question is too important to leave it solely in the hands of technologists. The participation of communities affected by the energy crisis is very important, everything done in this sense will be a contribution, if only a small are, to the solution of the energy crisis.

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TABLE 1

Taken from: Strategy for Guatemala's Regional Development
(Proposal) SGCNPE
Guate., Nov/79, p.268

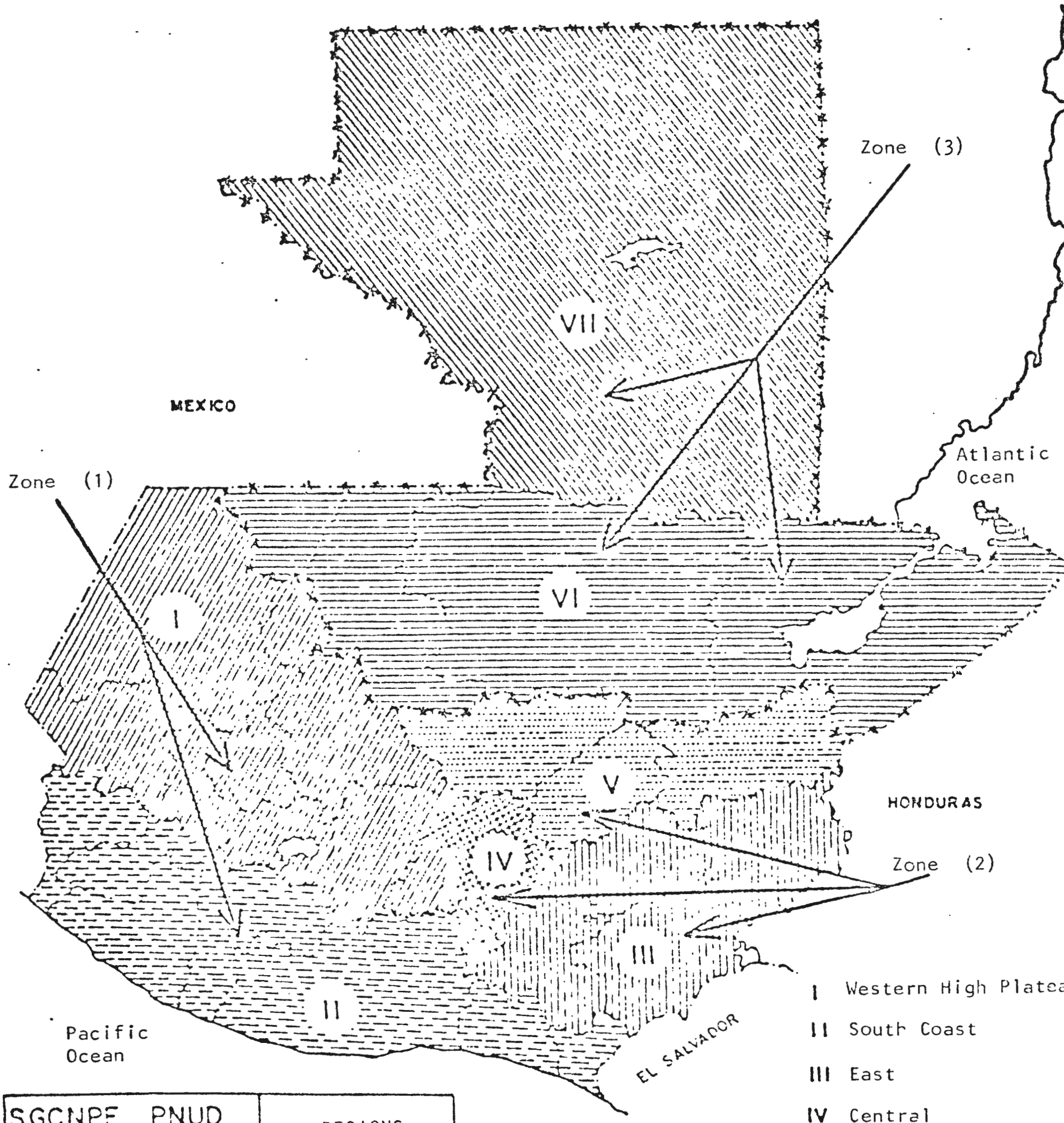
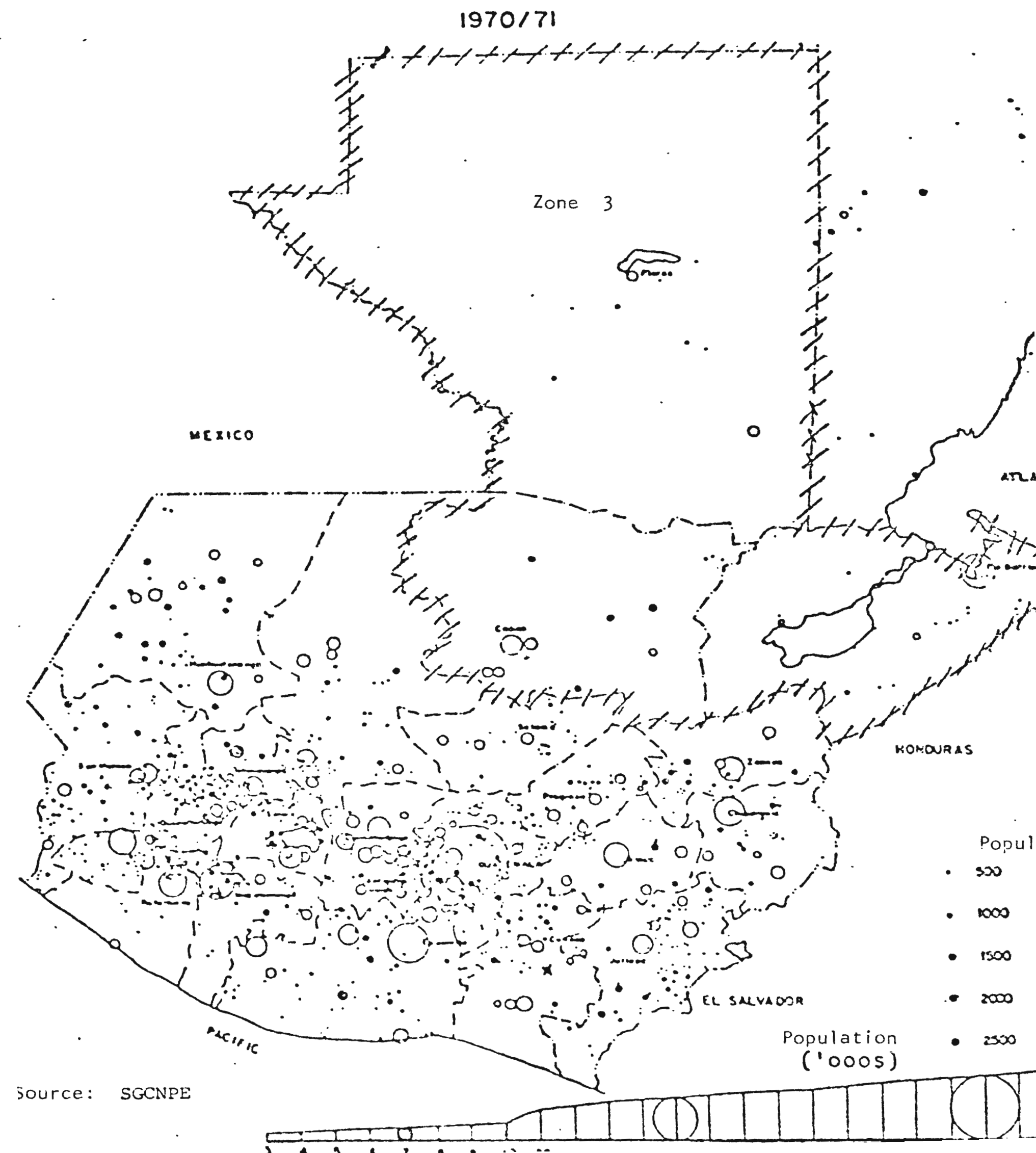


TABLE 2

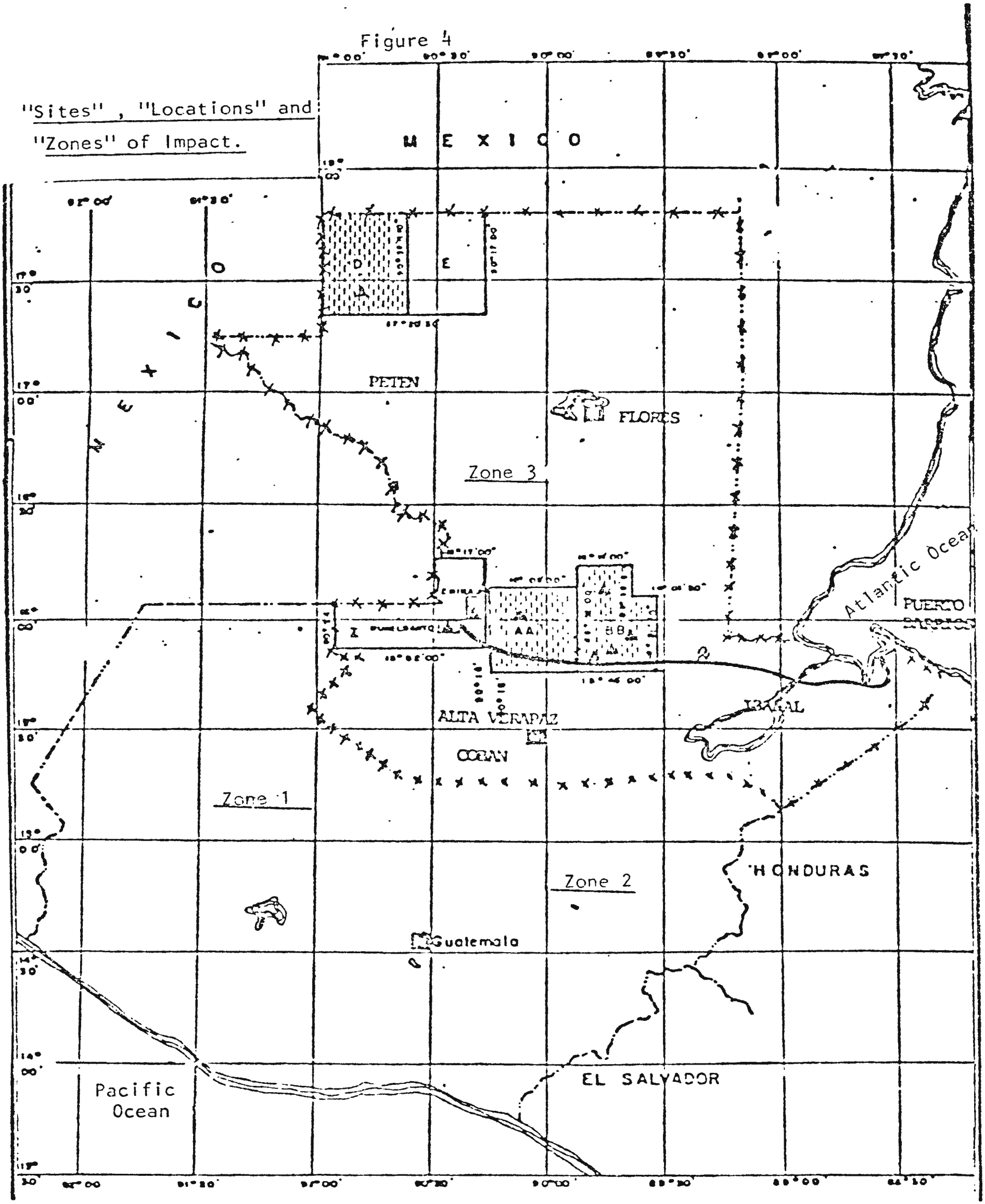
Population Distribution




Source: SGCNPE

Figure 4

"Sites" , "Locations" and "Zones" of Impact.




References:

▲ Perforation Sites (e.j. 1 Rubelsanto y Chinaja)

☐ Locations

Hired Areas

AA - Hispanoil
BB - Getty
D - Texaco - Amoco
E - Hispanoil
I - Elf - Aquitaine/Basic

☐ Cities of Main Impact

XXX ZONA 3

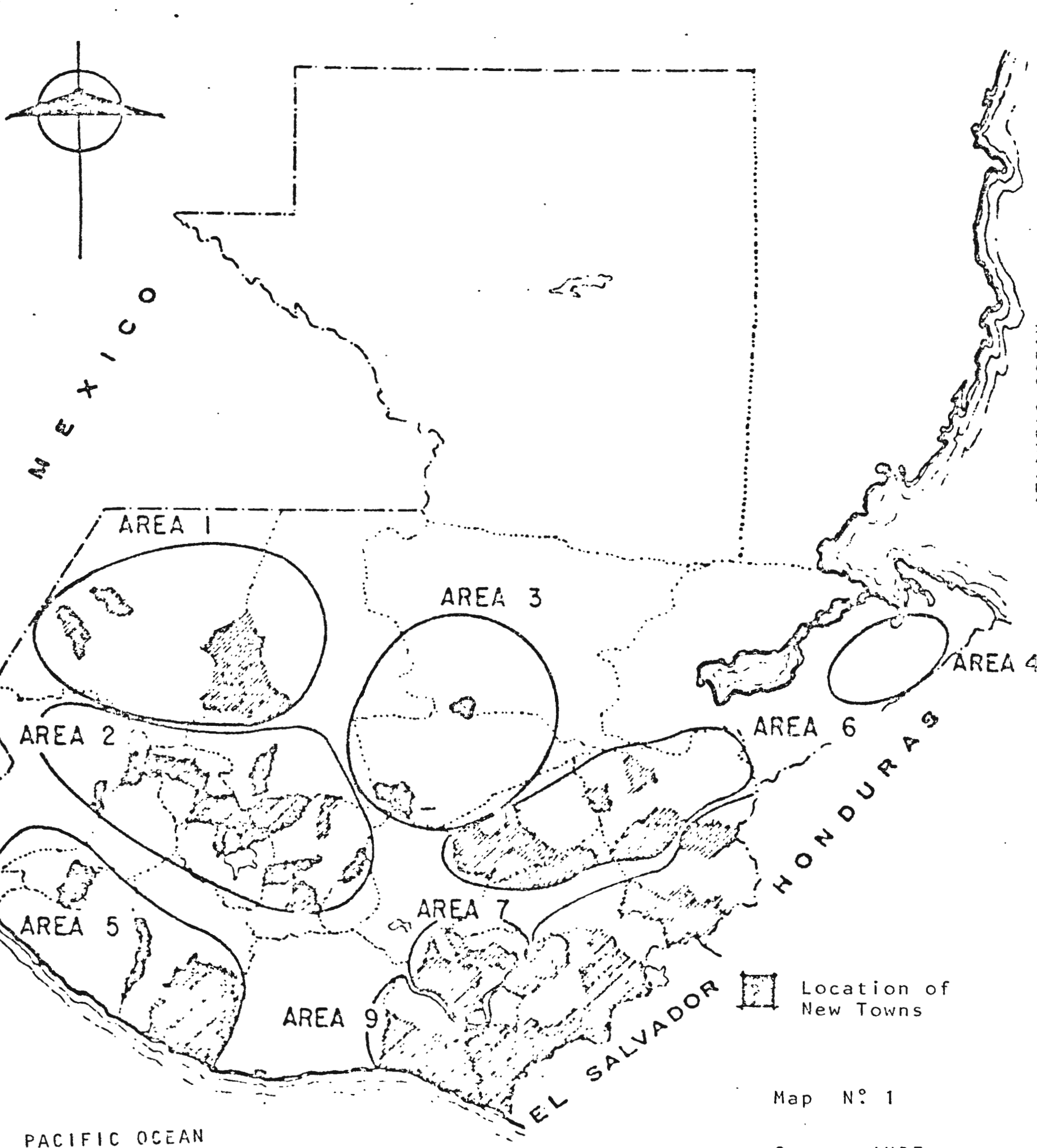
2 Oil Oilduct

TABLE 3

PLAN FOR RURAL ELECTRIFICATION N°. 2 PER-2

BENEFITED AREAS

REPUBLICA DE GUATEMALA

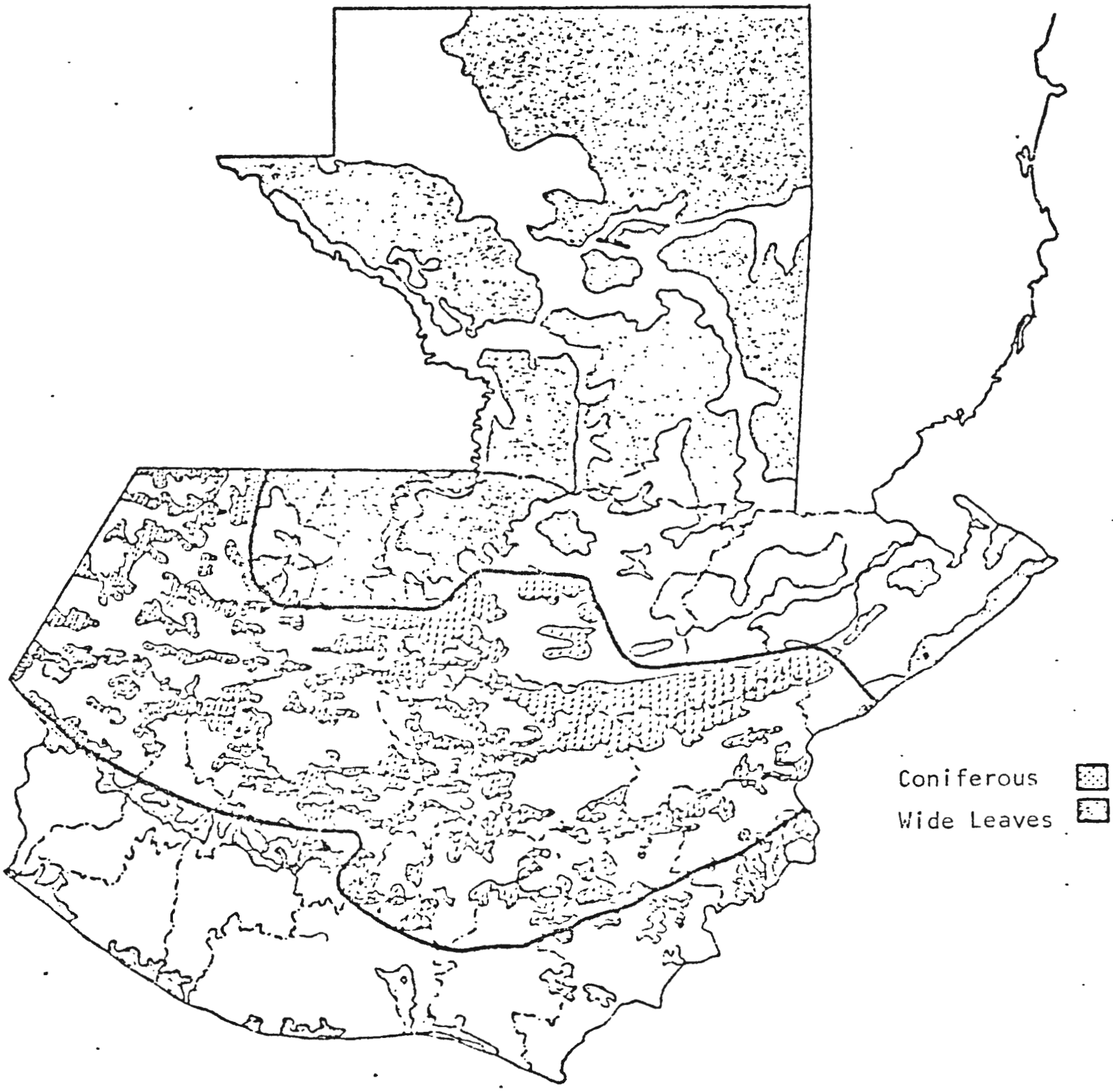



Map N°. 1

Source: INDE

TABLE 5

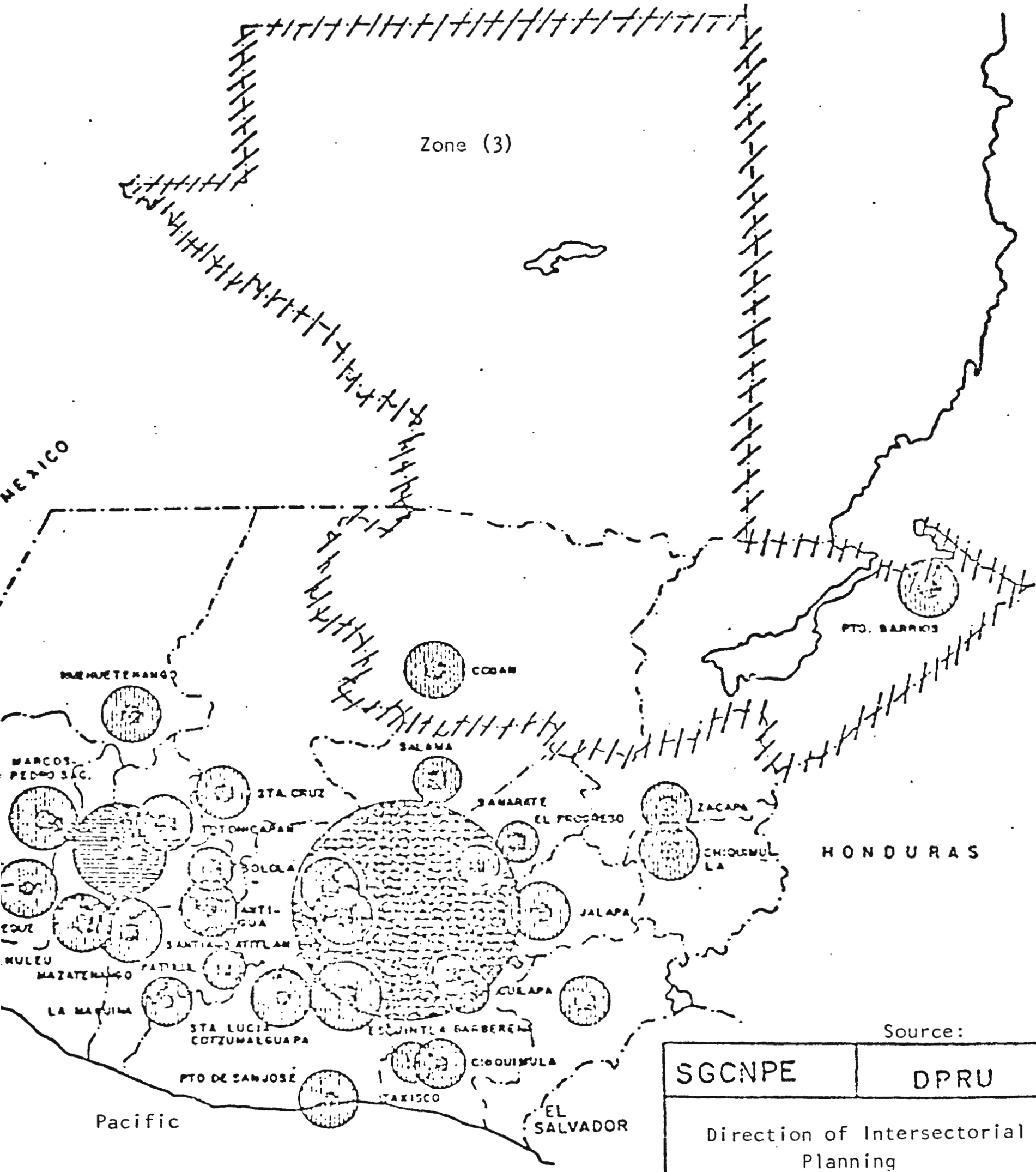
Forest Coverage




Source: SGCNPE

TABLE 6

## Urban Centres




Source:

| SGCNPE | DPRU |
|---|---|

Direction of Intersectorial Planning

- City of Guatemala
- Quezaltenango

FIGURE 7

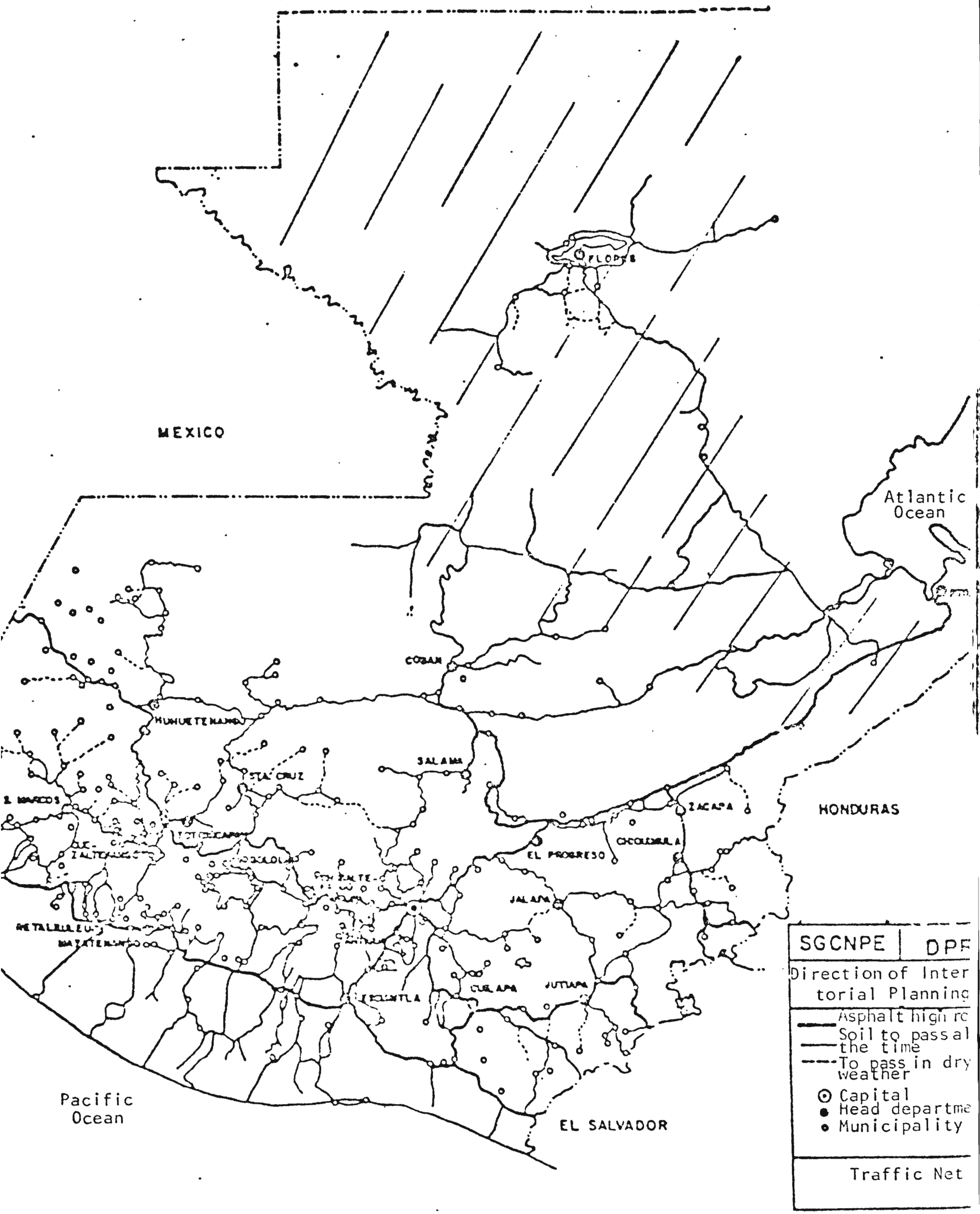
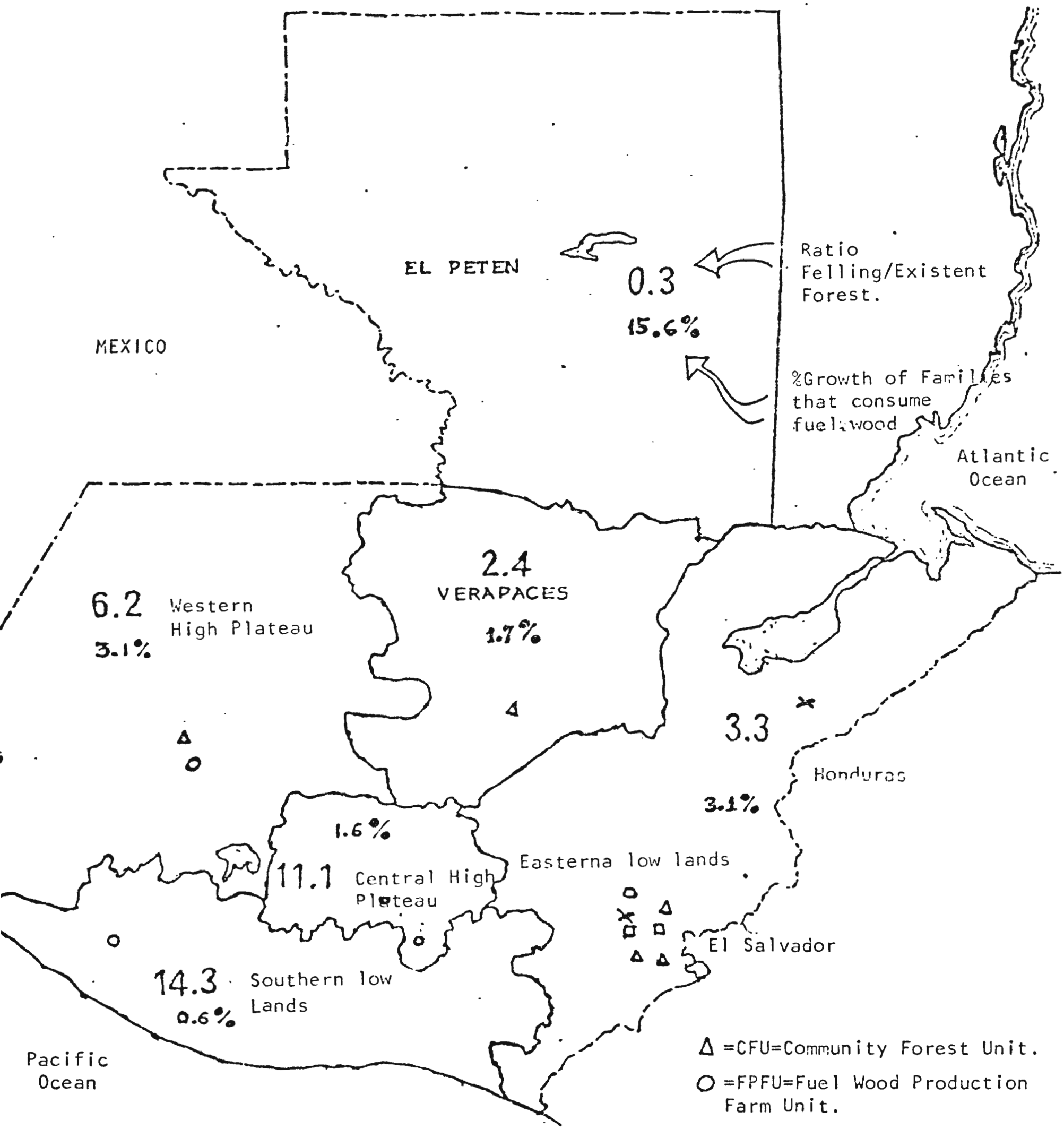

MEXICO
Atlantic Ocean
COBAN
HUEHUETENANGO
SALAMA
STA. CRUZ
ZACAPA
HONDURAS
EL PROGRESO
JALAPA
QUETZALTENANGO
RETALHULEU
ESCUINTLA
CUILAPA
JUTIAPA
Pacific Ocean
EL SALVADOR
SGCNPE | DPE
Direction of Inter
torial Planning
Asphalt high rc
Soil to pass al
the time
To pass in dry
weather
Capital
Head departme
Municipality
Traffic Net

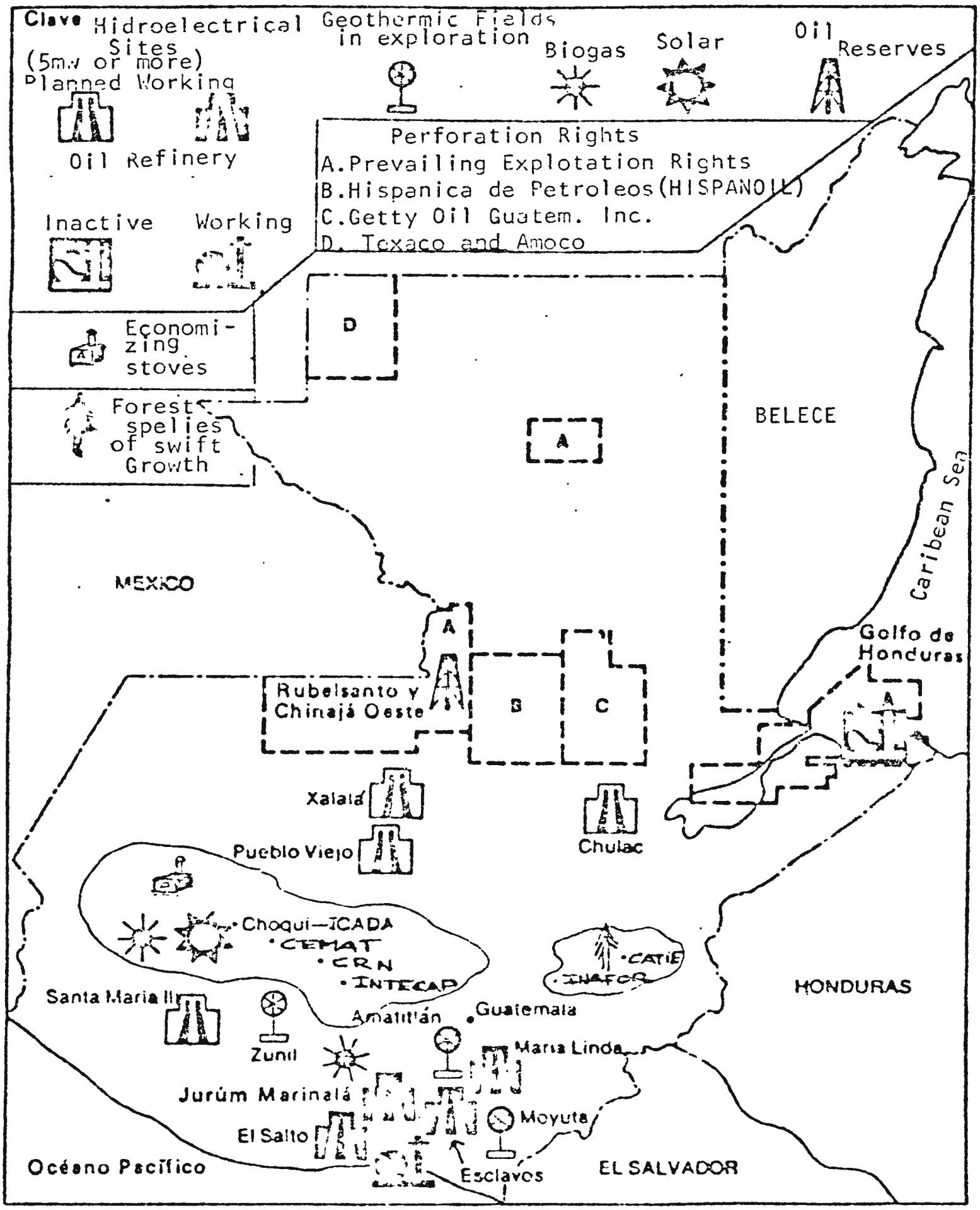
FIGURE 26

RATIO FELLING/EXISTING FOREST AND LOCATION OF FOREST UNITS
GUATEMALA 1981




Source: SGCNPE, CATIE.

