FARM MECHANIZATION OF HONDURAS

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Luis E. Mercillo

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FARM MECHANIZATION OF HONDURAS

By

Luis E. Morcillo

AN ABSTRACT

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The topography of Honduras is exceptionally rugged and it is estimated that about 80 percent of the total area is mountainous or hilly. This situation has greatly hampered the development of an efficient road system, and has cut up the country of Honduras into various small units which constitutes a formidable barrier to the establishment of economically strong agricultural population centers.

About 1,500,000 ha of good agricultural land is available in Honduras, and of this only a little more than 7 percent is under crop, three percent of which is laid idle each year as fallow land.

Development of irrigation water in some areas of the available flat land, plus modernization and mechanization of agriculture constitute the first steps toward economic improvement in Honduras.

Some of the problems of agricultural mechanization in Honduras are as follows: (1) land-ownership and land-tenure, (2) absentee farming, (3) low income of farmers and high cost of imported machinery, (4) lack of education and transportation facilities, and (5) shortage of trained personnel.

The limited number of tractors and farm machinery in Honduras can be used most efficiently through specialized custom organizations which are supplied with work shops, mechanics, agronomists, skilled operators, in addition to a complete line of machinery.

To illustrate how the modern agricultural machinery fits into the production of crops under the Honduran conditions, four farming situations were considered. The analysis of each farming situation was made taking into consideration all the factors that affect the operations performed, the time available and the time required. From this analysis, the proper machinery was selected.

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INTRODUCTION

The success of mechanization in highly developed farming countries has led a number of governments to conclude that they could solve their food production problems by following similar lines. But, almost without exception, the rapid introduction of tractors and the equipment that goes with them into countries long dependent on animal power has been very expensive and anything but successful.

Some governments, because of the poor results achieved, are reviewing the whole matter of mechanization, and a few are even advocating a return to, or continuation of, the traditional primitive tillage methods. The pendulum swung too far in one direction and it is now being pushed back. But, in the main, the desire is to profit by past mistakes and to put mechanization on sounder foundations.

Considering the fact that over 85 percent of the Honduran population depends on agricultural production, and that the area under crop represents only about 11 percent of the available flat land, and that the exploitation of this land is conducted with tools and methods of farming very primitive in character, it is easy to see that modernization and mechanization of agriculture should be one of the first steps toward the economic improvement of Honduras.

The mechanization of Honduran agriculture is not an easy-to-solve problem. There are many other social and economic problems which are closely associated with the technical problems of agricultural mechanization. For a practical approach to these problems, a thorough understanding of the natural, social, and economic conditions of the country seemed essential. For this reason, the first two sections of this study were devoted to a brief discussion of the land, climate, soil, water, and other resources, as well as the agricultural practices, regions, and opportunities existing in Honduras at the present time.

The space devoted to these first two sections may appear to be more than is necessary. This was justified because of the belief that technological changes must always be fitted into the social and economic pattern of the country.

It is very easy to learn to drive a tractor, but no machine will run economically for long unless it receives constant skilled attention. This fact has not been borne in mind in many parts of the world where tractors were brought in to take the place of muscular energy; nor has it been recognized that responsible planners must also have a good knowledge of machinery and its capabilities and limitations.

This knowledge is available, but it has not been crystallized and made readily accessible. It is the purpose of this study to outline and emphasize what must be considered and provided for to be reasonably sure that farm mechanization will lead to an improvement of agriculture in Honduras.

I. NATURAL, ECONOMIC, AND SOCIAL CONDITIONS IN HONDURAS

Geography and Topographical Features

The Republic of Honduras is located in the middle of Central America, between latitudes 12° 58' and 16° 2' N. and longitudes 83° 10' and 89° 17' W. The country is roughly triangular in shape, with a coastline of 459 miles on the north, narrowing almost to a point on the Pacific Ocean (Gulf of Fonseca) in the south. It is bounded on the west and southwest by Guatemala and El Salvador, respectively, and on the east by Nicaragua.

According to the official map of Prof. F. Aguilar Paz (1933), Informes de Fomento and Pinel (1949) the area of the Republic of Honduras is 115,205 sq. km. (approximately 59,000 square miles), or about the size of the state of Georgia.

The effective national territory is considerably smaller, however, as the entire northeastern part of the country, Mosquitia, consisting of the Department of Colon (17,000 square miles) and most of the Department of Olancho (13,000 square miles), is thinly inhabited.

The topography is exceptionally rugged, crossed from east to west by the Central American Cordillera. Apart from the relatively small coastal plains along the Caribbean sea in the north, along the Gulf of Fonseca in the south, and the

broad plain of Mosquitia in the northeast, Honduras is mountainous with numerous small valleys and some more extensive valleys as extensions of the coastal plains in the north and northeast. The highest peaks, some more than 10,000 feet in altitude, are in the southwest. The principal rivers are in the north and flow into the Caribbean.

The watersheds between the Caribbean area and the Pacific coast run through the southern part of Honduras, approximately over Ocotepeque-Gracias-La Esperanza-La Paz-Talanga-Danli and El Paraiso. The catchment area of the rivers in the northern part is much more extensive than that of the rivers in the south. They have therefore built up much broader plains and cut much deeper inland than the rivers in the south. Extensive marshes along the Gulf of Fonseca further reduce the area of the southern plain.

Joosten (1952) gives figures of estimated areas of the coastal plains and their inland extensions along the rivers (Table 1). It would not be correct to assume that this whole area is usable or adequate for agriculture on account of the elevation, for many parts are hilly.

About 80 percent of Honduras is mountainous or hilly, mostly with a broken down, dissected and degraded feature. In the northern part the mountains extend to the northeast, enclosing the extensive valleys of Chamelecon, Ulua, Aguan, Sico, and Paulaya. In the southern region the mountains range north to northwest, while the central part is more or

TABLE 1

ESTIMATED AREAS OF THE COASTAL PLAINS AND THEIR INLAND EXTENSIONS BELOW 1000 FT.

Plain or Valley	Width km.	Length km.	Area Sq. km.
I. North-east and east (unexplored)			
Mosquitia-coastal plain east of 85° W.L. (West Latitude)	75-190	145	15200
Rio Coco valley-west of 85° W.L.	3-6	120	580
Rio Patuca valley-west of 85° W.L.	5-20	140	1500
Rio Cuampu valley	3-20	65	670
Iriona coastal plain	20-30	20	550
Rio Platano valley	5	40	210
Rio Paulaya valley	4-20	70	510
Rio Sico valley	5	80	460
Rio Guayape valley (Olancho valley)	5-12	70	860
Rio Guayape valley (Catacamas ")	8	55	450
II. North			
Trujillo coastal plain	3-50	70	1570
Rio Aguan valley	10-30	110	1730
Armenia coastal plain	1-25	35	540
La Ceiba-Tela coastal plain	5-30	60	1180
Mangrove marshes Ulua river	10-35	20	390
Cuyamel coastal plain	3-10	50	240
Rio-Ulua-Chamelecon plain (Sula plain)	15-45	80	2400
Rio Ulua valley	3-12	50	430
Rio Comayagua valley	2-5	70	210
Rio Chamelecon valley	6-16	70	780
III. South			
Choluteca-coastal plain-dry marshes	10-45	60	1300 370
Rio Choluteca valley	3-10	60	500
Nacaome-coastal plain-dry marshes	15-30	45	930 120
Rio Nacaome valley	2-20	30	360
Total Area			34040
Area I minus Catacamas valley			20540
Area II plus III plus Catacamas valley			13500
Estimated area marshes in II plus III			1300
Area dry land below 1000 feet in areas II and III			12200

less a plateau with scattered mountain peaks. The most elevated region with very steep slopes to the numerous small valleys, many of them horseshoe-shaped, is found in the western part.

More than 50 percent of the country has an elevation higher than 3000 feet. In Central Honduras the area of these altitudes covers nearly the whole region which in many places takes the shape of disintegrated plains. East of Juticalpa-Danli the mountain ranges flatten and submerge in the Mosquitia plain near 85° W. L. Here the prevailing altitudes are between 1000 and 2000 feet, the plains less disintegrated and the valleys much broader (Table 2).

TABLE 2

ESTIMATED PERCENTAGES OF THE AREAS WITH ELEVATION OF MORE THAN 1000 FEET

Regions	1000 2000	2000 3000	3000 5000	more than 5000	Total Area Higher Than 1000 Feet Sq. Km.
I. Western Honduras	20	27	46	7	20,000
II. Central Plateau	19	28	48	5	43,900
III. Eastern Honduras west of 85° W.L.	56	33	11	0	13,700
					77,600

I. Between west frontier and Rio Ulua-North road from Potrerillos to Siguatepeque-Cordilleras de Montecillo.

II. Between I and Cordilleras de Agalta-Campamento-Yuscaran Nicaragua frontier.

III. Between II and 85° W.L.

TABLE 3

PERCENTAGES OF LAND ELEVATION

Altitude in Feet	Percentage
0-1000	30
1000-2000	19
2000-3000	19
3000-5000	28
5000 and higher	4

In the Mosquitia plain east of 85° W.L. 88 percent is less than 1000 feet in altitude.

The mountain tops of the Cordillera del Merendon running along the western frontier have altitudes of 9200 feet near Ocotepeque, 7000 feet near Copan and 7300 feet near San Pedro Sula. Near la Ceiba only 15 km. south of the coast the Sierra de Monte de Dios reaches 8050 feet. North of Catacamas runs the Cordillera de Agalta with its highest peak at 8500 feet. The Sierra de Celaque rises to 9400 feet west of Gracias, while the Sierra de Montecillos reaches 9300 feet west of Lake Yojoa and 8000 feet north of Siguatepeque. The Sierra de Comayagua reaches 8000 feet east of Comayagua and 7600 feet near Tegucigalpa. Peaks in the central plateau reach 7700 feet near Sulaco, 7400 feet near Yorito, 7800 feet south of Yoro and 7400 feet near Teupasenti.

East and south of the Cordillera de Agalta no altitude higher than just over 3000 feet is reported. Due to erosion

these mountain peaks and the ridges of the Sierras are in many places very steep, bare and rocky.

As already mentioned, the mountainous parts of Honduras contain numerous and more or less extensive valleys and plains, but because of the lack of suitable maps only a very rough estimate of their areas could be made; it is set out in Table 4. (Joosten, 1952).

TABLE 4

ESTIMATED AREAS OF VALLEYS AND PLAINS WITH ELEVATION HIGHER THAN 1000 FEET

Valley or Plain (Pinel-1955)	Width km.	Length km.	Area sq. km.
Talanga-Cedros plain	25	20	500
Siria valley	10	30	300
Los Angeles valleys	--	--	60
Jamastran-Danli plain and valleys	20	75	1500
Comayagua valley	15	70	1000
Espino valley	13	30	400
Quimistan valley	15	40	600
St. Barbara valley	10	45	450
Yoro plain	35	40	1400
Sulaco valley	6	15	90
Olanchito valley	8	12	100
Scattered valleys mainly in West Honduras	--	--	700
Total			7100

Adding the total of dry land (Table 1) to this area the figure for more or less flat land of 19300 sq. km. or 1,930,000 hectares (one hectare = 2.47 acres) is found for the whole of Honduras excluding the Mosquitia plain.

In evaluating the topographical features of Honduras it has to be emphasized that they present many difficulties for a rapid agricultural development.

The topography makes the survey and the evaluation of the available agricultural land very cumbersome, adds many difficulties to the development of small farming, to erosion safe land use, leaves only very restricted areas with good possibilities for mechanized agriculture, handicaps the efficient operation of the extension service and the development of the rural community and farmer unions, and greatly hampers the development of an efficient road system. Moreover, it has cut up the economy of Honduras into various small units, and this constitutes a formidable barrier to the establishment of economically strong agricultural population centers.

Geographically and commercially, the country may be considered as consisting of two general regions - the highlands of interior and southern Honduras and the tropical, banana-producing North Coast. The southern coastal lowland is grouped with the highland region because of its economic dependence on Tegucigalpa, the capital, located in the southwest central part of the country. Generally, the rugged

topography and lack of surface transportation facilities divide Honduras into numerous small, disconnected localities.

Climate and Rainfall

In Honduras a weather bureau has been established only recently. The information about temperature, winds, humidity and rainfall used is collected from various sources. Also some data was provided by the meteorological service.

The climate of Honduras is varied. In the highlands the tropical latitude is tempered by the altitude to produce an agreeable moderate climate. In Tegucigalpa the daytime temperature averages about 75° F., and the nights are cooler. Excessive high temperatures are very rare, because of the rainfall in the summer months and the influence of the "norte" in the winter months. On the North Coast and the southern coastal plain the climate is hot and humid throughout the year. The rainy and dry seasons in these areas correspond roughly with those for the highlands.

The entire Central American zone is under the influence of the trade winds, namely the northeast trade and the deflected southeast trade wind which blows on the Pacific side as a south-westerly. In the summer half-year, this trade wind is intensified by a monsoonal impetus and is then the rain maker on the Pacific slopes. In the winter half-year the northeast trade penetrates as far as the Pacific, where it

is very dry, as it loses its humidity over land from east to west. Another important climatological factor during the winter half-year consists in the outbreak of cold air masses from the north ("el norte"). This factor is responsible for lowering of the temperature and heavy rainfall along the north coast of Honduras in December and January. In some places, local air movements such as land and sea breezes and mountain and valley breezes also assume some significance.

Happily the West Indian hurricanes do not disturb the Honduras coast and gales and tempests are rare. The wind velocities are mainly low.

TABLE 5

MEAN TEMPERATURES IN DEGREES FAHRENHEIT

Month	La Lima 26 m.a.s. 1940-1950 max - min.		Toncontin 900 m.a.s. (1950) max - min.		Coyoles 130 m.a.s. (1950) max - min.		Zamorano 530 m.a.s. (1950) max - min.	
January	88	63	78	40	84	63	81	56
February	91	63	81	41	82	61	91	53
March	95	65	82	41	90	63	92	50
April	97	67	88	50	96	66	90	52
May	96	69	91	54	96	69	93	57
June	95	71	85	58	93	70	91	68
July	93	70	82	58	92	70	88	58
August	94	70	86	59	92	70	86	68
September	94	70	86	59	92	70	89	61
October	94	69	82	61	84	68	86	59
November	89	66	78	67	80	67	82	48
December	88	65	83	43	81	60	82	58

Atmospheric Humidity

Sapper (1932) mentioned for the north coast 70-90 percent as the day average of atmospheric humidity for Trujillo, and as year average 81 percent. At Toncontin aerodrome the averages for 1950 are given as

December	to	February	66%
March	to	May	60%
June	to	August	73%
September	to	November	75%

Bearing in mind the complicated topography of Honduras only scanty figures for mean monthly and mean annual rainfall could be collected. Several data are taken from Sapper (1932) others were received from United Fruit Company, Aguan Valley Company and the Direccion General de Aeronautica. In many cases the figures represent only the average precipitation over a small number of years and may not be truly representative.

By comparing the characteristics of the distribution of rain over the year and using Mohr's (1937) classification for the tropics (dry if the mean monthly precipitation is less than 60 mm. and wet when above 100 mm.), 5 main types of rainfall could be marked out. (See Figure 1 and Table 6)

The traced boundaries in Figure 1 are, of course, to be studied with due reserve. They coincide more or less with Sapper's figures and correspond with the rainfall zones of the FAO report on Nicaragua (1950). The characteristics

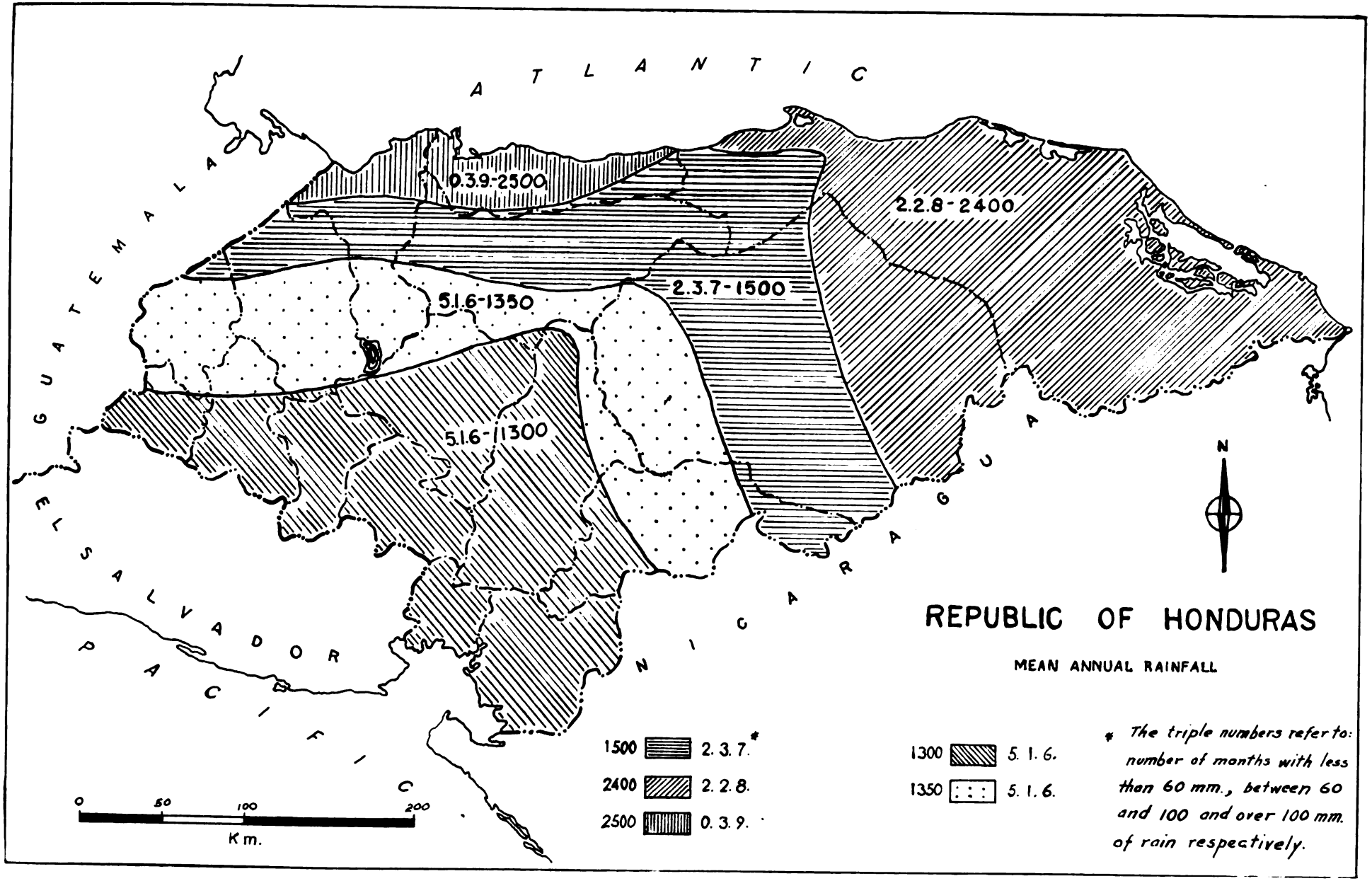
ATLANTIC
GUATEMALA
EL SALVADOR
NICARAGUA
PACIFIC
0.3.9-2500
2.2.8-2400
2.3.7-1500
5.1.6-1350
5.1.6-11300
N
REPUBLIC OF HONDURAS
MEAN ANNUAL RAINFALL
1500 2.3.7.*
2400 2.2.8.
2500 0.3.9.
1300 5.1.6.
1350 5.1.6.
* The triple numbers refer to: number of months with less than 60 mm., between 60 and 100 and over 100 mm. of rain respectively.
0 50 100 200
Km.