FIGURE 27




Energy source of Guatemala

TABLE 1

## POPULATION DISTRIBUTION

## BASED ON THE 1973 CENSUS

(000's)

| | Main Urban Centres | Other Urban Centres | Rural | Total |
|---|---|---|---|---|
| Western High Plateau | 69 | 249 | 1,346 | 1,664 |
| Central High Plateau | 890 | 186 | 327 | 1,403 |
| Southern Low Lands | 76 | 144 | 564 | 784 |
| Eastern Low Lands | 39 | 152 | 668 | 858 |
| Verapaces - El Petén | - | 74 | 377 | 452 |
| Total | 1,074 | 805 | 3,282 | 5,161 |

TABLE 2

POPULATION DISTRIBUTION ESTIMATED FOR 1979

Based on 1973 Census

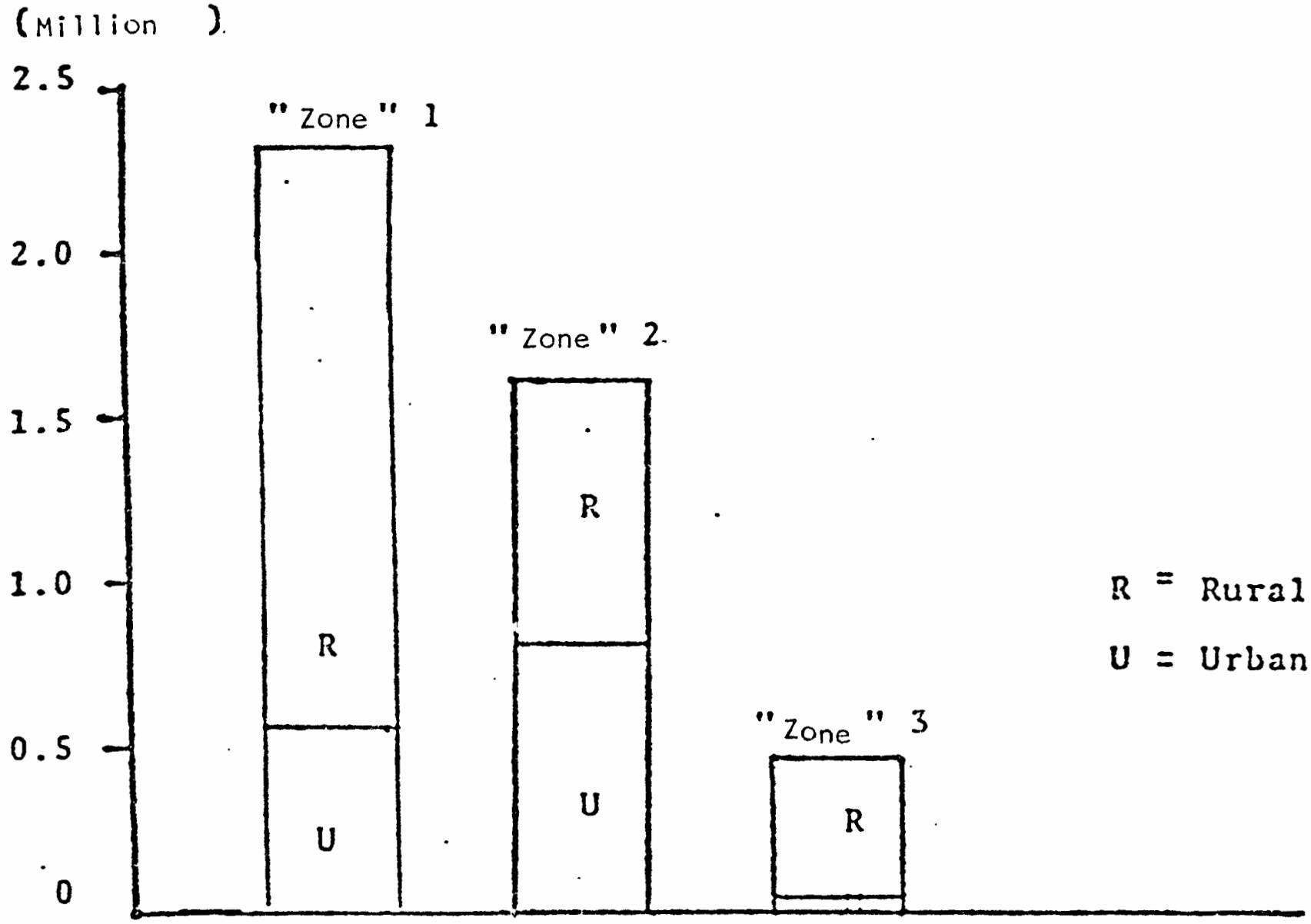
(000's)

| | Main Urban Centres | Other Urban Centres | Rural | Total |
|---|---|---|---|---|
| Western High Plateau | 91 | 329 | 1,776 | 2,196 |
| Central High Plateau | 1,175 | 246 | 432 | 1,852 |
| Southern Low Lands | 100 | 190 | 744 | 1,034 |
| Eastern Low Lands | 52 | 201 | 881 | 1,132 |
| Verapaces - El Petén | - | 98 | 498 | 597 |
| Total | 1,418 | 1,064 | 4,331 | 6,811 |

The information refering the total population in 1979 was obtained from the statistics of the Bank of Gautemala.

FIGURE 28

POPULATION DISTRIBUTION , 1973*




* Besides that the total population has considerably increased, the distribution is representative.

## DISTRIBUTION OF LAND'S AREA

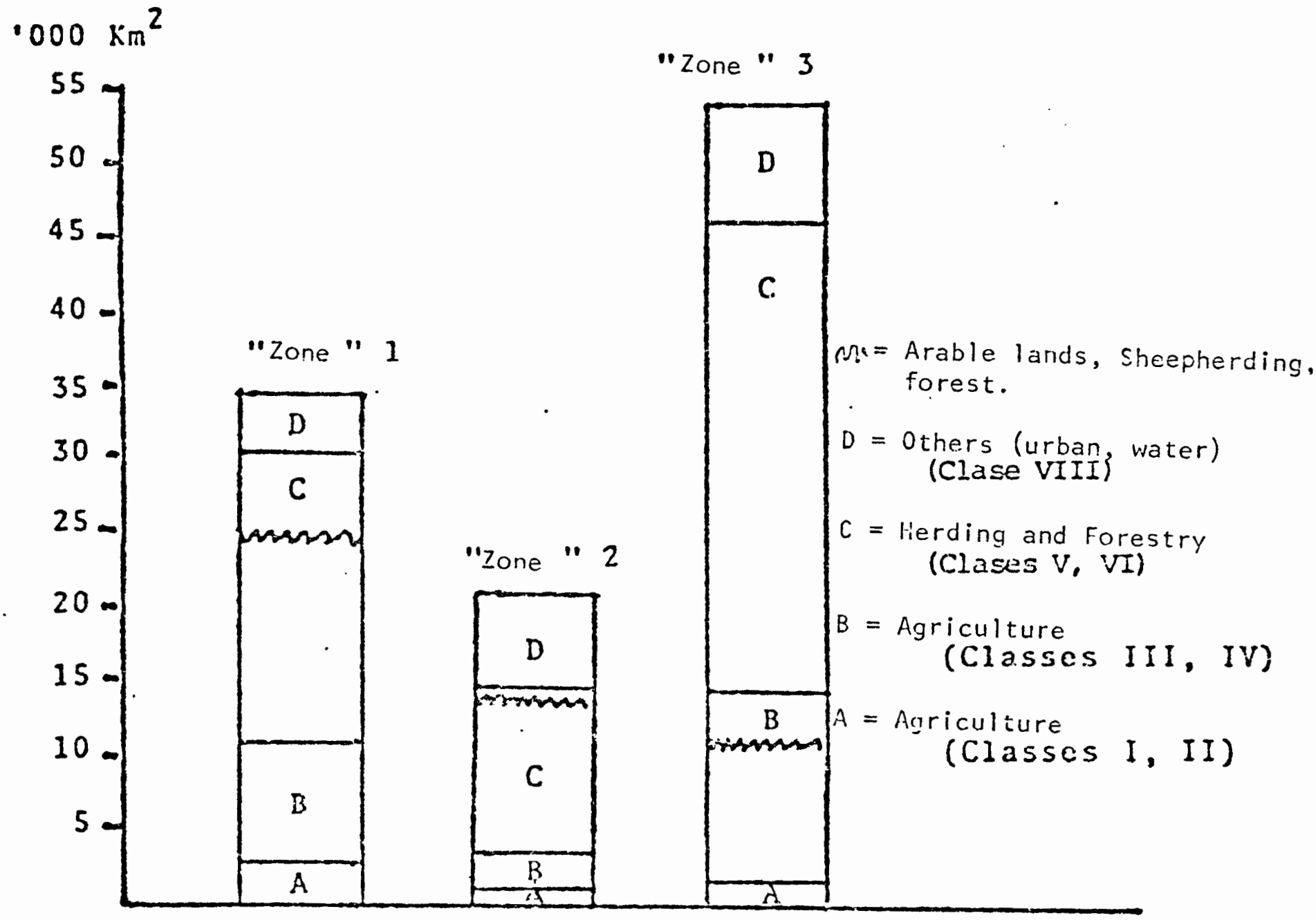


TABLE 4

LAND'S AREA OF THE TREE ZONES (1)

($Km^2$ and % )

| | Kind of Land | Zone 1 | Zone 2 (Km.2) | Zone 3 | Total |
|---|---|---|---|---|---|
| 1. | Agriculture (Classes I, II) | 2747 | 566 | 1381 | 4694 |
| 2. | Agriculture (Classes III, IV) | 8634 | 2433 | 12997 | 24064 |
| 3. | Total Agriculture | 11381 | 2999 | 14378 | 28758 |
| 4. | Grazing land (Calsses V,VI) | 7479 | 4463 | 11260 | 23202 |
| 5. | Forest (Classe VII) | 11683 | 7094 | 21577 | 40354 |
| 6. | Sub Total | 30543 | 14556 | 47215 | 92314 |
| 7. | Class VIII, Urban and Water | 4293 | 5919 | 6363 | 16575 |
| 8. | Total | 34836 | 20475 | 53578 | 108889 |
| 9. | "Cultured " (2) | 24813 | 14435 | 11452 | 50700 |
| 10. | Zone as % of: | | | | |
| | a) Sub-Total (L.6) | 32.0 | 15.9 | 51.1 | 100.0 |
| | b) Total (L.8) | 33.1 | 18.8 | 49.1 | 100.0 |
| | c) Cultured (L.9) | 48.9 | 28.5 | 22.6 | 100.0 |
| 11. | Cultured as % of: | | | | |
| | Sub-Total (L.6) | 81.2 | 99.2 | 24.3 | 54.9 |
| | Respecting each zone | | | | |

(1) Zone 1. Regions I y II; Zona 2. Regiones III, IV y V; Zona 3. Includes regions VI y VII.

(2) "Cultured" refers to areas under cultures as agricultura, grazing or forest. These are never the less, included in the subtotal on line 6

Source: "Estrategia de Desarrollo Regional de Guatemala" SGCNPE, Noviembre, 1,979.

T A B L E  5

GUATEMALA: WAY OF MANAGEMENT OF FARMS, 1964
(Relative figures)

| Concept | Managed by Producer | | Managed by Administrator | |
|---|---|---|---|---|
| | % of farms | % area | % of farms | % area |
| Less than a "manzana" | 99.8 | 99.7 | 0.2 | 0.3 |
| From 1 toless than 2 | 99.7 | 99.8 | 0.3 | 0.2 |
| From 2 toless than 5 | 99.8 | 99.9 | 0.2 | 0.1 |
| From 5 toless than 10 | 99.8 | 99.8 | 0.2 | 0.2 |
| From 10 toless than 32 | 99.4 | 99.2 | 0.6 | 0.8 |
| From 32 toless than 64 | 97.1 | 96.9 | 2.9 | 3.1 |
| From "caballeria" toless than 10 | 80.8 | 71.3 | 19.2 | 28.7 |
| From 10 toless than 20 | 46.3 | 45.0 | 53.7 | 55.0 |
| From 20 toless than 50 | 36.5 | 35.5 | 63.5 | 64.5 |
| From 50 toless than 100 | 23.2 | 22.3 | 76.8 | 77.7 |
| From 100 toless than 200 | 23.3 | 22.3 | 76.8 | 77.7 |
| From 200 and more | 00.8 | ____ | 100.0 | 100.0 |

1. Administrator was defined as the person that carriesout the general disposi-
tions of the farms cownor, who does not manage it directly the ones justactin
as wardens orkeepers are not included.

SOURCE: Agricultural census of 1964.

T A B L E  6

GUATEMALA: NUMBER AND AREAS OF FARMS BY GEOGRAPHICAL ZONES
(

| Zone | Number of explotations | | | | A R E A | | | |
|---|---|---|---|---|---|---|---|---|
| | 1950 | % | 1964 | % | 1950 | % | 1964 | % |
| Central | 51 072 | 14.6 | 53 205 | 12.7 | 607 226 | 11.4 | 197 427 | 10.0 |
| South | 26 008 | 7.4 | 35 490 | 8.5 | 1 024 822 | 19.2 | 971 528 | 19.7 |
| Western | 139 439 | 39.9 | 172 508 | 41.3 | 1 396 188 | 26.2 | 1 381 646 | 28.0 |
| North | 74 418 | 21.3 | 97 443 | 23.3 | 1 531 727 | 28.8 | 1 361 250 | 27.6 |
| Eastern | 57 750 | 16.5 | 58 698 | 14.0 | 755 512 | 14.2 | 714 915 | 14.5 |

1 A "manzana" is equivalent to 0.7 Ha.

SOURCE: Dirección Gencial de Estadística, Censo Agropecuario de 1964.

The ratio of land in farms with respect to total areas in the diferent zone was as follows:

# T A B L E  7

GUATEMALA: RATIO OF LAND IN FARMS TO TERRITORIAL EXTENSION

| Z o n e | Farms area |
|---|---|
| REPUBLIC | |
| Central | 31.6 |
| South | 53.5 |
| West | 92.5 |
| North | 49.2 |
| East | 48.3 |

SOURCE: Dirección General de Estadística, Censo Agropecuario de 1964.

TABLE 8

GUATEMALA: Number and Area of Farms
1950 y 1964

| Size | 1950 | % | 1964 | % | 1950 | % | 1964 | % |
|---|---|---|---|---|---|---|---|---|
| Republic | 348 657 | 100 | 417 144 | 100 | [illegible] | 100 | [illegible] | 100 |
| Less than 1 manzana | 74 253 | 21.3 | 85 083 | 20.4 | [illegible] | 0.8 | 46 683 | 1.0 |
| De 1 a menos de 2 | 91 591 | 26.2 | 98 654 | 23.6 | [illegible] | [illegible] | 130 815 | [illegible] |
| De 2 a menos de 5 | 99 779 | 28.6 | 129 115 | 30.9 | [illegible] | 5.7 | 386 704 | 7.8 |
| De 5 a menos de 10 | 42 444 | 12.2 | 52 023 | 12.5 | [illegible] | 5.3 | 386 904 | 14.0 |
| De 10 a menos de 32 | [illegible] | [illegible] | 37 035 | 8.9 | [illegible] | 8.4 | [illegible] | 19.9 |
| De 32 a menos de 64 | 6 125 | 1.8 | 6 631 | 1.6 | [illegible] | 5.1 | 293 736 | 5.9 |
| De 1 a menos de 10 Caballerías | 6 466 | 1.9 | 7 859 | 1.6 | [illegible] | 21.9 | 1 [illegible] | 39.5 |
| De 10 a menos de 20 | 566 | 0.2 | 561 | 0.1 | [illegible] | 9.5 | 441 914 | 10.3 |
| De 20 a menos de 50 | 354 | 0.1 | 294 | 0.07 | [illegible] | 11.1 | 852 [illegible] | 11.2 |
| De 50 a menos de 100 | 104 | 0.03 | 56 | 0.01 | [illegible] | 8.8 | 242 456 | 4.9 |
| De 100 a menos de 200 | 52 | 0.015 | 50 | 0.012 | [illegible] | 8.2 | 258 926 | 6.1 |
| De 200 y más | 32 | 0.009 | 9 | 0.002 | [illegible] | 11.4 | [illegible] | 4.7 |

**Fuente:** Censo Agropecuario de 1964.

TABLE 9

GUATEMALA: LAND USE ACCORDING TO AGRICULTURAL CENSUS OF 1950 AND 1964. (in "manzanas")

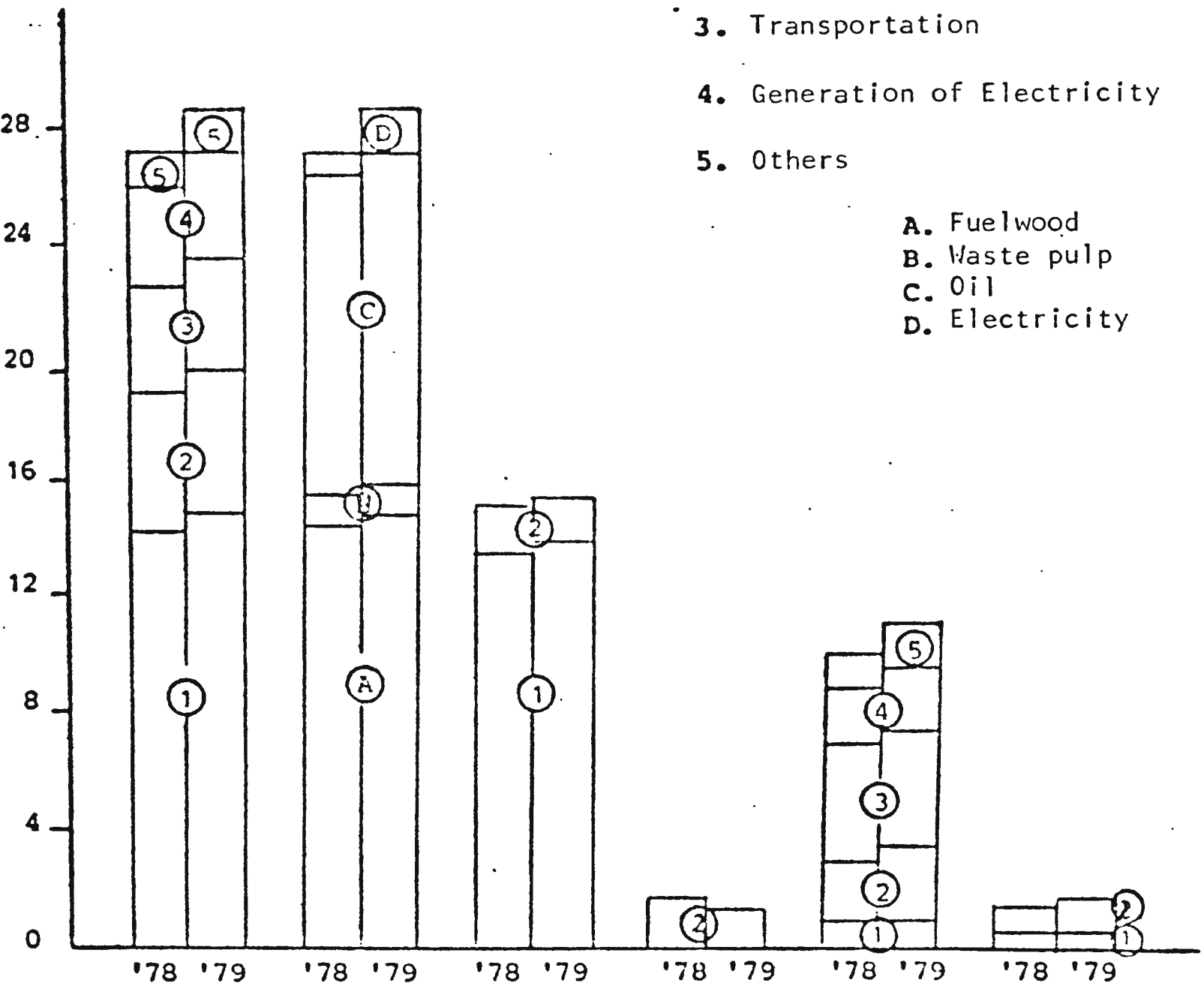
| USE | 1950 | 1964 | INCREASE (PERCENTAGE) |
|---|---|---|---|
| citronella, cotton, corn, beans, wheat, rice, abaca, potato, vegetables, sugar, sesame, cane, tabbaco, banana, lemmon tea, other cultures | 938,000 | 1.200,000 | 27.9 |
| Grazing lands | 332,800 | 829,333 | 149 1 |
| Farming hervested | 1.270,800 | 2.029,333 | 41.2 |
| Coffee, fruits, cacao, rubber, etc. | 237,200 | 450,311 | 80 8 |
| T O T A L U S E D : | 1.498,000 | 2.479,644 | 65.5 |
| Where harvest wast lost and resting lands. | 613,000 | 649,687 | 6 0 |
| Total already cultured | 2 111,000 | 3.129.331 | 48 2 |
| Natural grazing lands | 832,600 | 3.129.331 | - 191 2 |
| Agriculture and cattle Tot, | 2.943,600 | 673,447 | 29 2 |
| Woods, mountains, scrubs and non usables | 2.371,900 | 1.423 988 | — 52 6 |
| T O T A L | 5 315,500 | 4 926 766 | — 7 3 |

SOURCE: Dirección General de Estadística y Comisión Nacional de Programación, Guatemala.

FIGURE 15

Energy supply and use 1978, 1979

(equivalent millions of oil barrels)




Reference

1. Residential, Commerce, Government
2. Industry (including mining and energy indsutry)
3. Transportation
4. Generation of Electricity
5. Others

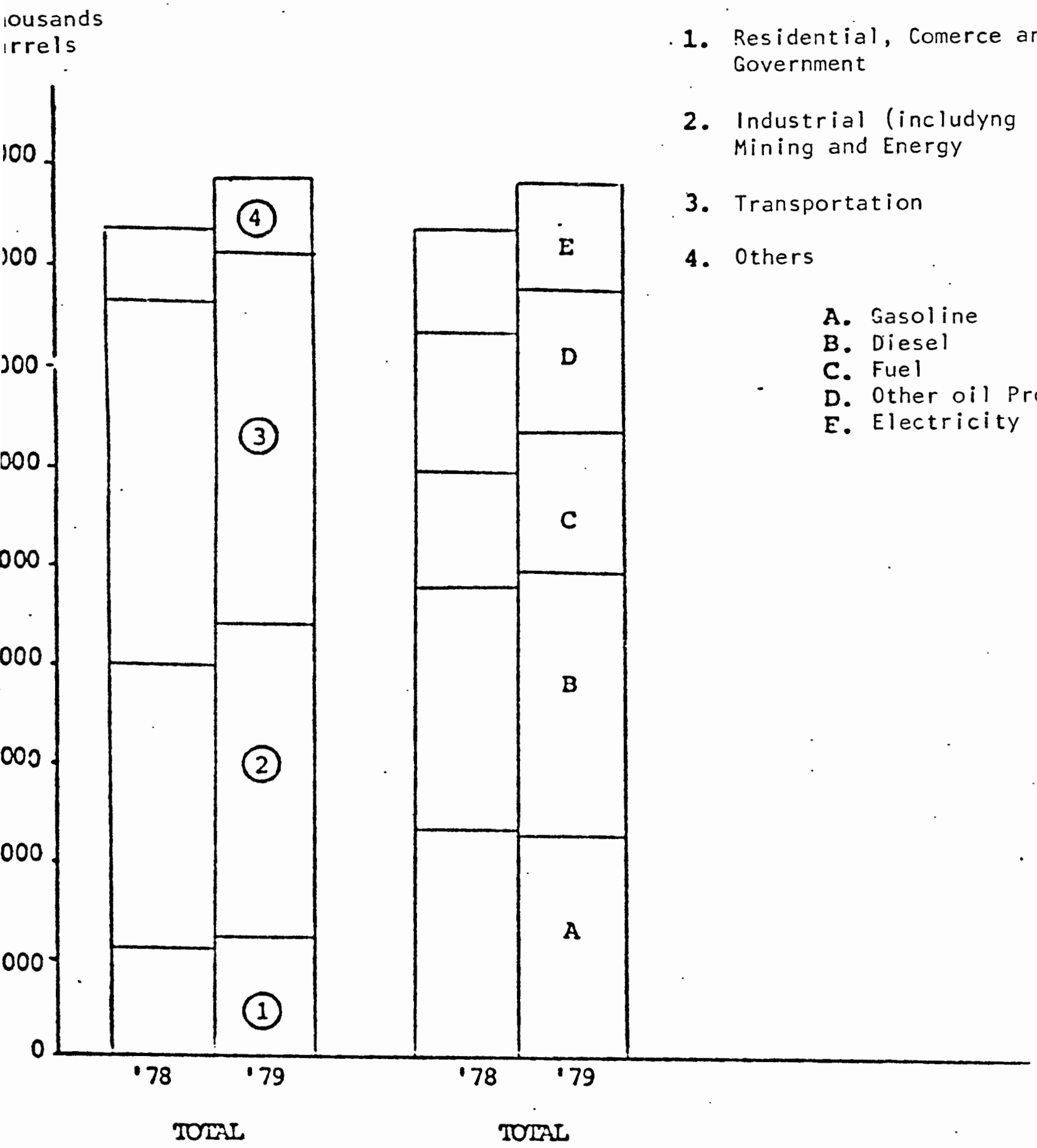
A. Fuelwood
B. Waste pulp
C. Oil
D. Electricity

Source: SGCNPE, VAN MEURS

FIGURE 16

ENERGY PRODUCTS SUPPLY AND USE

(equivalent thousands of oil barrels)




Reference

1. Residential, Comerce and Government
2. Industrial (includyng Mining and Energy
3. Transportation
4. Others

A. Gasoline
B. Diesel
C. Fuel
D. Other oil Products
E. Electricity

Source: SGCNPE, VAN MEURS

## TABLE 10

## URBAN AND RURAL POPULATION OF MIDDLE AGE AND OF MAIN WORKING AGE 1950-1978

('000)

| | 1950 | 1960 | 1970 | 1975 | 1978[E] |
|---|---|---|---|---|---|
| Population Total | 2962 | 3966 | 5353 | 6243 | 6842 |
| Urban | 741 | 1322 | 1793 | 2220 | 2484 |
| Rural | 2221 | 2644 | 3560 | 4023 | 4358 |
| % Urban | 25.0 | 33.0 | 33.5 | 35.6 | 36.3 |
| Middle age | 16.7 | 15.8 | 15.7 | 17.3 | 17.3 |
| % Age 15-64 | 55.8 | 53.8 | 54.3 | 52.1 | 52.7 |

| Increase % annual | 1960/'50 | 1970/'60 | 1975/'70 | 1978/'70 |
|---|---|---|---|---|
| Total | 2.9 | 3.0 | 3.1 | 3.1 |
| Urban | 6.0 | 3.1 | 4.4 | 4.2 |

E = estimated

Source; "Guatemala: Proyección de la Población por Sexo y Grupos de Edad, 1950-2000"; Febrero 1978 y Septiembre 1978; Dirección General de Estadística (CELADE) y United Nations "Statistical Yearbook for Latin America, 1976", U. N. Comisión Económica para América Latina.

TABLE 11

TOTAL POPULATION, RURAL AND URBAN, MIDDLE AGE AND WORKING AGE (Economically, Active), 1978 - 2000

('000)

| | 1978 | 1980 | 1985 | 1990 | 2000 |
|---|---|---|---|---|---|
| Total population | 6842 | 7262 | 8403 | 9677 | 12739 |
| Urban | 2484 | 2672 | 3247 | 2970 | 6004 |
| Rural | 4358 | 4590 | 5156 | 5707 | 6735 |
| % Urban | 36.3 | 36.8 | 38.6 | 41.0 | 47.1 |
| Middle Age % | 17.3 | 17.3 | 18.3 | 18.8 | 20.1 |
| 15.64 years % | 52.7 | 53.1 | 53.9 | 55.0 | 56.7 |
| % Annual Increase | | 1980/78 | 1985/80 | 1990/85 | 2000/90 |
| Total | | 3.0 | 3.0 | 2.9 | 2.8 |
| Urban | | 3.7 | 4.0 | 4.0 | 4.2 |
| Rural | | 2.6 | 2.4 | 2.1 | 1.7 |
| % Annual Increase S/1978 | | | | | |
| **Total** | | 3.0 | 3.0 | 2.9 | 2.9 |
| Urban | | 3.7 | 3.9 | 4.0 | 4.1 |
| Rural | | 2.6 | 2.4 | 2.3 | 2.0 |

Source: ibid, celade, junio y septiembre 1978.

TABLE 12 a

GUATEMALA

TOTAL USE OF RESOURCES, YEAR 200

| | 1977 | Year 2000 Case I | Year 2000 Case II |
|---|---|---|---|
| Hydroelectric | 3,260 | 97,704 | 97,704 |
| Geothermic | 0 | 20,088 | 20,088 |
| Oil | 51,002 | 204,209 | 141,062 |
| Direct uses | 31,171 | 161,009 | 97,862 |
| Electric Generation | 14,165 | 43,200 | 43,200 |
| Losses and unexpected | 5,666 | | |
| Non Commercial | 45,647 | 87,509 | 87,509 |
| Total Resources | 99,909 | 409,510 | 346,343 |

Source: MITRE/E/DI.

# GUATEMALA

## SUMARY OF ENERGY RESOURCES, 1979

| | |
|---|---|
| **Hydroelectrical Potential** | |
| Theoritical Capacity | 10 900 MW (1) |
| Installed Capacity | 101 MW (2) (26% tot.cap.ins.) |
| **Geothermic Energy** | |
| - The potential of the Zunil zone has been estimated between 70 and 370 MW for 30 years. The electrical capacity forecasted for Zunil in 1985 is 55 MW. | |
| - Another promising geothermic field but not proven is located in the north part of Amatitlan with a potential of 1800MW. (3) | |
| **Oil Reserves:** | |
| Proven | 10 300 000 barrels (4) |
| Estimated | 20 000 000 barrels (5) |
| Refining Capacity | 15 200 barrels/day (5) |
| **Gas Reserves** | |
| Proven: | 240 million cubic metres (!) |
| **Charcoal** | |
| There are not known deposits. Some layers of lignite and peat have been descovered southeast of Peten. | |
| **Aeolic Energy** | |
| Winds of the south coast have a uniform diurnal pattern. The country's winds are generally stronger in the dry season, november to end of March (6) | |
| **Solar Energy** | |
| Medium solar radiation varies between 0.21 and 0.35 KW/cubic metres. (7) | |
| **Biomass** | |
| Forests: | There are 5.8 million Ha. of forest and woolands |
| Sugar: | Aroun 77 000 Ha of sugar cane have been harvested in 1978. (8) |

Source: MITRE


(1) Plan Maestro de Suministro de Electricidad, Tomo I, INDE.
(2) Informe Estadistico, 1977, INDE.
(3) Obiols, La situacion del sector de energia en los paises miembros del Mercado Común Centroamericano, 1979.
(4) Actualidad Petrolera en Guatemala, enero a junio de 1979, No. 1.
(5) Petroleum and Energy Policy Guatemala, Capítulo 6 "Analysis".
(6) Comunicación personal con el INSIVUMEH.
(7) Con base en informes de cinco años sobre Huehuetenango y Escuintla.
(8) Anuario de Producción FAO, 1978, Tomo 32.

TABLE 13

SUPPLY AND DEMAND OF ENERGY IN GUATEMALA

('000 bpe and %)

| | ('000 epb) | | (% del Total) | |
|---|---|---|---|---|
| upply | 1978 | 1979 | 1978 | 1979 |
| roduction: | | | | |
| .. Fuelwood | 14,079 | 14,264 | 53.6 | 51.5 |
| 2. Waste Pulp | 1,744 | 1,604 | 6.6 | 5.8 |
| 3. Oil | 221 | 571 | 0.9 | 2.1 |
| 4. Hydro | 172 | 166 | 0.7 | 0.6 |
| | 16,216 | 16,605 | 61.8 | 60.0 |
| mports: | | | | |
| 6. Raw oil | 5,829 | 5,724 | 22.2 | 20.7 |
| 7. Oil Derivatives | 4.203 | 5,341 | 16.0 | 19.3 |
| 8. Total Supply | 26,248 | 27,670 | 100.0 | 100.0 |
| 9. (-) Changes of Stocks and exports | (178) | (664) | 0.7 | 2.4 |
| 0. Available for domestic use | 26,070 | 27,006 | 99.3 | 97.6 |
| Uses | | | | |
| Minus 11. Generating Electricity | (2,517) | (2,809) | 9.6 | 10.2 |
| Minus 12. Losses in Refining | ( 119) | ( 121) | 0.4 | 0.4 |
| 13. Availability for final use. | 23,434 | 24,076 | 89.3 | 87.0 |
| Out of Wich: | | | | |
| Fuelwood | 14,079 | 14,264 | 60.1 | 59.2 |
| Waste Pulp | 906 | 834 | 3.9 | 3.5 |
| Raw oil | 197 | 192 | 0.8 | 0.8 |
| Oil Derivatives | 7,276 | 7,699 | 31.0 | 32.0 |
| Electricity | 976 | 1,087 | 4.2 | 4.5 |

TABLE 14

DEMAND OF ENERGY BY RESOURCE AND FINAL USE 1979

('000 bpe y % del Total)

| | Product | Available for use | Electric converage | Refining losses | Final use | Residential (1) | Industrial | Mining | Transportation | Indus. Energy | Bunker | Without energy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | **Total** | 27006 | 2809 | 121 | 24076 | 14271 | 4485 | 545 | 3776 | 331 | 403 | 265 |
| 2. | % of Total | 100.0 | 10.4 | 0.5 | 89.1 | 52.8 | 16.6 | 2.0 | 14.0 | 1.2 | 1.5 | 1.0 |
| 3. | Fuelwood | 14264 | | | 14264 | 13075 | 1189 | | | | | |
| 4. | Waste Pulp | 1307 | 473 | | 834 | | 834 | | | | | |
| 5. | Oil | 11269 | 3257 | 121 | 7891 | 800 | 2069 | 404 | 3776 | 174 | 403 | 265 |
| 6. | Hydro | 166 | 166 | | | | | | | | | |
| 7. | Electricity from above | | (1087) | | 1087 | 396 | 393 | 141 | | 157 | | |
| 8. | Use of oil derivates and electricity | | | | 8978 | 1196 | 2462 | 545 | 3776 | 331 | 403 | 265 |
| 9. | % Final use of Energy by sector | | | | 100.0 | 13.3 | 27.4 | 6.1 | 42.0 | 3.7 | 4.5 | 3.0 |
| 10. | % Oil use | 100.0 | 28.9 | 1.1 | 70.0 | 7.1 | 18.3 | 3.6 | 33.5 | 1.5 | 3.6 | 2.4 |

TABLE 15

FINAL USE OF ENERGY

1975-1979

($10^6$ c.b.p.)

| | Commercial | | | Non Commercial | | | |
|---|---|---|---|---|---|---|---|
| | Oil and Derivatives | Electricity | Sub Total | Fuelwood | Waste pulp | Sub Total | Total |
| 1975 | 6.01 | 0.66 | 6.67 | 13.17 | 0 94 | 14.11 | 20.78 |
| 1976 | 6 35 | 0.72 | 7.07 | 13.52 | 1.08 | 14 60 | 21 67 |
| 1977 | 7.22 | 0.89 | 8.11 | 13.80 | 1.04 | 14.84 | 22.95 |
| 1978 | 7.47 | 0.98 | 8.45 | 14.08 | 0.91 | 14.99 | 23.44 |
| 1979 | 7.89 | 1.09 | 8.98 | 14.26 | 0.84 | 15.10 | 24.08 |

Source:. "Anuario Estadístico", Secretaría de Minería, Hidrocarburos y Energía Nuclear , Julio 1,980.

TABLE 16 ENERGY BALANCE - GUATEMALA -

YEAR 1979

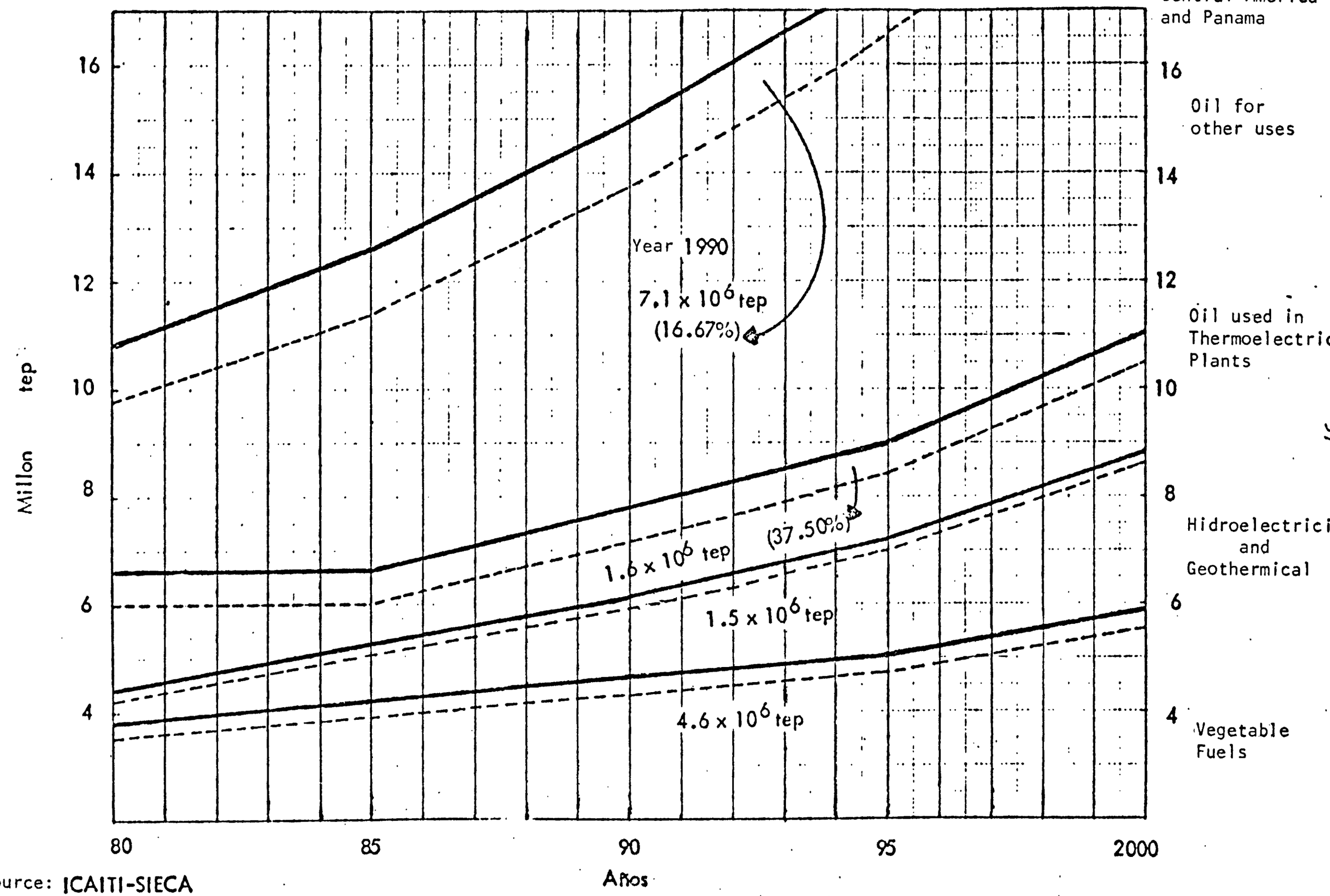
ATRIZ RESUMEN

Unidad Teal.

| | | BALANCE | | | | | | TRANSFORMATION | | | GROSS CONSUMPTION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Origin | Imports | Exports | V.STOCK | Closing | Destiny | Electric Stations | Refine-ries | Fictious Center | Residen-tial and Commer. | Trans porta-tion | Industri and Agro | Others | TOTAL |
| PRIMARY ENERGY | Hydraulic Energy | 232 | -- | -- | -- | -1 | 231 | 231 | -- | -- | -- | -- | | | |
| | Oil | 788 | 7 898 | -- | -59 | -- | 8 745 | 523 | 7 957 | 265 | -- | -- | 265 | -- | 265 |
| | Natural Gas | 47 | -- | -- | -- | -- | -- | -- | -- | 47 | -- | -- | | | |
| | Fuelwood | 20 189 | -- | -- | -- | -- | 20 189 | -- | -- | 20 189 | 18 507 | -- | 1 682 | -- | 20 189 |
| | Vegetable Wastes | 2 765 | -- | -- | -- | -- | 2 765 | 719 | -- | 2 046 | -- | -- | 1 269 | -- | 1 269 |
| | TOTAL | 24 021 | 7 898 | -- | -59 | -1 | 31 859 | 1 473 | 7 957 | 22 547 | 18 507 | -- | 3 216 | -- | 21 722 |
| SECUNDARY ENERGY | Electricity | 1 514 | -- | -- | -- | -- | 1 514 | -- | -- | -- | 457 | -- | 543 | 509 | 1 511 |
| | Liquid Gas | 30 | 554 | -- | -- | -87 | 497 | -- | -- | -- | 379 | -- | 113 | 5 | 497 |
| | Gasoline | 1 395 | 1 887 | -- | -113 | -226 | 3 169 | -- | -- | -- | -- | 3 168 | -- | -- | 3 168 |
| | Kerosene & Jet.F | 826 | 210 | -- | 4 | - 13 | 1 027 | -- | -- | -- | 383 | 28 Int. 445 Ext. | 171 | -- | 1 027 |
| | DIESEL OIL | 2 584 | 2 497 | -- | 168 | -337 | 4 914 | 1 271 | -- | -- | 46 | 2886 Int. 29 Ext. | 1 122 | 355 | 3 537 |
| | Heavy Fuel | 3 007 | 1 835 | -- | 150 | -311 | 4 681 | 2 492 | -- | -- | 15 | 81 | 1 222 | 699 | 2 009 |
| | Non Energetic | -- | 320 | -- | 29 | - 64 | 485 | -- | -- | -- | -- | -- | | 368 | 368 |
| | Refined Gas | 32 | -- | -- | -- | -- | 32 | -- | -- | -- | -- | -- | | 32 | 32 |
| | TOTAL | 9 399 | 7 303 | -- | 464 | -1052 | 16 328 | 3 763 | -- | -- | 1 280 | 5 736 | 3 176 | 1 968 | 12 159 |
| Transfor. Losses | | | | | | | | 3722 | 72 | -- | | | | | |
| Total Consumption | | | | | | | | | | | 19 787 | 5 736 | 6 391 | 1 968 | 33 880 |

TABLE 17

CENTRAL AMERICA AND PANAMA ESTIMATES OF ENERGY CONSUMPTION FOR 1980 TO 2000




Source: ICAITI-SIECA

TABLE 18

WOODLANDS AND POPULATION

GUATEMALA 1979

| | Area $K^2$ | % | Woodlands $K^2$ | % | Rural Population (5000) | Hab. Per $K^2$ |
|---|---|---|---|---|---|---|
| 1. Central Plateau | 4,660 | 4.3 | 1,370 | 3.2* | 775 | 566 |
| 2. High Plateau | | | | | | |
| - Central | 7,864 | 7.2 | 1,805 | 4.2* | 1,269 | 703 |
| - North | 15,781 | 14.5 | 5,400 | 12.4 | 864 | 160 |
| 3. South Coast | 11,715 | 10.7 | 1,278 | 2.9 | 947 | 741 |
| 4. West | | | | | | |
| - Central | 12,270 | 11.3 | 3,616 | 8.3 | 835 | 231 |
| - Atlántic | 9,038 | 8.3 | 2,993 | 6.9* | 208 | 69 |
| 5. Verapaz | 11,810 | 10.8 | 5,228 | 12.0 | 368 | 70 |
| 6. Subtotal | 73,138 | 67.1 | 21,690 | 49.9 | 5,266 | 2,540 |
| 7. El Petén | 35,854 | 32.9 | 21,760 | 50.1 | 182 | 8 |
| 8. Total | 108,992 | 100.0 | 43,450 | 100.0 | 5,448 | 2,548 |

Source: FAO, CEMAT

TABLE 19

PRODUCTION, DISTRIBUTION AND CONSUMPTION OF FUELWOOD AND WOOD

GUATEMALA, 1979

PRODUCTION

| | Stock Forest $10^6 \times M^3$ (2) | Forest Growth $10^3 \times M^3$ (2) | Felling $10^3 \times M^3$ (3) | Grouth Balance 2 - 3 $10^3 \times M^3$ (4) | Lasting of Stock 1 ÷ 4 years (5) |
|---|---|---|---|---|---|
| 1. Central Plateau | 15.3 | 410 | 1,700 | -1,290 | 12 |
| 2. High Plateau | 81.0 | 1,685 | 5,050 | -3,365 | 19* |
| 3. South Coast | 14.7 | 285 | 2,100 | -1,815 | 8 |
| 4. East | 80.9 | 1,650 | 2,630 | - 980 | 44* |
| 5. Verapaz | 62.1 | 1,190 | 1,465 | - 275 | 32* |
| 6. Sub-total | 254.0 | 5,220 | 12,945 | -7,725 | 23* |
| 7. El Petén | 673.0 | 600 | 2,080 | -1,480 | |
| 8. TOTAL | 927.0 | 3,545 | 15,025 | -12,525 | 60* |

Source: FAO, CEMAT

TABLE 20

PRODUCTION, DISTRIBUTION AND CONSUMPTION OF FUELWOOD AND WOOD

GUATEMALA, 1979

DISTRIBUTION

| | COMMERCIALIZED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (6) Domestic Fuelwood + Industrial $10^3 \times M^3$ | (7) Price Q/$M^3$ | (8) Value 6 x 7 $10^{12}$ Q. | (9) Other Vol. $10^3 \times M^3$ | (10) Price Q/$M^3$ | (11) Value 9 x 10 Q. | Total commercial Vol. $10^3 \times M^3$ | No. Commercialized in Vol. $10^3 \times M^3$ |
| 1. Central Plateau | 1,076 | 20.0 | 21.5 | 57 | 25.6 | 1.4 | 1,133 | 567 |
| 2. High Plateau | 1,459 | 15.6 | 22.8 | 234 | 20.0 | 4.6 | 1,693 | 3,357 |
| 3. South Coast | 734 | 12.0 | 8.8 | 51 | 15.3 | 0.7 | 785 | 1,315 |
| 4. East | 495 | 18.0 | 8.9 | 126 | 23.0 | 2.9 | 621 | 2,009 |
| 5. Verapaz | 265** | 10.0 | 2.6 | 128 | 12.0 | 1.2 | 393 | 1,042 |
| 6. Sub-total | 4,029 | 16.0 | 64.6 | 596 | 18.1 | 10.8 | 4,625 | 8,290 |
| 7. El Petén | ** | | | | (11.0) | (11.0) | (1,000) | (1,080) |
| 8. TOTAL | | | 64.6 | | | 10.8 | | |

Source: FAO, CEMAT

TABLE 21

PRODUCTION, DISTRIBUTION AND CONSUMPTION OF FUELWOOD AND WOOD

GUATEMALA, 1979

CONSUMPTION

| | TOTAL $10^3 \times M^3$ | Fuelwood domestic $10^3 \times M^3$ | Small industry $10^3 \times M^3$ | Others (Wood ..) $10^3 \times M^3$ | TOTAL $10^3 \times M^3$ |
|---|---|---|---|---|---|
| 1. Central Plateau | 1,630 | 1,345 | 285 | 70 | 1,700 |
| 2. High Plateau | 4,465 | 3,685 | 780 | 585 | 5,050 |
| 3. South Coast | 1,990 | 1,640 | 350 | 110 | 2,100 |
| 4. East | 2,180 | 1,800 | 380 | 450 | 2,630 |
| 5. Verapaz | 1,010 | 830 | 180 | 455 | 1,465 |
| 6. Sub-total | 11,275 | 9,300 | 1,975 | 1,670 | 12,945 |
| 7. El Petén | 150 | 125 | 25 | 1,930 | 2,080 |
| 8. TOTAL | 11,425 | 9,425 | 2,000 | 3,600 | 15,025 |

Source: FAO, CEMAT

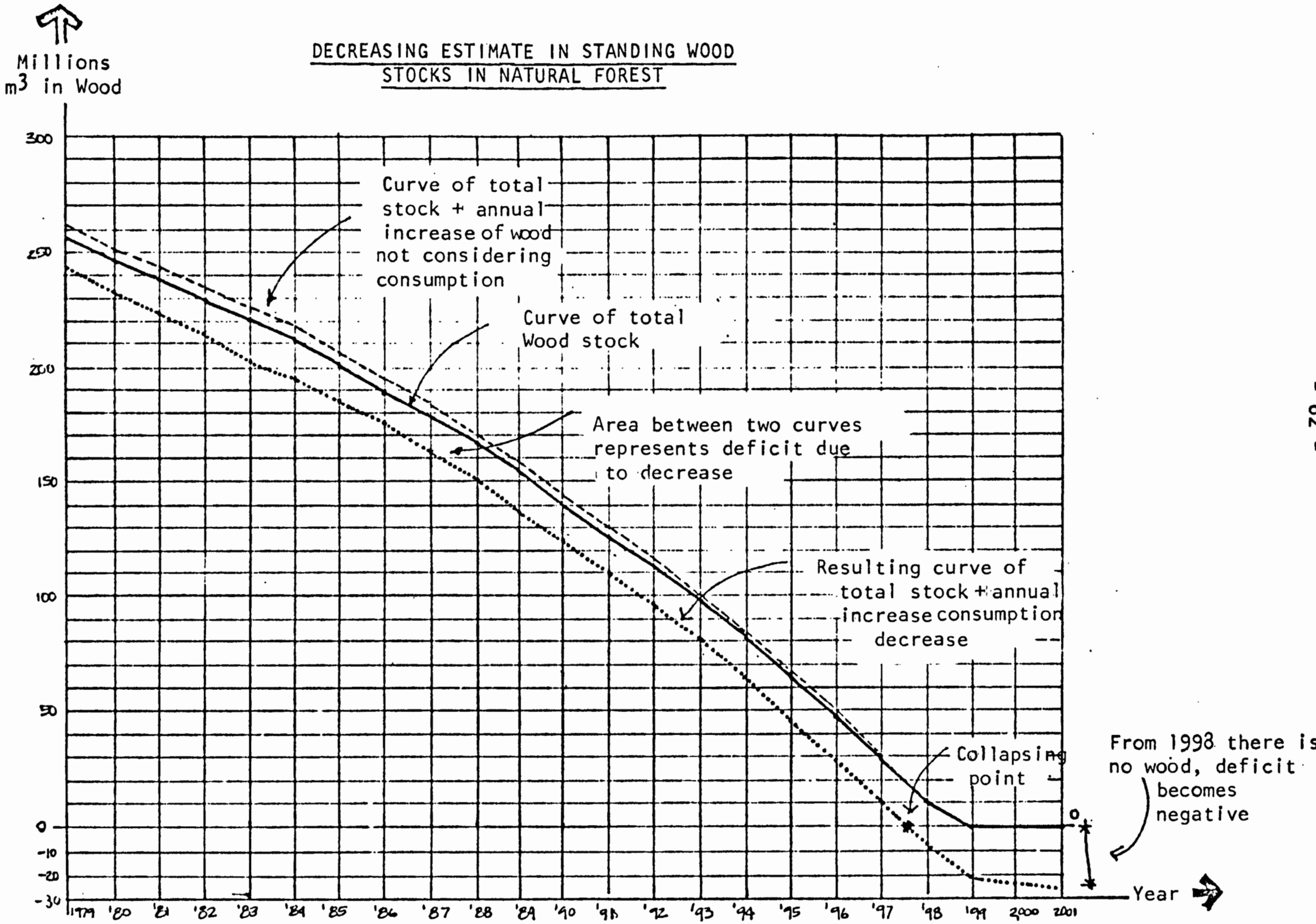
TABLE 21 a

ESTIMATED NUMBER OF HOUSE HOLDS THAH BUY FUELWOOD, 1980

(000)

| | Urban | Rural | Total | % |
|---|---|---|---|---|
| Western High Plateau | 54.0 | 89.0 | 143.0 | 36 |
| Central High Plateau | 88.5 | 17.0 | 105.5 | 27 |
| Low lands of the Pacific | 33.0 | 39.0 | 72.0 | 18 |
| Western Low Lands | 20.5 | 28.0 | 48.5 | 12 |
| Verapaz-Petén | 9.5 | 16.5 | 26.0 | 7 |
| TOTAL | 205.5 | 189.5 | 395.0 | 100 |

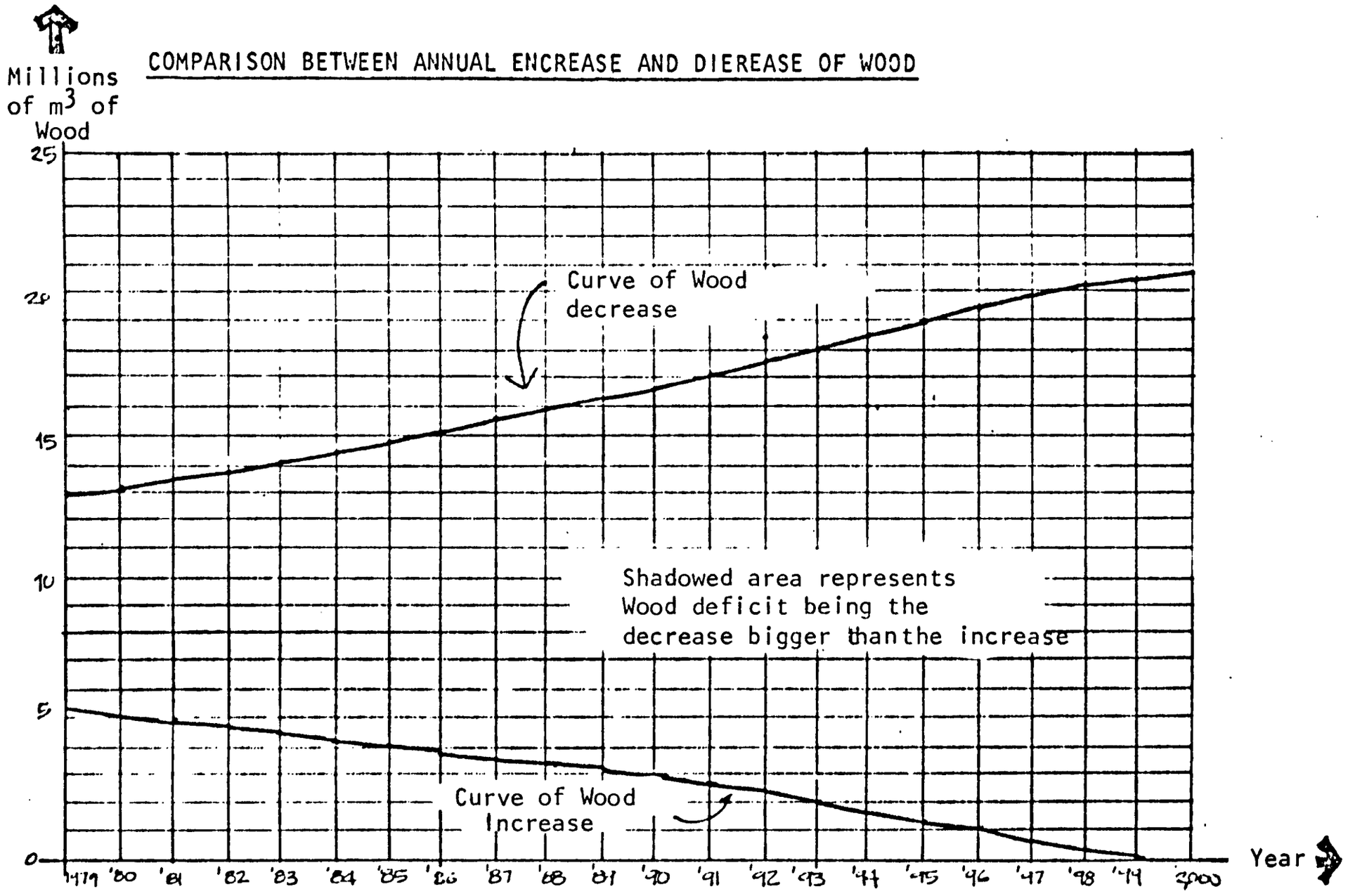
FIGURE 10




Source: FAO, CEMAT

FIGURE 11

COMPARISON BETWEEN ANNUAL ENCREASE AND DIEREASE OF WOOD




Source: **FAO, CEMAT**

TABLE 22

MAIN FUEL *

USED FOR COCKING

% OF FAMILLIES

CENSO - 1973

| | |
|---|---|
| Electricity | 1 |
| Propane Gas | 7 |
| Kerosene | 7 |
| Charcoal | 2 |
| Fuelwood | 81 |
| No Answer | 2 |
| | 100 % |

TABLE 23

ANNUAL AVERAGE USE

OF FUEL, PER PERSON *

| | Natural Units | Energy Equivalent (m.J.) |
|---|---|---|
| Fuelwood | | |
| Families that only use Fuelwood | 1,650 lbs. | 15,000 |
| Families that combine it with other Fuels | 1,125 lbs. | 10,230 |
| Families that use Fuelwood | 1,560 lbs. | 14,200 |

TABLE 24

| | Natural Units | Energy Equivalent (M.J.) |
|---|---|---|
| Kerosene | | |
| Families that only use Kerosene | 14 gal. | 1,980 |
| Families that combine it with other Fuels | 4.4 gal. | 620 |
| Families that use Kerosene | 9 gal. | 1,270 |
| Propane Gas | | |
| Families that only use Propane | 75 lbs. | 1,695 |
| Families that combine it with other Fuels | 30 lbs. | 680 |

TABLE 25

AVERAGE ANNUAL FUEL COST

FOR A SIX MEMBER FAMILY *

| | (Quetzales of 1979) |
|---|---|
| Fuelwood (for families that buy it) | 175.00 |
| Propane Gas | 85.00 |
| Kerosene | 74.00 |

TABLE 26

% OF FAMILIES THAT USE DIFFERENT SOURCES OF LIGHTING, ACCORDING TO THE 1973 CENSUS *

| | |
|---|---|
| Electricity (public) | 26 |
| Electricity (private) | 2 |
| Gas/Kerosene | 50 |
| Canole | 7 |
| Others | - |
| Not Available | 15 |
| | 100 % |

* Source: VAN MEURS, SGCNPE

TABLE 28

| Fuel | Natural Units | Energy Equivalent (MJ) |
|---|---|---|
| Fuelwood | 1,650 lbs. s.h. | 13,530 |
| Kerosene | 14 galones | 1,855 |
| Propane | 75 libras | 1,580 |

TABLE 29

| | | Cooking Fuel | Lighting Fuel | Total Fuel |
|---|---|---|---|---|
| Fuel wood | - Tons dried in ovens | 3,851,445 | - | 3,851,445 |
| | - Millions MJ | 69,480 | - | 69,480 |
| Kerosene | - Barrels | 216,095 | 77,025 | 293,120 |
| | Millions MJ | 1,205 | 430 | 1,635 |
| Propane Gas | - Barrils | 387,079 | - | 387,079 |
| | Millions MJ | 1,550 | - | 1,550 |

| | Quetzales 1979 |
|---|---|
| Fuel Wood ( Bought ) | 175 |
| Propane | 85 |
| Kerosene | 74 |

TABLE 30

| Cooking Fuel | % of Families | | | |
|---|---|---|---|---|
| | Main Urban Areas | Other Urban Areas | Area Rural | Total |
| Fuelwood | 32 | 52 | 79 | 66 |
| Fuelwood and Propane gas | 14 | 12 | 3 | 6 |
| Fuelwood and Kerosene | - | 6 | 12 | 8 |
| Propane Gas | 35 | 19 | 3 | 12 |
| Kerosene | 17 | 8 | 3 | 7 |
| Charcoal | 2 | 3 | - | 1 |

TABLE 30 a

EXAMPLES OF FUELWOOD PRICES TO THE FINAL CONSUMER DECEMBER. 1979

(Q/m$^3$ solid )

| | Pine | Oak or other |
|---|---|---|
| Central High Plateau | | |
| Chimaltenango | - | 19.00 |
| Tecpán | - | 18.00 |
| Ciudad de Guatemala | - | 23.00 (30.00)* |
| Western High Plateau | | |
| Sololá | - | 13.50 |
| Quiché | - | 15.00 |
| Huehuetenango | - | 18.00 |
| Quetzaltenango | 17.00 | - (27.00)* |
| San Antonio Sacatepéquez, San Marcos | - | 10.00 |
| Low Land of the Pacific | | |
| Escuintla | - | 16.00 |
| Retalhuleu | - | 10.00 |
| Mazatenango | - | 10.00 |
| Western Low Land | | |
| Jutiapa | - | 17.00 |
| Zacapa | - | 17.00 |
| Chiquimula | | 20.00 |
| Verapaz-Petén | 8-10.00 | |

* Prices in brackets are 1980 prices.