Fig. 1

TABLE 6

AVERAGES IN mm. OF THE MEAN MONTHLY AND ANNUAL RAINFALL IN THE RAINFALL ZONES OF FIGURE 1

Month	Type I	Type II	Type III	Type IV	Type V
January	249	246	97	33	7
February	167	180	60	31	6
March	81	60	39	22	12
April	73	18	38	30	22
May	87	47	87	125	174
June	133	80	148	228	259
July	181	167	154	170	113
August	213	151	136	140	177
September	186	140	214	279	260
October	319	314	190	172	199
November	465	658	184	74	64
December	325	365	126	50	8
Total	2479	2426	1473	1354	1301
Number of months with less than 60 mm.	0	2	2	5	5
60-100 mm.	3	2	3	1	1
over 100 mm.	9	8	7	6	6

can be explained fairly satisfactorily from the prevailing wind system and the topography of the country.

A tentative interpretation of the rainfall data is given in the following annotations (Joosten, 1952).

Type I: The zone in which Type I prevails occupies the western part of the north coast region north of the Sierra Omoa, Nombre de Dios and Cangrejal, the latter touching the coast off la Ceiba. The mean annual rainfall decreases from east toward west with 2859 mm. at la Ceiba and 1992 mm. at Guanacastal. Lancetilla (an experimental garden near Tela) with 3392 mm. is likely to be a wet spot in this region.

Type I has no dry months, and 9 wet months with March, April and May as intermediates. The peak is reached in November (465 mm.), October (319 mm.) forming the ascending, and December (325 mm.) the descending slope.

This rainfall distribution is, granted proper soil management, favorable to the growth of nearly all tropical economic plants, such as bananas, abaca, rice, grasses, cacao, oilpalm, coconut, cassava, ramie, jute, agave, derris, nutmeg, canela, and several fruit trees. For profitable cropping of sugar-cane, tobacco, cotton, corn, tomato, oranges, mandarines, mango and Java-kapok the conditions are poor. The rainfall constitutes a major hindrance to mechanization.

Type II: This zone occupies roughly the Mosquitia plain. The boundary is drawn up by taking into account some data

for Nicaragua. The Honduras figures consist of the data of two stations on the north coast recording only 3 and 6 years respectively.

There are 8 wet months (July-February) and 2 dry months (April and May). The peak in November is very high; heavy rainfall is also recorded in October and December. The mean annual precipitation amounts to about 2400 mm. This type of rainfall suits a wide range of tropical plants and is quite favorable for mechanization. The high rainfall in November and December may interfere with the tillage and sowing of a second crop and may also be unfavorable to the ripening of the first crop if dry weather is needed. For permanent crops, such as rubber, oilpalm, cacao, Java-kapok, cassava, agave, oranges and sugar-cane, the climate of this zone provides good conditions. Other crops which will probably do well in this region, on the evidence of the climatic factors, are rice, sweet potatoes, soy beans, roselle, mangos, avocados and coconuts, and perhaps tobacco.

Type III: The zone of Type III is marked out according to data available at stations located near San Pedro Sula and one station east of Olanchito (Planes). The southern boundary has been traced on the evidence of the data of Juticalpa, the vegetation east of Danli and the Nicaraguan rainfall map. The wet season extends over 7 months (June-December). January nearly falls within the wet category, and March and April are dry, although not without some precipitation. The

peak rainfall is low (214 mm. in September) and thus also the annual rainfall which is estimated at about 1475 mm.

The climate of this zone is favorable for mixed farming in smaller units (20-100 ha) and peasant agriculture. With some supplementary irrigation farming in this zone will be free from any noticeable risk due to climatic factors. As the area also includes some important valleys and plains there are good possibilities here for agricultural development.

Type IV: The division of the central and western part of Honduras into two zones is quite provisional. The topography may influence the rainfall in many spots; the number of years recorded is insufficient to give a reliable picture of the rainfall.

Moreover, the number of stations is too small, and only for the western part west of Comayagua-Marcala in Copan has rainfall been recorded. Nevertheless the difference between the rainfall distribution in the northern parts (Danli) and southern parts (Choluteca-Nacaome) is noticeable. The prevailing wind system there also justifies the recognition of different zones in this area. The boundary is drawn mainly along the watershed.

Zone IV occupies the southern part of the Sula Valley and the Central and western part of Honduras north of the mountains near Ocotepeque-Gracias-Comayagua-Tegucigalpa and east of Talanga-El Paraiso. The mean annual rainfall varies

from 1100-1600 mm. The region has 6 wet months (May-October), without excessive rainfall; the peaks are in June (228 mm.) and in September (279 mm.). The 5 dry months December to April have some precipitation. This rainfall distribution means a difficult situation; the cropping risks will be particularly great for the sowing of the first crop and the ripening of the second crop. The decrease in the rainfall in August adds some more difficulties to farming.

Because of the rather short wet season and the risk of early sowing many farmers grow corn once a year only. Others grow beans as a second crop or corn or maicillo (grain sorghum) as a "risk crop", keeping it to ripen if the weather turns out well, and to be cut for fodder if the reverse happens. In the western part tobacco is grown (Copan).

Real skill is needed for profitable farming in this zone. Medium and small units must be based on mixed farming using wherever possible the small streams for supplementary irrigation. Provision must be made for the dry season. If mixed farming is not possible large-scale beef-cattle raising of low productivity seems to be the alternative.

In many relatively small spots coffee grows well, while chatos, yuca, lemon and citronella grass, several legumes, sesame and sweet potatoes can be used to diversify the crop rotation and minimize the risks. The agriculture in this zone is in need of short growing varieties of corn, maicillo and beans and of grasses suitable for haymaking or ensiling.

Type V: The Pacific plain and slopes and the region around Comayagua and Tegucigalpa are joined in zone V. In fact the central part should be marked out separately with about 800-950 mm. rain annually. The main characteristics are, however, similar to those of the Marcala-Nacaome-Choluteca region where the annual precipitation amounts to 1300-1750 mm. There are 6 wet months (May-October), 5 very dry months (December-April) and one intermediate (November), which is on the dry side. The peaks are in June (259 mm.) and September (266 mm.), with a deep decrease in July (118 mm.). In some places in the hills the rainfall may be much higher, but the type remains the same.

Growing two crops a year on the same spot will be difficult; the second crop will be a risky one. Quick growing beans and drought resistant legumes or maicillo will do. The rainfall distribution is favorable to cotton. With irrigation the climate offers excellent conditions for sugar-cane and a number of other crops and for a fully mechanized agriculture.

Soil and Soil Erosion

Taking into consideration the geological and topographical features of Honduras, it stands to reason that the soils vary widely even within small areas. Most of the mother strata, on which and from which soils are formed, give in fact only poor soil-building material.

In Honduras marine, aeolic and vegetative activities in marshes, bogs and moors have never been of noticeable significance as soil building agents. There have been only two major processes: a) the weathering of the bedrock in geological time and geological erosion giving alluvial and residual soils in the mountains, and b) secondary deposition of soil material transported by surface water and rivers, giving old alluvial soils as wash-down in the upland valleys and plains, forming old and recent alluvial plains in the lowlands and recent alluvial strips along the river banks bordered with old alluvial terraces.

For centuries human interferences in the central and western mountainous parts of Honduras has accelerated erosion over vast areas of mountain soils, adding to the alluvial soil-building capacity of the rivers by increasing the silt-content and augmenting the floods, in particular of the Chamalecon, Ulua and Aguan rivers.

Nearly all the soils of Honduras are mineral soils, generally with a low content of humus or organic matter, save for sites where broad-leafed forests remained fairly undisturbed, as is evident in most of the coffee-lands, which may also be called forests.

It is evident that the climatic factors are of considerable significance. There is a wide difference between the wet northern and eastern parts (Zones I and II) and the semi-humid to semi-arid central, western and southern regions.

If undisturbed the residuary soils in the wet regions are mainly deep with pronounced profiles and, except for the A horizon, red in color. The recent alluvial soils are mainly coffee brown to greyish brown. In the semi-arid zones most of the alluvial soils in the valleys are grey to black when wet and greyish to white when dry. It is remarkable that excessively heavy soils are practically absent in the valleys and plains, whereas sandy loam and silty clays are common.

The following broad division of the soils of Honduras may give some guidance:

I. The alluvial soils on the mountains and lower hills in the central and western parts of Honduras formed under semi-arid to semi-humid conditions. Quoting Pendleton (1945) it can be said that "where the rocks of these regions are exposed to moderate rainfall, moderately fertile brown clay loams carrying broad-leafed forests have developed on the granites and limestones; on the acidic rocks are dark grey to black soils forested by pine".

"On the leeward slopes, toward the Pacific Ocean, acidic tuffs and other, older metamorphosed volcanics have given rise to a relatively very shallow black clay soil. Though this soil has a rich black color, it is infertile to an astonishing degree. It readily assumes a finely granular structure during the long dry seasons, while when wet it is unusually sticky. This soil seems to offer very little

possibility of use except for pastures, and even then its value is low."

Due to wide variation of the parent rocks, soil may also differ widely and in some spots better soils are not commonly found. In several places soils under broad-leafed forest showed a high humus content and were well adapted for coffee growing. Denuded of forest cover the soil deteriorates quickly, being extremely susceptible to erosion. Vast areas of land in these regions have been destroyed already as a result of injudicious land use, and the growing of annual crops without measures to check erosion.

This is evident in all regions south of Tegucigalpa and all over the mountains ranging from San Marcos de Colon to Ocotepeque. Erosion has already gone so far, that one can talk of "dying lands", with bare rocks and shallow stony soils on the slopes and steep, cut in, narrow river valleys with threads of productive soil along the banks.

II. The alluvial soils in the mountains ranging to the north coast developed under humid conditions (Zones I and II).

Pendleton remarks:

"Where the mountains are exposed to much heavier rainfall and the profiles are more mature, striking differences in natural vegetation are not apparent. The soils are not fertile: for tens of miles at intermediate elevations the tall dense tropical rain forest is unbroken by a single "kaingin" or other sign of human activity. As with most

profiles, where the soil is undisturbed, the color of the uppermost decimeter is considerably darkened by organic matter and the clay texture is frequently masked by mountain granulation."

III. The washed-down alluvial soils of the smaller upper valleys and inland plains in semi-arid regions. The soil in these valleys and the lower slopes of the bordering hills are mainly blackish gray to greyish white, sometimes with a glow of red or brown. They are mainly very poor in humus content with low nitrogen production. A wide variation within small areas in the content of phosphorus is found. Most of the soils are well supplied with potassium. The pH, ranging between 6 and 8, is commonly on the acid side. The soils are mostly rather light in texture, sandy loam, to silty loam, well friable when in proper moisture condition, and generally very hard when dry. Good Jaragua pasture and well developed crops of maize, beans, sugar-cane, rice and several other plants may be encountered on these soils, in particular if irrigated. Careful management to maintain or if possible to increase the humus content should be the leading policy in using these soils. Therefore well balanced systems of mixed farming, leaving the soil several years under grass between the plantings of annual crops with due regard to legumes, should be developed to secure good farming results in the future.

IV. The old alluvial soils of the Choluteca-Valle plains formed under semi-arid conditions. But for rather small areas of recent soils on the west banks of the Choluteca river, south of Nacaome, and the mangrove marshes along the coast, a shallow, sandy, unfertile soil is found over vast areas of this plain. The savannah type vegetation consists of extremely poor grasses, weeds and "Moro" trees which give the landscape a peculiar appearance. Here, the moisture situation becomes most critical at different seasons of the year, at one time as an excess and at another time as a deficiency of moisture, for the surface soil is mainly very shallow and of unfavorable physical nature. These soils can be used for grazing purposes only.

V. The old alluvial soils of the Mosquitia plain developed under humid conditions. The sole available source of information regarding this region is Pendleton, who pointed out:

"Of interest pedologically, yet practically useless agriculturally, is the vast mass of sediment carried out during earlier times by the Coco and Patuca rivers in northeastern Nicaragua and Honduras. Elevated roughly 20 meters above the present sea level these materials have been exposed to heavy and nearly continuous rainfall for such a long time that the surface portions of these deposits have become extremely impoverished and are now a light yellowish, very acid lixivium. In places, at least, the weathering process has

reached the senile (true Buchanan) laterite stage. These soils normally carry short sparse grasses and dimunitive sedges, with here and there considerable stands of Caribbean pine. Where ravines have cut back into this plain, the slopes which expose less drastically weathered sediments are occupied by shrubs and dwarfish broad-leafed trees. The lower courses of the rivers are through poorly drained often swampy regions. The recent sediments deposited by the Coco river have formed very narrow natural levees of brown fine sandy loam and silt loam. These are considered better agricultural soils."

Soil conditions similar to these may extend also along the other rivers of the Mosquitia valley. The valleys of the lower courses of the Patuca river however are broader with probably bigger areas of fertile recent alluvial soils.

VI. The recent alluvial soils along the banks of the rivers to the north and of the plains built up by these rivers. The prominent rivers are: Chamelecon, Ulua (with Comayagua tributary), Aguan, Sico and Paulaya. The Sula plain built up by the Chamelecon and Ulua rivers, and the coastal plains near Cuyamel, between Tela to la Ceiba, with extensions between the mountain ranges and near Trujillo. Pendleton's description of these soils was as follows:

"Since the recent alluvial soils of the lower valleys of the Ulua and Chamelecon rivers in northern Honduras come

from mountains, composed largely of acidic tuffs, which might be expected to give only poor sediments, it is surprising that the recent alluvial deposited by those rivers are neutral to slightly basic reaction, well supplied with phosphorus and potassium, and are considered to be among the best banana soils in the world. The mountains in which these rivers rise do not have such heavy rainfall, so that at the start the sediments carried by these rivers are not so thoroughly weathered. By contrast, the Comayagua valley, which is one of the tributary valleys of the Ulua river, has four groups of very diverse and relatively poor soils, namely: (a) narrow strips of fertile alluvial soils along the river; (b) poor, leached terrace soils, back from the flood plain; (c) poor, black soils on gravelly substrata; and (d) fertile, purplish red clay loam on some of the hills in the upper valley."

The description given on the situation in the Comayagua valley fits also the inland valleys of the other rivers in the eastern part of Honduras, in particular the Aguan and tributaries and the Guayape and tributaries in the Juticalpa-Catacamas-Olancho valleys.

The recent alluvial soils are mainly moderately friable, with a fairly light texture, and deep profiles which are as yet undeveloped. If under pasture or forest, the humus content may rise considerable, giving black top soil of 10 or more inches. Denuded of permanent vegetation the humus content drops quickly causing a low nitrogen production of

the soil. Large quantities of nitrogen therefore are applied to the banana and abaca plantations. The pH varies from 5.5 to 7.8, being mainly on the basic side in the Sula Valley. The soils in the coastal plains near Tela are on the whole slightly acid with a pH between 6.2 - 6.9. In these plains old residuary soils with red to brownish red colors may also be found on the spurs of the mountains.

It is however highly important to remember that soils do differ greatly from place to place. Within a comparatively small radium, types of the most diverse nature are found as is clearly seen by looking at the few soil maps which are made for small areas; e.g. the Abaca land. It is manifest, therefore, that large-scale development of new areas or reorganization of fields already in cultivation should be preceded by a careful study of the character, distribution and extent of the soils types, rather than by more or less haphazard regional studies and evaluations that do not reveal this necessary information.

Soil erosion is a serious matter for the agricultural economy of Honduras. The principle erosive agents are water and the main reasons for the rapid erosion are as follows:

1. Topographical features of the country, extensive mountain ranges with steep slopes.

2. Lack of vegetation and over-grazing specially near urban centers of population.

3. Denudation of lands adjacent to villages and farm lands of trees, shrubs, and other vegetation and plants.

4. Lack of proper soil conservation and soil conserving crop rotation practices.

5. Lack of humus in the soil brought about by the removal of all crop residue and the utilization of manure, which should be returned to the soil as humus.

From the above discussion, it is apparent that the use of power and machinery in Honduras should be linked together with soil conservation practices if any positive result is to be obtained.

Resources of Agricultural Land

Estimates of Honduras' resources of agricultural land are mainly guesswork, as hardly any reliable information exists. As already mentioned there are neither any reliable maps on a suitable scale, nor soil maps. Only highly tentative estimates can therefore be made; nevertheless, such estimates have to be attempted.

The assumptions are that:

(a) there is no real good agricultural land in the mountainous parts, but only in the valleys and peneplains.

(b) the estimated area of land below the 1000 feet elevation mark (Table 1) cannot be assumed to be

agricultural land unless evaluated on basis of the available knowledge of terrain and soils as to the percentage of fertile and fairly fertile land. The result of this evaluation is given in Table 7 (Joosten, 1952).

TABLE 7

TENTATIVE ESTIMATES OF AGRICULTURAL LAND IN HONDURAS

Region	Area sq. km.	Percentage agricultural Land	Area of agricultural land sq. km.	Area under climatic conditions suitable for mechanization sq. km.
Mosquitia plains	15,200	20	3,000	--
Rio Coco, Patuca, Guayape valleys	2,750	30	800	--
Iriona coastal plains and adjacent valleys	1,730	40	700	--
Olancho-Catacamas Juticalpa valleys	1,310	40	520	--
Trujillo coastal plains	1,570	50	790	--
Aguan valley	1,730	60	1,040	500
Armenia, La Ceiba, Tela plain	1,720	50	860	--
Cuyamel coastal plain	240	50	140	--
Sula plain	2,400	80	1,920	1,000
Ulua, Chamelecon, Comayagua valleys	1,420	40	570	200
Choluteca-Valley plains	2,230	20	450	400
Choluteca-Nacaome valleys	620	25	150	--
Plains and valleys in the central and western highlands	7,100	60	4,300	1,200
Total			15,240	3,300

According to these estimates 1,500,000 ha of good agricultural land is available in Honduras, of which 30 percent is in the unexplored Mosquitia plains, 16 percent in the thinly populated Aguan and Olancho-Catacamas valleys and 20 percent in the north coastal plain and Sula valley. These regions also offer the best possibilities for agricultural development from the point of view of climatic conditions. In the inner parts of Honduras, general agricultural improvement only requires attention. The estimate of the land area for mechanization is based on technical considerations of soil and climate only.

Water Resources

Very little is known about the water resources of Honduras. No results of investigations, if ever made, relating to the minimum run off or the maximum floods of the rivers are available. Neither are there any figures available for sub-soil water or the capacity to supply a well constantly with water.

The rivers on the south side of the watersheds are small and carry nearly no water in the dry season. The catchment area of the rivers running to the Caribbean Sea are much larger and these rivers will carry much more water also in the dry season.

A well organized irrigation system in the Sula valley would serve a general need. At present several enterprises

are using water for irrigation purposes. Without centralized management, this situation constitutes a troublesome hindrance to further agricultural development of this valley with its large resources of good land. Furthermore, the smaller enterprises and farms cannot be served except by a general irrigation system, and even the larger enterprises, now to some extent using expensive pumps, would be able to make economies.

Although the numerous small streams might not be suited for central governmental projects, they might be used for local small-scale irrigation by constructing dams to serve one or a few farms. The piling up of loose stones in the riverbed will often suffice. The only need here is technical advice regarding the best location of the dams and the layout of the canals or pipes.

Forestry and Fishing

The forest resources of Honduras have never been thoroughly surveyed; some parts of the country have been barely explored. Of the approximately 41,500 square miles of forest land, representing about 70 percent of the total land area, it is estimated that the Honduran Government owns a minimum of 75 percent. All of the forest area could be considered potentially productive, although only a small percentage is currently exploited.

Although the most heavily forested areas are located in the more inaccessible localities, forest-covered land is fairly well distributed throughout the entire country. However, land immediately adjacent to towns and means of transportation is quickly being denuded of its forest cover.

Because of the engineering problems involved in constructing roads in the rugged mountainous area of the country and the difficulty of maintaining the roads usable during the rainy season, lumber companies seldom practice logging more than 30 kilometers on either side of the few existing main roads. As a result, the area now within reach of economic exploitation is a small percentage of the total forest resources of Honduras. Although the lumber industry has expanded tremendously since World War II, its further development and even its existence depend primarily upon the road-building program in Honduras and the world market price for lumber.

It is estimated that at least 90 percent of the forested area of the country consists of pine, the remaining 10 percent comprising cedar and hardwood, such as mahogany, primavera, and small quantities of lignum vitae. The principal commercial species are pine and mahogany, both of high quality.

An estimated 60 percent of all lumber sawed in Honduras is exported. Local lumber consumption is principally in construction activities; furniture making is on a small scale, and there are no paper mills in the country. While the

importance of timber to the Honduran economy has on the whole diminished, it may regain some lost ground when a new plywood factory at Puerto Castilla begins production.

In recent years pine has accounted for almost 90 percent of total lumber exports, principal customers being Cuba, Venezuela and El Salvador. Table 8 gives lumber exports, by principal kinds and destination, for the fiscal year ending June 30, 1953 (U. S. Dept. of Commerce, 1955).

One of the most urgent problems of the Honduran Government at present is that of forest conservation. Perhaps the greatest menace to the country's forest resources is the destructive custom of burning forest cover to clear land for small agricultural plantings ("milpas") and to rid pastures of ticks. While often wanting no more than 2 or 3 acres of cleared land, farmers frequently start fires which burn thousands of acres of valuable timber. The rugged terrain and lack of roads and other means of transportation further complicate the problem, seriously handicapping forest fire control measures.

Indicative of governmental concern over the steadily declining forest reserves of the country was the establishment of a Forestry Service in the Ministry of Agriculture late in 1953 to perform certain technical services originally carried on by STICA (Interamerican Cooperative Service for Technical Agriculture). These services include the control of forest fires, fostering of selective logging operations, reforestation,

TABLE 8

LUMBER EXPORTS FROM HONDURAS, BY PRINCIPAL KINDS AND DESTINATION, FISCAL YEAR 1952-1953

(Quantity in cubic meters; value in dollars)

Country of destination	Total		Pine		Cedar		Mahogany	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
United States	12,000	319,715	5,580	156,228	675	29,204	1,157	54,897
Belgium	22	368	22	368	--	--	--	--
Canal Zone	18	1,160	18	1,160	--	--	--	--
Costa Rica	4,000	155,132	3,386	128,416	--	--	--	--
Cuba	65,000	1,736,624	63,290	1,682,874	435	22,439	300	17,402
Egypt	182	6,544	182	6,544	--	--	--	--
El Salvador	22,000	505,012	18,496	396,912	1,019	32,841	13	550
France	522	31,775	522	31,775	--	--	--	--
Germany	843	25,446	843	25,446	--	--	--	--
Italy	25	834	25	834	--	--	--	--
Jamaica	4,364	159,669	4,364	159,669	--	--	--	--
Mexico	427	10,850	427	10,850	--	--	--	--
Netherlands	195	6,455	195	6,455	--	--	--	--
Norway	490	10,778	490	10,778	--	--	--	--
Panama	499	23,042	499	23,042	--	--	--	--
United Kingdom	408	11,667	408	11,667	--	--	--	--
Venezuela	30,682	807,076	30,682	807,076	--	--	--	--
Total	141,667	3,862,192	129,429	3,460,090	2,129	84,484	1,470	72,798

and improvement of turpentine-gathering techniques. (Turpentine production amounts to some 160 metric tons per year; resin production, 860 metric tons.)

No commercial fishing of any kind is being done in Honduras by foreign firms. One small local company does limited fishing in the Gulf of Fonseca on the southwest coast, and trucks its catch daily to Tegucigalpa where it is sold as fresh fish. Private fishermen on both coasts bring in small catches daily for sale in the immediate area. There is only one fish cannery, and its product is sold only in the local market; no freezing operations exist.

Grassland and Forage Production

The cattle of Honduras are fed almost entirely on grass. There are no crops sown specifically for forage, nor are there any legume forages. Some corn and sorghum plants are given to the cattle, should the second crop fail to ripen because of the early ceasing of the rains. In some dairies concentrates are used, whose main components are coconut and palm-kernel meal. A certain amount of forage-seed is imported; 1116 tons was the average in the period 1944/45 - 1949/50, valued at $332.500. (Joosten, 1952)

According to figures given in the Informe de Fomento, Honduras kept 475,000 hectares of pastures for grazing in 1949/50. Vast areas of these pastures are in bad condition,

in some places due to over-grazing and in others to under-grazing. Hardly any special care to maintain good pastures is in evidence in any part of the country.

TABLE 9

SIZE OF PASTURES IN HECTARES

Guinea grass	(Panicum maximum)	106,702
Para	(Panicum barbinode)	29,785
Jaragua	(Hyparrhenia ruffa)	103,137
Calinguero	(Melinis minutiflora)	5,530
Natural pastures		229,591
Total		474,745

Guinea grass is common in the wetter lowlands (North coast, Mosquitia, Olancho), where it grows spontaneously in every spot where the land has been cleared. In higher and dry inland regions Jaragua is most common. Vast areas of natural pastures are found in the hills and mountains under thin pine forests, which are kept open by cutting and burning. There are vast areas of natural pastures in the plains of the central plateau and the southern coastal plain, although here they are generally badly infested with weeds and shrubs. The lack of legumes is noticeable in all the pastures of Honduras.

Almost everywhere there is bad management of the pastures. As long as people do not care for their pastures it would be waste of effort trying to introduce better grasses and legumes. The improvement of the pastures is linked with the problems of livestock production and dairying, which appear to be primarily of an economic and educational nature.

Mining

The mineral resources of Honduras are claimed to be considerable and include gold, silver, lead, antimony, iron, copper, tin, zinc, coal, cinnabar, and pitchblende. With the exception of gold and silver and small amounts of lead and zinc, none are being extracted at the present time because of transportation difficulties.

There are 3 main mines now operating in the country, of which only one, a United States company, is operating on anything resembling a large scale. Its principal production is silver and, to a lesser extent, gold, all of which is exported to the United States. Considerable quantities of gold amalgam have, however, been shipped by other companies to the United Kingdom for refining and reshipment; the value of these exports was estimated at 0.9 million lempiras* for the year 1952-53. Exports of gold in bars and nuggets for the same year amounted to 1.8 million lempiras (U. S. Department of Commerce, 1955).

*One lempira equals U.S. $0.50.

While mineral production, particularly of gold and silver, has long been fairly important, the mining industry may now be entering a period of decline as a result of the exhaustion of proved high-grade ore reserves. This trend was highlighted during 1953 when the largest operator closed because the low quality of the ore had rendered its operations unprofitable. Nevertheless, the feeling persists that rich mineral resources still remain to be developed. Some credence to this optimism may be taken from the fact that 62 mining claims were filed in the fiscal year ending June 30, 1953, of which 37 were for gold and silver, with others covering lead, copper, manganese, opals, agates, etc.

The quantity and value of minerals produced in Honduras during calendar year 1952 are shown in Table 10.

The country's mining laws have encouraged private activity, as the Government has a liberal policy toward mining exploration and exploitation. To implement its policy under the Honduran Mining Code, the Government encourages the mining industry by permitting duty-free importation of machinery, tools, and other equipment directly related to mining activities.

Problems incident to further development of mining in Honduras consist mainly of transportation difficulties in the producing areas, coupled with the progressive exhaustion of proved high-grade ore reserves and the increasing costs of extraction.

TABLE 10

QUANTITY AND VALUE OF MINERALS

PRODUCED IN HONDURAS IN 1952

Commodity	Quantity	Value
Silver, crude....troy ounces	3,712,755	$3,126,864.00
Gold: crude....do.....	29,655	738,934,00
fine ....do.....	2,313	85,088.00
Salt, sea.....pounds.....	10,000,000	400,000.00
Lead .....do.....	1,186,533	164,064,00
Zinc .....do.....	548,000	71,240.00
Copper, in concentrates .... short tons.	25	6,553.75

Industry

Being primarily an agricultural country, the manufacturing industries of Honduras are few and confined principally to the production of light consumer goods. These include beer, rum, and soft drinks; cigarettes, cigars, and matches; laundry soap; lard and butter; cotton drill; candles; vegetable shortening and oil from palm nuts; some clothing; and footwear.

Following the established pattern, manufcaturing continued during 1953 to occupy a comparatively unimportant position in the Honduran economy, although some studies were

initiated to consider the establishment of new industries, such as a cement plant near San Pedro Sula, where there are ample deposits of limestone, and a milk-processing plant. Attempts to start a canning industry, using local meat and fruit, have not been very successful, mainly because of cheap imports and distribution difficulties.

The National Development Bank estimated that manufacturing comprised only about 10 percent of the total national production in terms of value, with nearly all manufacturing being for domestic use. With the expected continuation of this trend, there is no indication that manufacturing will become a dominant factor in the Honduran economy in the foreseeable future.

With no fuel produced domestically except wood and a small amount of sugarcane bagasse used in operating the sugar mills, Honduras is heavily dependent upon future hydroelectric energy development as a source of light and power to supply the country's expanding requirements. The lack of adequate available hydroelectric power facilities constitutes a major deterrent to local industry expansion, as well as to the general development of the entire economy.

With a view to providing power for light industry in central Honduras, and in order to furnish electricity at reasonable rates to the Tegucigalpa area, which now has one of the highest electricity rates in the world (over 10 cents per kw. hr. to the domestic consumer), the Rio Lindo

hydroelectric project, estimated to cost some $5 million, has been under consideration by the Honduran Government for the past 10 years. In the fall of 1954 preliminary engineering studies were carried out by a United States firm, and it was hoped that actual construction of the project would begin some time in 1956.

Transportation

There are 3 railways operating in Honduras with a total length of 800 miles. Including mainlines, branches, and spurs, they are

National Railways of Honduras	90 miles
The Tela Railroad Company	393 "
Standard Fruit and Steamship Company Railroad	317 "
Total	800 miles

All are located on the North Coast, serving principally as outlets for the banana crop.

The most important, from the standpoint of freight tonnage other than bananas, is the National Railways, connecting Puerto Cortes with San Pedro Sula and Potrerillo, the terminus of the Intercoastal Highway serving Tegucigalpa, at which junction point passengers and freight are transferred to buses and trucks to complete the trip to Tegucigalpa. This route is at present the only overland one from the Atlantic coast of Honduras to Tegucigalpa.

As recently as 1951, the Ministry of Development was studying the possibility of extending the National Railways some 64 kilometers 1/ from Potrerillos (then the rail-head) to Rio Lindo, where the proposed hydroelectric plant is to be located. Although this idea was dropped for the time being, a 32-kilometer extension of the rail line was built in 1952 between Proterillos and El Higuerito, where new banana lands were being opened up.

The success of the El Higuerito venture (nearly a million stems were hauled from this area by the railroad during the year) has contributed much to popular enthusiasm for a transisthmian railroad line, the lack of which has long constituted a major obstacle to Honduran economic development. The current necessary transshipment of all goods and passengers at Potrerillos is expensive and impracticable.

The inadequacy of the rail transport system, indeed the total absence of lines in most of the country, makes marketing and distribution of all merchandise unnecessarily expensive.

Highways

There are a few improved earth roads in Honduras. Of the relatively few paved highways, the most important is the all-weather Intercoastal Highway, connecting the port of San Lorenzo on the Pacific with Tegucigalpa - 81 miles - and thence continuing to Potrerillos to the north - 161 miles - where it meets the railroad from Puerto Cortes on the Caribbean

1/ One kilometer equals 0.62137 mile.

coast. Most of the imported freight is brought into the interior over this route.

The Honduran section of the Inter-American Highway, which is easily passable in any weather from the Salvadoran border southeast to the Nicaraguan frontier, is 95 miles long and intersects the Intercoastal Highway about 73 miles south of Tegucigalpa. Other roads extend radially from Tegucigalpa, but are not always passable.

Until a very few years ago the only important all-weather highway in Honduras was the so-called Inter-Oceanic Highway, linking the commercial center of San Pedro Sula in the north with the south coast at San Lorenzo via Tegucigalpa. Even this road was winding, with a rough, uneven surface, and at times impassable when flood waters washed out bridges or covered low lying sections. Roads to many hinterland producing areas were either nonexistent or poorly graded, unsurfaced trails. In some regions, transportation by mule or horseback remained the most practicable method of getting out produce and bringing in supplies.

To remove these impediments to increased production and commerce, the Government in 1950 undertook a widespread program of highway construction and improvement, and has steadily increased its expenditures for that purpose in every succeeding year. The expenditures that have been budgeted for the highway department are as follow:

For the fiscal year 1951-52.....$ 1,750,000

For the fiscal year 1952-53..... 2,739,000

For the fiscal year 1953-54..... 6,476,000

The last amount represents nearly 20 percent of total budgeted expenditures.

The south Highway (that section of the Inter-Oceanic Highway between Tegucigalpa and the south coast) received a greater percentage of new investment than any other section of the Honduran highway system. A United States contractor was awarded a contract in 1952 for widening, relocating, and surfacing the southernmost 40 kilometers of this road and a new contract was awarded the firm in October 1953 for an additional 35 kilometers. At the same time, the Honduran Highway Department itself undertook to surface the northern section of the road beginning at Tegucigalpa and working toward the Caribbean. The economic justification for paving this road lies in the comparatively heavy trade between Honduras and El Salvador and the need for better communications facilities between the capital and the port of Amapala, Honduras' fourth important port, the only one on the south coast and the nearest port to the capital.

Meanwhile, serviceable, unpaved roads are being cut through to inland provincial cities, and a net increase of 92 kilometers was added to the national highway length in the 1952-53 fiscal year. As the network of secondary roads is expanded, an immediate increase in overall production will almost certainly follow, particularly because the National

Development Bank's promotional activities are always felt wherever there is road transportation.

The new roads program is being financed entirely from Honduran resources, the major part being derived from regularly budgeted receipts, plus small bond issues. Because of the country's consistently favorable balance of trade in recent years, adequate foreign exchange has been available to purchase heavy equipment and construction materials for this program.

Ocean Shipping and Seaports

Honduras has three major seaports on the Caribbean and one on the southwest Pacific coast. The principal ports on the Caribbean are Puerto Cortes, Tela, and La Ceiba, in that order of importance, and, on the Pacific coast, Amapala in the Gulf of Fonseca, which is located about 20 miles offshore on the island of El Tigre. Goods handled through Amapala must be lightened between it and San Lorenzo, a shallow-draft port on the mainland, then trucked to Tegucigalpa, over 81 miles of mountain road.

Other ports on the Caribbean are Trujillo on the mainland and Roatan on the Bay Islands. Trujillo is no longer important, and Roatan is of significance only because Honduran exports of coconuts are in large part shipped from there.