TABLE 30 b

FUELWOOD COST FOR DISTRIBUTOR IN GUATEMALA CITY DECEMBER, 1980

| | Q/task | Q/$m^3$ solid |
|---|---|---|
| 1. Felling, cutting, stocking up | 1.70 | 2.00 |
| 2. Transportation to road | 2.00 | 2.50 |
| 3. Transportation to distribution center | 5.00 | 7.50 |
| 4. Other costs (20%) | 2.00 | 2.50 |
| 5. Sub-total | 11.70 | 14.50 |
| 6. Utility | 3.30 | 4.50 |
| 7. Distributor's Price | 15.00 | 19.00 |

TABLE 31

ESTIMATE WASTE PULP CONSUMPTION

1975 - 1979

(000's t.m.)

| Year | Total | sugar mill use (co generating) | Panelling use (heat generating) |
|---|---|---|---|
| 1975 | 1,223 | 1,056 | 167 |
| 1976 | 1,419 | 1,225 | 194 |
| 1977 | 1,359 | 1,174 | 186 |
| 1978 | 1,184 | 1,022 | 162 |
| 1979 | 1,089 | 940 | 149 |

Source: "Anuario Estadístico", Secretaría de Minería, Hidrocarburos y Energía Nuclear, Julio 1980.

FIGURE 12

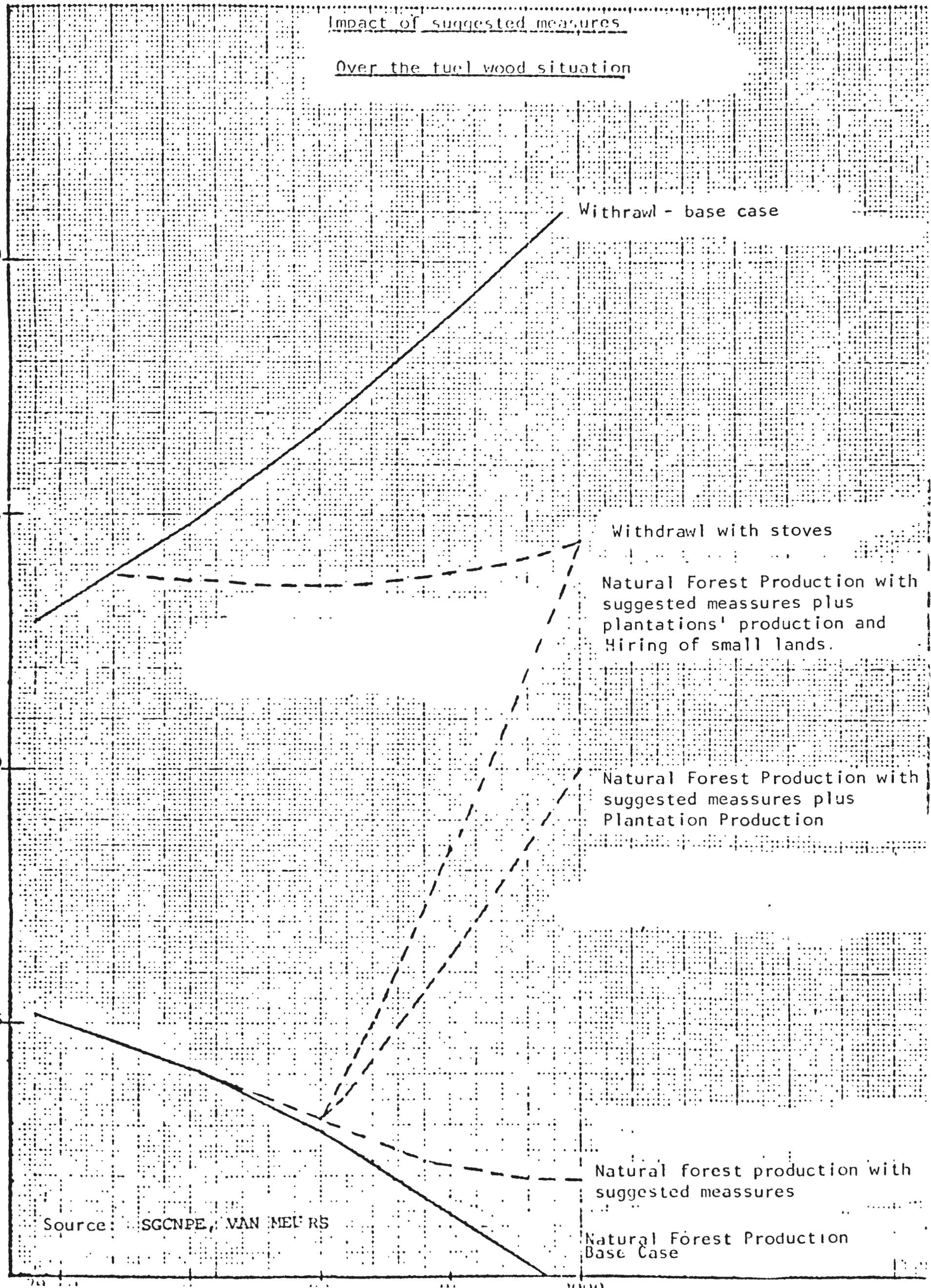
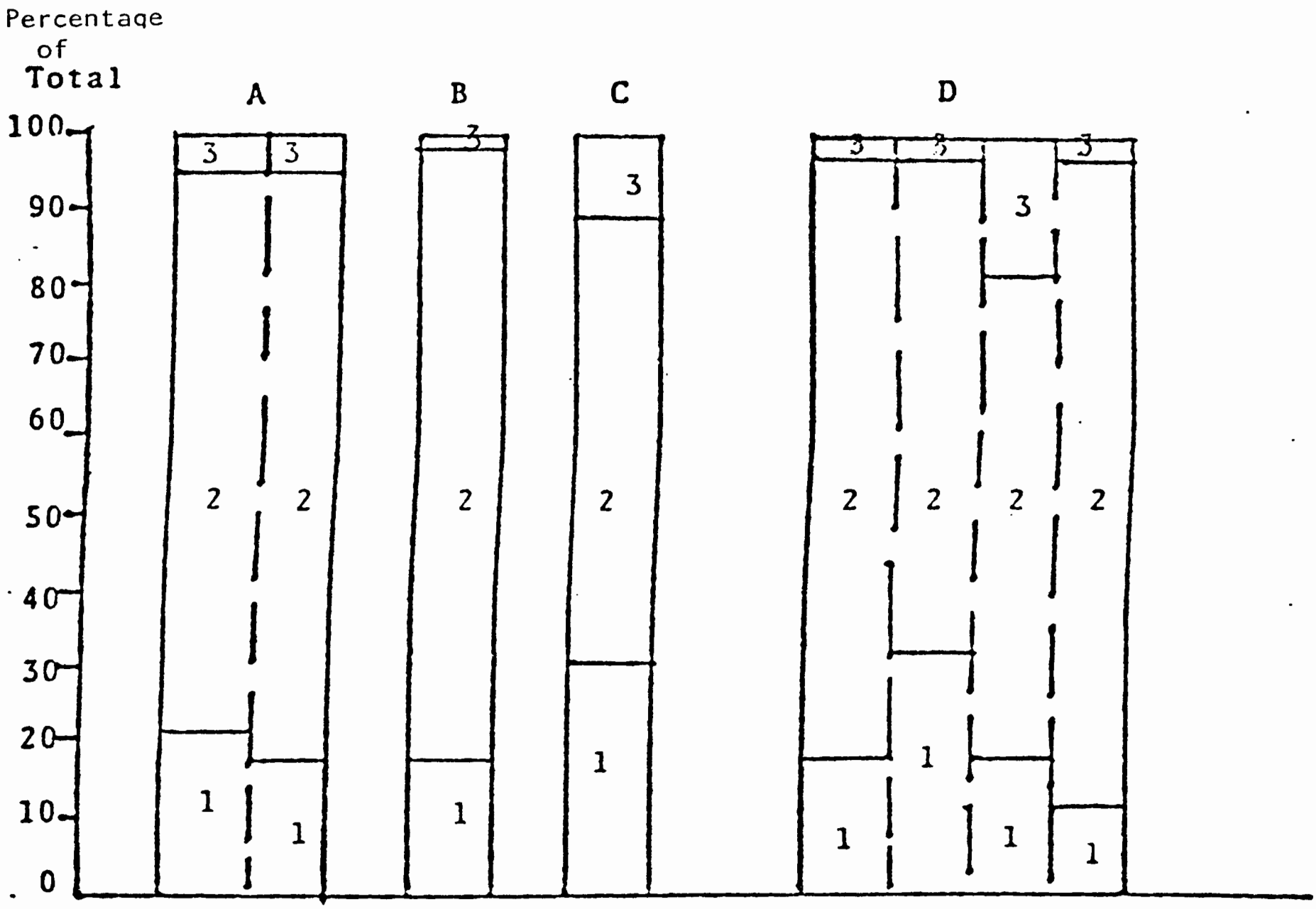

Impact of suggested measures
Over the fuel wood situation
Withrawl - base case
20
15
10
5
Withdrawl with stoves
Natural Forest Production with suggested meassures plus plantations' production and Hiring of small lands.
Natural Forest Production with suggested meassures plus Plantation Production
Natural forest production with suggested meassures
Natural Forest Production Base Case
Source: SGCNPE, VAN MEURS

Figure 13

MAIN ECONOMIC INDICATORS




1,2,3 = Zone 1, 2, 3.

A = Industrial Establishments; Number and Laborers

B = Electricity Consumption

C = Total Public Investment, 1970-76

D = Manufactured Added Value: total Foodstuff and Beverages, Wood and Furnitures, Others.

Source: SGCNPE, VAN MEURS

TABLE 32

GUATEMALA'S TRADE BALANCE MAIN CONSTITUENTS, SELECTED YEARS

(Q. Millions Q.)

| | 1975 | 1977 | 1978 | 1979 |
|---|---|---|---|---|
| Exports, F.O.B. | 517 | 1189 | 1092 | 1221 |
| Imports, F.O.B. | 554 | 1142 | 1284 | 1403 |
| Commercial Balance | -37 | 47 | -192 | -182 |
| Export Services | 60 | 214 | 263 | 330 |
| Import Services | 154 | 418 | 449 | 481 |
| Gross Transfers | 27 | 97 | 114 | 127 |
| Current account Balance | -104 | -60 | -263 | -206 |
| Gross Private Investment | 20 | 125 | 233 | 76 |
| Long Term Government | 78 | 67 | 102 | 119 |
| Short Term Government | 11 | 36 | 8 | 2 |
| Working Capital Balance | 109 | 228 | 342 | 197 |
| Others | 25 | 9 | -11 | -6 |
| Changes in Reserves | -30 | -179 | -69 | 15 |
| (-) It is an increase in Reserves | | | | |
| Total of Reserves (Dec) | | 723 | 792 | 777 |

Source: Based on data privided by El Banco de Guatemala

TABLE 33

IMPACTS IN TRADE BALANCE INDUCTED BY ENERGY FOR 1980

1985, 1990.

(MMQ Q. of 1977)

| | | 1980 | 1985 | 1990 |
|---|---|---|---|---|
| (A) | Payments | | | |
| 1. | Imports of energy items | 145 | - | - |
| 2. | Imp. of machinery and equipment | 125 | 350 | 800 |
| 3. | Interest and payment of dividends | 15 | 125 | 435 |
| 4. | Total of payments in current account | 285 | 475 | 1235 |
| (B) | Income | | | |
| 5. | Exports of energy items | - | - | - |
| 6. | Exports of consumers goods and additional services inducted by energy | - | 280 | 640 |
| 7. | Direct imports | - | 100 | 140 |
| 8. | Total of earnings current account | - | 380 | 780 |
| (C) | Balance of current account | | | |
| 9. | (line 8 - line 4) | -285 | -95 | -455 |
| II. | Capital acount | | | |
| 10. | New income capital | 150 | 400 | 850 |
| 11. | Minus repratiations | -10 | -100 | -360 |
| 12. | Gross income | 140 | 300 | 490 |
| III. | Total balance of payment | | | |
| 13. | (line 9 - line 12) | -145 | -205 | 45 |
| IV. | Comparison with no investment | | | |
| 14. | Imports of energy products | 255 | 325 | 420 |
| 15. | Favorable effect (L.13+14) | 110 | 530 | 465 |

(1) Estimate

TABLE 34

ENERGY DEMAND BY CONSUMER SECTOR AND BY RESOURCE

(MM bpe)

| | 1979 | 1980 | 1985 | 1990 | 2000 |
|---|---|---|---|---|---|
| Residential, Commercial and Government | | | | | |
| Oil | 0.80 | 0.83 | 1.06 | 1.21 | 1.47 |
| Electricity | 0.40 | 0.44 | 0.71 | 1.17 | 2.23 |
| Commercial Total | 1.20 | 1.27 | 1.77 | 2.38 | 3.70 |
| Fuelwood | 13.08 | 13.18 | 14.19 | 14.29 | 16.58 |
| Others | - | - | - | 0.25 | 0.65 |
| Total of Sector | 14.28 | 14.45 | 15.96 | 16.91 | 20.93 |
| Transportation | | | | | |
| Oil | 3.78 | 3.89 | 5.05 | 6.55 | 10.93 |
| Electricity | - | - | - | - | 0.40 |
| Others | - | - | - | 0.20 | 0.50 |
| Industry (1) | | | | | |
| Oil | 2.65 | 2.74 | 3.26 | 3.85 | 5.95 |
| Electricity | 0.69 | 0.74 | 1.19 | 1.84 | 4.62 |
| Commercial total | 3.34 | 3.48 | 4.45 | 5.69 | 10.07 |
| Fuelwood | 1.19 | 1.21 | 1.30 | 1.47 | 1.80 |
| Waste Pulp | 0.83 | 0.85 | 0.92 | 1.05 | 1.20 |
| Others | - | - | - | 0.20 | 0.65 |
| Total Sector | 5.36 | 5.54 | 6.67 | 8.40 | 13.72 |
| Not energy oil products | | | | | |
| Bunkers | 0.67 | 0.68 | 0.80 | 0.94 | 1.50 |
| Total Final Demand | 24.08 | 24.56 | 28.48 | 33.01 | 47.98 |
| Total Commercial (2) | 8.99 | 9.32 | 12.07 | 15.76 | 27.10 |
| Total Oil (3) (3) | 7.89 | 8.14 | 10.17 | 12.55 | 19.35 |
| Total Electricity | 1.09 | 1.18 | 1.90 | 3.00 | 7.25 |
| Total Fuelwood | 14.27 | 14.39 | 15.49 | 15.75 | 18.38 |
| Total Waste Pulp | 0.83 | 0.85 | 0.92 | 1.05 | 1.20 |
| Others | - | - | - | 0.65 | 1.80 |

(1) Industry: Including manufactures, mining, agriculture, forestry, fishing and energy industry for self-use.

(2) Commercial energy considers oil and electricity. Much of the fuelwood is also commercial and part of the new resources will also be commercial, but there is no estimate of the Comercial portion.

(3) In addition to oil for the final consumers sector, considerable guantities are used to generate electricity and great amounts are last in refining.

Oil estimates for the needed amounts for electricity generation and total oil recquirements are:

| (MM bpe) | 1979 | 1980 | 1985 | 1990 | 2000 |
|---|---|---|---|---|---|
| Oil to generate electricity | 3.26 | 3.48 | 3.90 | 4.20 | 11.50 |
| Total oil recquirements | 11.27 | 11.77 | 14.24 | 17.05 | 31.54 |

TABLE 35

TOTAL ESTIMATE PRODUCTION OF

SUGAR CANE AND WASTE PULP

1975 - 1979

(000's t.m.)

| Year | Sugar Cane | Waste Pulp* |
|---|---|---|
| 1975 | 5,560 | 1,501 |
| 1976 | 6,449 | 1,741 |
| 1977 | 6,179 | 1,668 |
| 1978 | 5,380 | 1,453 |
| 1979 | 4,949 | 1,336 |

* With average humidity of 50%

Source: "Anuario Estadístico", Secretaria de Minería, Hidrocarburos y Energía Nuclear, Julio 1980.

TABLE 36

## OIL SUPPLY AND USE AND BALANCE 1978-79.

('000 bpe)

| | | |
|---|---|---|
| a) OFFER (SUPPLY) | 1978 | 1979 |
| 1. Production | 221 | 571 |
| 2. Raw imports | 5,829 | 5,724 |
| 3. Imports products | 4,203 | 5,341 |
| 4. Chages in stock and exports | 145 | (367) |
| TOTAL SUPPLY | 10,398 | 11,269 |
| b) USES | | |
| 1. Electricity Conversion | 2,806 | 3,257 |
| 2. Refining losses | 119 | 121 |
| 3. Products Production | 7,276 | 7,699 |
| 4. Direct use of raw | 197 | 192 |
| TOTAL USE | 10,398 | 11,269 |
| FINAL TOTAL USE (b) 3 + 4 = | 7,473 | 7,891 |

TABLE 37

GUATEMALA: APPARENT CONSUMPTION OF DERIVATES OF OIL FUELS 1960 to 1976

(Thousands of tons)

| Year | TOTAL CONSUMPTION Gross | Net | Gasoline | Kerosene | Diesel and Gas oil | Bunker (fuel Oil) | Gas (Propane/ Butane) | Fuel consumpti in refineries and losses |
|---|---|---|---|---|---|---|---|---|
| 1960 | 464 | 459 | 129 | 34 | 86 | 208 | 2 | 5 |
| 1961 | 483 | 473 | 130 | 45 | 91 | 209 | 3 | 5 |
| 1962 | 478 | 473 | 110 | 53 | 88 | 220 | 2 | 5 |
| 1963 | 493 | 479 | 125 | 58 | 81 | 212 | 3 | 14 |
| 1964 | 579 | 562 | 147 | 54 | 137 | 219 | 5 | 17 |
| 1965 | 636 | 617 | 171 | 47 | 156 | 230 | 13 | 19 |
| 1966 | 619 | 600 | 171 | 41 | 136 | 237 | 15 | 19 |
| 1967 | 653 | 637 | 176 | 42 | 168 | 233 | 18 | 16 |
| 1968 | 734 | 666 | 166 | 72 | 192 | 215 | 21 | 68 |
| 1969 | 791 | 714 | 172 | 76 | 208 | 237 | 21 | 77 |
| 1970 | 710 | 675 | 170 | 64 | 194 | 223 | 24 | 35 |
| 1971 | 781 | 744 | 176 | 95 | 193 | 258 | 22 | 37 |
| 1972 | 867 | 821 | 203 | 97 | 235 | 262 | 24 | 46 |
| 1973 | 943 | 903 | 225 | 100 | 266 | 288 | 24 | 40 |
| 1974 | 944 | 907 | 228 | 88 | 259 | 304 | 28 | 37 |
| 1975 | 1 026 | 987 | 248 | 76 | 324 | 308 | 31 | 39 |
| 1976 | 1 036 | 1 014 | 256 | 74 | 336 | 318 | 30 | 22 |

Calculated by SIECA With Data from SIECA and CEPAL

TABLE 38

FINAL USE OF ENERGY BY SECTOR 1979

(000' b.p.e.)

| Uses of Energy | Ships Planes (1) | Energy Industries | Internal Transportation | Mining | Agriculture | Cement Industry | Other Industries. | Residential |
|---|---|---|---|---|---|---|---|---|
| Oil and derivatives and gas | | | | | | | | |
| 1. Raw oil | | | | | | 192 | | |
| 2. Propanel/butane | | | | | 16 | | 64 | 223 |
| 3. Refinery gas | | 43 | | | | | | |
| 4. Plane Fuel | | | 76 | | | | | |
| 5. Regular/super gasoline | | | 2,275 | | | | | |
| 6. Kerosene | | | 1 | | 48 | | 76 | 260 |
| 7. Jet Fuel | 325 | | 19 | | | | | |
| 8. Diese | 20 | 12 | 1,405 | 53 | 395 | 10 | 396 | |
| 9. Heavy Fuel | 58 | 119 | | 351 | 64 | 245 | 563 | |
| 10. Not eenergy oil products (oils and grease) | | | | | | | | |
| Oil and derivatives | 403 | 174 | 3,776 | 404 | 523 | 447 | 1,099 | 483 |
| Fuelwood | | | | | | | 1,189 | 11,886 |
| Electricity | | 157 | | 141 | 57 | 44 | 292 | 190 |
| Waste Pulp | | | | | 834 | | | |
| Total . . . . . | 403 | 331 | 3,776 | 545 | 1,414 | 491 | 2,580 | 12,559 |

Includes fuel used by craft traveling abroad
Source: Anuario Estadístico SMHEN, Julio 1980

TABLE 39

VOLUME OF IMPORTS OF RAW OIL AND DERIVATIVES

1975 - 1979

(000's Bbls.)

| Year | Propane/ Butane | Super Gasoline | Regular Gasoline | Kerosene | Turbo Jet | Diesel | Heavy Fuel | Other Products | Sub-Total | Raw oil | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1975 | 317.0 | 246.8 | 400.8 | 51.4 | - | 711.6 | 88.2 | 335.9 | 2152.0 | 4423.3 | 6575.3 |
| 1976 | 337.5 | 374.0 | 537.7 | 133.1 | - | 975.0 | 314.5 | 344.9 | 3016.7 | 5186.6 | 8203.3 |
| 1977 | 418.7 | 523.6 | 753.6 | 158.6 | - | 1765.8 | 729.5 | 363.3 | 4713.1 | 5291.2 | 10004.3 |
| 1978 | 467.3 | 582.7 | 728.6 | 162.6 | - | 1702.0 | 522.5 | 356.4 | 4522.1 | 5829.4 | 10351.5 |
| 1979 | 571.1 | 632.6 | 888.9 | 160.4 | - | 1809.2 | 1239.7 | 376.6 | 5678.5 | 5723.5 | 11402.0 |

Source: "Anuario Estadístico", Secretaría de Minería, Hidrocarburos y Energía Nuclear, Julio 1980.

TABLE 40

PRICES OF OIL DERIVATIVES FOR CONSUMERS

1975 - 1980

| Date of Change | Super Gasoline (Q/Galón) | Regula Gasolune (Q/Galón) | Kerosene (Q/Galón) | Diesel (Q/Galón) | Heavy Fuel (Q/Galón) | Propane Butane (Q/100 lb) |
|---|---|---|---|---|---|---|
| 21-AG-75 | 0.787 | 0.750 | 0.533 | 0.545 | 0.322 | 16.50 |
| 23-EN-75 | 0.868 | 0.828 | 0.555 | 0.545 | 0.322 | 16.50 |
| 19-EN-77 | 0.978 | 0.935 | 0.550 | 0.564 | 0.348 | 17.85 |
| 01-FB-79 | 1.030 | 0.967 | 0.560 | 0.593 | 0.348 | 17.85 |
| 16-MY-79 | 1.310 | 1.250 | 0.610 | 0.670 | 0.424 | 17.85 |
| 18-AG-79 | 1.570 | 1.52 | 0.705 | 0.755 | 0.484 | 17.85 |
| 21-NV-79 | 1.600 | 1.550 | 0.760 | 0.770 | 0.484 | 17.85 |
| 20-DC-79 | 1.600 | 1.550 | 0.760 | 0.770 | 0.484 | 20.40 |
| 16-FB-80 | 1.920 | 1.880 | 0.870 | 0.980 | 0.640 | |
| 24-AB-80 | 1.950 | 1.900 | 0.900 | 0.990 | 0.620 | |
| 05-AG-80 | 2.000 | 1.960 | 0.900 | 1.030 | 0.620 | |
| 15-OC-80 | 1.950 | 1.910 | 0.830 | 1.030 | | |

Source: Secretaría de Minería, Hidrocarburos y Energía Nuclear
Publicaciones Oficiales

TABLE 41

GEOGRAPHICAL GROSS PRODUCT AND ENERGY DEMAND AT DIFFERENT GROWTH

RATES 1978-2000

| | 1978 | 1985 | 1990 | 2000 |
|---|---|---|---|---|
| IGP (Q de 1976) | 5.3 | | | |
| 1. Plentiful Energy (7.5% annual) | | 8.6 | 12.4 | 25.6 |
| 2. Moderate Restriction (6% annual) | | 7.9 | 10.6 | 19.0 |
| 3. Severe Restriction (5% annual) | | 7.5 | 9.6 | 15.6 |
| Commercial Energy (MMbpe) | 8.4 | | | |
| 1. Plentiful Energy (7.5% annual) | | 13.4 | 19.2 | 39.5 |
| 2. Moderate Restriction (5.5% annual) | | 12.2 | 15.9 | 27.1 |
| 3. Strong Conservation (4% annual | | 11.9 | 15.1 | 24.7 |
| 5% annual) | | 11.3 | 13.8 | 20.4 |
| 4. Severe Restriction 3.5% annual) | | 11.0 | 13.1 | 18.5 |
| Total Demand of Final Energy (MM BPE) (1) | 23.4 | | | |
| 1. Plentiful Energy (5.5% annual) | | 32.2 | 42.0 | 71.8 |
| 2. Moderate Restriction (4.5% annual) | | 30.7 | 38.2 | 59.3 |
| 3. Strong Conservation (4% annual) | | 29.9 | 36.4 | 53.9 |
| 4. Severe Restriction (2.5% annual) | | 24.6 | 31.5 | 40.3 |

(1) The total demand of final energy includes in addition to Commercial Energy, fuelwood, waste pulp and other energy resources used by the sector, final consumer, they are all expressed in millions of equivalent oil barrels

TABLE 42

INTERNAL GROSS PRODUCT AND IGP/PERSON

1960-78 (PRESENT AND CONSTANT QUETZALES)

| | 1960 | 1970 | 1973 | 1975 | 1976 | 1977 | 1978 |
|---|---|---|---|---|---|---|---|
| IGP (MM Q actual) | 1044 | 1862 | 2521 | 3577 | 4292 | 5448 | 6145 |
| IGP (MM Q 1976) | 1950 | 3180 | 3738 | 3966 | 4292 | 4850 | 5069 |
| | | 1970/ 60 | 1973/ 70 | 1975/ 70 | 1976/ 70 | 1977/ 70 | 1978/ 70 |
| Increase (Q 1976) | | 5.0 | 5.5 | 4.5 | 5.1 | 6.2 | 6.1 |
| | | 1978/ 75 | | | | | |
| | | 8.5 | | | | | |
| IGP/Person (Q 1976) | 492 | 594 | 634 | 640 | 671 | 735 | 745 |
| Increase | | | | | | | |
| 1970/60 and since 1970 | | 1.8 | 2.5 | 1.7 | 2.2 | 3.2 | 3.0 |
| Since 1975 | | | | | 4.8 | 7.2 | 5.2 |

Source: Desarrollo Económico y Demanda de Energía en Guatemala 1978-2000. Abril y mayo 1980, Proyecto de Desarrollo Petrolero y Energético.