Imports and exports by international ocean shipping for the fiscal year 1952-53 aggregated 708,409 tons. Vessels

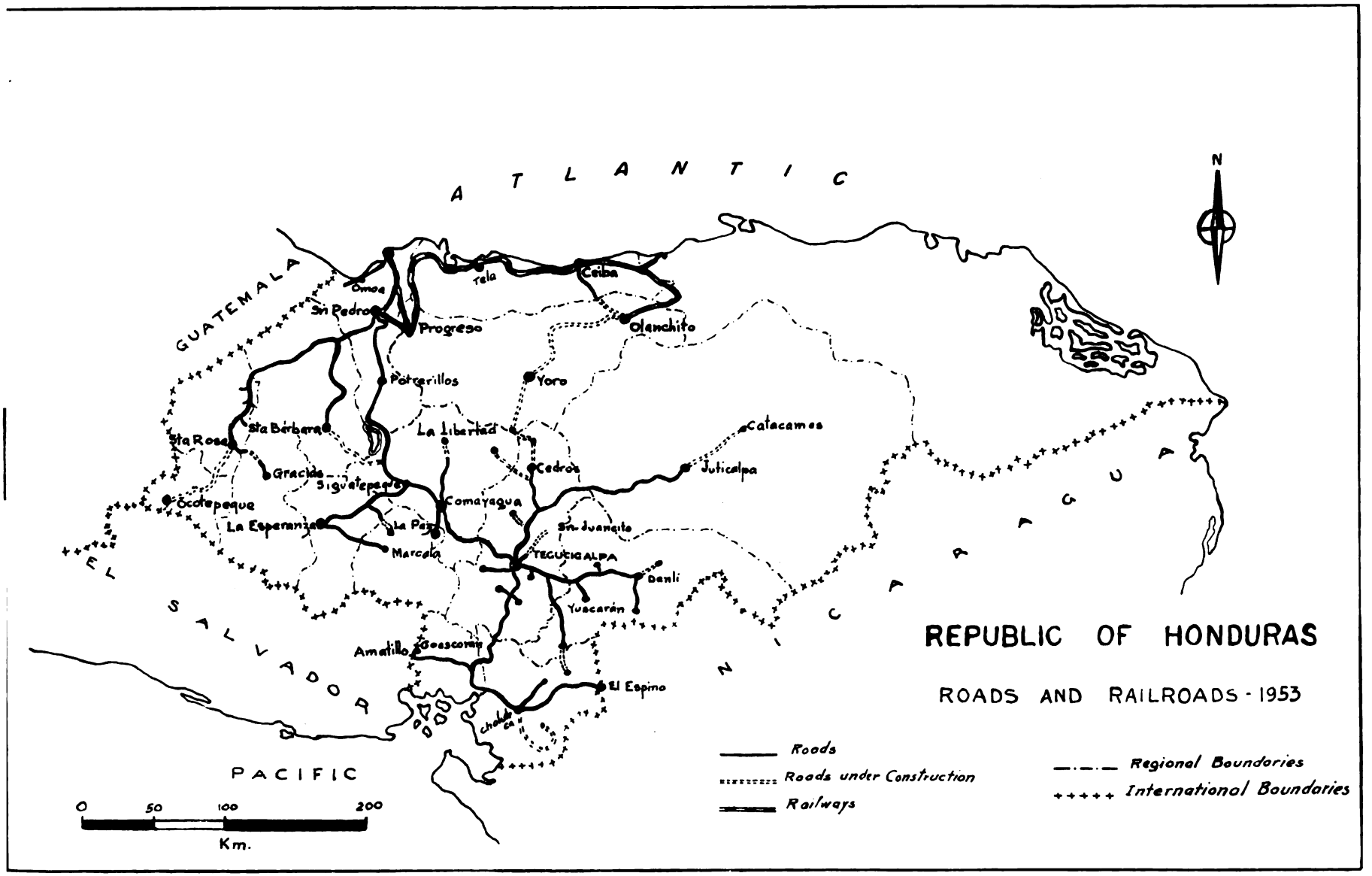
ATLANTIC
N
GUATEMALA
Omoa
San Pedro
Progreso
Tela
Ceiba
Olanchito
Potrerillos
Yoro
Santa Barbara
Santa Rosa
La Libertad
Catacamas
Gracias
Cedros
Juticalpa
Siguatepeque
Comayagua
Ocotepeque
La Esperanza
La Paz
San Juancito
Marcala
TEGUCIGALPA
Danli
Yuscarán
Amatillo
Goascoran
El Espino
Choluteca
EL SALVADOR
NICARAGUA
PACIFIC
0 50 100 200
Km.
REPUBLIC OF HONDURAS
ROADS AND RAILROADS - 1953
Roads
Roads under Construction
Railways
Regional Boundaries
International Boundaries

FIG. 2

entering and clearing Honduran ports in that year totalled 1,493. The two most active ports in volume of trade were Puerto Cortes and Tela followed by La Ceiba and Amapala.

The ocean transport facilities of the various shipping lines serving Honduran ports appear adequate to handle the country's present volume of exports and imports. The most pressing need, particularly at Amapala, is for the expansion and repair of existing port facilities, i. e., docks, harbors, and cargo-handling equipment. With the eventual expansion and development of Amapala's facilities, the volume of shipping should increase substantially there.

The People

According to the 1950 census there were 1,428,089 inhabitants in Honduras, distributed among the 17 departments as shown in Table 11 and Figure 3.

TABLE 11

THE POPULATION OF HONDURAS BY DEPARTMENTS

1950

Department	Area in sq. km.	Population	
		Total	Per sq. km.
1. Atlantida	4,290	66,556	15.5
2. Colon	26,630	37,250	1.4
3. Comayagua	5,216	71,145	13.6

TABLE 11 (Cont.)

Department	Area in sq. km.	Population	
		Total	Per sq. km.
4. Copan	3,150	100,044	31.8
5. Cortes	4,056	131,082	32.2
6. Choluteca	4,304	112,030	26.0
7. El Paraiso	7,403	86,141	11.6
8. Francisco Morazan	8,110	198,687	24.5
9. Intibuca	3,130	61,741	19.7
10. Bay Islands	275	8,653	31.5
11. La Paz	2,286	53,599	23.4
12. Lempira	4,375	94,477	21.6
13. Ocotepeque	1,745	47,457	27.2
14. Olancho	25,222	87,479	3.5
15. Santa Barbara	5,220	100,561	19.3
16. Valle	1,670	68,323	40.9
17. Yoro	8,134	102,864	12.6
	115,205	1,428,089	12.4

The estimated population in 1952 was 1,513,000.

Approximately three-fourths of the people are classed as rural, although many of the others also live in small rural villages, as there are few cities of importance. The largest cities, according to the 1950 census, are Tegucigalpa (99,948), San Pedro Sula (54,268), La Ceiba (20,949), Tela (12,614, and Puerto Cortes (12,228).

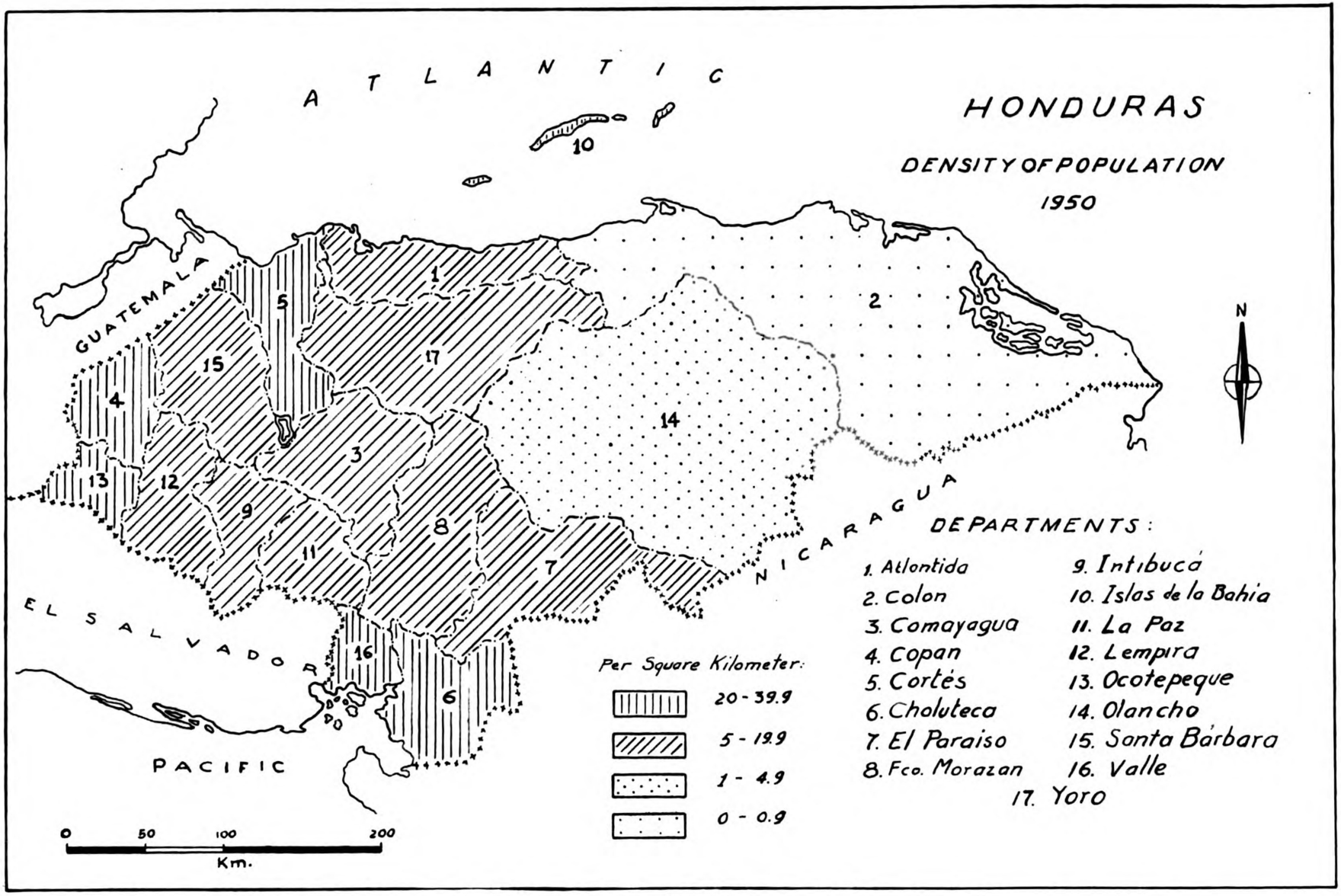
HONDURAS
DENSITY OF POPULATION
1950
ATLANTIC
PACIFIC
GUATEMALA
EL SALVADOR
NICARAGUA
N
DEPARTMENTS:
1. Atlantida
2. Colon
3. Comayagua
4. Copan
5. Cortés
6. Choluteca
7. El Paraiso
8. Fco. Morazan
9. Intibucá
10. Islas de la Bahia
11. La Paz
12. Lempira
13. Ocotepeque
14. Olancho
15. Santa Bárbara
16. Valle
17. Yoro
Per Square Kilometer:
20 - 39.9
5 - 19.9
1 - 4.9
0 - 0.9
0 50 100 200
Km.

FIG. 3

Some of the people have pure Spanish or Indian blood, but by far the majority are mixed Spanish and Indian and, in the North Coast area especially, there is some admixture of Negro blood.

Percentage distribution of the population by racial groups, according to the 1950 census, was as follows:

Mestizos (mixed)	91 percent
Indians	6 "
Negroes	2 "
Whites	1 "
	100 percent

The language of the country is Spanish, although English is spoken in the Bay Islands and generally understood in many parts of the country. Indian tongues are still spoken in the remote parts of the Departments of Colon and Olancho.

Per capita annual income was $120 in 1950 but rose to $140 in 1952. The economically active in the population in 1950 numbered 631,500, distributed as shown in Table 12 occupationally.

TABLE 12

POPULATION ECONOMICALLY ACTIVE

1950

Economic activity	Number of persons	Percentage of total
Agriculture, livestock, forestry	526,000	83.3
Mining	3,600	0.6
Manufacturing	37,200	5.9
Construction	9,500	1.5
Utilities	900	0.1
Commerce	12,800	2.0
Transportation and communications	12,000	1.9
Services	20,500	3.2
Government	9,000	1.5
Total	631,500	100.0

Source: Direction General de Estadistica and Banco Central de Honduras and Banco Nacional de Fomento.

Education

According to the 1950 census, 64.8 percent of the 1,061,799 persons who were 10 years or older were illiterate. Of the urban population in this age category, 43.6 percent were illiterate; of the rural population, 74.7 percent.

Only 25.6 percent of the children between 7-15 years attend school. In 1952, there were reported to be 2,270

primary schools (4-6 years term) of which 588 urban and 1,682 rural; 32 high and normal schools with 5,905 students; there is one agricultural school (The Escuela Agricola Panamericana) with 160 pupils, and over 800 students are attending lectures at the University of Honduras, which includes the following co-educational schools or colleges: medicine, dentistry, pharmacy, law, political science, economics, and civil engineering.

There are also other schools such as the School of Fine Arts, Music, Nursing, and some other technical and trade schools administered by the Ministry of Education.

Foreign Trade

The trend of Honduran imports and exports in recent years is shown in Table 13.

TABLE 13

VALUE OF TOTAL HONDURAN TRADE, 1949-53 1/

(Thousands of dollars)

Year	Total imports	Total exports
1949	33,975	20,763
1950	34,167	21,743
1951	39,448	28,064
1952	54,589	34,466
1953	57,468	54,338

1/ Fiscal years July 1-June 30

Honduran exports consist almost entirely of agricultural, mineral, and forest products, such as bananas, coffee, pine lumber, silver bars, and coin, while its imports are mostly manufactured consumer goods. The United States has consistently remained the leading market for Honduran exports, as well as the main source of the country's imports.

Manufactured consumer goods comprise approximately three-fourths of the country's imports. Leading imports include textiles and clothing, followed by diesel oil, insecticides, sugar, automobiles and trucks, and agricultural, mining, and road building machinery. Foodstuffs regularly comprise about 10 percent of the total value of Honduran imports. In this category sugar, wheat, and flour are the most important single items. The principal items for industrial use are fuel and diesel oil, which are used by the fruit companies and mines and by smaller industries, and fertilizers and copper sulfate, used almost entirely in the banana industry.

For a number of the World War II years and thereafter, Honduras had an apparent adverse trade balance, which declined steadily each year, until in the fiscal year 1953, largely owing to revised methods of computing the export value of bananas, the country's trade was virtually balanced.

The importance of the United States as a supplier of Honduras and as a market for Honduran exports was intensified during World War II, but is gradually receding now as a greater percentage of the country's foreign trade is with Europe and Japan.

Tables 14 and 15 show Honduran foreign trade by principal commodities and countries.

Honduran exports of all commodities reached a new high in value - $54,338,000 - in the fiscal year 1952-53. This represented a value increase of 58 percent over the preceding fiscal year total of $34,466,000. A large portion of this increased value was effected by the revaluation of banana exports, from $12.7 million to $28.2 million, although the number of stems exported decreased by 1,710,526, 12 percent below the preceding period. In addition, the export value of Honduran coffee increased by approximately $3.7 million, totaling $12,800,000 in 1952-53. These two commodities accounted for nearly all of the increase.

TABLE 14

VALUE OF HONDURAN FOREIGN TRADE, BY PRINCIPAL COMMODITIES, 1952-53 1/

(Thousands of dollars)

Commodity	1952	1953
	Exports	
Total exports	34,466	54,338
Bananas	12,732	28,204
Coffee	9,092	12,763
Pine lumber	3,618	3,460
Silver bars	2,358	3,211
Steers	878	987
Hogs	576	826
Abaca fiber	874	472
Other commodities	4,338	4,415
	Imports	
Total imports	54,589	57,468
Wheat flour	697	659
Wheat	780	574
Cotton fabric	3,968	4,580
Silk and artificial silk fabric	1,609	1,487
Diesel oil	2,268	2,064
Gasoline	875	1,031
Iron pipe	782	850
Pipe and pipe accessories used in irrigation	584	1,021
Agricultural, mining, and road machinery	1,878	2,292
Heavy machinery, all kinds	774	1,141
Automobiles, trucks and buses	2,352	3,221
Automobile accessories, parts and tubes	647	662
Automobile and truck tires	744	634
Fertilizers	1,100	852
Copper sulfate	2,805	3,088
Pharmaceutical specialties	1,089	1,447
Other commodities	31,687	31,865

1/ Fiscal years, July 1-June 30

TABLE 15

VALUE OF HONDURAN FOREIGN TRADE, BY PRINCIPAL COUNTRIES, 1952-53 1/

(Thousands of dollars)

Country of destination or origin	1952	1953
	Exports	
Total exports	34,466	54,338
United States	24,404	40,946
Canada	1,688	4,243
El Salvador	3,475	3,966
Cuba	2,545	1,831
Venezuela	567	895
Netherlands	359	405
Other countries	1,428	2,052
	Imports	
Total imports	54,589	57,468
United States	41,473	40,702
Netherlands Antilles	2,146	2,305
Belgium	1,142	2,661
United Kingdom	1,466	1,889
Germany	1,537	1,863
El Salvador	1,640	1,356
Japan	539	980
Mexico	759	906
Netherlands	217	594
Guatemala	274	521
Cuba	798	224
Other countries	2,598	3,467

1/ Fiscal years, July 1-June 30

II. AGRICULTURE IN HONDURAS

Agricultural Production as Part of the General Economy of Honduras

Honduras is predominantly an agricultural country; manufacturing is of minor importance and mining is relatively insignificant. The national income at factor cost in 1950 was 332.5 million lempiras and, in 1951, 359.4 million lempiras (one lempira equals U.S. $0.50). The distribution of national income in 1950 by economic sectors was as shown in Table 16.

TABLE 16

VALUE OF HONDURAS' PRODUCTION IN MILLIONS OF LEMPIRAS

1950

Economic sector	Total	Percentage of total
Agriculture, forestry and fishing	182.8	55.
Mining	1.6	0.5
Manufacturing	29.4	8.8
Construction	15.6	4.7
Utilities	1.8	0.5
Commerce	50.3	15.1
Transportation and communications	19.5	5.9
Services	21.0	6.3
Government	10.5	3.2

It is estimated that more than 85 percent of the population of Honduras depends on agricultural production and related industries. In Honduras, where raw materials and cheap power for industrialization are very scarce, it is evident that most emphasis must be placed on development of agricultural production and that industrialization is based on such agricultural raw materials as can be produced in the country.

Agricultural production is extremely one-sided, as the following table shows:

TABLE 17

AGRICULTURAL PRODUCTION

Commodity	Value of production in millions of Lempiras	Percentage
Bananas	61.4	40.4
Coffee	15.5	10.0
Maize	22.7	14.9
Sugar	5.6	3.7
Other crops	17.8	11.7
Livestock and dairy	29.0	19.0

As shown in Table 14, agricultural and livestock products play the most important part in the export trade, constituting over 80 percent of the value of total exports.

Except for the operations of the two large banana companies (The Tela Railroad Company and the Aguan Valley

Company) controlled by United States firms and the numerous individual coffee producers, agriculture is practiced on a small scale and is largely of a subsistence nature.

In 1949-50 the banana companies controlled 21,350 ha of bananas, 6,117 ha of other crops and 18,553 ha of pastures in more than 200,000 ha of land (one ha equals 2.47 acres). The companies' share in the total acreage of Honduras, reported as 382,000 ha crops and 475,000 ha pasture in that year, was 5.5 percent.