TABLE 43

## RATIO OF POPULATION, IGP AND ENERGY

## 1950 - 1978

| | 1950 | 1960 | 1970 | 1975 | 1978 |
|---|---|---|---|---|---|
| 1. Population ('000) | 2962 | 3966 | 5353 | 6243 | 6842 |
| 2. IGP (MM Q de 1976) | 1382 | 1950 | 3180 | 3966 | 5069 |
| 3. Dinal demand of Commercial Energy (M boe) | 1415 | 2607 | 5457 | 6103 | 9077 |
| 4. Total Energy (M boe) | 4170 | 6366 | 10682 | 12893 | 16477 |
| | | | (%/año) | | |
| 5. Population (1950)... | | 3.0 | 3.0 | 3.0 | 3.0 |
| 1978/70 | | | | | 3.1 |
| 6. IGP (1950)... | | 3.5 | 4.3 | 4.3 | 4.7 |
| 1978/70 | | | | | 6.1 |
| 7. Commercial Energy (1950)... | | 6.3 | 7.0 | 6.0 | 6.9 |
| 1978/70 | | | | | 6.6 |
| 8. Total Energy (1950)... | | 4.3 | 4.8 | 4.6 | 5.0 |
| 1978/70 | | | | | 5.6 |
| 9. Commercial Energy/Per (bls) | 0.5 | 0.7 | 1.0 | 1.0 | 1.3 |
| 10. Total Energy/Person (1) | 1.4 | 1.6 | 2.0 | 2.1 | 2.4 |
| 11. Commercial Energy/IGP | 1.2 | 1.34 | 1.72 | 1.54 | 1.79 |
| 12. Total Energy/IGP | 3.02 | 3.26 | 3.36 | 3.25 | 3.25 |
| | | Ratio : Increase % / Year | | | |
| 13. Increase/Year | | | | | |
| a) Commercial Energy/Person (1950)... | | 2.1 | 2.3 | 2.0 | 2.3 |
| b) 1978/70 | | | | | 2.1 |
| c) Total Energy/Person (1950)... | | 1.43 | 1.6 | 1.53 | 1.67 |
| d) 1978/1970 | | | | | 1.81 |
| e) Commercial Energy/IGP (1950) | | 1.8 | 1.63 | 1.40 | 1.47 |
| f) 1978/1970 | | | | | 1.08 |
| g) Total Energy/IGP (1950)... | | 1.23 | 1.12 | 1.07 | 1.06 |
| h) 1978/1970 | | | | | 0.92 |

(1) It excludes oil for electricity but includes demands of oil for "no energy puposes"

TABLE 44

INTERNAL GROSS PRODUCT AND ENERGY DEMAND IN DIFFERENT GROW RATES 1978 - 2000

| | | 1978 | 1980 | 1985 | 1990 | 2000 |
|---|---|---|---|---|---|---|
| **IGP (Q de 1976)** | | | | | | |
| (A) Limited | (5%) | 5.1 | 5.6 | 7.1 | 9.1 | 14.8 |
| (B) Standard | (6%) | 5.1 | 5.7 | 7.6 | 10.2 | 18.3 |
| (C) Plentiful Energy | (7.5%) | 5.1 | 5.9 | 8.4 | 12.1 | 24.9 |
| **Comercial Energy (MM boe)** | | | | | | |
| (A) Limited | (4%) | 9.1 | 9.6 | 11.9 | 14.5 | 21.5 |
| (B) Standard | (6.5%) | 9.1 | 10.3 | 14.1 | 19.3 | 36.5 |
| ($B^1$) Conservation | (5.5%) | 9.1 | 10.1 | 13.2 | 17.3 | 29.5 |
| (C) Plentiful Energy | (10%) | 9.1 | 11.0 | 17.7 | 28.5 | 73.9 |
| **Total final Demand of Energy (MM boe)** | | | | | | |
| (A) Limited | (2.5% | 16.5 | 17.3 | 19.6 | 22.2 | 28.4 |
| (B) Standar | (5%) | 16.5 | 18.2 | 23.2 | 29.6 | 48.2 |
| ($B^1$) Conservation | (4%) | 16.5 | 17.8 | 21.7 | 26.4 | 39.0 |
| (C) Plentiful Energy | (7.5%) | 16.5 | 19.0 | 27.3 | 39.2 | 80.9 |
| **IGP/Person (Q 1976)** | | | | | | |
| (A) Limited | (2%) | 741 | 770 | 849 | 941 | 1164 |
| (B) Standard | (3%) | 741 | 784 | 907 | 1054 | 1434 |
| (C) Plentifull Energy | (4.5%) | 741 | 807 | 1001 | 1248 | 1953 |
| **Commercial Energy/Person (Boe)** | | | | | | |
| (A) Limited | (2%) | 1.33 | 1.35 | 1.42 | 1.50 | 1.69 |
| (B) Standard | (3.5%) | 1.33 | 1.42 | 1.68 | 2.00 | 2.85 |
| ($B^1$) Conservation | (2.5%) | 1.33 | 1.39 | 1.57 | 1.78 | 2.31 |
| (C) Plentifull energy | (7%) | 1.33 | 1.51 | 2.11 | 2.94 | 5.80 |
| **Total Final Energy/Person (boe)** | | | | | | |
| (A) Limited | (-0.5%) | 2.41 | 2.38 | 2.33 | 2.29 | 2.23 |
| (B) Standard | (2%) | 2.41 | 2.50 | 2.76 | 3.06 | 3.78 |
| ($B^1$) Conservation | (1%) | 2.41 | 2.45 | 2.58 | 3.73 | 3.07 |
| (C) Plentifull Energy | (4.5%) | 2.41 | 2.62 | 3.25 | 4.06 | 6.35 |

TABLE 44

INTERNAL GROSS PRODUCT AND ENERGY DEMAND IN DIFFERENT GROW RATES 1978 - 2000

| | | 1978 | 1980 | 1985 | 1990 | 2000 |
|---|---|---|---|---|---|---|
| **IGP (Q de 1976)** | | | | | | |
| (A) Limited | (5%) | 5.1 | 5.6 | 7.1 | 9.1 | 14.8 |
| (B) Standard | (6%) | 5.1 | 5.7 | 7.6 | 10.2 | 18.3 |
| (C) Plentiful Energy | (7.5%) | 5.1 | 5.9 | 8.4 | 12.1 | 24.9 |
| **Comercial Energy (MM boe)** | | | | | | |
| (A) Limited | (4%) | 9.1 | 9.6 | 11.9 | 14.5 | 21.5 |
| (B) Standard | (6.5%) | 9.1 | 10.3 | 14.1 | 19.3 | 36.5 |
| ($B^1$) Conservation | (5.5%) | 9.1 | 10.1 | 13.2 | 17.3 | 29.5 |
| (C) Plentiful Energy | (10%) | 9.1 | 11.0 | 17.7 | 28.5 | 73.9 |
| **Total final Demand of Energy (MM boe)** | | | | | | |
| (A) Limited | (2.5% | 16.5 | 17.3 | 19.6 | 22.2 | 28.4 |
| (B) Standar | (5%) | 16.5 | 18.2 | 23.2 | 29.6 | 48.2 |
| ($B^1$) Conservation | (4%) | 16.5 | 17.8 | 21.7 | 26.4 | 39.0 |
| (C) Plentiful Energy | (7.5%) | 16.5 | 19.0 | 27.3 | 39.2 | 80.9 |
| **IGP/Person (Q 1976)** | | | | | | |
| (A) Limited | (2%) | 741 | 770 | 849 | 941 | 1164 |
| (B) Standard | (3%) | 741 | 784 | 907 | 1054 | 1434 |
| (C) Plentifull Energy | (4.5%) | 741 | 807 | 1001 | 1248 | 1953 |
| **Commercial Energy/Person (Boe)** | | | | | | |
| (A) Limited | (2%) | 1.33 | 1.35 | 1.42 | 1.50 | 1.69 |
| (B) Standard | (3.5%) | 1.33 | 1.42 | 1.68 | 2.00 | 2.85 |
| ($B^1$) Conservation | (2.5%) | 1.33 | 1.39 | 1.57 | 1.78 | 2.31 |
| (C) Plentifull energy | (7%) | 1.33 | 1.51 | 2.11 | 2.94 | 5.80 |
| **Total Final Energy/Person (boe)** | | | | | | |
| (A) Limited | (-0.5%) | 2.41 | 2.38 | 2.33 | 2.29 | 2.23 |
| (B) Standard | (2%) | 2.41 | 2.50 | 2.76 | 3.06 | 3.78 |
| (B1) Conservation | (1%) | 2.41 | 2.45 | 2.58 | 3.73 | 3.07 |
| (C) Plentifull Energy | (4.5%) | 2.41 | 2.62 | 3.25 | 4.06 | 6.35 |

TABLE 45

ESTIMATE OF TOTAL VOLUME OF FUEL USE IN GUATEMALAN HOUSEHOLDS

The use of fuel in the domestic sector can be calculated as Follows:

| | % Population | Number of persons (000's) | Anual use/person | Total Use |
|---|---|---|---|---|
| Propane Gas | | | | |
| Cook only with Propane | 12 | 817 | 75 lbs. | 61,275,000 lbs. |
| Cook combining fuels | 6 | 409 | 30 lbs. | 12,270,000 lbs. |
| Total of Propane | | | | 73,545,000 lbs. |
| | | | That is: | 387,079 Bls. |
| Kerosene | | | | |
| Cook only with Kerosene | 7 | 477 | 14.0 gal. | 6,678,000 gal. |
| Cook combining Fuels | 8 | 545 | 4.4 gal. | 2,398,000 gal. |
| For lighting purpose | 19 | 1,294 | 2.5 gal. | 3,235,000 gal. |
| Total of Kerosene | | | | 12,311,000 gal. |
| | | | That is: | 293,119 Bls. |
| Fuelwood | | | | |
| Cook only with Fuelwood | 66 | 4,495 | 1650 o.d. lbs. | 3,365,000 o.d.t. |
| Cook combining fuels | 14 | 953 | 1125 o.d. lbs. | 486,445 o.d.t. |
| | | | | 3,851,445 o.d.t. |
| | | | That is: | 9,425,000 $m^3$ |

TABLE 46

ESTIMATE POPULATION

THAT USED FUELWOOD IN 1979

| | Main Urban Centres | Others Urban Centres | Rural | Total |
|---|---|---|---|---|
| Western High Plateau | 84 | 273 | 1,776 | 2,133 |
| Central High Plateau | 494 | 74 | 207 | 775 |
| Southerna Low Lands | 56 | 162 | 729 | 947 |
| Eastern Low Lands | 29 | 177 | 837 | 1,043 |
| Verapaces-El Petén | - | 57 | 493 | 550 |
| Total | 663 | 743 | 4,042 | 5,448 |

It includes families who only use fuelwood and those who use it with propane and kerosene.

TABLE 47

% OF FAMILIES
THAT USE DIFFERENT COOKING METHODS
WITH FUELWOOD

| | | Open fire on the ground | Open fire stone bench or barrel | Stone bench with plate | Others | Total |
|---|---|---|---|---|---|---|
| Western High Plateau | Urban | -- | 35 | 63 | 2 | 100 |
| | Rural | 20 | 51 | 29 | - | 100 |
| Central High Plateau | Urban | 25 | 53 | 22 | - | 100 |
| | Rural | 33 | 55 | 12 | - | 100 |
| Southern Low Lands | Urban | 6 | 71 | 19 | 3 | 100 |
| | Rural | 14 | 76 | 9 | - | 100 |
| Eastern Low Lands | Urban | -- | 69 | 31 | - | 100 |
| | Rural | 1 | 91 | 8 | - | 100 |
| Verapaces-El Petén | Urban | -- | 83 | 17 | - | 100 |
| | Rural | 7 | 91 | 2 | - | 100 |
| All areas | Urban | 7 | 55 | 37 | 1 | 100 |
| | Rural | 14 | 69 | 17 | - | 100 |
| | Total | 13 | 66 | 21 | - | 100 |

"Urban" includes main urban centres and others
"Others" includes Lorena stones and all metal stones

TABLE 48

SUMMARY OF THE RESULT OF THE STUDY OF COOKING FUEL USE

(% OF FAMILIES)

| | | Propane | Kerosene | Fuelwood | Fuelwood+ Kerosene | Fuelwood+ Propane | Charcoal | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Western Hihg Plateau | Main urban centres | 8 | - | 31 | - | 61 | - | 100 |
| | Other urban centres | 17 | - | 60 | 6 | 17 | - | 100 |
| | Rural | - | - | 92 | 5 | 3 | .0 | 100 |
| | Total | 3 | - | 85 | 5 | 7 | - | 100 |
| Central High Plateau | Main urban centres | 36 | 20 | 32 | 0 | 10 | 2 | 100 |
| | Other urban centres | 27 | 29 | 30 | - | - | 14 | 100 |
| | Rural | 26 | 24 | 45 | 3 | - | 2 | 100 |
| | Total | 31 | 22 | 36 | 1 | 3 | 4 | 100 |
| Southern Low Lands | Main urban centres | 30 | 13 | 30 | - | 27 | - | 100 |
| | Other urban centres | 15 | - | 56 | 7 | 22 | - | 100 |
| | Rural | 1 | 1 | 72 | 23 | 3 | - | 100 |
| | Total | 7 | 2 | 65 | 18 | 9 | - | 100 |
| Eastern Low Lands | Main urban centres | 45 | - | 44 | - | 11 | - | 100 |
| | Other urban centres | 13 | - | 65 | 10 | 13 | - | 100 |
| | Rural | 3 | 2 | 61 | 26 | 8 | - | 100 |
| | Total | 7 | 2 | 61 | 22 | 9 | - | 100 |
| Verapaces - El Petén | Main urban centres | - | - | - | - | - | - | - |
| | Other urban centres | 21 | 21 | 50 | 8 | - | - | 100 |
| | Rural | - | 1 | 99 | - | - | - | 100 |
| | Total | 3 | 4 | 91 | 1 | - | - | 100 |
| All areas | Main urban centres | 35 | 17 | 32 | - | 14 | 2 | 100 |
| | Other urban centres | 19 | 8 | 52 | 6 | 12 | 3 | 100 |
| | Rural | 3 | 3 | 79 | 12 | 3 | .. | 100 |
| | Total | 12 | 7 | 66 | 8 | 6 | 1 | 100 |

TABLE 49

FUELWOOD CONSUMPTION

| | Only Fuelwood | Fuelwood and other fuels | TOTAL Fuelwood |
|---|---|---|---|
| Annual Average use per person (task) | 2.2 | 1.5 | 2.0 |
| Annual average use per person (LBS. S.H.) | 1650 | 1125 | 1560 |
| Annual average use per family (LBS. S.H.) | 9900 | 6750 | 9360 |
| Annual average cost per family ( Q ) | 175 | 120 | 165 |

TABLE 50

KEROSENE CONSUMPTION

FOR COOKING

| | Only Kerosene | Kerosene and Fuelwwodd | All families using Kerosene |
|---|---|---|---|
| Annual average use per person | 14 gal. | 4.4 gal. | 9 gal. |
| Annual average use per family | 84 gal. | 26.4 gal. | 54 gal. |
| Annual average cost per family | Q 74 | Q 26 | Q 48 |

KEROSENE CONSUMPTION

FOR LIGHTING

| | |
|---|---|
| Annual average use per person | 2.5 gal |
| Annual average use per family | 15 gal |
| Annual average cos per family | Q. 14.20 |

TABLE 51

CONSUMPTION OF PROPANE

| | Only Propane | Propane and Fuelwood | All Families using Propane |
|---|---|---|---|
| Annual average use per person | 75 Lbs. | 30 Lbs. | 60 Lbs. |
| Annual average use per family | 450 Lbs. | 180 Lbs. | 356 Lbs. |
| Annual Average cost per famili | Q. 85 | Q. 34 | Q. 68 |

TABLE 52

% OF FAMULIES USING

KEROSENE FOR LIGHTING

| | Main Urban Centres | Other Urban Centres | Rural | Total |
|---|---|---|---|---|
| Western High Plateau | - | 2 | 18 | 15 |
| Central High Plateau | - | - | 27 | 7 |
| Southern Low Lands | - | 7 | 69 | 51 |
| Eastern Low Lands | 10 | 26 | 28 | 26 |
| Verapaces-El Petén | - | 7 | 1 | 2 |
| Total | — | 8 | 28 | 19 |

TABLE 53

## TOTAL USE OF FUEL WOOD BY AREA

## 1979

| | 000's Tons. S. . | 000's M3 |
|---|---|---|
| Western High Plateau | 1,505 | 3.585 |
| Central High Plateau | 550 | 1,310 |
| Southern Low Lands | 670 | 1,595 |
| Eastern Low Lands | 735 | 1,750 |
| Verapaces-El Petén | 390 | 930 |
| Total | 3,850 | 9,170 |

TABLE 54

% OF FAMILIES WHO BUY THE FUELWOOD THEY USE

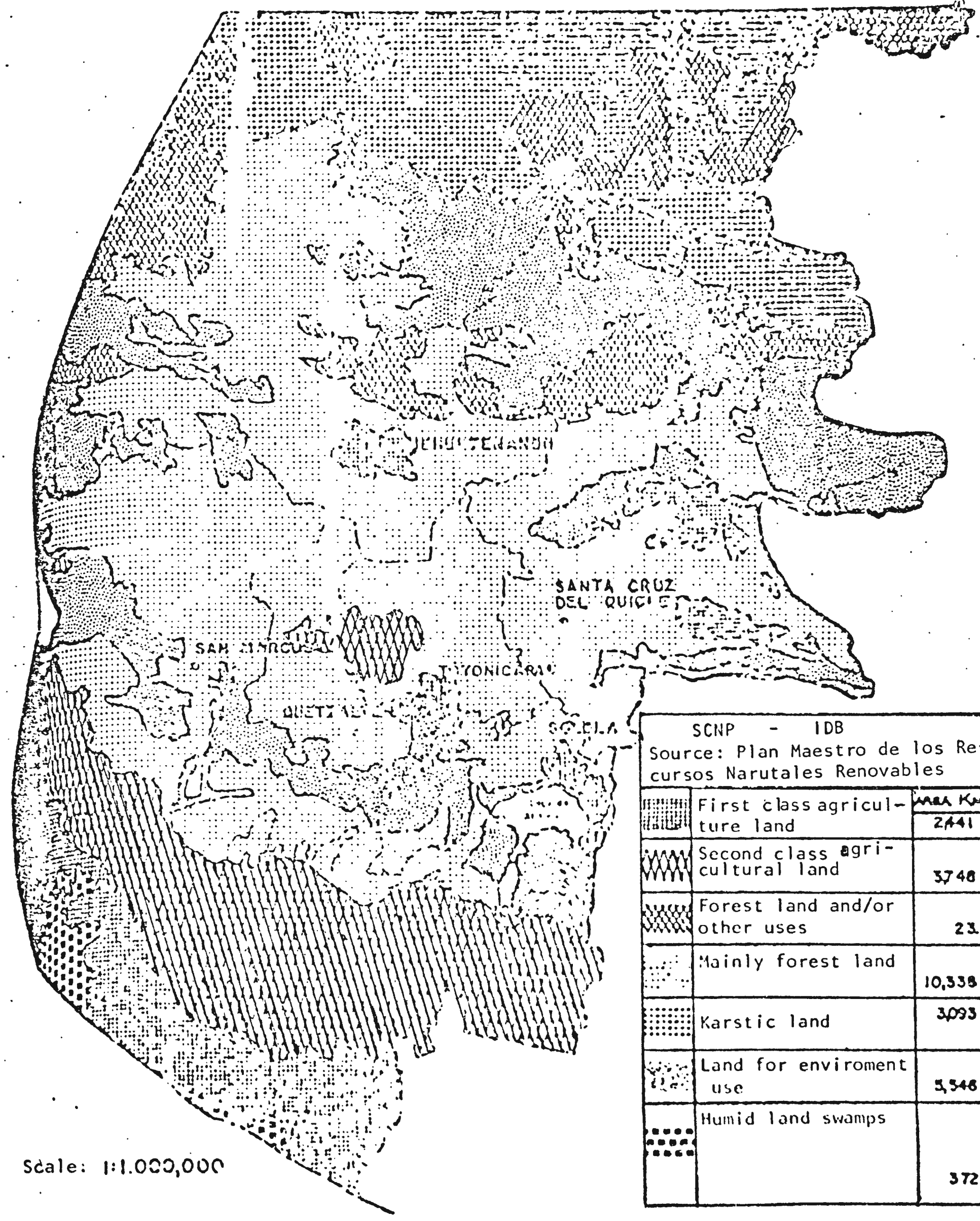
| | Main Urban Centres | Other Urban Centres | Rural | Total |
|---|---|---|---|---|
| Western High Plateau | 100 | 88 | 45 | 53 |
| Central High Plateau | 97 | 71 | 65 | 82 |
| Southern Low. Lands | 100 | 87 | 47 | 57 |
| Eastern Low Lands | ** | 70 | 35 | 40 |
| Verapaces-El Petén | - | 100 | 40 | 44 |
| Total | 96 | 84 | 44 | 53 |

** It was a small sample therefore no results are given

FIGURE 17

POTENTIAL USE OF SOIL

MAP N° 1



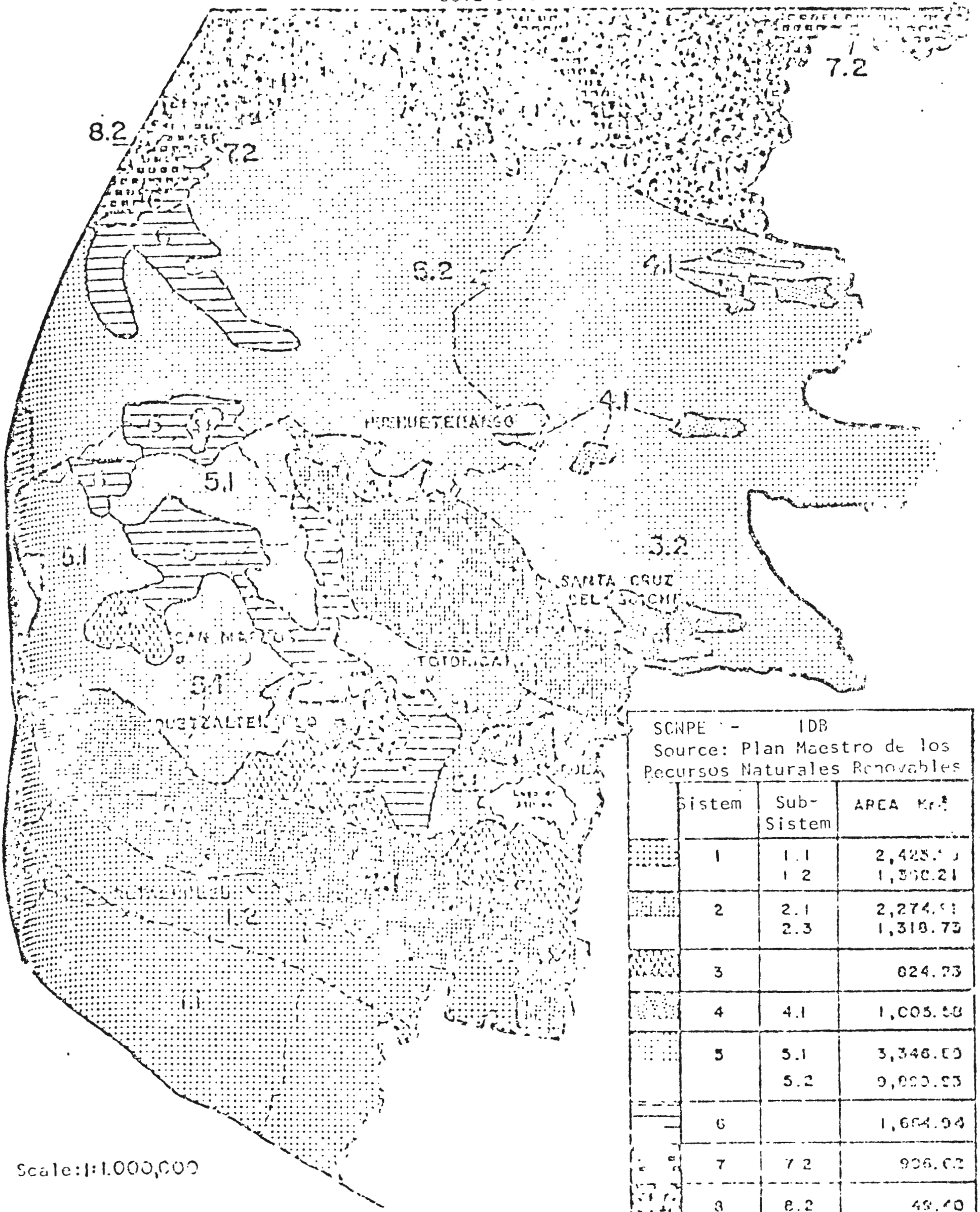

Scale: 1:1.000,000

| SCNP - IDB<br>Source: Plan Maestro de los Recursos Narutales Renovables | | |
|---|---|---|
| | | Mes Km² |
| | First class agriculture land | 2441 |
| | Second class agricultural land | 3748 |
| | Forest land and/or other uses | 2372 |
| | Mainly forest land | 10,338 |
| | Karstic land | 3093 |
| | Land for enviroment use | 5,546 |
| | Humid land swamps | 372 |

FIGURE 18

MAP Nº 2

SOIL SYSTEMS




Scale: 1:1.000,000

SCNPE - IDB
Source: Plan Maestro de los Recursos Naturales Renovables

| Sistem | Sub-Sistem | AREA Kr.² |
|---|---|---|
| 1 | 1.1 | 2,425.1 |
| | 1.2 | 1,360.21 |
| 2 | 2.1 | 2,274.91 |
| | 2.3 | 1,318.73 |
| 3 | | 824.73 |
| 4 | 4.1 | 1,005.80 |
| 5 | 5.1 | 3,346.80 |
| | 5.2 | 9,000.93 |
| 6 | | 1,664.94 |
| 7 | 7.2 | 906.62 |
| 8 | 8.2 | 48.40 |
| 9 | | 2,130.00 |

PRESENT USE - POTENTIAL USE IN THE REGION (AGRICULTURAL)

| Departments | Agricultural | | |
|---|---|---|---|
| | Present (1) | Potential (2) | Difference |
| Sololá | 20.1 | 35.4 | 15.3 |
| Totonicapán | 17.4 | 37.9 | 20.5 |
| Quetzaltenango | 67.0 | 40.5 | - 26.5 |
| San Marcos | 100.7 | 167.4 | 66.7 |
| Huehuetenango | 86.6 | 222.9 | 136.3 |
| El Quiché | 36.3 | 98.1 | 61.8 |
| Total Región | 328.1 | 602.2 | 274.1 |

Source: (1) Table 2.3 (2) Table 2.1

BOVINE LIVESTOCK IN THE REGION

| Departments | Meat | Milk | Mixed | Total | % |
|---|---|---|---|---|---|
| Sololá | - | - | 7136 | 7136 | 2.5 |
| Totonicapán | - | - | 7136 | 7136 | 2.5 |
| Quetzaltenango | 32771 | 244 | 15751 | 48766 | 16.9 |
| San Marcos | 57752 | - | 58215 | 115967 | 40.2 |
| Huehuetenango | 3540 | - | 41263 | 44803 | 15.5 |
| El Quiché | - | - | 64427 | 64427 | 22.4 |
| Total | 94063 | 244 | 193930 | 288237 | 100.0 |

Source: (1) Dirección General de Estadística
Encuesta Pecuaria 1,977.

## AREA OF PRODUCTION WITH BASIC GRAINS CULTURE

| Culture | 1964 | | | Average 1975-77 | | |
|---|---|---|---|---|---|---|
| | Area Ha. | Regional porcentage | National porcentage | Area Ha. | Regional porcentage | National porcentage |
| Total | 237.034 | 100.0 | 32.7 | 184,927 | 100.0 | 25.0 |
| Corn | 185,462 | 78.3 | 32.6 | 137,366 | 74.3 | 25.7 |
| Beans | 30,534 | 12.9 | 33.2 | 27,538 | 14.9 | 26.1 |
| Wheat | 19,717 | 8.3 | 85.5 | 18,357 | 9.9 | 76.5 |
| Rice | 451 | 0.2 | 3.8 | 1,514 | 0.8 | 11.2 |
| Sorghum | 810 | 0.3 | 2.9 | 122 | 0.1 | 0.2 |

Source: a) II Censo Agropecuario 1,964, Dirección General de Estadística.
b) Encuestas de Granos Básicos 1,975, 1,976 y 1,977, Dirección General de Estadística.

AREA OF EXPORTS CULTURE AND AGRO-INDUSTRIAL CONSUMPTION YEAR 1964

| Farming | Sololá | | Totonicapán | | Quetzaltenango | | San Marcos | |
|---|---|---|---|---|---|---|---|---|
| | Has. | % | Has. | % | Has. | % | Has. | % |
| **Total** | 5,586 | 100.0 | 46 | 100.0 | 30,286 | 100.0 | 47,302 | 100.0 |
| Coffee | 5,418 | 97.0 | -- | --- | 26,260 | 86.7 | 43,043 | 91.0 |
| Sugar Cane | 123 | 2.2 | -- | --- | 801 | 2.6 | 342 | 0.8 |
| Cotton | --- | --- | -- | --- | 789 | 2.6 | 3,423 | 7.3 |
| Rubler | --- | --- | -- | --- | 1,550 | 5.1 | 64 | 0.1 |
| Citronella | --- | --- | -- | --- | 446 | 1.5 | 108 | 0.2 |
| Lemmon tea | --- | --- | -- | --- | 138 | 0.5 | 67 | 0.1 |
| Peanuts | --- | --- | -- | --- | --- | --- | 41 | 0.1 |
| Others* | 45 | 0.8 | 46 | 100.0 | 302 | 1.0 | 214 | 0.4 |

| Crops | Huehuetenango | | El Quiché | | Total Regional | | Porcentaje |
|---|---|---|---|---|---|---|---|
| | Has. | % | Has. | % | Has. | % | Nacional |
| **Total** | 8,271 | 100.0 | 3,987 | 100.0 | 95,479 | 100.0 | 24.9 |
| Coffee | 6,140 | 74.2 | 1,942 | 48.7 | 82,803 | 86.7 | 35.8 |
| Sugar cane | 1,901 | 23.0 | 1,969 | 49.4 | 5,136 | 5.4 | 12.4 |
| Cotton | --- | -- | --- | -- | 4,212 | 4.4 | 4.9 |
| Rubler | 1 | 0.0 | 3 | 0.2 | 1,623 | 1.7 | 22.6 |
| Citronella | --- | -- | --- | -- | 554 | 0.6 | 15.4 |
| Lemmon tea | --- | -- | --- | -- | 205 | 0.2 | 2.5 |
| Peanut | 101 | 1.2 | 11 | 0.3 | 153 | 0.2 | 30.6 |
| Others* | 128 | 1.6 | 57 | 1.4 | 792 | 0.8 | 12.3 |

* Includes: Kenaf, cacao, sesame, tabacco, and others

Source: II Censo Agropecuario 1964, Dirección General de Estadística.

LEVESTOCK STOCKS

| Kinds | Sololá No. | % | Totonicapán No. | % | Quetzaltenango No. | % | San Marcos No. | % |
|---|---|---|---|---|---|---|---|---|
| Bovine | | | | | | | | |
| 1964 | 3,621 | 2.0 | 4,366 | 2.5 | 52,326 | 29.6 | 44,356 | 25.1 |
| 1974-77 | 6,060 | 2.8 | 6,645 | 3.1 | 41,161 | 19.1 | 86,663 | 40.3 |
| Porcine | | | | | | | | |
| 1964 | 2,294 | 2.2 | 11,525 | 10.9 | 14,526 | 13.7 | 19,031 | 18.0 |
| 1974-77 | 8,803 | 3.6 | 39,043 | 16.2 | 40,693 | 16.8 | 55,596 | 23.0 |
| Sheep | | | | | | | | |
| 1964 | 18,116 | 3.5 | 44,593 | 8.6 | 33,070 | 6.4 | 128,021 | 24.7 |
| 1974-77 | 39,174 | 5.9 | 86,159 | 17.5 | 27,581 | 5.6 | 136,353 | 27.7 |

| Kinds | Huehuetenango No. | % | Quiché No. | % | Total Regional No. | % | Porcentaje Nacional |
|---|---|---|---|---|---|---|---|
| Bovine | | | | | | | |
| 1964 | 33,795 | 19.1 | 38,474 | 21.7 | 176 [illegible]9 | 100.0 | 15.9 |
| 1974-77 | 37,323 | 17.4 | 37,097 | 17.3 | 214,979 | 100.0 | 14.4 |
| Porcine | | | | | | | |
| 1964 | 24,148 | 22.8 | 34,276 | 32.4 | 105,800 | 100.0 | 44.2 |
| 1974-77 | 45,195 | 17.9 | 54,389 | 22.5 | 241,719 | 100.0 | 39.5 |
| Sheep | | | | | | | |
| 1964 | 187,135 | 36.0 | 108,287 | 20.8 | 519,212 | 100.0 | 96.8 |
| 1974-77 | 132,960 | 27.0 | 74,870 | 15.3 | 492,097 | 100.0 | 98.6 |

Source: a) II Censo Agropecuario 1,964. Dirección General de Estadística.
b) Encuestas Pecuarias 1,974, 1,976 y 1,977. Dirección General de Estadística.