Crop Production

According to the figures given by the Anuario Estadistico (1952), the following table shows the acreage and production of crops in Honduras.

TABLE 18

ACREAGE AND PRODUCTION OF CROPS IN HONDURAS

1952

Commodity	Acreage in hectares	Production in tons
Annual Crops:		
Corn	291,200	182,480
Sorghum	61,850	45,990
Rice	11,620	11,020
Wheat	1,400	830
Beans	51,290	20,220

TABLE 18 (Cont.)

Commodity	Acreage in hectares	Production in tons
Cassava	3,500	11,980
Potatoes	1,130	2,560
Sesame	520	360
Tobacco	7,750	3,894
Peanuts	40	33
Cotton	2,100	1,470
Others	1,090	2,940
Total	433,490	
Commercial Permanent Crops:		
Sugar-cane	24,700	617,000
Coffee	71,900	15,060
Bananas and Plantains	64,000	851,020
Abaca	1,640	1,030
Oilpalm	1,500	158
Coconuts	1,600	8,820
Cacao	140	110
Sisal	410	120
Total	165,890	
Vegetables:		
Onions	360	890
Tomatoes	13,500	2,700
Others	4,188	10,838
Total	18,048	

TABLE 18 (Cont.)

Commodity	Acreage in hectares	Production in tons
Fruit trees:		
Oranges	4,550	43,800
Avocados	500	2,560
Mangos	3,520	21,140
Bananas	350	2,270
Others	450	2,040
Total	9,370	

Export Crops

Bananas

Since the middle of the 1920's Honduras has been the world's greatest exporter of bananas. The exports since 1917-18 are recorded in Table 19.

TABLE 19

BANANA EXPORTS

Annual Average	Millions of bunches	Annual Average	Millions of bunches
1917-1922	10.3	1932-1937	16.7
1922-1927	14.2	1937-1942	12.0
1927-1932	27.4	1942-1946	9.9
		1946-1950	14.6

Although bananas account for nearly 60 percent of the country's total exports, the volume of shipments has undergone a slight decline during the past five years. A further decline is forecast for the immediate future at least, as a result of disastrous floods which occurred in the summer of 1954.

Coffee

The next most important export crop is coffee, produced principally in the region of San Pedro Sula in the North Coast area, and below Tegucigalpa in southern Honduras, in which area it is the principal crop. There are approximately 40,000 coffee farms in Honduras, 75 percent of which are of less than 50 acres in size. About 60 percent of annual production is derived from farms of less than 125 acres.

Coffee steadily is assuming a more important role as the country's number two foreign exchange earner, production having increased so remarkably during the past few years that exports of 12,289 metric tons in the fiscal year 1952-53 were almost 44 percent over those of the preceding year, and amounted to 15 percent of the total exports by value. High world prices have provided the main stimulus to increased production, complemented by Government programs to increase plantings and improve yields.

Two Government agencies are engaged in promoting increased coffee development. The Department of Agriculture conducts an extension program for the improvement of cultivation

methods and maintains experimental stations, as well as coffee nurseries from which seedlings are distributed to growers. The National Development Bank complements these activities by advancing credit to coffee growers, and by constructing coffee-processing centers in the important producing areas and drying stations at the more isolated points. Over the past four years, new coffee plantings have averaged 6 million trees per year, and an estimated 30 million trees are now in production.

Abaca

From the standpoint of value, abaca exports dropped from third in importance in 1949 to seventh in 1953. This fiber is produced on the North Coast by a United States-owned company under a contract with the United States General Services Administration. Exports in the fiscal year 1952-53 were valued at 944,000 lempiras, compared with 1,700,000 lempiras in the preceding year, the decline stemming from fiber losses suffered when the processing plant at Guaymas was destroyed by fire. Following restoration of the plant, monthly fiber shipments recently have been approaching earlier levels.

Coconuts

Coconuts are grown principally in the Bay Islands off the North Coast and along the Caribbean coast in the Tela area. Exports have tended to decline in recent years,

amounting to only 500,000 lempiras in 1952-53, as a result of increasing consumption by local vegetable oils producers.

Tobacco

Production of tobacco supplies virtually all of the local needs and provides moderate quantities for export. Tobacco raising constitutes the main source of income in the Department of Copan, where both the climate and the soil are well adapted to the cultivation of this plant. The greater part of production now is consumed locally in the manufacture of cigarettes by a branch of a British-American tobacco company at San Pedro Sula. Leaf tobacco exports in 1952-53 amounted to 1,664 metric tons, valued at 916,000 lempiras, most of which were shipped to neighboring El Salvador.

Rice

Rice is grown in the Departments of Cortes and Santa Barbara, and the greater part of the exportable surplus, which varies from year to year, is shipped to British Honduras. Exports in 1952-53 amounted to 809 metric tons.

According to the data in the Anuario Estadistico (1952), the rice acreage has not expanded in the last five years. The average in 1947-1952 was 12,300 ha; in 1952 only 11,620 ha were planted. The production is rather low with an average of 840 kg/ha. Irrigated rice is planted in small plots only. Most of the rice is of the upland type.

In Honduras the climatic conditions and the soils in the populated regions are mainly unfavorable for rice. Furthermore rice growing as a permanent proposition in a rotation system would demand too much labor for tilling, cultivation and harvesting. Rice is therefore mainly grown on fresh clearings of forest or shrub-lands all over the country, mostly in small patches. The largest acreages are found in Olancho (2,400 ha), Atlantida (2,400 ha) and Comayagua (2,100 ha). The varieties are of a thin long grain type of good quality.

Domestic Crops

Corn

Nearly 64 percent of the areas planted to annual crops are for corn, about 90 percent of which is planted by the campesino on "ejidal" land, in tenancy or on land without title. Three quarters of the acreage is planted in the beginning of the rainy season (May-June) and the other part in September-October. In September, October and December-January, the crop is harvested. The second crop however is risky. With favorable weather the corn may ripen; if not the crop must be cut for feed.

On good land beans are planted as catchcrop (about 10 percent). Mixed cultivation of sorghum and corn is often seen. The growing methods are quite simple. After clearing

by cutting and burning, the land is either ploughed with a wooden plough or not ploughed at all (70 percent). Hardly any weeding or other soil care is practiced and at the most only once. A very small area is ploughed by tractor. No other mechanization is practiced. Neither fertilizing with manure or chemicals nor green manuring with legumes is practiced.

As the corn is mainly used for "tortillas" (type of bread), the white kernel varieties are preferred. The growing period is rather long and for many parts of the country too long for a suitable rotation within the wet season or for more than one crop. Furthermore in most places people do not plant more than twice in successive years on the same land. They then leave the land idle for a long time. Apart from some development in the planting of catchcrop beans, the methods of cultivation have not changed for hundreds of years. Effective crop rotation as part of a well-balanced farming program is practically unknown.

The average acreages and yields of corn in the various departments of Honduras in the period 1944/45 - 1949/50 are given in Table 20.

The variation in the yields is wide, due to conditions of soils and rainfall. In many districts the land is badly eroded and barren yielding very meager crops, in particular in La Paz, Intibuca, and Francisco Morazan. It appears that the pressure of the population on the land is already too

heavy in many parts of these departments. People there are faced by an expanding population and a contracting area of land. The campesino is consequently forced to extend his plantation and the land is being increasingly damaged in the process.

TABLE 20

AVERAGE ACREAGE AND YIELDS OF CORN IN 1944/45 - 1949/50

Department	Acreage 100 ha	Yields 100 kg/ha	Percentage acreage of total area
Atlantida	22	8.7	0.5
Colon	12	11.7	0.05
Comayagua	179	8.3	3.4
Copan	161	15.3	5.1
Cortes	79	12.4	1.7
Choluteca	132	8.9	3.1
El Paraiso	160	6.1	2.2
Francisco Morazan	305	6.2	3.7
Intibuca	135	5.1	4.3
La Paz	91	5.4	4.0
Lempira	162	8.3	3.7
Ocotepeque	98	8.8	5.6
Olancho	98	13.5	0.4
Santa Barbara	159	9.7	3.1
Valle	82	14.1	4.9
Yoro	69	13.8	0.8
Honduras	1944	9.1	1.7

Sorghum

Sorghum (maicillo) accounts for 18 percent of the annual crops planted. It is the most suitable grain-crop in dry season. It can also stand excessive rainfall. Because of the long growing period of the strains used, sorghum is only planted once a year in May and June. It is very often mixed with corn. In many places, it is sown late between corn and remains on the field after the corn is harvested. Generally sorghum is planted by the campesino only.

Beans

Small grained red beans are planted in many parts of the country. Beans are important in the diet of Hondurans; a meal without beans is unthinkable. Beans are commonly cultivated as catchcrop between corn.

Wheat

The average acreage sown to wheat in the period 1944-1950 was 5,600 ha per year with a range in yields from 220 to 960 kg/ha. Except for some small parts at high altitudes, the climatic and soil conditions are unsuited to wheat. It is grown on a small scale in the westernmost part of the country, but owing to the lack of internal transportation is exported virtually in its entirety to El Salvador, while local flour mills import their supplies.

Sugar-cane

This crop is kept perennial in Honduras. On the average it is replanted only once in 10 - 12 years. The regrowth is cut every year. There are only two enterprises making white sugar; all the other cane is used for the production of panela (cakes of brown sugar). The acreage since 1944/45 has been an annual average of 17,000 ha, with a production of 23,000 tons, the yield being 1,340 kg/ha. With the exception of the two large-scale enterprises (San Jose near San Pedro Sula and Chumbagua in the Chamelecon valley) sugar-cane is planted in numerous small spots scattered over the country. Plantations exceeding 20 ha are rare. Generally little care is given to the crop. For the milling of the cane in 1949-50 there were 3,970 wooden and 2,158 iron mills, mainly in poor condition. The mills extract at most 6 percent of the sugar from cane, and this 6 percent is low in sugar content.

Animal Production

According to highly tentative estimates based on 1949-50 figures published by Informe de Fomento, the annual value of animal production in million of Lempiras is:

Cattle (consumption and export)	7.2
Hogs (id)	3.0
Dairy products	16.9
Fowl and eggs	1.9
Total	29.0

This total accounts for nearly 10 percent of the national income and 19 percent of the total agricultural production, not including the value of the services of cattle, horses and mules as draft animals.

The livestock population in 1952 in numbers of head was:

Cattle	1,157,000
Horses	192,000
Mules and asses	110,600
Hogs	521,200
Goats and sheep	60,300
Fowl	4,212,000

Cattle

The annual value of the production from dairies and beef cattle ranches of 24 million lempiras is derived from an area of at least 475,000 ha, giving only U. S. $25 as an average per ha per annum. The estimates for beef production are as low as $5 - $10. These figures show the low intensity of the cattle industry in Honduras. Large beef-cattle herds are managed by a few persons only and in the dairies one man alone normally handles 30 - 50 cows and the additional calves, steers, and bulls.

The dairy farmers and the cattlemen seem nevertheless to make good profits, as they hold large areas of land and reduce labor costs and investments as much as possible. There is consequently no economic pressure for improvement.

Absentee farming is widespread even in the dairy industry. Furthermore, poor transportation facilities, particularly serious for dairy products, the price policies, and other economic factors and difficulties hamper further improvements.

It is evident that in this situation natural factors of soil and climate and economic factors of nearby markets have directed the development of the cattle industry to dairy farming, dairy and cattle ranching or beef ranching in the different parts of Honduras. Dairy farming is prominent in San Pedro Sula (milk, butter and cheese), La Ceiba (milk), Tela (milk), Tegucigalpa and environments of Danli (milk, butter and cheese), and Choluteca (milk and cheese).

Although grazing has been a relatively undeveloped activity, the importance of cattle raising in Honduras has increased steadily in recent years. In the fiscal year 1952-53, 35,785 head were exported, chiefly to El Salvador and Guatemala.

Pigs

In every part of rural Honduras, on roads, in farm yards, houses, pigs are running about. The total number in 1952 was given as 521,200. Controlled and well managed pig-raising is not practiced, although this animal is very adaptable to the natural and economic conditions, in particular in the dry central and western parts of Honduras. The poor campesino can afford to raise pigs, while it is impossible for him to have cattle.

During the fiscal year 1952-53, 51,294 pigs were exported. The development of pig production is evident and every suitable measure to speed up this development should be applied. Nearly every thing produced on a farm can be fed to pigs, as e.g. bananas (Chatos), plantains, mangoes, sweet potatoes, corn, sorghum, skimmed milk, waste of vegetables, grass and also rice bran, copra-meal and cotton-seed meal.

Mixed farming with pigs, therefore, would give a better basis for agriculture in the remote inland regions, where lack of roads and drought are major factors checking development. In fairly well managed mixed farms based on pig-raising, the annual gross output can be estimated at $100 - $150/ha, while corn would give $50 and beef-cattle only $10/ha.

Hindrances to Development

A lack of modern technology, failure to make full use of available arable lands, need for extensive irrigation, and inadequacy of transportation facilities are some of the major obstacles of the development of nearly all branches of the country's agriculture, with the exception of bananas and other crops, such as abaca, grown by the American fruit companies.

More specific problems demanding attention are the need for foods grown for domestic consumption to provide sufficient

nutrition and variety; the fact that imports of food require the expenditure of a large volume of foreign exchange which might otherwise be allocated to other activities devoted to the development of the country; and the need for the development of a wider variety of exports, whereby the earnings of foreign exchange would not be so dependent on the vicissitudes of nature and on foreign demand for one or two crops.

Government Policy

The agricultural policy of the Honduran Government is designed to increase domestic production of food crops and develop livestock breeding in order to reduce food-stuffs imports. The program involves a thorough study of actual and potential agricultural resources, education in improved agricultural methods, and financial assistance in the form of agricultural loans. Any material increase in the standard of living of the people depends upon the successful achievement of these objectives.

The program is being carried out on a number of fronts, by various instrumentalities. The Ministry of Agriculture recently was reorganized to include four principal bureaus, or "directiones" - agriculture, livestock, and veterinary; agricultural education; forestry and mining; and land and resettlement.

Both the Ministry of Agriculture and the National Development Bank are striving to increase and diversify production

and to raise the standard of living of the agricultural population. The Ministry of Agriculture, largely with the assistance of the Inter-American Technical Service for Agricultural Cooperation (STICA), a joint United States-Honduran operation under Point IV, aims at increasing overall cultivation, raising yields, modernizing cultivation techniques, and encouraging greater crop diversification through research and practical education. The National Development Bank grants financial assistance to farmers in connection with these broad aims.

Complementing these activities are the activities of the Pan-American Agricultural School (Escuela Agricola Panamericana), financed by the United Fruit Company, and the Government's rural schools, which are endeavoring to improve cultivation practices by teaching the advantages of modern methods. Another complementary feature is the Government's road building program, which will open up new producing areas and permit better distribution of agricultural products.

Technical Assistance

Technical assistance from the United States under the Point IV Program is administered by the U. S. Foreign Operations Administration, implemented by various cooperative "Servicios" and other non-Servicio activities.

Servicios have been formed in health, agriculture, and education, operating under United States direction as legal

units in the Honduran Government, and supported by contributions to a joint operating fund from each of the two Governments. Under non-Servicio activities, mainly advisory in nature, such as those for civil aviation, highways, census, budget, etc., technicians paid directly from FOA funds are assigned directly to the appropriate Honduran Government agency where they function as advisers-consultants.

The agriculture and natural resources program involves advising farmers on irrigation and erosion control, spraying and insect control, breeding methods and stock improvement, seed selection and agronomy research; soil utilization, and forest-fire control and reforestation; furnishing farm machinery services through a machinery pool; well drilling; and the inauguration of a national livestock center.

A health and sanitation program covers improvement of water supplies; construction of sewage plants; an antituberculosis campaign; organization of a nursing service; and a nationwide DDT and chlordane antimosquito campaign.

Under transportation, communications, and power, the technical assistance program includes activities for the improvement of civil aviation facilities; countrywide highway development; and port development. Activity in the industry and mining field includes the stimulation of industrial investment development, surveys of coal resources, etc.

In community development work, assistance is being given in developing a health education program, extension

work, and, in more isolated rural areas, the development of 4S clubs similar to the U. S. 4H organization.

An agriculture directorate has been organized under the Ministry of Agriculture. Progress in agricultural programs is indicated by the establishment of extension offices and 4S Clubs; home canning demonstrations; antiforest-fire and grasshopper-eradication campaigns; the stimulation of private business through the sale and distribution of agricultural supplies, equipment, and seeds; the formation of a national livestock growers association; cattle breeding improvements; three major schools (10 to 25 buildings each) constructed in collaboration with the Education Servicio (two rural normal schools and one vocational agriculture school); notable interest developed in irrigation, educational pamphlets printed and distributed; and educational movies shown from a traveling sound truck to thousands of farmers.

STICA's activities during 1953 covered such diverse phases of agriculture as testing and developing improved varieties of corn, rice, beans, potatoes, and other vegetables; teaching farmers the advantages of putting up hay and ensilage for supplemental feeding during the dry season when pastures dwindle, and teaching them how to spray livestock to control ticks and the torsola fly. STICA also cooperated closely with the Department of Agriculture's extension service in all of these projects, as well as in the designing and construction of breeding stations and irrigation

works, demonstrating erosion control methods, combating grasshopper plagues, and instructing in fertilization methods.

Methods of Farming

The farming of the land - the plowing, sowing and reaping is done in the same manner as in other undeveloped countries and by methods in use for thousands of years. The ground is broken by a team of oxen pulling a plow. This plow consists of a cone shaped wooden part, a wooden handle, and a long beam which connects the plow, through a chain, to the source of power, the team of oxen. The cone-shaped wooden part is covered with an iron casing or plow share which has to be changed every year if the plow is to be used in a sandy soil. There is not any resemblance between this plow and a modern steel walking plow. There is no way to change the width of the furrow. The tool, in its best performance, cuts a vee shaped furrow three to six inches deep and about six inches wide.

In plowing a field, the plow man starts plowing in one direction, trying to overlap about one-third of one furrow over the other, until the field is finished. Then he starts in another direction at right angle to the first furrows. After the field is completed, portions of the land which have not been disturbed by the cone-shaped plow remain untouched and provide an ideal condition for the growth of weeds and other non-crop vegetations. In this fashion, a man and a

pair of oxen can plow from one-half to three-fourths of an hectare in a 10-hour day, depending on whether the field is being plowed in one or two directions.