KINDS OF FARMS USED WITH WOODSAND FORESTS YEAR 1964

PERCENTAGE FIGURES

| | Sololá | | Totonicap. | | Quetzalten. | | San Marcos | | Huehueten. | | El Quiché | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | | No. | | No. | | No. | | No. | | No. | | No. | |
| | Farms | Area | Farms | Area | Farms | Area | Farms | Area | Farms | Area | Farms | Area | Farms | Areas |
| Microfarms | 7.0 | 0.4 | 22.6 | 2.4 | 11.0 | 0.6 | 5.3 | 0.3 | 3.2 | 0.1 | 4.0 | 0.1 | 7.8 | 0.3 |
| Subfamiliar | 77.6 | 23.1 | 69.2 | 44.1 | 72.4 | 22.0 | 75.8 | 27.8 | 69.2 | 10.9 | 65.2 | 18.1 | 69.0 | 19.2 |
| Familiar | 13.4 | 18.3 | 8.0 | 48.1 | 13.9 | 26.9 | 17.2 | 31.5 | 28.3 | 31.4 | 27.7 | 38.1 | 20.8 | 34.2 |
| Medium Multifamiliar | 1.9 | 33.2 | 0.2 | 5.4 | 2.5 | 35.4 | 1.6 | 22.2 | 5.2 | 45.0 | 2.0 | 23.1 | 2.3 | 30.1 |
| Big Multifamiliar | 0.1 | 20.0 | -.- | -.- | 0.2 | 15.1 | 0.1 | 18.2 | 0.1 | 12.6 | 0.1 | 20.5 | 0.1 | 16.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: Censo Agropecuario 1,964.

DISTRIBUTION OF AGRICULTURAL LAND IN THE WESTERN REGION

BY KIND OF EXPLOTATION

| Kind of explotation | Hectares | of each type over total | of area over total |
|---|---|---|---|
| Microfarms | less than 0.7 | 33.90 | 3.1 |
| Small subfamiliar | 0.7 to 3.5 | 45.88 | 17.8 |
| Medium subfamiliar | 3.5 to 7.0 | 10.20 | 11.0 |
| Familiar | 7.0 to 44.8 | 8.60 | 22.5 |
| Medium multifamiliar | 44.8 to 448.0 | 1.30 | 22.3 |
| Big multifamiliar | more than 448.0 | 0.2 | 23.3 |

PERCENTAGE DISTRIBUTION OF AGRICULTURAL LAND BY KIND OF EXPLOTATION

| Department | 0.7 Has. Micro-Farms No. | Area | 0.7 to 3.5 Has Sub-Fam. No. | Small Area | 2.5 to 7 Has. Sub-Fam. No. | Medium Area | 7 to 44.8 Familiares No. | Area | 44.8-448 Has Multi-Fam. Med. No. | Area | 448 Has. Multi No. | Fam-Big Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SOLOLA | 32.2 | 5.1 | 55.5 | 36.0 | 8.7 | 17.2 | 3.2 | 15.6 | 0.3 | 15.8 | 0.1 | 10.3 |
| TOTONICAPAN | 48.7 | 9.7 | 41.0 | 37.7 | 6.5 | 19.6 | 3.7 | 30.4 | 0.1 | 2.6 | --- | --- |
| QUETZALTENANGO | 42.7 | 3.2 | 42.7 | 13.6 | 7.7 | 7.5 | 5.7 | 16.9 | 1.1 | 32.3 | 0.1 | 26.5 |
| SAN MARCOS | 24.4 | 2.0 | 51.4 | 18.9 | 14.9 | 14.8 | 8.3 | 22.4 | 0.9 | 22.7 | 0.1 | 20.6 |
| HUEHUETENANGO | 14.8 | 1.0 | 55.5 | 16.1 | 16.4 | 12.9 | 11.7 | 29.1 | 1.5 | 22.3 | 0.1 | 18.6 |
| QUICHE | 12.9 | 0.8 | 49.5 | 13.4 | 18.4 | 13.4 | 17.9 | 38.4 | 1.2 | 17.5 | 0.1 | 16.5 |
| NAZTENANGO | 51.5 | 1.5 | 33.8 | 3.9 | 3.6 | 1.5 | 7.7 | 12.2 | 2.9 | 37.7 | 0.6 | 43.2 |
| RETALHULEU | 42.9 | 1.3 | 37.3 | 3.9 | 4.8 | 1.7 | 10.8 | 14.9 | 2.6 | 27.5 | 0.6 | 50.7 |
| REGIONAL | 33.9 | 3.1 | 45.8 | 17.8. | 10.1 | 11.0 | 8.6 | 22.5 | 1.3 | 22.3 | 0.2 | 23.3 |

Source: Adapted from charts elaborated by------- Molina Cabrera, Tomo II
Diagnóstico Sector Agrícola Plan de Desarrollo Regional de Occidente
Datos Censo Agropecuario 1964.

MEAN ARE (HA.) BY KIND OF EXPLOTATION AND BY DEPARTMENT

| Department. | Micro farms | Sub-Fam. Small | Sub-Fam. Medium | Familiars | Multi-Fam. Med. | Multi-Fam. Big |
|---|---|---|---|---|---|---|
| SOLOLA | 0.38 | 1.56 | 4.96 | 12.18 | 143.38 | 643.65 |
| TOTONICAPAN | 0.33 | 1.52 | 5.01 | 13.43 | 69.00 | ---- |
| QUETZALTENANGO | 0.37 | 1.55 | 4.99 | 14.52 | 140.96 | 982.42 |
| SAN MARCOS | 0.40 | 1.72 | 4.71 | 13.27 | 133.60 | 982.28 |
| HUEHUETENANGO | 0.41 | 1.74 | 4.90 | 14.88 | 90.75 | 1,316.38 |
| QUICHE | 0.42 | 1.75 | 4.76 | 14.10 | 92.11 | 1,224.93 |
| SAZATENANGO | 0.34 | 1.32 | 4.55 | 18.13 | 154.28 | 868.70 |
| RETALHULEU | 0.40 | 1.37 | 4.55 | 18.06 | 147.56 | 1,171.87 |

Source: Adapted from Charts elaborated by------- Molina Cabrera. Tomo II Diagnóstico Sector Agrícola
Plan de Desarrollo Regional de Occidente.
Datos Censo Agropecuario 1964.

## PORCENTAGE DISTRIBUTION OF PROPERTIES SMALLER AND BIGGER THAN 7 HA.

| Departmen | Properties of less than 7 Has. No. of fam. | Area | Properties of more than 7 Ha. No. of fams | Area |
|---|---|---|---|---|
| SOLOLA | 96.4 | 58.3 | 3.6 | 41.7 |
| TOTONICAPAN | 96.2 | 67.0 | 3.8 | 33.0 |
| QUETZALTENANGO | 93.1 | 24.3 | 6.9 | 75.7 |
| SAN MARCOS | 90.7 | 34.3 | 9.3 | 65.7 |
| HUEHUETENANGO | 86.7 | 30.0 | 13.3 | 70.0 |
| EL QUICHE | 30.8 | 27.6 | 19.2 | 72.4 |
| SUCHITEPEQUEZ | 88.8 | 6.9 | 11.2 | 93.1 |
| RETALHULEU | 86.0 | 6.9 | 14.0 | 93.1 |
| REGIONAL | 89.8 | 31.9 | 10.2 | 68.1 |

Source: Author's elaboration, based on data from the 1964 Agricultural Census 1964.

DENSITY BY DEPARTMENT OF THE WESTERN REGION

| Department | Total density person/Ha. | Rural density person/Ha. | Total density Ha./person | Rural density Ha./person. |
|---|---|---|---|---|
| SOLOLA | 1.52 | 0.95 | 0.65 | 1.05 |
| TOTONICAPAN | 2.01 | 1.70 | 0.50 | 0.59 |
| QUETZALTENANGO | 2.02 | 1.24 | 0.49 | 0.80 |
| SAN MARCOS | 1.28 | 1.12 | 0.77 | 0.89 |
| HUEHUETENANGO | 0.58 | 0.49 | 1.70 | 2.03 |
| EL QUICHE | 0.45 | 0.39 | 2.20 | 2.56 |
| SUCHITEPEQUEZ | 1.05 | 0.73 | 0.94 | 1.35 |
| RETALHULEU | 0.88 | 0.63 | 1.13 | 1.58 |
| REGION | 1.22 | 0.91 | 1.05 | 1.36 |

Source. Author's elaboration, based on data of projected population up to 1977, by Dirección General de Estadística

SUPPORTING CAPACITY SATURATION RATIO AND POPULATION

BALANCE BY DEPARTMENT

| Department | Basic rural population 1977. | Rural Population 1977 | Saturation Rcdio | Rural Population Balance |
|---|---|---|---|---|
| SOLOLA | 27,206 | 100,995 | 3.76 | - 73,789 |
| TOTONICAPAN | 65,504 | 180,580 | 2.76 | - 115,076 |
| QUETZALTENANGO | 137,555 | 243,619 | 1.77 | - 106,064 |
| SAN MARCOS | 228,307 | 424,713 | 1.86 | - 196,406 |
| HUEHUETENANGO | 332,008 | 363,511 | 1.09 | - 31,503 |
| EL QUICHE | 321,347 | 323,457 | 1.01 | - 2,110 |
| SUCHITEPEQUEZ | 166,712 | 184,352 | 1.10 | - 17,640 |
| RETALHULEU | 118,820 | 117,296 | 0.98 | + 1,524 |

* Negative sign should he read as exceeding population

Source: Autor's elaboration, based on data on Chart 8 and data of population projected by General Statistics Direction

SUPPORTING CAPACITY SATURATION RATIO AND POPULATION

BALANCE BY DEPARTMENT

| Department | Basic rural population 1977. | Rural Population 1977 | Saturation Ratio | Rural Population Balance |
|---|---|---|---|---|
| SOLOLA | 27,206 | 100,995 | 3.76 | - 73,789 |
| TOTONICAPAN | 65,504 | 180,580 | 2.76 | - 115,076 |
| QUETZALTENANGO | 137,555 | 243,619 | 1.77 | - 106,064 |
| SAN MARCOS | 228,307 | 424,713 | 1.86 | - 196,406 |
| HUEHUETENANGO | 332,008 | 363,511 | 1.09 | - 31,503 |
| EL QUICHE | 321,347 | 323,457 | 1.01 | - 2,110 |
| SUCHITEPEQUEZ | 166,712 | 184,352 | 1.10 | - 17,640 |
| RETALHULEU | 118,820 | 117,296 | 0.98 | + 1,524 |

* Negative sign should be read as exceeding population

Source: Autor's elaboration, based on data on Chart 8 and data of population projected by General Statistics Direction.

## POTENTIAL USE OF LAND BY DEPARTMENTS ($Km^2$)

| Department | First Class agricultural lands | Second class agricultural lands | Forestry and/or multiple use | Mainly Forestry lands | Lands for environmental use | Humid lands and swamps | Karstic lands |
|---|---|---|---|---|---|---|---|
| SOLOLA | 22 | 49 | | 423 | 434 | | |
| TOTONICAPAN | 28 | 175 | | 847 | 11 | | |
| QUETZALTENANGO | 159 | 455 | | 1044 | 293 | 30 | |
| SAN MARCOS | 200 | 566 | | 1941 | 994 | 90 | |
| HUEHUETENANGO | 99 | | 1284 | 2925 | 1418 | 27 | 1647 |
| EL QUICHE | 731 | | 1088 | 2703 | 2330 | | 1446 |
| SUCHITEPEQUEZ | 489 | 1676 | | 252 | 66 | 27 | |
| RETALHULEU | 713 | 827 | | 118 | | 198 | |
| REGION | 2441 | 3748 | 2372 | 10336 | 5546 | 372 | 3093 |

Source: Plan Maestro de los Recursos Naturales Renovables de Guatemala Tomo II. Recurso Suelo.

## ESTIMATE OF AREAS COVERED BY WIDE LEAVES AND CONIFERUS WOODS

| Department | Number of Ha. of coniferus woods | Number of Ha. of wide leaves woods | Total | % of Forest of total area |
|---|---|---|---|---|
| SOLOLA | 15,700 | 5,400 | 21100 | 23.2 |
| TOTONICAPAN | 35,800 | 1,000 | 36800 | 25.0 |
| QUETZALTENANGO | 19,300 | 22,700 | 42000 | 21.0 |
| SAN MARCOS | 36,800 | 43,800 | 80600 | 21.0 |
| HUEHUETENANGO | 68,000 | 135,000 | 203000 | 27.2 |
| EL QUICHE | 103,000 | 234,000 | 337000 | 40.2 |
| SUCHITEPEQUEZ | 2,000 | 24,200 | 26200 | 10.4 |
| RETALHULEU | - - - | 20,000 | 20000 | 10.4 |
| REGION | 280,600 | 486,100 | 766700 | 23.5 |

Source: Información proporcionada por W.L. Mittack.

NUMBER OF ILLEGALLY FELL TREES BY FORESTRY SPECIES

| Department | Coniferus | | | | Wide leave | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | pine | fir | cypress | total | cedar | mahogany | oak | others | total |
| QUETZALTENANGO | 206 | 2 | 89 | 297 | - | - | 259 | 822 | 1081 |
| TOTONICAPAN | 235 | 1 | 12 | 248 | - | - | 100 | 90 | 190 |
| SAN MARCOS | 120 | 66 | 53 | 239 | 1 | - | 105 | 416 | 523 |
| EL QUICHE | 437 | - | - | 437 | - | - | 420 | 30 | 450 |
| HUEHUETENANGO | 607 | - | - | 607 | - | - | - | 783 | 783 |
| SOLOLA | 43 | - | - | 43 | - | - | 1 | 69 | 70 |
| SUCHITEPEQUEZ | - | - | - | - | 11 | - | - | 125 | 136 |
| RETALHULEU | - | - | - | - | 2 | - | - | 871 | 873 |

Source: Boletín No. 2 INAFOR

PROJECTED BASIC POPULATION AND RURAL

POPULATION OF THE DEPARTMENTS OF THE WESTERN REGION

| Department | Basic Population | Rural Population 1977 | Rural Population 1983 | Rural Population 2000 |
|---|---|---|---|---|
| Sololá | 27,206 | 100,995 | 119,428 | 190,865 |
| Totonicapán | 65,504 | 180,580 | 213,531 | 341,265 |
| Quetzaltenango | 137,555 | 243,619 | 288,082 | 460,401 |
| San Marcos | 228,307 | 424,713 | 502,228 | 802,648 |
| Huehuetenango | 332,000 | 363,511 | 429,855 | 686,993 |
| El Quiché | 321,347 | 323,457 | 342,292 | 547,445 |
| Suchitepéquez | 166,712 | 184,352 | 217,998 | 348,809 |
| Retalhuleu | 118,820 | 117,296 | 138,704 | 221,692 |
| Región | 1,397,459 | 1,938,523 | 2,252,125 | 3,600,139 |

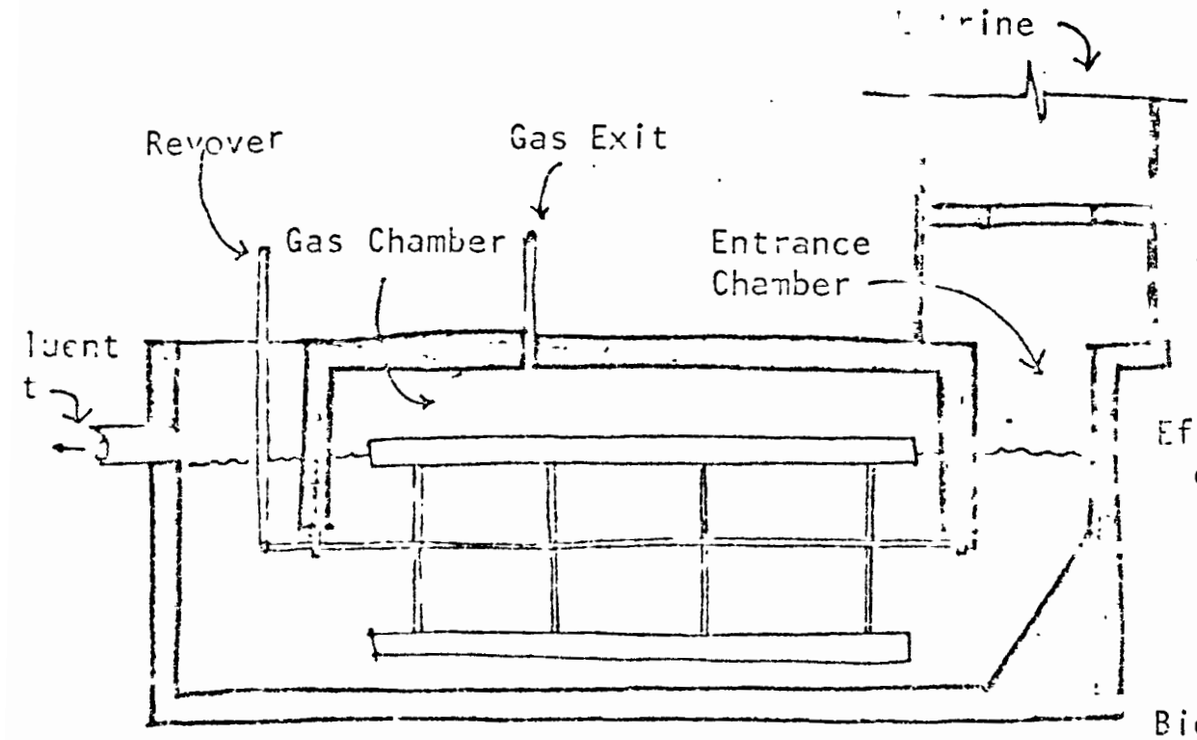
PROJECTED EXCEEDING RURAL POPULATION FOR THE WESTERN REGION

DEPARTMENTS

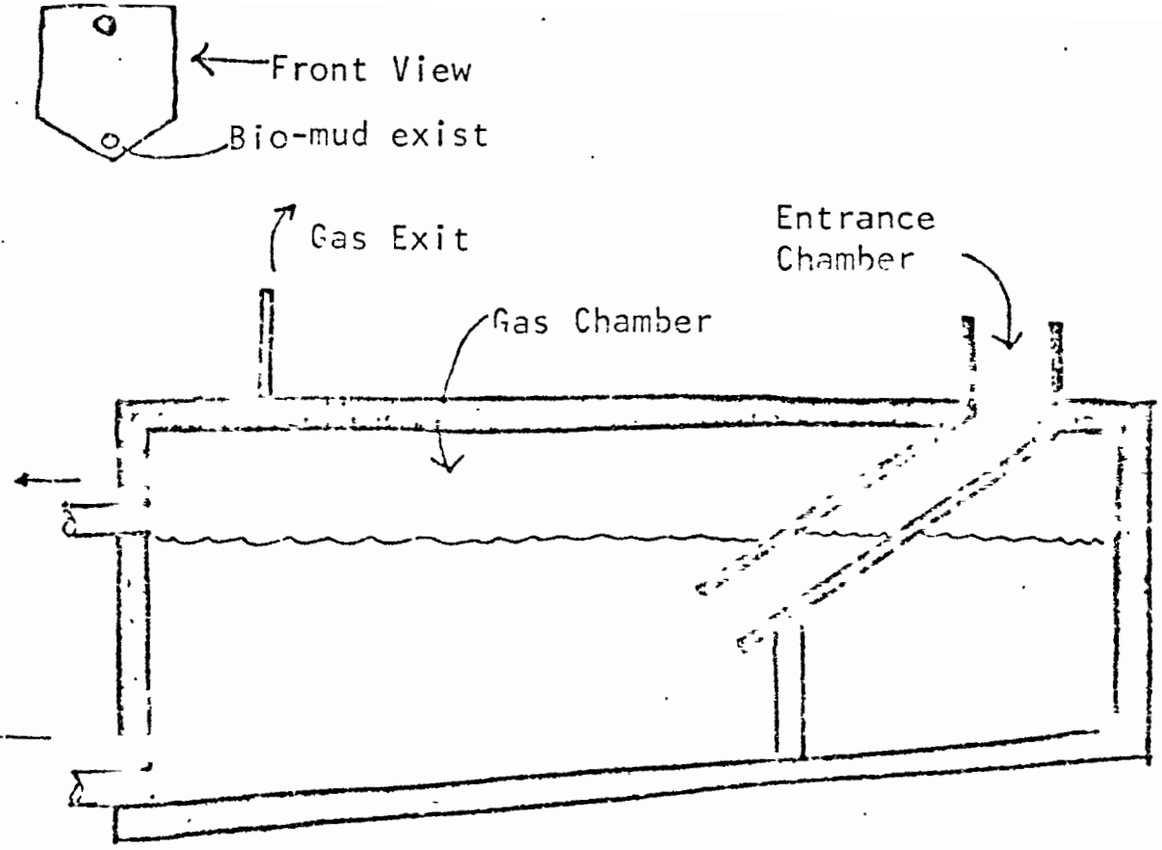
| Departments | Year 1977 | Year 1983 | Year 2000 |
|---|---|---|---|
| Sololá | 73,789 | 92,222 | 163,659 |
| Totonicapán | 115,076 | 148,034 | 275,782 |
| Quetzaltenango | 103,064 | 150,527 | 322,846 |
| San Marcos | 196,406 | 273,521 | 574,341 |
| Huehuetenango | 31,503 | 97,847 | 354,935 |
| El Quiché | 2,110 | 20,945 | 226,096 |
| Suchitepéquez | 17,640 | 51,286 | 182,097 |
| Retalhuleu | 1,524 | 19,884 | 102,872 |
| Región | 539,540 | 854,656 | 2,206,680 |

## DEFORSTATION ESTIMATES

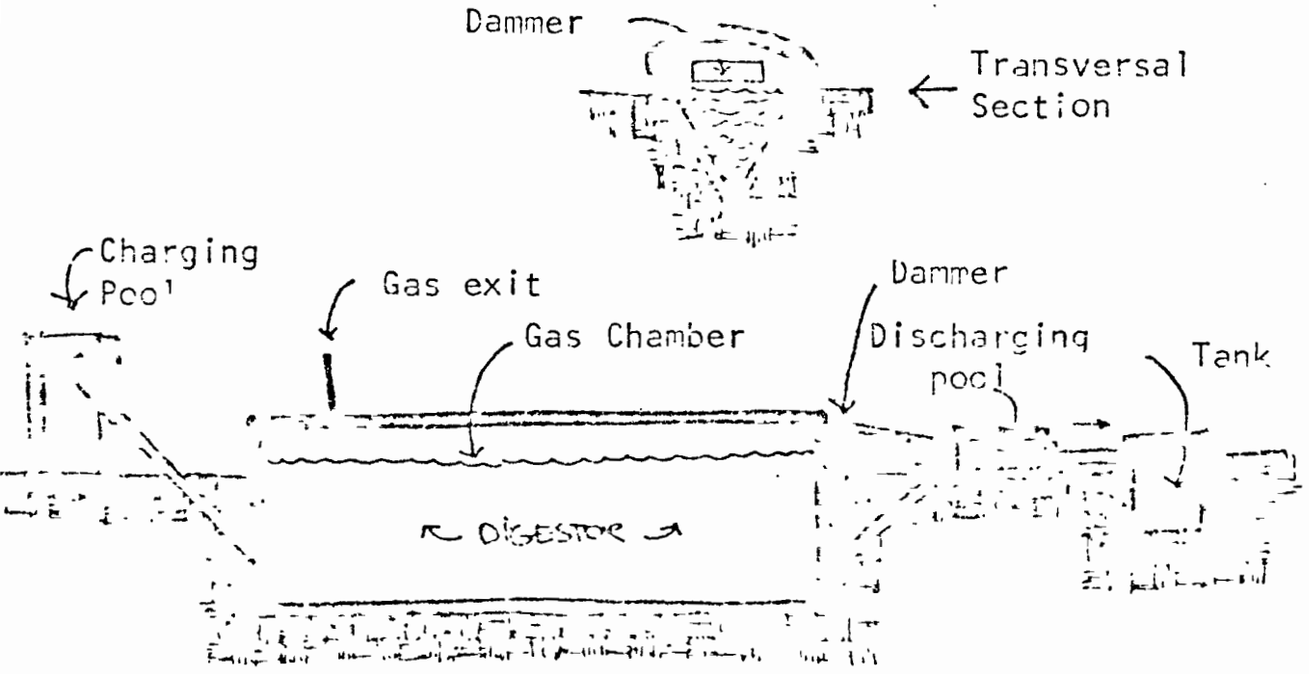
| Year | Population | Annual deforstation | Available Volume M3 |
|---|---|---|---|
| 1977 | 2.498,599 | 3,241,678 | 114,824,988 |
| 1978 | 2,565,171 | 3.384,722 | 114.552,265 |
| 1979 | 2,638.802 | 3,430 442 | 114.176,550 |
| 1980 | 2,714,544 | 3,528,907 | 113,691,324 |
| 1981 | 2,700,456 | 3,627.592 | 113.095,500 |
| 1982 | 2,80. ,401 | 3,729,032 | 112,832,342 |
| 1983 | 2.948,705 | 3.833.316 | 111,545,898 |
| 1984 | 3,031,165 | 3,940,514 | 110,579,931 |
| 1985 | 3,115,032 | 4.050,711 | 109,478,019 |
| 1986 | 3,205,149 | 4,166,694 | 108,230,737 |
| 1987 | 3,29 .132 | 4,288,679 | 106,833,210 |
| 1988 | 3,387,653 | 4 403.949 | 105,278,146 |
| 1989 | 3.482,766 | 4,527,596 | 103,557,967 |
| 1990 | 3,580,549 | 4,654 714 | 101,664,798 |
| 1991 | 3,681,078 | 4.785,401 | 99,590,458 |
| 1992 | 3,784,428 | 4,919.756 | 97,325,447 |
| 1993 | 3,890,680 | 5,057,884 | 94,861,934 |
| 1994 | 3,99 ,916 | 5,199,890 | 92,191,695 |
| 1995 | 4,112,221 | 5,845,887 | 89,634,253 |
| 1996 | 4,227,676 | 5,405,979 | 86,528,520 |
| 1997 | 4,346,373 | 5,650,285 | 83,185,662 |
| 1998 | 4,468,403 | 5,808,924 | 79,595,022 |
| 1999 | 4,593,860 | 5,972,018 | 75,745,537 |
| 2000 | 4,722,837 | 6.139,676 | 71,545,729 |




(A) D'GESTOR CETA.



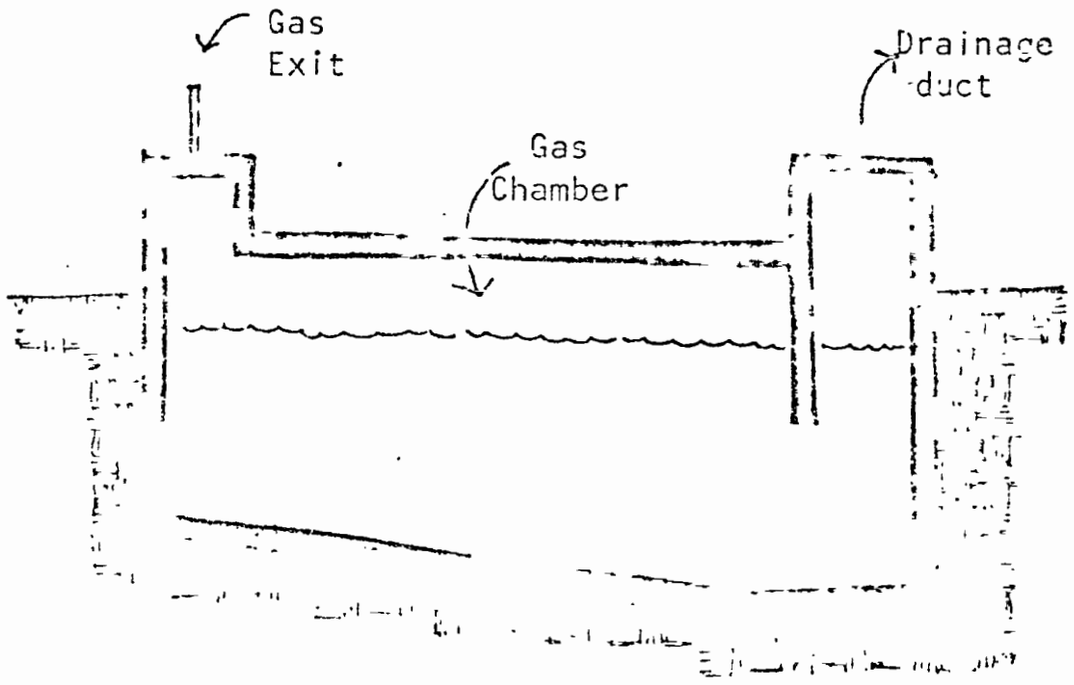

(B) DIGESTOR XOCHICALLI



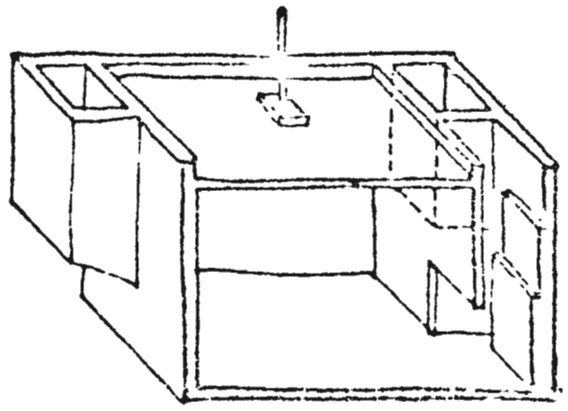

(C) DIGESTOR IIE

Source: CEINT

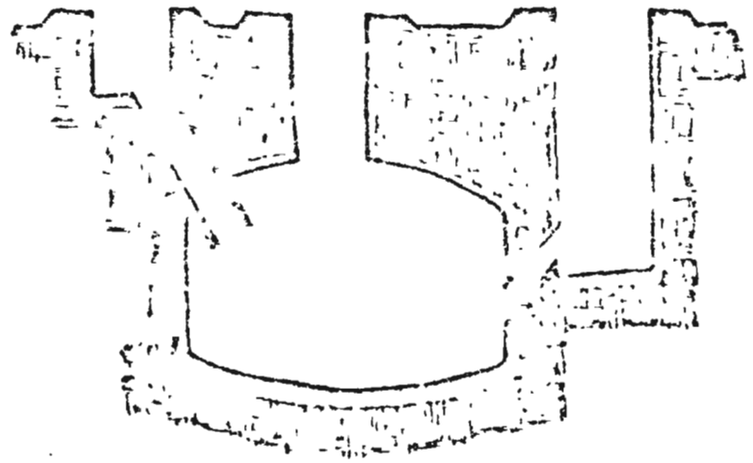
CONTINOUS DIGESTOR



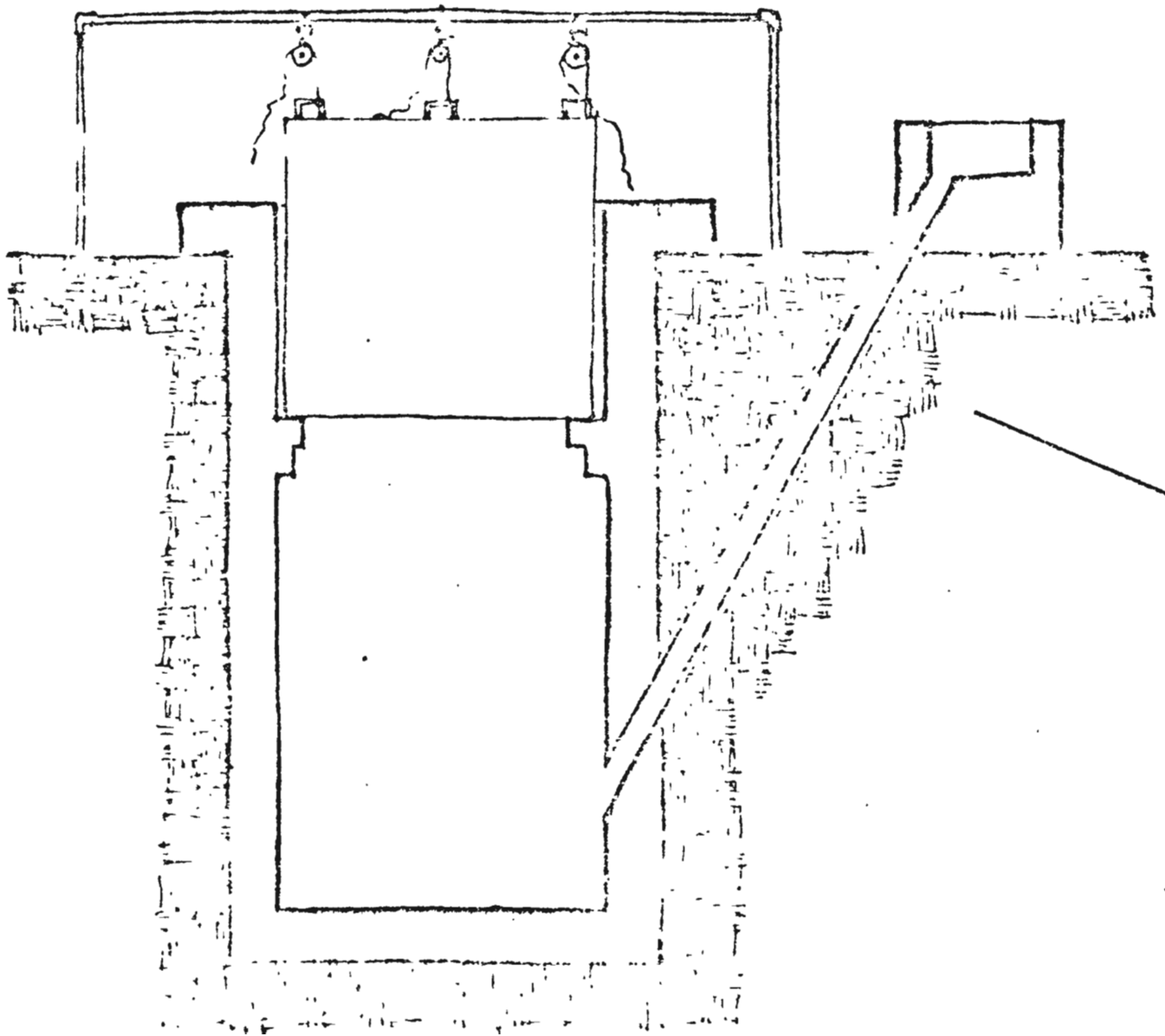

(D) DIGESTOR ICAITI



Chinese Rectangular Digestor

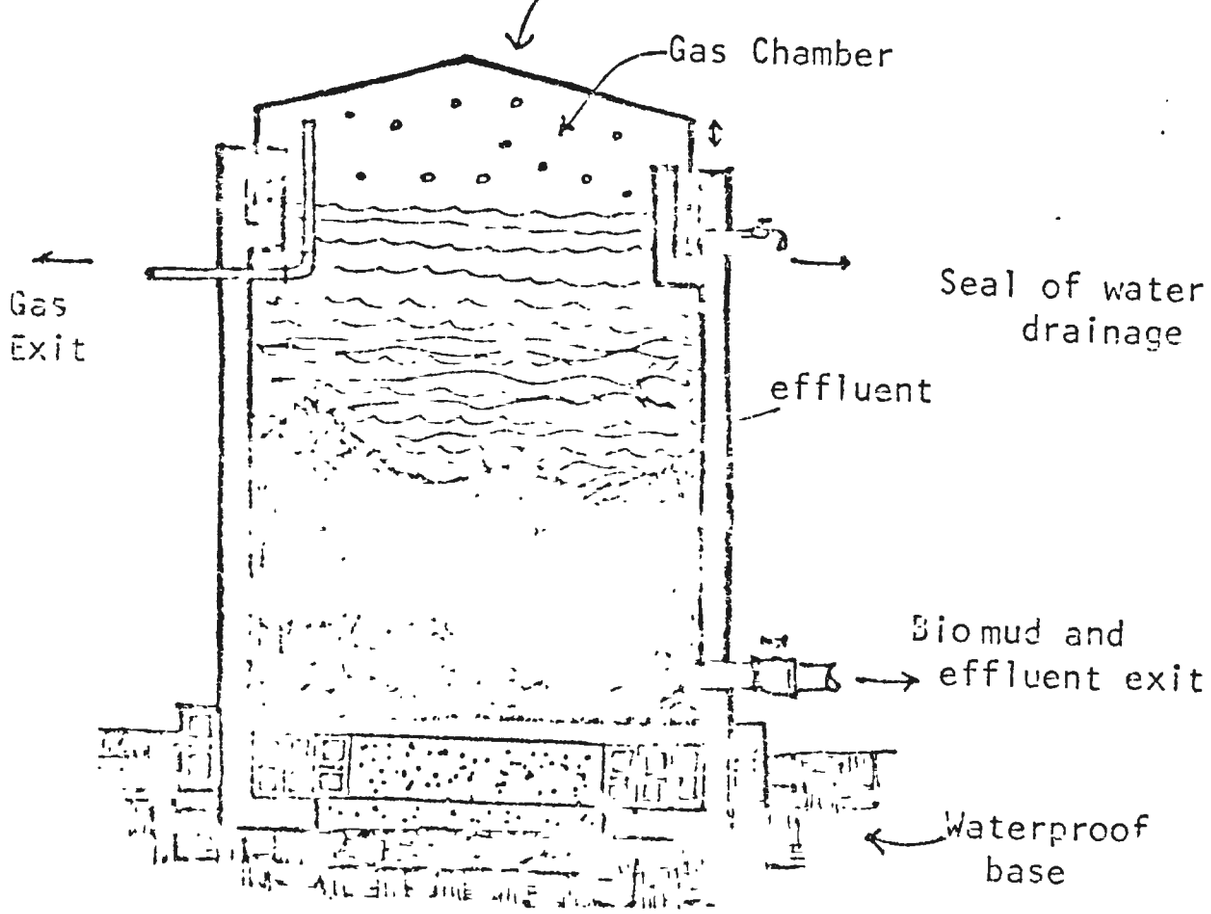


Chinese Round Flattened Digestor

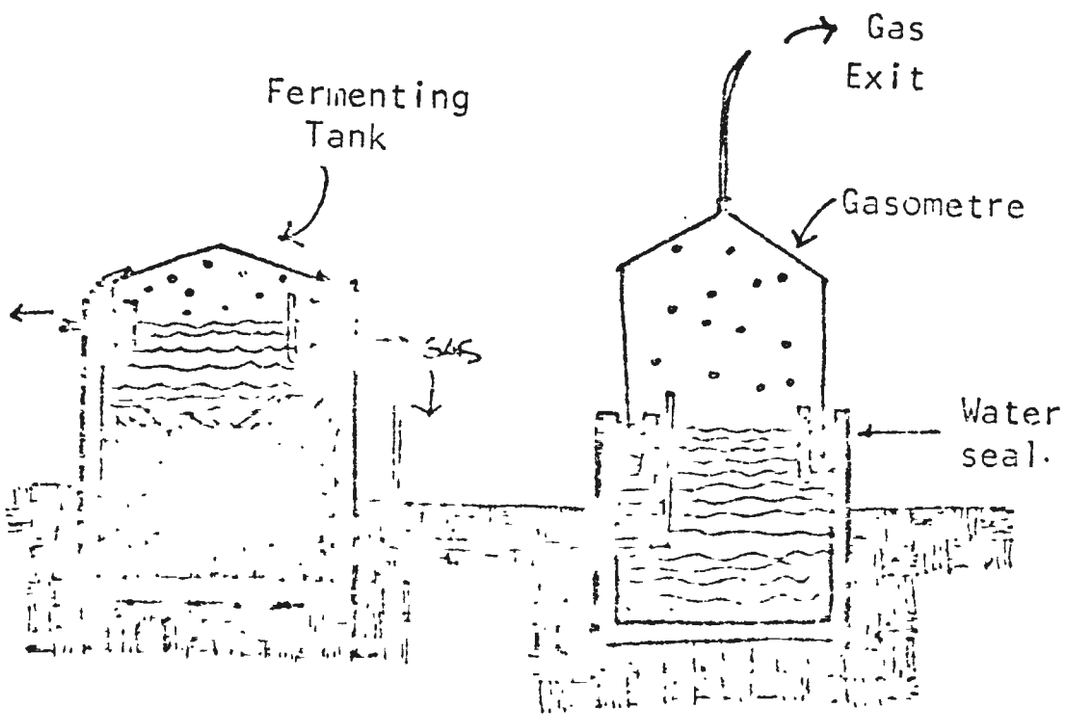


Indian Digestor

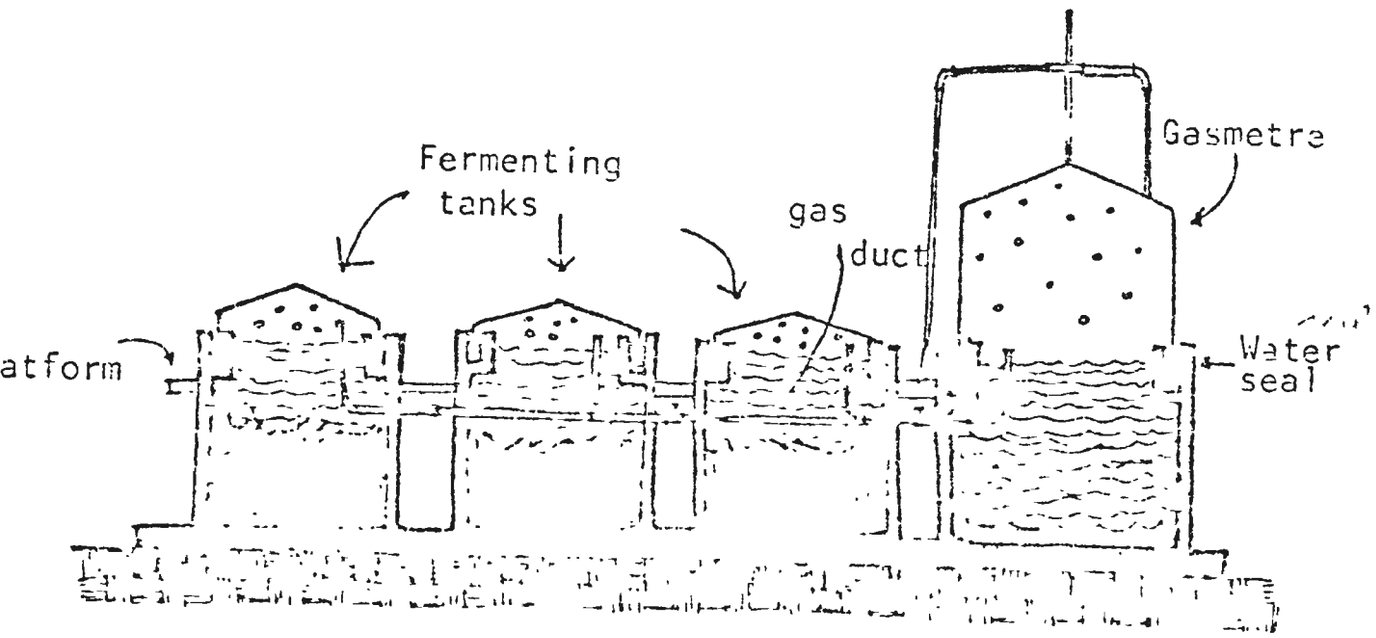
SEMICONTENOUS
DIGESTOR



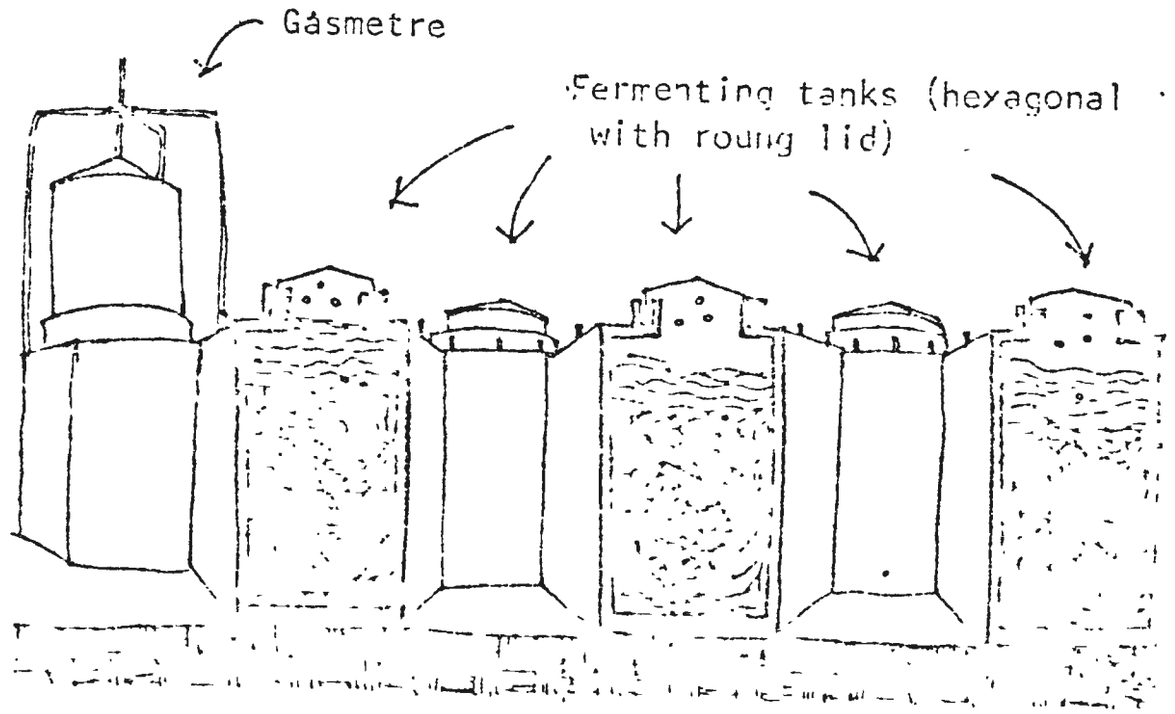

DIGESTOR GUATEMALA - OLADE
TYPE FARM




DIGESTOR T[illegible] - GUATEMALA - OLADE
(ALTIPLANE)
SAN ANDRES SEMETABAT




PLANT SAN ALEGRITO.
PATULUL

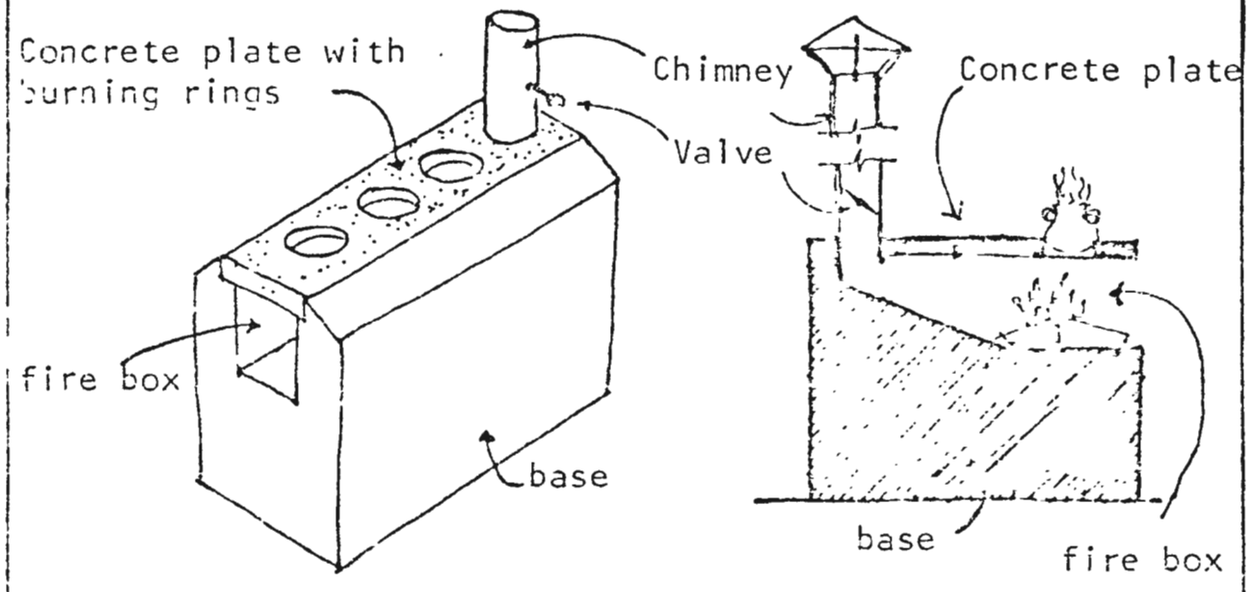



PLANT BIOFERT.

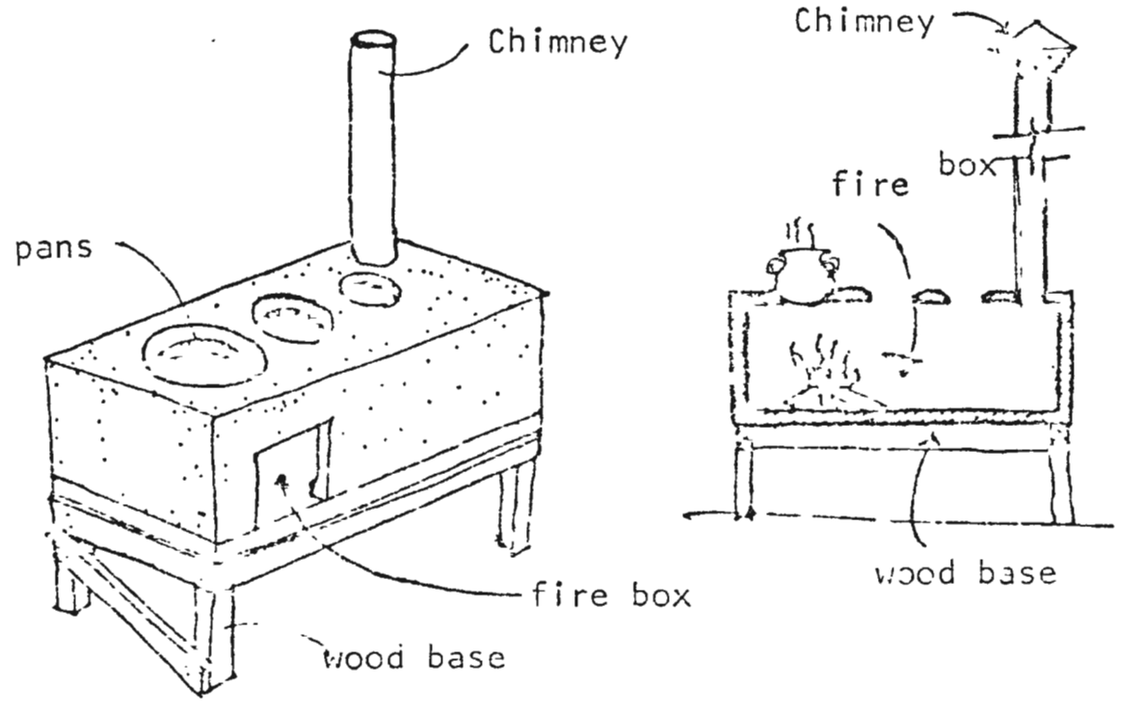
DISCONTINOLS DIGESTORS

Source: CEMAT

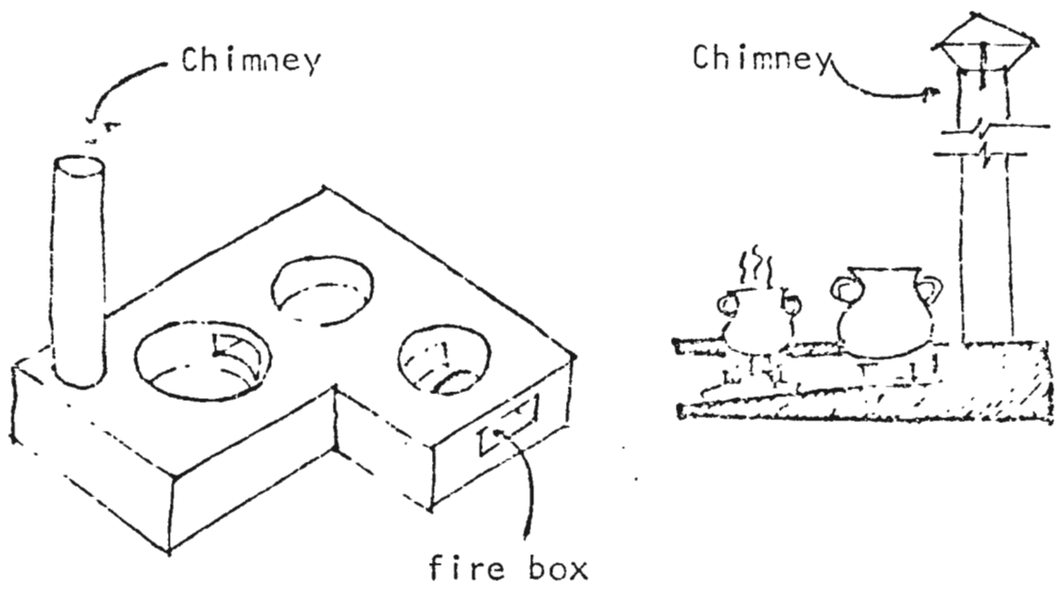
FIGURE 22



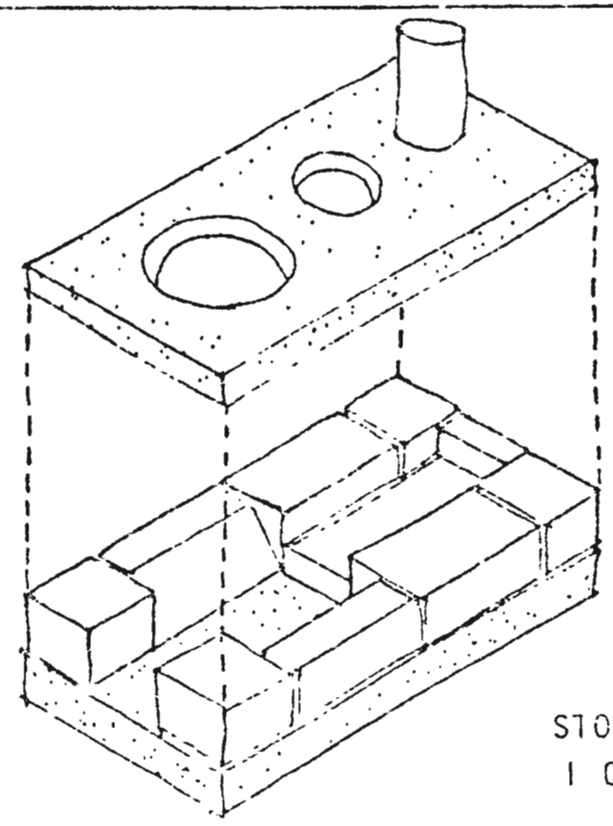

STOVE GHANATYPE
Efficiency CEI = 9%




SOTOVE SINGER TYPE



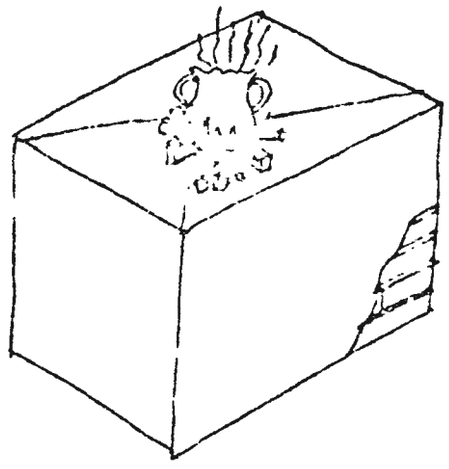

STOVE CHULAH

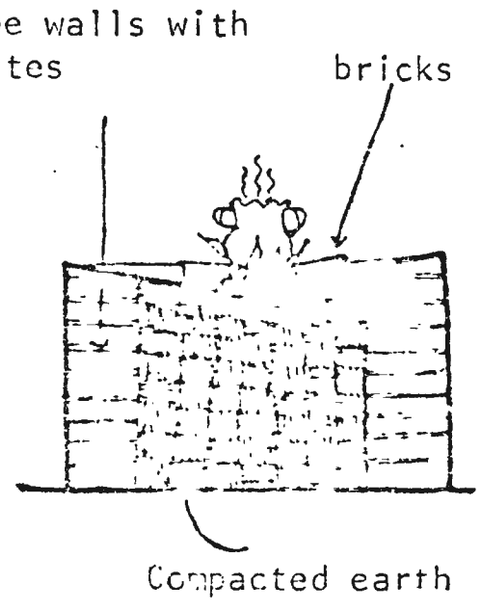


STOVE TYPE
I CHULAH

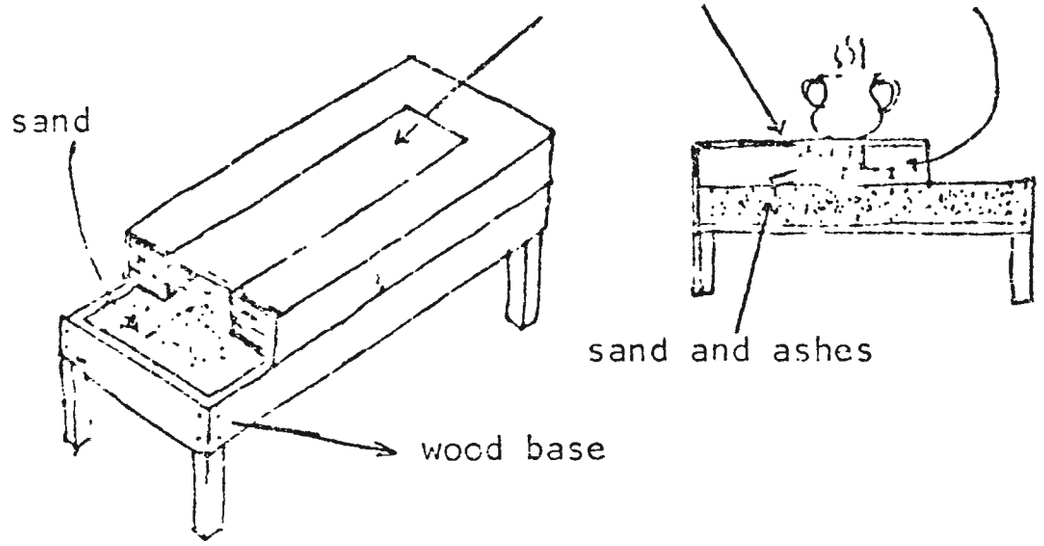
SOURCE: CEMAT

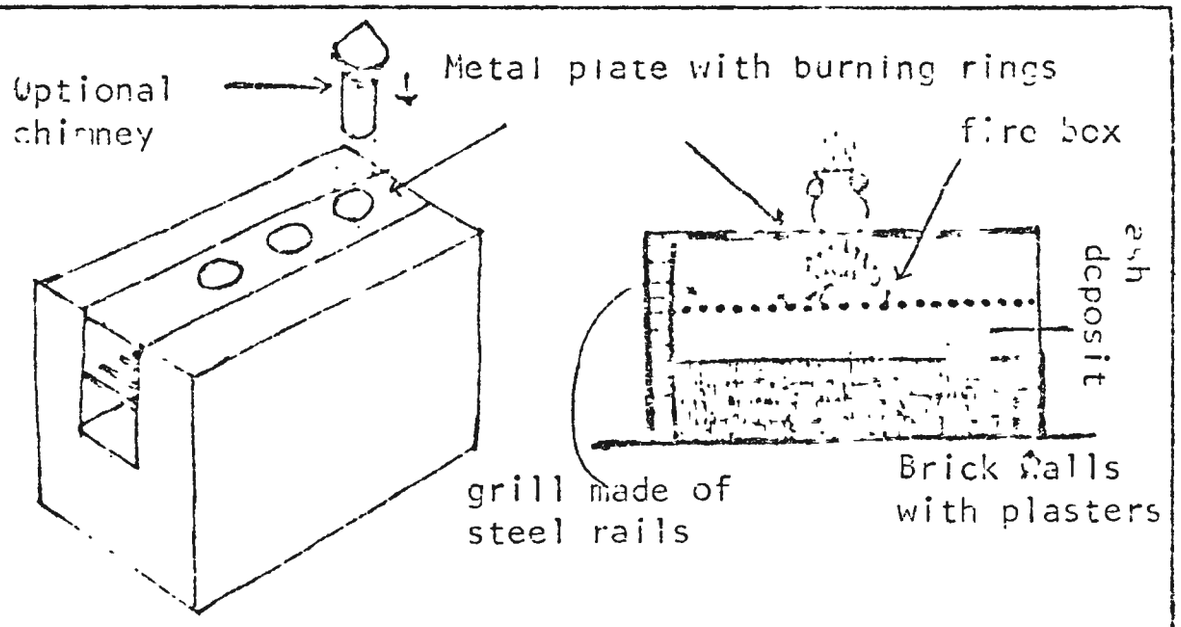
Traditional open fire
Efficiency (E) 12.9%