In some parts of Honduras, specially in the highlands, the farmer uses a special shovel to plow and prepare the seed bed for the cultivation of corn, beans or sorghum. In this fashion, by animal or human labor, the land is prepared and then sowing is done by hand.

At present all the crop products in Honduras are harvested by hand, since there are not extensive areas under cultivation which may justify the use of combines, corn-pickers or other types of harvesting machines. There are few localities in which corn-shellers and small threshing machines are now being used, and fortunately they are gaining popularity among the farmers.

Agricultural Machinery in Honduras

With the exception of the two banana companies in the North Coast of Honduras, agricultural machinery such as tractors, steel plows, harrows, threshers, have been introduced very recently in the other parts of the country.

The Direccion General de Agricultura, a dependence of the Ministry of Agriculture, has already initiated a partial program of mechanization. According to our knowledge and the information received, part of the policy of this program is

Fig. 4. The Honduran plow

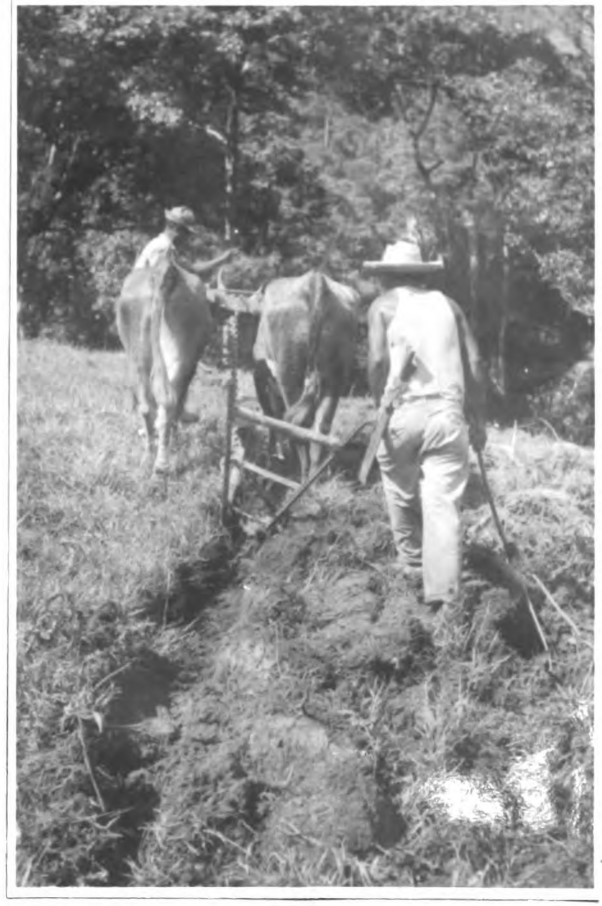

Fig. 5. The use of steel plows is now gaining popularity among the farmers.

Fig. 6. Planting of the field. Note the seed bed and the two receptacles for carrying two different crop seeds.

to undertake part of the land preparation and charge the farmer or the landlord for its service.

At the present time, there are a few tractors, steel plows, threshing machines, and other farm machinery used in large scale farming by landlords and custom operators. But so far, we can say that very little has been done to change the design of the old wooden plow and give the peasant a steel plow and other elementary equipment such as harrows, cultivators, and grain drills which can be pulled by his yoke of oxen.

According to the Census of 1952, Table 21 shows the number of farms, tractors and plows in Honduras.

TABLE 21

Department	Number of farms	Tractors	Steel plows	Wood plows
Atlantida	3,495	20	26	8
Colon	3,961	3	7	24
Comayagua	8,471	11	94	2,353
Copan	13,049	15	95	2,433
Cortes	6,688	100	119	127
Choluteca	13,245	22	88	2,564
El Paraiso	10,540	10	129	5,066
Francisco Morazan	17,269	36	179	9,265
Intibuca	9,239	--	33	2,277
Bay Islands	947	--	10	2
La Paz	7,583	1	44	909

TABLE 21 (Cont.)

Department	Number of farms	Tractors	Steel plows	Wood plows
Lempira	15,017	--	16	2,661
Ocotepeque	6,632	--	23	2,236
Olancho	10,461	5	51	2,341
Santa Barbara	13,794	12	56	291
Valle	7,292	5	25	2,094
Yoro	8,452	43	45	606
Total Honduras	156,135	283	1,040	35,257

The imports of farm machinery to Honduras during the years 1950 - 1954, given by the United States Exports of Domestic Merchandise, are shown in Table 22.

TABLE 22

FARM MACHINERY IMPORTS

1950-1954

Commodity	1950	1951	1952	1953	1954
Sprayer and duster (hand)	321	465	372	---	650
Sprayer and duster (power)	4	30	23	---	76
Plows (animal drawn)	20	190	300	---	---
Plows (tractor drawn or mntd.)	17	64	68	80	110
Harrows	8	44	41	17	15

TABLE 22 (Cont.)

Commodity	1950	1951	1952	1953	1954
Cultivators	21	61	49	48	43
Planters	8	37	28	14	--
Mowers (tractor drawn or Mntd.)	1	29	--	--	10
Harvesting implements	--	--	--	--	3
Combines (pull type)	--	--	3	--	--
Pickup balers	--	--	2	--	--
Threshers	--	--	4	--	--
Shellers (corn and other seed separators)	14	18	40	18	22
Tractors:					
Tracklaying: under 35 D.B.HP	11	2	--	--	--
35 - 49 " "	2	8	17	21	14
50 - 69 " "	6	7	5	6	2
70 - 95 " "	4	20	18	16	3
Wheel Type - Row Crop:					
8-14 Belt HP	--	6	--	4	--
15-24 " "	8	29	14	13	2
25-29 " "	6	19	16	--	1
30-34 " "	--	--	10	7	3
35-over "	5	12	16	18	--
Standard Wheel Type:					
20-24 Belt HP	2	--	--	--	1
25-34 " "	6	--	--	67	24
35-44 " "	1	7	--	2	--
45-over "	--	2	--	--	--

Fig. 7. Land clearing is one of the major problems for the incorporation of new crop land.

Fig. 8. One type of equipment used by the Ministry of Agriculture in its custom work program.

Fig. 9. Contour planting is now in practice, but note the rough seed bed and great amounts or organic matter that would be incorporated if better tillage equipment were used.

Fig. 10. Animal drawn disk harrow enables better seed beds to be prepared.

Fig. 11. Stationary threshing machine. Units of this type are now being operated under the supervision of the Extension Service.

Fig. 12. Cleaning operation. With the use of small seed cleaners, loss of grains and labor would be reduced to a minimum.

Agricultural Regions

The following is a brief discussion of the important agricultural regions of Honduras, each characterized by a distinctive pattern of agricultural conditions and possibilities:

(I) The Lowland Along the Caribbean Coast Between Cuyamel and La Ceiba

Large parts of this region were formerly banana-land, now abandoned, but many squatters have moved in. The rainfall (Type I - formula 0.3.9 - 2500)* is favorable for a wide range of commercial crops, such as bananas, abaca, African oil palm, cassave, agave, cacao. The population amounts to 17 persons/sq. km. including the cities; the rural population is about 7 persons/sq. km. Nearly 3 percent of the total area is planted to crops; vast areas of flat land are waste. The soils vary widely, but probably a great part is fertile. Dairies are found near Tela and La Ceiba; west of Tela is the sole oilpalm enterprise of Honduras. In the neighboring hills cohume palms are frequent, and rice is cultivated on milpas. The coast is locally swampy or sandy in which case coconuts are grown.

In the mountains erosion is not yet serious and a number of small streams could be used for irrigation, while the

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*0.3.9 - 2500 refers to precipitation as follows:
2500 - total precipitation in mm.
0 - number of months with less than 60 mm.
3 - " " " between 60-100 mm.
9 - " " " of over 100 mm.

swamps could largely be drained. The three ports, La Ceiba, Tela and Puerto Cortes are connected by a railroad, with little traffic between La Ceiba and Tela. This region has no roads, but has two attractive residential areas (La Ceiba and Tela).

(II) The Sula Valley

This region is agriculturally the most advanced, with the best soils in Honduras. The climatic conditions are favorable for agricultural activities, in the northern part wet (0.3.9 - 2500) becoming drier further inland (3.2.7 - 1500). The population is 40 persons/sq. km. including the cities San Pedro Sula, Puerto Cortes, and La Lima (headquarters of the United Fruit Company). The rural population amounts to about 16 persons/sq.km. The National Railroad and a railroad system of the Tela Railroad Company run through the valley from the south to Puerto Cortes. An all-weather road runs inland from San Pedro to Tegucigalpa, and also a fairly good road is now connecting San Pedro with Santa Rosa and Santa Barbara.

The Tela Railroad Company has concentrated all its banana plantations along the banks of the Chamelecon and Ulua rivers and holds extensive pastures in the east and south. Along the west side of San Pedro Sula a large number of the best dairy-farms of Honduras are found. Furthermore, a large white-sugar enterprise and the sole abaca plantation are located in this valley.

The area planted to crops and covered with good pasture is approximately 30 percent of the total area and there are large possibilities left to develop dairy farming and commercial agriculture, in particular sugar-cane, agave and cassava in the southern part and oilpalm and abaca in the north.

(III) The Aguan Valley and Coastal Plain off Trujillo

The lower parts of the Aguan valley were banana land before, but abandoned in 1940 because of the Panama disease. The Aguan Valley Company has now concentrated its banana-growing in the very dry inland part west of Olancho (Coyoles). Cattle-raising is limited here by lack of water. In the lower regions of the valley vast areas of fertile land lie waste or are in unused pastures. This region would probably be irrigable. The rainfall here is favorable (2.2.8 - 2400). The region is thinly populated with probably not more than 5 persons/sq.km.

About 5 percent of the land of the valley is planted to crops. Combining the possibilities of the dry inland and the more moist coastal region, beef-cattle raising would probably prove profitable. Priority should be given, however, to development of large scale agriculture since the conditions for mechanization are extremely good.

(IV) Mosquitia Plain

This plain is completely unexplored. The climate is probably of Type II (2.2.8 - 2400) and may be favorable for

a wide range of crops. The general features of the soils may be unfavorable, but it is quite possible that there will be vast areas of fertile alluvial soils. The peasants grow rice along the lagoons and the riverbanks.

(V) The Eastern Central Part and Olancho-Jamastran

This region, part of rainfall Zone III (3.2.7 - 1500) south of the Aguan Valley, is thinly populated (5 persons/ sq. km.) but possesses vast resources of good valley land (Juticalpa-Catacamas and further east in the department of Olancho and Jamastran in El Paraiso). Only one percent of the total area is planted to crops but in some parts vast areas are under pasture for grazing a few cattle. The higher terraces are mainly infertile and usable as grazing grounds only.

An agricultural colony is in operation now near Catacamas, where the Ministry of Agriculture in cooperation with the SCIDE (Servicio Cooperativo Interamericano de Educacion) (Inter-american Cooperative Service for Education) is running a vocational agriculture school. Farm mechanization in this region shows possibilities of great value, but the lack of transportation facilities, and lack of irrigation are the major obstacles for the development of a well-mechanized program.

In some parts the structure of landownership is unfavorable, i.e., Juticalpa and Jamastran, where people are already

forced to farm the mountains, while vast areas of flat-land lie waste or are used for unprofitable cattle grazing.

(VI) The Mountainous Central and South-Western Region

This region, which has unfavorable soil, climate and landownership conditions covers parts of Choluteca, El Paraiso, Yoro and Santa Barbara and the Departments Francisco Morazan, La Paz, Comayagua, Intibuca, Lempira, Ocotepeque and Copan.

The climatic conditions are unfavorable (Zones IV and V: 5.1.6 with 1300-1400 mm. rainfall annually) the soils are easy victims of erosion and commonly infertile, except for small strips of alluvial land in the narrow valleys. South of the line Tegucigalpa-Comayagua-Copan the land is over-populated and in this part there is hardly any fertile land. The structure of landownership is extremely unsound. Subsistence farming, based on methods of shifting cultivation resulting in severe losses in land and forest, is the prevailing system and vast areas of pine-land are kept thin by cutting and burning to benefit very poor pasture. On these dying lands 30 to 50 percent surplus population tries to find a living in agriculture. Most of the Honduras coffee is grown here and many patches of sugar-cane are scattered over the mountain slopes. In the northeastern parts of this region erosion is less severe but absentee farming is widespread.

(VII) The Pacific Coastal Plain

In this plain unfavorable conditions of soil and climate prevail. With six very dry months, unreliable rainfall in two other months, and no possibilities for irrigation, there is little chance for agricultural improvement. A large part of the plains is under very poor communal pasture and the better soils are controlled by a few landlords. Cotton would perhaps be successful if rotated with pastures in mixed farming, and in places where the land is irrigable white sugar production could be considered.

III. PROBLEMS OF AGRICULTURAL MECHANIZATION OF HONDURAS AND THE PROPOSED SOLUTIONS

Land Use and Landownership

Land Use

According to the information given by the Information Service of the Central Bank of Honduras and of the National Development Bank, Tables 23 and 24 show the distribution and land utilization of the territory of Honduras.

TABLE 23

DISTRIBUTION OF HONDURAS' TERRITORY

Departments	Total acreage in ha.	Mountains		Plains and Valleys	
		Area in ha	% of total	Area in ha.	% of total
Total Honduras	11,520,500	7,307,500	63.4	4,213,000	36.6
Atlantida	429,000	255,000	59.4	174,000	40.6
Colon	2,663,000	654,500	24.6	2,008,500	75.4
Comayagua	521,600	396,600	76.0	125,000	24.0
Copan	315,000	255,600	81.1	59,400	18.9
Cortes	406,500	96,000	23.6	310,500	76.4
Choluteca	430,400	215,500	50.1	214,900	49.9
El Paraiso	740,300	590,300	79.7	150,000	20.3
Francisco Morazan	811,000	686,000	84.6	125,000	15.4
Bay Islands	27,500	24,300	88.4	3,200	11.6
Intibuca	313,000	278,500	89.0	34,500	11.0
La Paz	228,600	202,100	88.4	26,500	11.6
Lempira	437,500	403,500	92.2	34,000	7.8
Ocotepeque	174,500	142,500	81.7	32,000	18.3
Olancho	2,522,200	2,205,700	87.5	316,500	12.5
Santa Barbara	520,000	352,000	67.7	168,000	32.3
Valle	167,000	29,500	17.7	137,500	82.3
Yoro	813,400	519,900	63.9	293,500	36.1

TABLE 24

LAND UTILIZATION IN HONDURAS, 1950-51

Major land used	Area in hectares	Percentage of total
Annual crops	312,300	2.7
Perennial crops	123,500	1.1
Fallow land	389,300	3.4
Pastures	1,994,000	17.3
Mountains	3,027,100	26.3
Forests	4,873,500	42.3
Cities, roads, railroads, etc.	391,800	3.4
Others	409,000	3.5
Total Honduras	11,520,500	100.0

These figures demonstrate the fact that only a small part of the land is under crops, namely a little more than 7 percent of which more than 3 percent is laid idle each year as fallow land (shifting cultivation in 8-12 years rotation).

Joosten (1952) gives some figures for the mountain-land and flat-land used for crop production. These estimates are shown in Table 25. Some results of an analysis of these data are mapped in Figures 13, 14 and 15.

TABLE 25

ESTIMATED AREAS OF MOUNTAINLAND AND FLAT LAND IN USE FOR CROP PRODUCTION

(Area in sq. km.)

Crop	Yearly area planted on:		Total area of land in use for cropping	
	Mountains	Flat land	Mountains	Flat land
Corn	1300	650	6500	450
Sorghum	400	140	650	70
Rice and wheat	150	30	750	30
Beans	60	215	---	75
Other annual crops	50	55	150	55
Sugar-cane	100	70	100	70
Coffee	360	--	360	--
Bananas	50	270	50	270
Plantains	40	25	40	25
Other perennial crops	--	85	--	85
Vegetables	25	30	100	60
Fruit trees	60	30	60	30
Well-kept pastures on flat land	--	450	--	450
Total	2595	2080	8760	1670
In use as "milpa" (shifting cultivation)			8150	

These estimates show that:

a) between 800,000 and 900,000 ha mountainland are used in shifting cultivation, approximately 450,000 ha of which are already degraded to shrub and weed land showing severe erosion;

b) 165,000 ha of flat land is in use for agriculture, that is, only 11 percent of the available flat land adaptable to agriculture.

According to Joosten, vast areas of flat land or nearly flat good land lay waste or were used largely as grazing grounds, although they were poor pastures, being infested with weeds and shrubs, while steep slopes in the neighboring hills were used for growing corn, resulting in loss of soil and destruction of the forest. Furthermore, vast areas of pine forest are kept thin by cutting and burning to favor pastures. These pastures are mainly very poor and probably this practice costs more in losses of soil, timber and water resources than it produces in beef.