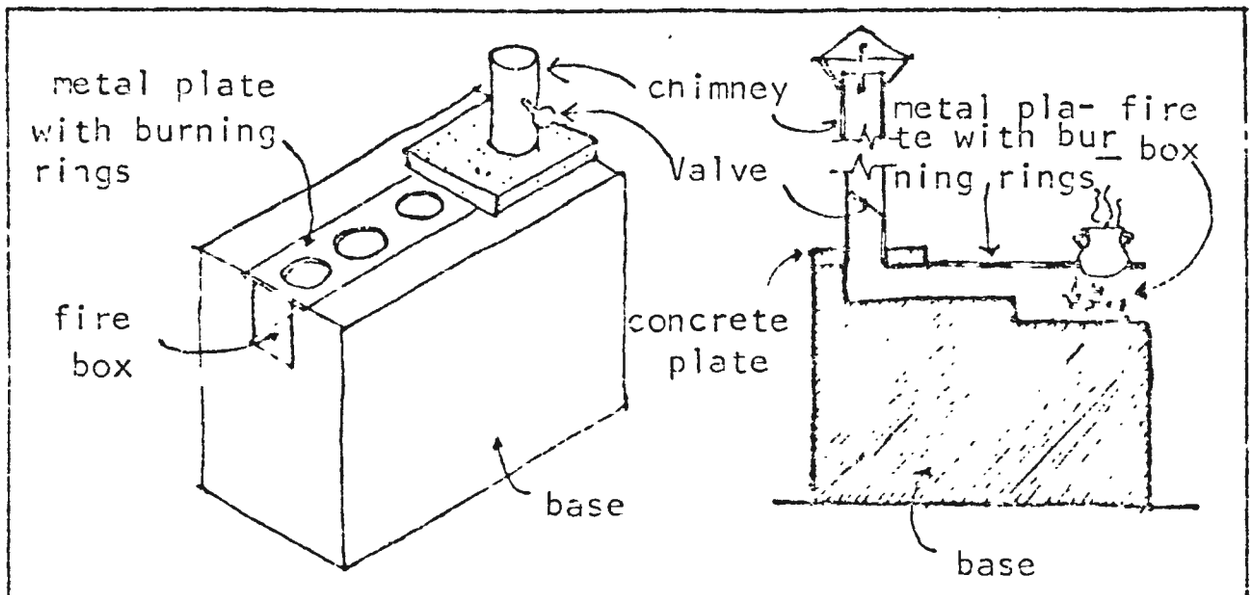

Lonch of adobe or brick



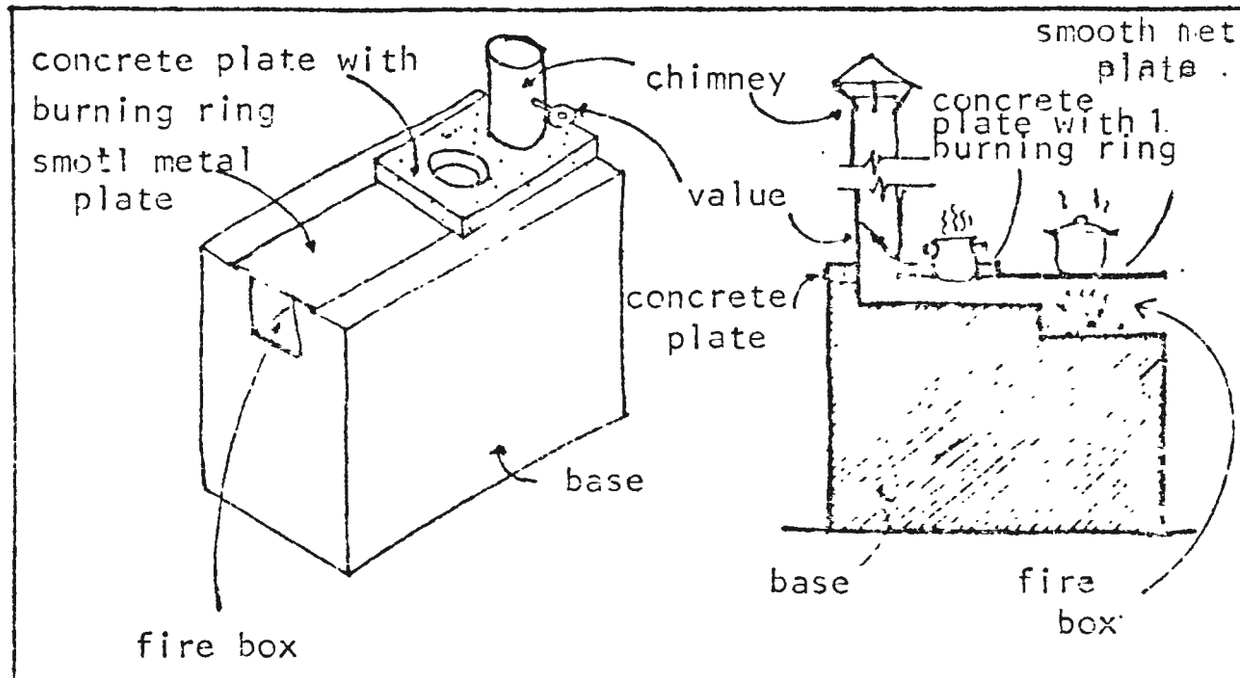




Bench with iron plate and
ash deposit

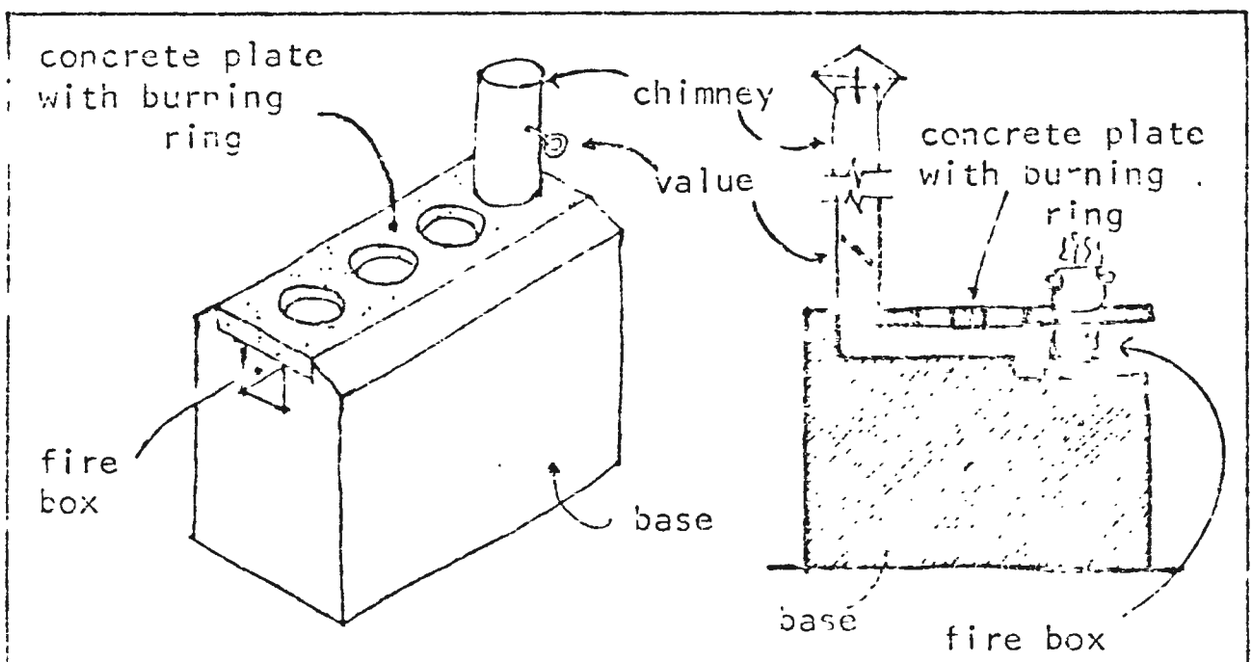
FIGURE 24



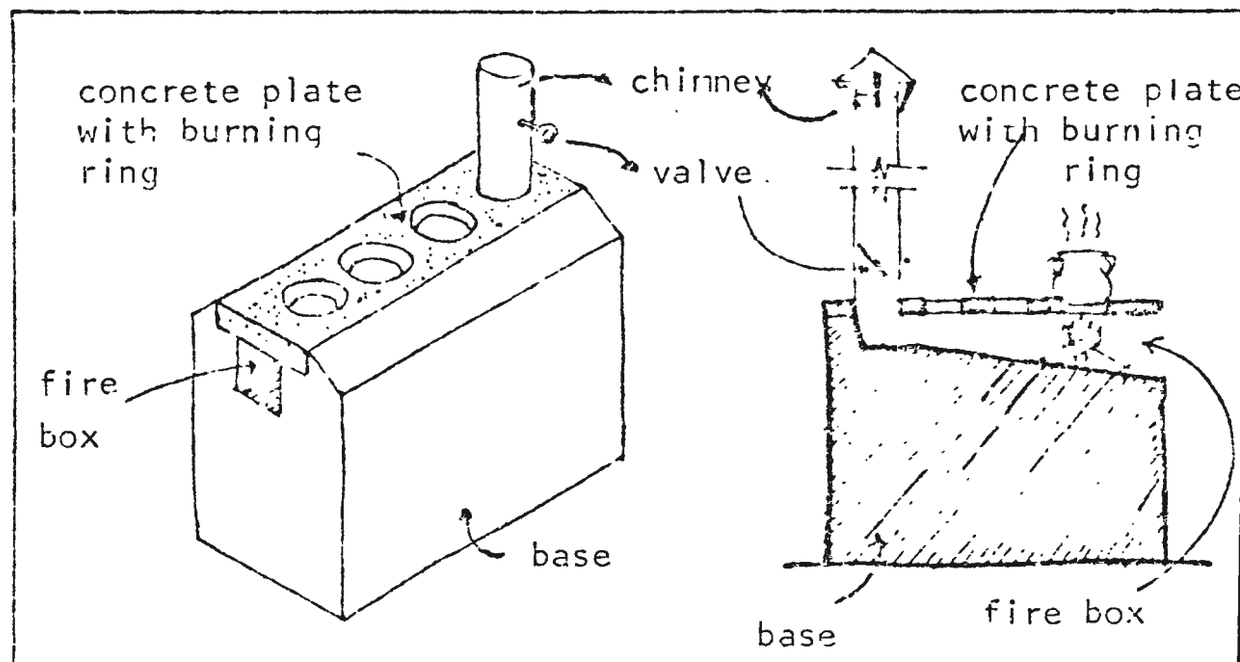

STOVE TIPO ZETA I
EFFICENCY (E) = 15.6 %



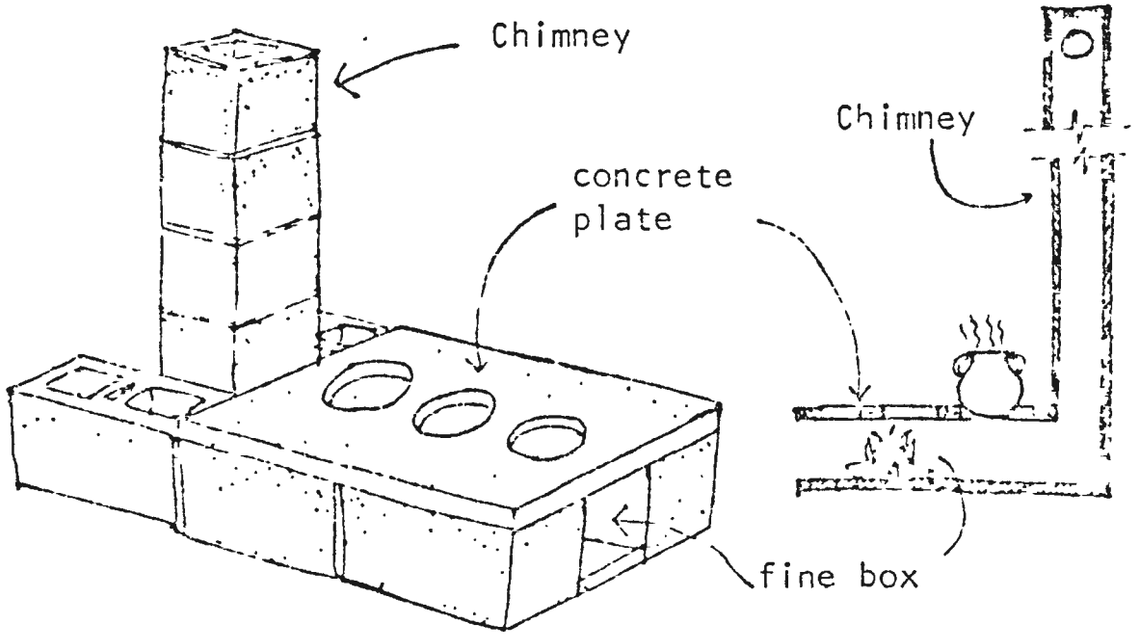

STOVE TIPO ZETA II
EFFICENCY (E) = 20.3%



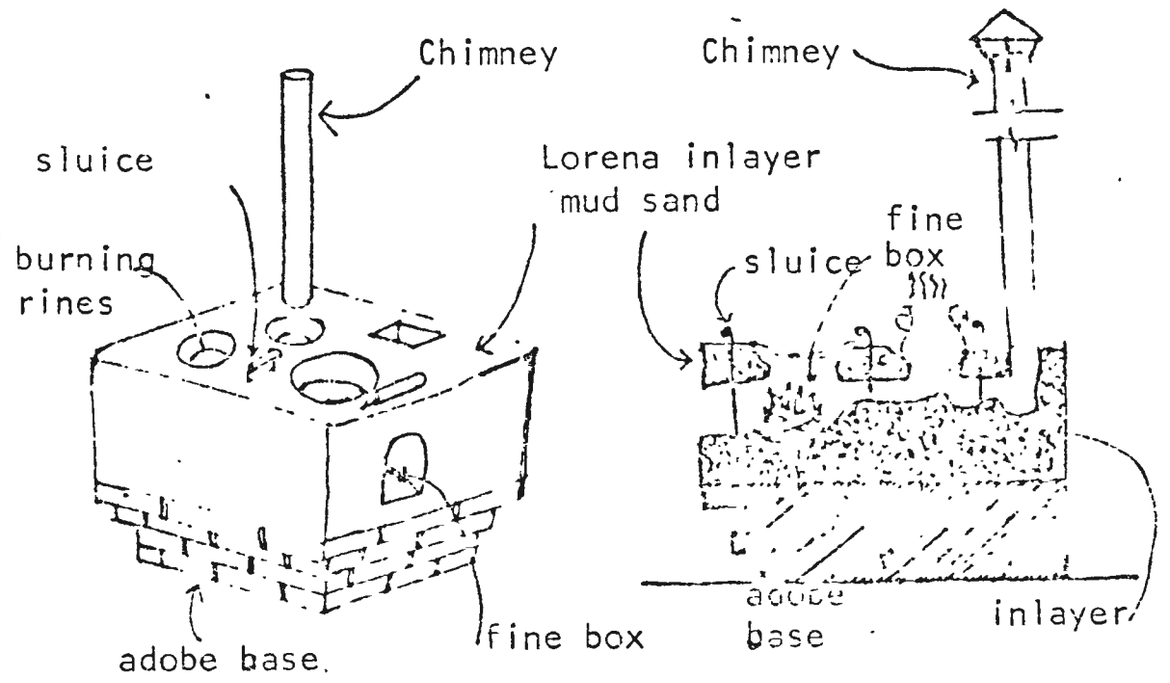

STOVE TIPO CHULAH I
EFFICENCY (E) = 19.2%



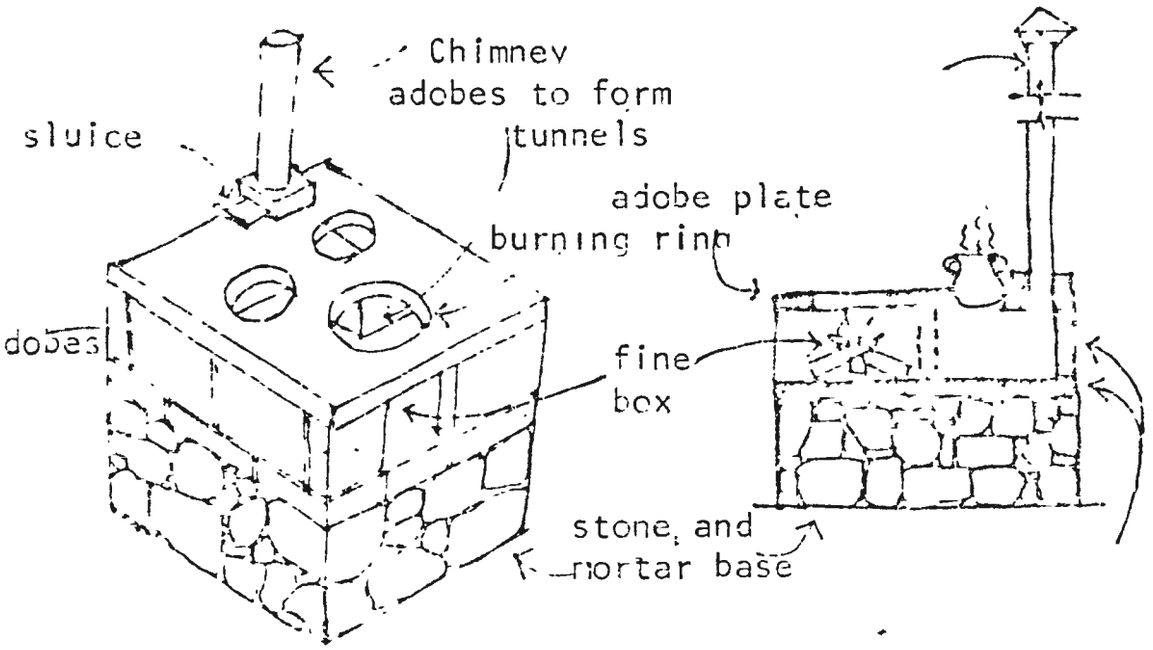

STOVE TIPO CHULAH II
EFFICENCY (E) = 15.9%



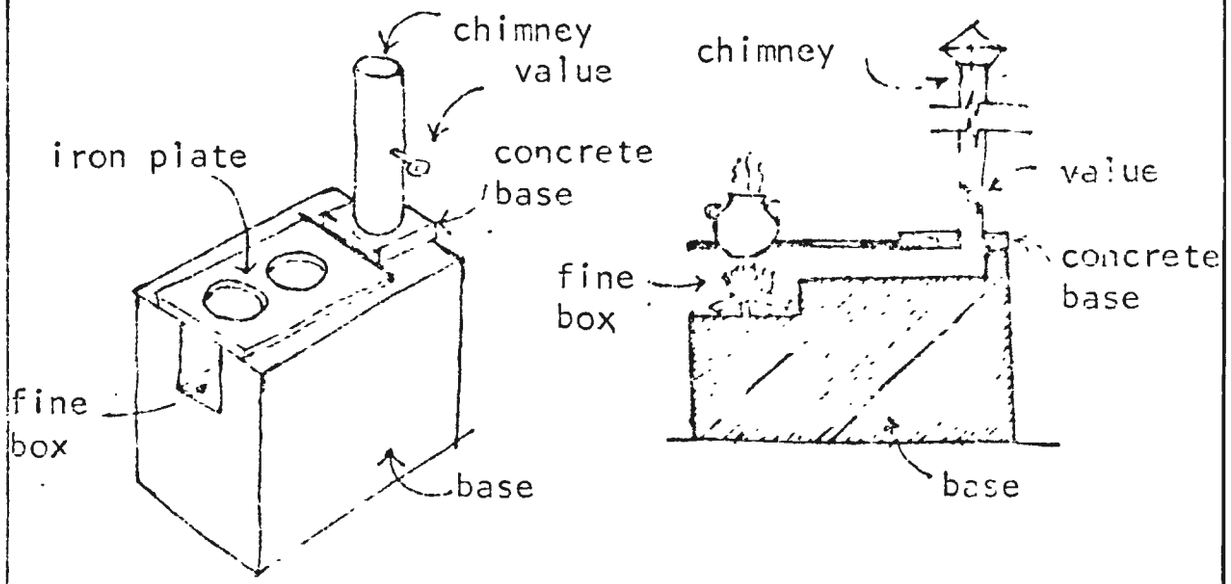

Brick stone




Lorena stone efficiency




Adobe stone




farmers bench efficiency

MANAGEMENT OF FORESTS PROGRAM

| KIND OF OPERATIVE UNITS | LOCATION | | SPECIES |
|---|---|---|---|
| | Departamento | Municipio | |
| | Quezaltenango | Cabricán | Alnus jorullensis<br>Eucalyptus globulus<br>Eucalyptus microtheca<br>Cupressus lusitanica |
| | Suchitepequez | La Máquina | Acacia senegal<br>Eucalyptus camaldulensis<br>Gliricidia sepium<br>Leucaena leucocephala |
| | Zacapa | Gualán | Acacia senegal<br>Caesalpinia velutina<br>Casuarina equisetifolia<br>Leucaena leucocephala |
| AGROFORESTRY UNIT | Izabal | Morales | Eucalyptus deglupta<br>Gmelina arborea<br>Phaseolus vulgaris<br>Zea mays |
| | Zacapa | Huité | Caesalpinia velutina<br>Cucurbita sp.<br>Leucaena leucocephala<br>Zea mays |
| NATURAL VEGETATION UNIT | El Progreso | Sanarate | |
| | Zacapa | Río Hondo | |

SOURCE: CATIE

| Kinds of demonstrative units | location | | species |
|---|---|---|---|
| | Departamento | Municipio | |
| Community forests unit | Baja Verapaz | San Jerónimo | Casuarina equisetifolia<br>Gliricidia sepium<br>Eucalyptus saligna |
| | El Progreso | El Jícaro | Acacia senegal<br>Caesalpinia v[illegible]tina<br>Casuarina equ[illegible]etifolia<br>Leucaena leucocephala |
| | Jutiapa | Jutiapa | Acacia senegal<br>Casuarina equisetifolia<br>Eucalyptus camadulensis<br>Leucaena leucocephala (4 procedencias) |
| | Jutiapa | San José Acatempa | Acacia senegal<br>Casuarina equisetifolia<br>Eucalyptus camaldulensis<br>Gliricidia sepium<br>Leucaena leucocephala (4 procedencias) |
| | Quezaltenango | Quezaltenango | Alnus jorullensis<br>Eucalyptus globulus<br>Eucalyptus microtheca |
| fuelwood production farm unit | Guatemala | Bárcenas | Casuarina equisetifolia<br>Eucalyptus paniculata<br>Leucaena leucocephala |
| | Guatemala | San Pedro Ayampuc | Casuarina equisetifolia<br>Eucalyptus robusta<br>Eucalyptus saligna<br>Eucalyptus globulus<br>Eucalyptus citriodora<br>Fraxinus chinensis<br>Grevillea robusta |

SOURCE: CATIE

CONVENTIONAL SOURCES — NON CONVENTIONAL SOURCES

Entities

I. Public

1. CII - USAC
2. CNEE
3. COFINA
4. COMISION RDS. E.E.
5. CPN
6. DIGESA
7. EEGSA
8. FYDEP
9. ICTA
10. INE
11. INFOM
12. INDE
13. INTIVUMEH
14. INTECAP
15. MUNICIPALIDADES
16. SACEXCO
17. SHCEN

II. REGIONAL

18. ICAITI
19. FEICA
20. SIECA

III. PRIVATE

21. ASOCASCO
22. ASOC. GUAT. EN SOLAR
23. CEMAT
24. CETA
25. COMP. MINERAS
26. COMP. PETROLERAS
27. IQUISOL
28. FINCA Y EMP. PRIV.
29. ICADA/CHOQUI
30. INGENIOS
31. CPINA
32. ORG. IND. Y COM.
33. PLANTA SOL

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) |
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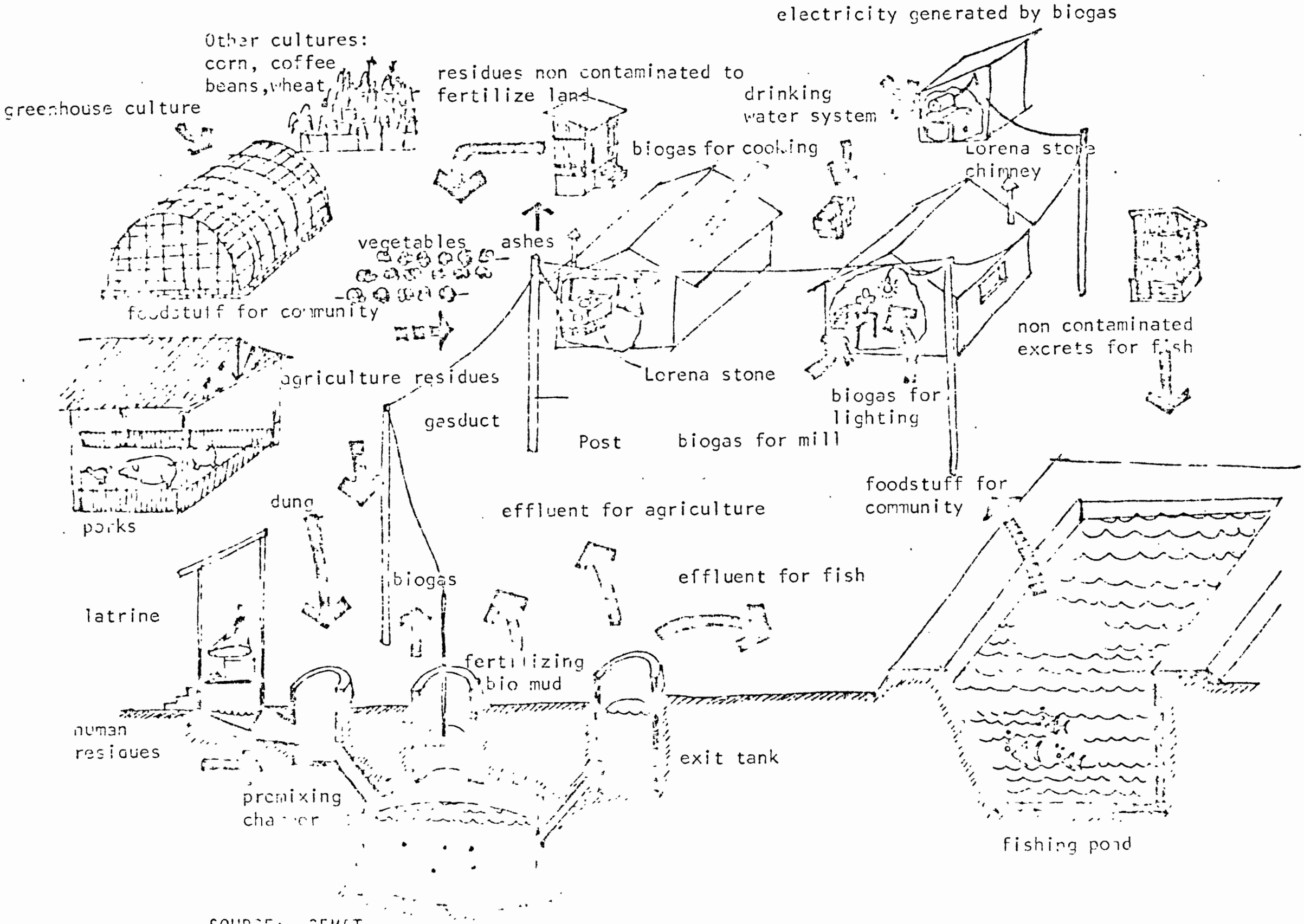
(1) Oil, natural gas, other hydrocarburates,
(2) Hydroelectrical energy
(3) Thermical energy
(4) Mineral carbon
(5) fuelwood
(6) Waste pulp
(7)
(8) Other materials
(9) Geothermy
(10) Bicgas
(11) Solar energy
(12) Aeolic energy
(13) Tidal and waves energy
(14) Nuclear energy
(15) Energy sector planning

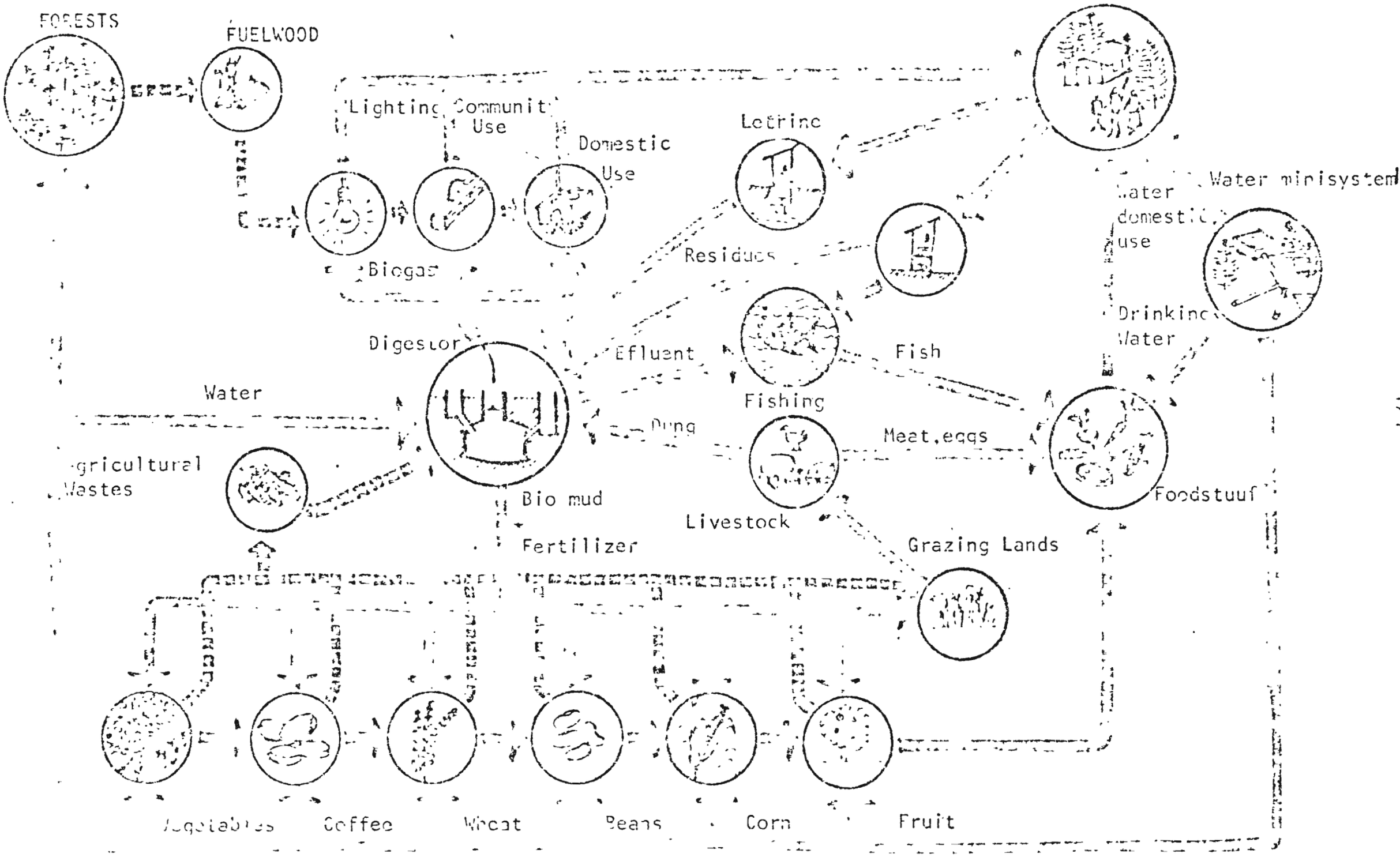
MODEL OF RURAL DEVELOPMENT WITH APPROPIATE TECHNOLOGY




SOURCE: CEMAT.

ALTERNATIVE RURAL SYSTEM

WATER, ENERGY, SANITATION




SOURCE: CEMAT.