In the southwestern part of Honduras, south of the line Copan-Santa Barbara-Talanga and west of Talanga-San Marcos de Colon there is hardly any usable flat land, leaving the possibilities for agriculture to shifting cultivation of the mountain slopes or grazing cattle on very poor pastures. This is nevertheless the most densely populated region of Honduras, with about 30 persons/sq.km. Here is also found the highest average area planted to cereals per capita of

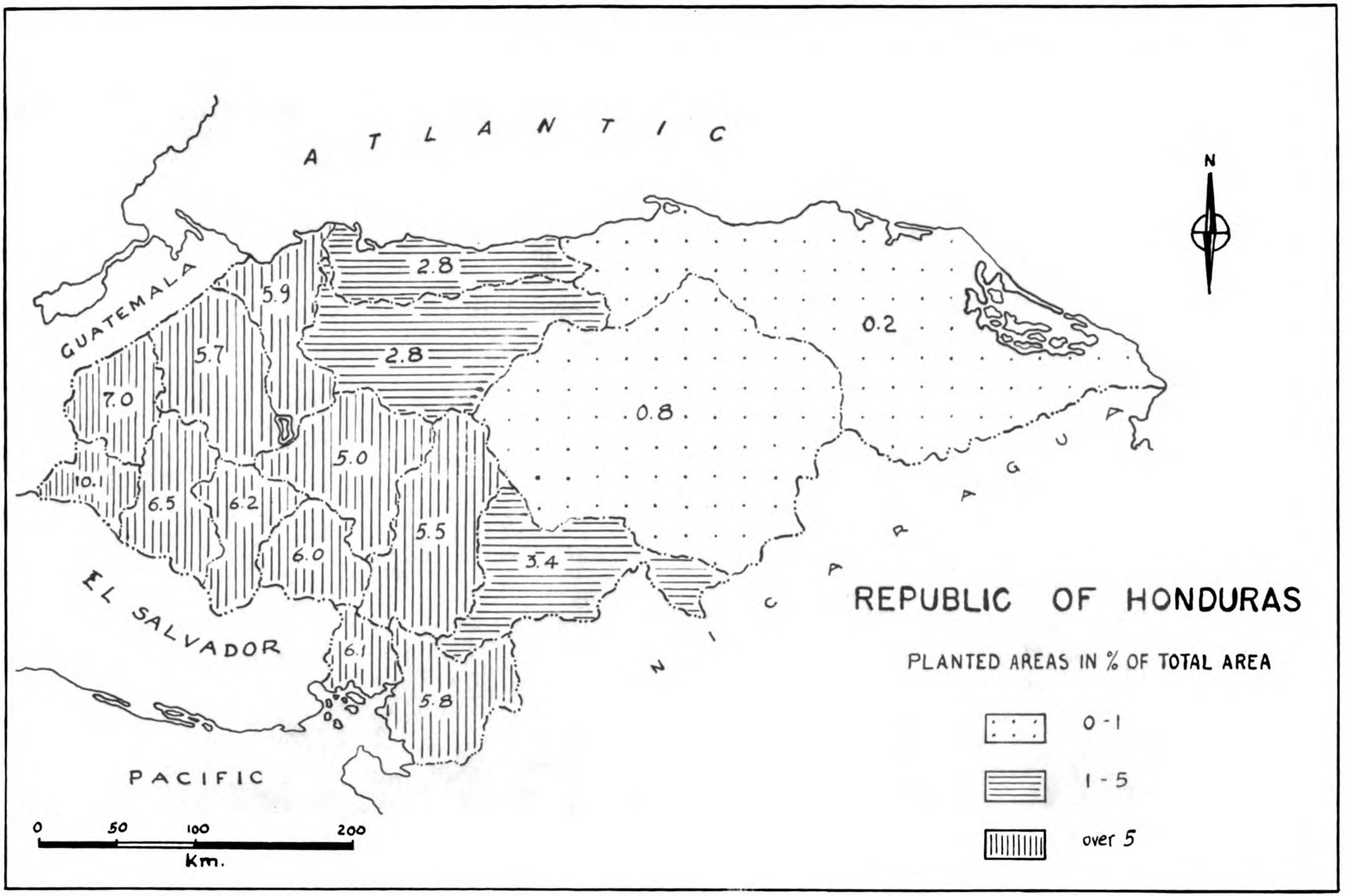
ATLANTIC
GUATEMALA
EL SALVADOR
PACIFIC
2.8
5.9
5.7
2.8
7.0
0.2
0.8
5.0
10.1
6.5
6.2
5.5
6.0
3.4
6.1
5.8
N
REPUBLIC OF HONDURAS
PLANTED AREAS IN % OF TOTAL AREA
0 - 1
1 - 5
over 5
0
50
100
200
Km.

Fig. 13

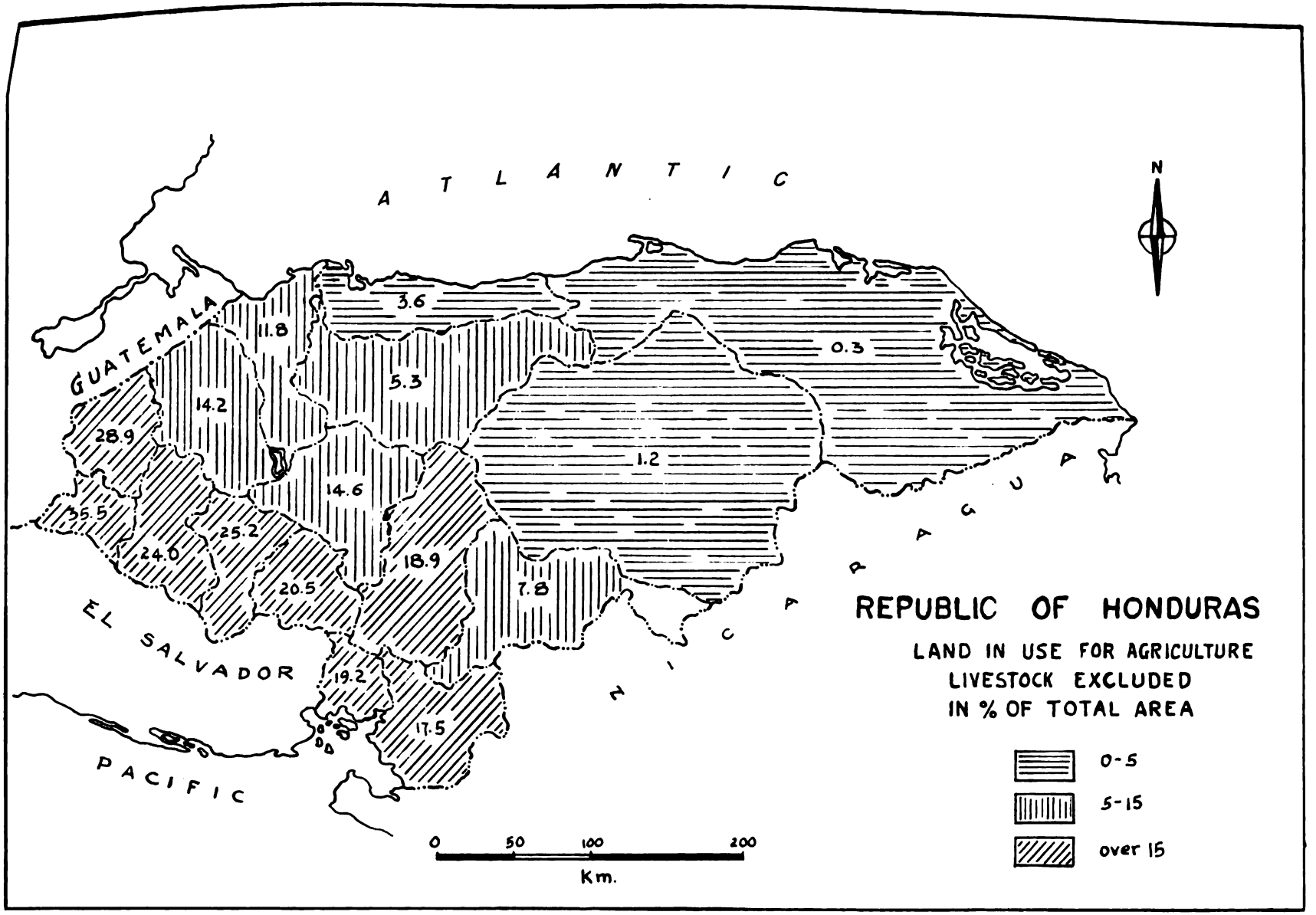
ATLANTIC
N
GUATEMALA
EL SALVADOR
PACIFIC
3.6
11.8
0.3
5.3
14.2
28.9
1.2
14.6
35.5
25.2
24.0
18.9
20.5
7.8
19.2
17.5
REPUBLIC OF HONDURAS
LAND IN USE FOR AGRICULTURE
LIVESTOCK EXCLUDED
IN % OF TOTAL AREA
0-5
5-15
over 15
0 50 100 200
Km.

Fig. 14

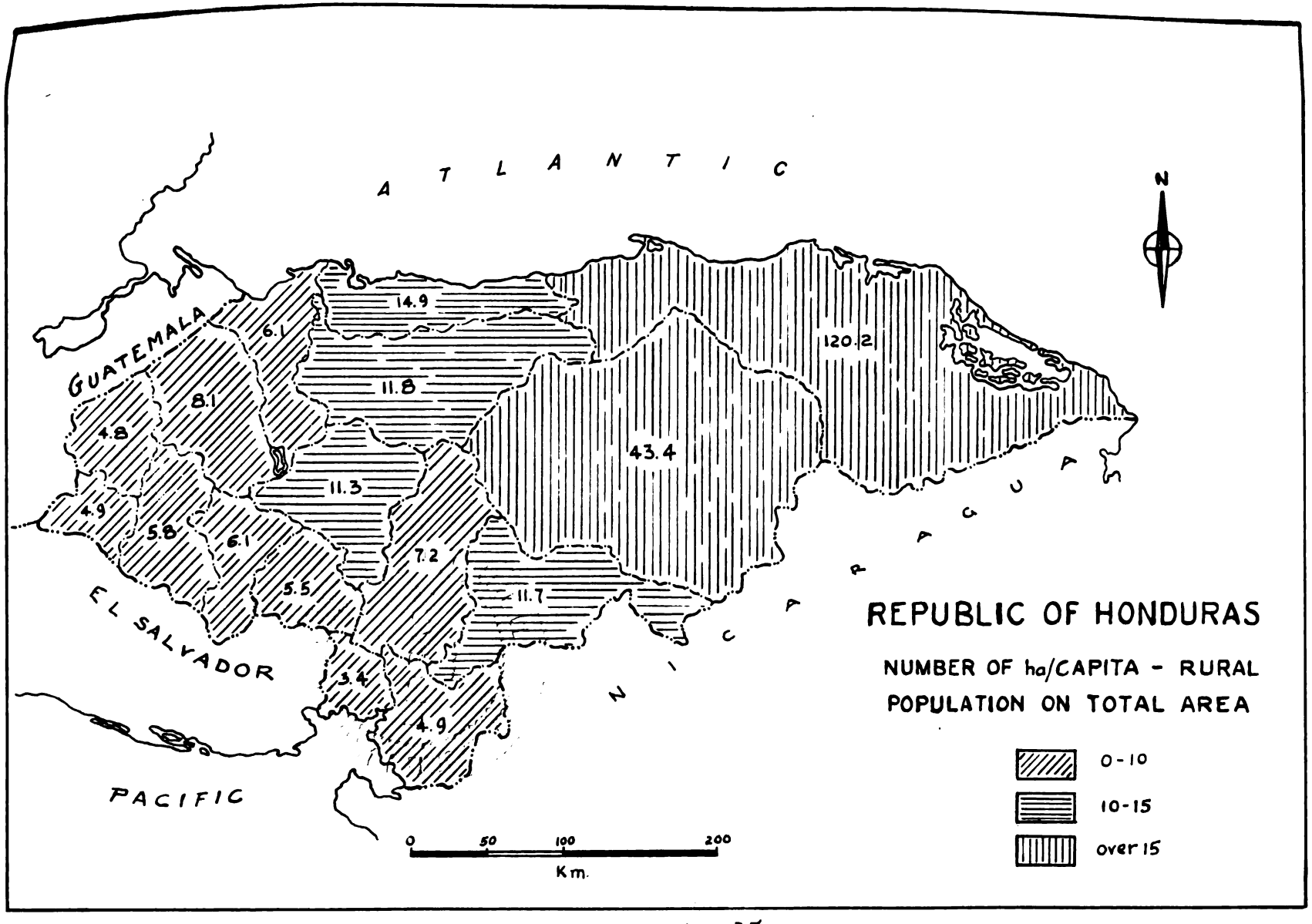
ATLANTIC
N
GUATEMALA
14.9
6.1
11.8
120.2
8.1
4.8
43.4
11.3
4.9
5.8
6.1
7.2
5.5
11.7
EL SALVADOR
3.4
4.9
PACIFIC
0 50 100 200
Km.
REPUBLIC OF HONDURAS
NUMBER OF ha/CAPITA - RURAL POPULATION ON TOTAL AREA
0-10
10-15
over 15

FIG. 15

the rural population and the highest percent of land is planted to crops (see Figures 13 14). All these facts support the local observations that the population in these infertile mountainous regions has already exhausted the carrying capacity of the land, accelerating erosion and resulting in a steadily contracting area of usable land for the growing population. The land difficulties have been made more severe still by the attitude of the great landowners, who control vast areas and who ask heavy rents for the use of their mountain slopes.

The following points are well emphasized by Joosten:

a) only 0.22 ha/capita annually are planted to crops in a total area of 7.5 ha per capita; calculated on the basis of the rural population only 0.37 ha per capita or about 2 ha per family are planted. This figure remains practically constant in every department, and demonstrates the primary fact that the agriculture of Honduras is based on subsistence farming.

Except for the large scale banana, coffee and sugarcane plantations, the prevailing system of land management of the large estates consists in leasing the land in small units to peasants or grazing a few cattle on large areas, giving a low return per hectare. While the peasant obtains a bare subsistence, the landlord enjoys a large income because of the extensive area of land at his disposal.

b) 90 percent of good flat land lies unused, and even in the more densely populated regions of Honduras only 15 percent of that land is used for crop production, the rest

being waste land or used extensively as grazing grounds;

c) in spite of the availability of unused flat land, vast areas of mountain slopes are under methods of shifting cultivation without erosion control;

d) vast areas of pine forests are kept thin by cutting and burning in favor of poor pastures.

All measures aiming at an improvement of the land use by the peasants might be paralyzed as a result of the prevailing structure of land-ownership and the attitude of the landlords to their land and the tenants.

Size of Farms

Number of farmers in Honduras in 1949/50 (From "Informe de Fomento"):

Farmers and dairy-men engaged in agriculture only	124,206
Idem, partly engaged in agriculture	87,419
Total	211,625

The number of dependents may be estimated at 1,058,125 (5 x 211,625) or 74 percent of the total population. These 211,625 farmers use annually 350,000 ha of land for crops (1.6 ha/farmer) and 475,000 ha grassland (2.2 ha/farmer). The average size of the farms is 3.8 hectares.

Apart from the large banana enterprises, two large sugar-cane plantations, a number of small sugar-cane farms producing panela, a limited number of coffee fincas, in the dairy industry only a limited number of enterprises can be called real farms.

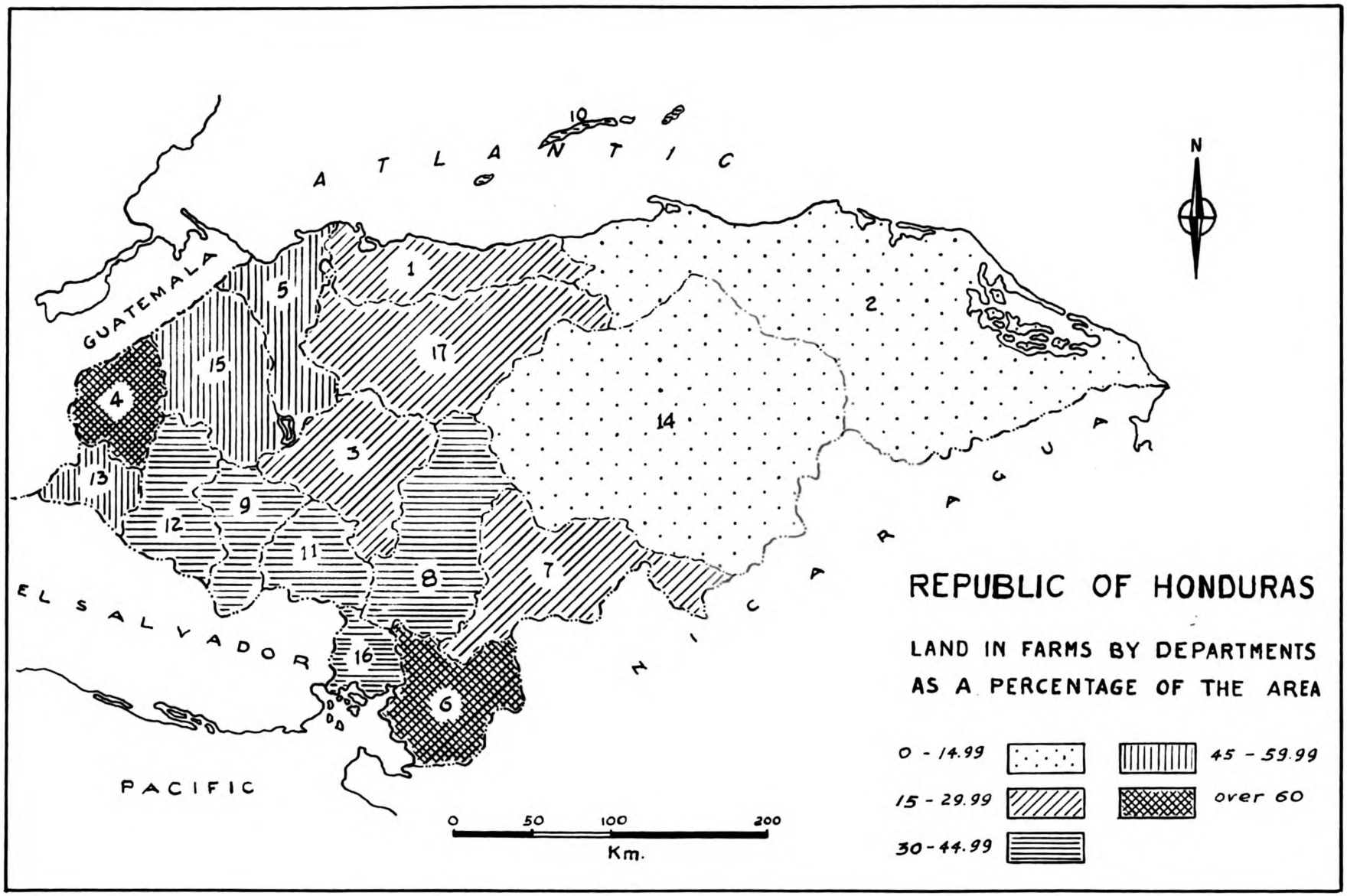
ATLANTIC
GUATEMALA
EL SALVADOR
PACIFIC
CARIBBEAN SEA
N
REPUBLIC OF HONDURAS
LAND IN FARMS BY DEPARTMENTS
AS A PERCENTAGE OF THE AREA
0 - 14.99
15 - 29.99
30 - 44.99
45 - 59.99
over 60
0 50 100 200
Km.

FIG. 16

Beef-cattle is usually raised over vast areas owned by one person or on communal and national land without fencing by a large number of cattle owners. Here too it would be difficult to speak of farms in the real sense of that term.

It would be contrary to the factual evidence to think that Honduras could do without farming based on shifting cultivation. The greater part of the rural population is dependent on that method of agriculture, and in most regions there is hardly any usable flat land available. The practice of shifting cultivation should therefore be incorporated in a well balanced system of hill-farming on adequately sized farms. Assuming that all possible measures to check erosion are applied, including long rotation periods and replanting where possible with leguminous trees and coffee, cacao or other cash crops, at least 25 hectares would be needed to maintain the farmer and his family at an acceptable standard.

Absentee Farming

Most owners of large-landed, and many owners of medium-landed property are not living on their land. They leave the farming to a manager, generally poorly paid. Much farming in Honduras appears to be done by absentee farmers in that way.

This also may be one of the causes of the backward state of the agriculture in Honduras. Farm management involving a well planned and balanced use of mixed farming and crop rotation does not appear to exist. As most of the knowledge

needed for a system of proper farm management has not yet been collected, it would be desirable to start studies on this subject. The natural and economic conditions vary widely in Honduras and for each different region the suitable size of the farm, the crop rotation and rotation period with pastures and legumes have to be calculated and tested on experimental farms. In these studies attention should be given to the possibilities of mechanization, as the larger properties in particular would have to compete for labor if a more intensive land use were practiced.

As long as absentee farming prevails progress will be slow and in any case might not last. To achieve lasting progress it is necessary that the farmer should live on his farm and be inspired by the spirit to build a modern farm based on the principles of modern agriculture. He will then find ways to use the resources available for permanent profit to himself and the community.

Land-ownership and Land-tenure

There are five official kinds of titles on land in Honduras:

1) National land, which comprises all the land without any legal title and the land bought by the government;

2) National land leased to enterprises;

3) Ejidal land, which is land granted to the municipalities and villages according to the regulations of the Ley

Agraria and divided among the members of the community as rights of occupation, which rights are hereditary. The community can sell this land, if it is not occupied, into ownership, while the occupier can only dispose of his right of occupancy. There is practically no real difference between the title of occupancy and that of full ownership, and it would be desirable to discard the former, thus simplifying the legislation and the structure of landownership;

4) Communal land, belonging to the community and commonly used by all its members for grazing cattle without any title by single members to any particular spot.

5) Privately owned land; property without restriction.

The government can dispose of national land by selling, granting in ejidal and granting to settlers in so-called "lotes de Familias" at a maximum of 20 hectares per farm. The law also provides regulations for the lease of land for agricultural or other undertakings, if the company is approved by the government. Concessions to companies are granted by resolution of the Congress. The rent is L. 0.25/ha if brought under cultivation by the Company or L. 1./ha per annum if left idle.

The idea behind the "lotes de familias" is to encourage the foundation of farmsteads by the peasants and in particular to promote resettlement. It would be desirable to alter the regulation regarding the maximum size of the "lotes de familias", which might be made the responsibility of the

Ministry and the Comision Permanente de Immigration y Colonization. As the natural and economic conditions in different parts of Honduras vary widely, farms of 20 ha would mean waste of land in some parts, while in others this unit would be too small to support a family adequately. Table 26 shows the distribution of Honduras' territory during 1950-1951.

TABLE 26

LAND TENANT IN HONDURAS

(Area in 1000 ha.)

Department	Total area	National		Ejidal		Communal		Private	
		Area	%*	Area	%	Area	%	Area	%
Honduras	11,520.5	3,632.0	31.5	1,962.0	17.0	427.5	3.7	5,499.0	47.8
Atlantida	429.0	20.0	4.7	26.0	6.0	2.0	0.5	381.0	88.8
Colon	2,633.0	1,833.0	70.7	49.0	1.8	1.3	0.1	729.9	27.4
Comayagua	521.6	33.0	6.3	142.0	27.2	8.2	1.6	338.4	64.9
Copan	315.0	42.0	13.3	83.0	26.4	4.2	1.3	185.8	59.0
Cortes	406.5	59.0	14.5	91.0	22.4	23.0	5.7	233.5	57.4
Choluteca	430.4	28.0	6.5	57.0	13.2	33.0	7.7	312.4	72.6
El Paraiso	740.3	84.0	11.4	97.0	13.1	21.0	2.8	538.3	72.7
Francisco Morazan	811.0	252.0	31.1	244.0	30.1	13.0	1.6	302.0	37.2
Bay Islands	27.5	16.0	58.2	----	---	---	---	11.5	41.8
Intibuca	313.0	7.0	2.2	128.0	40.9	1.2	0.4	176.8	56.5
La Paz	228.6	6.0	2.6	85.0	37.2	17.4	7.6	120.2	52.6
Lempira	437.5	10.0	2.3	169.0	38.6	2.8	0.6	255.7	58.5
Ocotepeque	174.5	3.0	1.7	29.0	16.6	3.0	1.7	139.5	80.0
Olancho	2,522.2	862.0	34.2	581.0	23.0	173.2	6.9	906.0	35.9
Santa Barbara	520.0	28.0	5.4	97.0	18.7	97.5	18.7	297.5	57.2
Valle	167.0	3.0	1.8	21.0	12.6	17.5	10.5	125.5	75.1
Yoro	813.4	296.0	36.4	63.0	7.8	9.2	1.1	455.2	54.7

*Percentage of total area

The following is the general picture of the landownership in the country:

a) the peasant (campesino) has practically no land of his own but works for the greater part on rented or ejidal land, and in many places he has merely occupied national land or remote parts of the latifundia (large estates) without any legal title at all (colonos);

b) there is a limited number of owners of medium-sized landed property, many of whom live in towns, and are absentee farmers;

c) a small number of landlords controlling vast areas of land on titles based on old Spanish grants.

Tenancy of small parcels of undetermined ownership, absentee medium sized landownership and landlordism appear to be the elements of the structure of the landownership in Honduras and the "standard indictment" of Latin-American agriculture by Hanson (1951) is applicable to many aspects of the situation. This indictment may therefore be appropriately quoted here:

"The substance of the charge is that a small group of land monopolists has controlled the bulk of the productive land of Latin America, has failed to accept the social responsibility that properly attaches to landownership, has prevented the state from aligning the exercise of this private power with the public welfare, has provided a base for the economy which is both weak and unstable."

"The landowner has failed to discharge effectively with a long-range broad viewpoint the duties of estate management. His preference for the immediate gains of commercial crops keyed to foreign markets has prompted over-concentration on a few crops, holding of land unproductively to permit quick shifts into such crops as world markets indicate, development of a transportation and marketing mechanism adjusted to the demands of export markets rather than to the broadening of the domestic market. His willingness to accept the particular year's returns as a measure of success in exploitation of the land - whether as is frequently the case he is an absentee owner or whether he is himself directing the operation of the property - has militated against sound agricultural practices, such as maintenance of soil fertility, in favor of exploitative agriculture, soil mining, and the like."

"The landowner has failed to provide the capital and managerial drive for a continuing expansion of production, for constant improvement of the competitive position of commercial crops in export markets, for broadening of domestic outlets through the larger purchasing power that might flow from greater productivity per man. His comfortable acceptance of the lush livelihood provided him by his estates, of the social prestige attaching to landownership, of the knowledge that land values might be expected to rise almost inevitably to reward speculative holding of idle lands, and his easy command of both the political and financial machinery

of the country which lessened his concern over periodic fluctuations in international markets, reduced his interest in making adjustments to the economic and social needs of the community."

"The landowner has not been disturbed by the lower carrying capacity of the land which was a consequence of the system. His tenants have been exposed to insecurity of occupancy and meagerness of opportunity to transfer capital into land ownership. His workers have been inadequately protected by the government, not provided with conditions that might furnish incentive to personal effort and education for eventual assumption of managerial responsibilities. His government has been discouraged from adequately taxing the rural properties, from penalizing the practice of withholding extensive tracts of land from productive use, from raising sufficient funds to provide the minimum of social services, from enforcing adequately such protective legislation as occasionally but increasingly filtered through the landowner's control of the political machinery. And far from attracting to the land the leadership which should have gravitated toward it in so overwhelmingly agricultural an economy, the educational and social system has tended to separate the ablest youth from the soil."

Almost all the land cultivated by the peasants, in particular in the mountainous south-western and central part of Honduras, is rented from landlords or is "ejidal"

or national land without legal title. It appears that about 70 percent of the producers do not possess a farm at all and for the greater part of these people there are probably no opportunities to establish a farm, as long as the structure of landownership remains as it is.

In several places the country people named landlords with properties of 10,000 - 50,000 ha, and occasionally even higher figures were mentioned. The peasant has often to pay 50 percent of the yield and only in very few cases was the rent said to be lower than 25 percent. This land, it must be clearly understood, is spread over large mountainous areas fit for shifting cultivation only, which in almost every case means heavy erosion. The high rents asked for the land accentuate the burden on the peasant who has to work more and more land to gain a living. This system also means prolonged planting in shortening rotation periods, thus destroying the land. The peasant is naturally not prepared to put labor and money into land that is not his and no measures to stop erosion or to improve the land are practiced.

It is generally recognized that the majority of people who possess meager resources are slow to apply new techniques. Agriculture is a highly personal matter, and every producer should be given opportunity to maintain himself and his family at an acceptable standard.

Pride of land ownership is an essential part of agricultural improvement, and only by government action can the necessary steps be taken to provide the producers with an opportunity to possess land. Wise steps in this direction can create a strong body of agricultural producers who by their own united efforts can do much to apply the modern technical knowledge which can be made available to them.

Without radical changes in the structure of landownership and tenancy there can be no expectations of agricultural improvement and progress even if the most elaborate efforts to apply modern techniques are made. If the government really desires progress, it has to face this problem first of all.

A strong and determined policy combatting malmanagement, unsocial behavior by landlords and absentee landownership, is essential to prepare the way for sound improvement of the country's agriculture. The results would benefit the nation as a whole.

This problem could be tackled along several lines:

a) taxation of the landed property to raise the funds for the General Bureau of Land Records and to force the landlords to apply better management or to dispose of property;

b) buying up all estates which come for sale; dividing the land into workable units of cultivation with well-equipped farms to be sold or leased to experienced farmers willing to live on the farm. Credit facilities will doubtless be needed. In this field the Banco Nacional de Fomento could find a broad field of activity;

c) passing of a law on tenancy, with provision for security for the faithful tenant, reasonable rents and the support of efforts to improve the land;

d) propaganda and educational action to persuade the landlords to take more interest in their land and to change their attitude to the tenants. This could be supported by granting reduction on the land tax if the landowner can prove, to the satisfaction of the Ministry, that he has made considerable investments to improve his land or supported improvement of the landuse by the tenants. If the properties are suitable for division in workable farms, efforts to this effect should be supported by granting reduction of the land tax and loans at very low interest.

Costs of Mechanization

The factors which affect the cost of using machinery may be grouped under two headings:

I. Factors related to machine ownership
   - A. Original cost
   - B. Service life (depreciation)
   - C. Interest on the investment
   - D. Miscellaneous items: taxes, insurance, shelter, etc.

II. Factors related to machine operation
   - A. Fuel, oil and lubrication
   - B. Repairs

C. Labor of operation

D. Number of days of use per year

The capital costs of tractors and power machines, in any country, are readily ascertainable. Manufacturers fix their prices and generally have agreements with their dealers about the prices farmers and other users are charged. Matters like ocean freightage, inland transport, import duties, delivery to the customer, preliminary instruction, after-sales service and so forth, all affect the price the farmer pays; nevertheless, it is comparatively easy to calculate how much a set of machines will cost.

Initial outlay can sometimes be reduced by buying machines, seemingly efficient and quite up to requirements, but not well known and marketed by firms new to the business. While it would be wrong to say that only products from old-established concerns should be bought, it must be pointed out that, unless guarantees are given that newcomers to the trade - whether they be the manufacturers or their recognized dealers - are in position to supply replacement parts and give all the subsequent service that is always necessary, dissatisfaction will inevitably result. There are tractors today in various parts of the world out of commission because it is impossible to obtain a few spare parts.

All figures relating to expected yearly hours of working, output and life of tractors and machines, emanating from countries which have been mechanized for many years, should

be looked at with reserve in areas new to this form of farming. That remark does not mean that the figures in question are not reliable, but that they are attainable only if every ancillary service touching on mechanization functions effectively.

The figure of 1,000 hours per tractor per year is often quoted, and a well-managed tractor with work to do throughout the year can easily put up such a performance, but if a farmer cannot keep his machine in proper trim, he will find that there are long periods when his costly equipment is perforce out of action. A variety of machines for the tractor are often essential to reach this proposed figure of 1,000 hours of operation per year and to insure economical use of the tractor.

The high capital outlay involved in complex farm machines makes it imperative for economic operation that the equipment should give long, reliable service without the need for expensive repairs and maintenance. It is clearly impossible to lay down any absolute scale of useful life to be expected from a particular piece of equipment as this will vary widely with the amount of use and kind of care it receives. The rough and heavy work required of farm machinery increases the need for an efficient organization to insure not only that the operator is familiar with the proper use of the machine, but also that adjustments and repairs can be made promptly and efficiently as defects develop.

The question of prompt repairs is of special importance because the speed and timeliness of operations made possible by farm machines is one of their main advantages over older methods. Long delays and critical periods may destroy any economic advantage which mechanization might otherwise confer.

No apology is made for again mentioning maintenance and repairs - it is a matter that largely governs the costs of mechanization. Even in highly developed agricultural countries some farmers, after a few years' experience with tractors, are giving very serious thought to the repair bills they have to meet and the effects these have on the costs of production.

The size of repair bills, in any part of the world, is dependent on factors generally beyond the tractor users' control, on such things as the price of replacement parts, mechanics' and fitters' wages, and the overheads of establishments equipped to undertake the repairs. In some countries the price of spare parts is excessively high, due to import duties, scarcity, and consequent black markets. Scarcity is occasionally brought about by a lack of understanding by the dealers, and of government departments who regulate imports of what will be required. A method of equipment purchase should always be adopted to insure that spares are available, but the burden of storage, ownership and service should be carried by private enterprise if such arrangements can be made at the time of equipment purchase.

Ownership and Use of Mechanized Equipment

Despite the high cost of modern machinery, a number of methods can be suggested for the ownership and management of farm machinery in Honduras, so that both the landlord who owns hundreds of acres of flat land of the plain and the peasant who is fortunate enough to own a few acres of slope lands of the mountain region can be given the benefits of mechanical equipment.

Machinery may be owned and operated in the following ways:

a) By individual farmers who use it either exclusively on their own farms or also for hire or contract work among neighbors. In countries where this type of ownership and use prevails, machinery manufacturers usually have dealers who sell the equipment and maintain repair and maintenance shops.

b) By individuals who use it for hire or contract work on farms at a charge per unit of land worked, per hour worked, or per unit of measure - for example, per bushel of grain threshed. Such individuals may own one tractor and its attachable implements or they may operate a large business with many machines (custom work).

c) By farmers organized in machinery cooperatives which employ skilled operators of machines for work on members' farms. This method has not developed as rapidly as the first

two methods because of the complicated problems of skillful cooperative management of the machinery.

d) By public machine stations, where the government or other public institution owns, maintains, and operates machinery of farms, charging farmers at rates per hour or per unit of area or measure. As already mentioned, the Direction General de Agricultura of Honduras have been doing this during the past two years.

Some of these methods, and the evolution that may take place, are illustrated by the Swedish experience described by Berglund (1949). For several hundred years it was the custom of farmers in Sweden to lend one another implements and horses and to exchange labor for various farm operations. This type of informal cooperation was modified in the 1880's when steam threshing machines came into general use. The owners took these machines from farm to farm, threshing grain and charging farmers for the work done. During the 1930's tractors came into general use, and contract work with other machines has since become prevalent.

Contract work in Sweden is, at present, of two types:

(a) Work carried out by farmers or contractors who own the machines and operate them for others in return for payment per hour, per unit of land, or per unit of weight (in the case of grain threshed).

(b) Work done by cooperative farm machinery associations; the machines in this case are jointly owned

by several farmers who, in order to secure full use of them, also do contract work for other farmers who are not members.

There are now thousands of both individual and cooperative association contractors, most of whom operate small enterprises serving some 20 to 30 farms. The tendency is for individual contractors to concentrate on work for other farmers rather than to farm for themselves, and for cooperative associations to employ one or more machinery operators rather than have farmer members of the associations operate the machine themselves.

Both individual contractors and machinery associations usually begin operating with small amounts of machinery, such as one tractor and the attached implements and one threshing machine. As the demand for their work has increased, these contractors and machinery associations have increased the number and variety of their machines, and large privately operated machine stations have thus developed.

In Sweden, it has been found better for the contractor to start in a small way and to enlarge his enterprise gradually as his experience grows and the need for further machines becomes apparent, rather than to begin on a large scale without previous experience. The machinery stations are purely complementary to the machines available on the individual farms, and most of the work done by them for farmers is at peak periods on ordinary farm operations and on special

operations, such as the removal of stones, the clearing of land, and the preparation of land for drainage.

The establishment and usefulness of a machinery station can often be hindered by lack of capital, especially if the farms to be served are small. Since 1938, therefore, the Swedish Government has given the stations assistance, through the medium of a special machinery loan fund, in financing the purchase of machinery.

This Swedish experience illustrates some of the ways in which the use of machinery may develop in Honduras. The farmer is able to secure service as needed, either from a neighboring farmer who does some contract work for others or from cooperative stations operated for the benefit of their members.

Shortage of Trained Personnel

The successful and economical use of mechanical equipment in agricultural production requires skilled operators, who cannot only handle such equipment skillfully but can also make the necessary adjustments and repairs.

The Honduran farmer has never had the opportunity to work with mechanical equipment and develop the type of mechanical aptitude which exists so frequently among most of the American farmers. The Honduran mechanics, blacksmiths, and carpenters are usually found to be remarkably skillful

with their native tools, in jobs to which they are accustomed. But as the introduction of farm equipment in Honduras has been very recent and on a very small scale, such mechanics and their apprentices have had no opportunity to become familiar with modern machines.

Recognizing the importance of repair and maintenance, it would be the responsibility of the government and machinery distributors to see that every piece of machinery which is sold to a landlord, a state farm, or a farmer's cooperative has the services of trained men available for its operation, maintenance, and repair so that the machine will function satisfactorily over a long period.

It can be said with confidence that tractors and machines break down and wear out sooner than they should because the men in charge of them have had insufficient tuition in handling, care and maintenance. The measure of skilled and instructed tractor driving - and that is taken to mean implement and machinery operations as well - is a workshop seldom beset with emergency repairs.

Kinds of Training Needed

From the point of view of a future program of farm mechanization of Honduras, and the helpful information obtained and the observations made during the years worked at the Pan American Agricultural School in this country, the kinds of training needed may be listed:

1. Administrative and supervisory staff
2. Farm machinery and tractor operators.

Training of Administrative and Supervisory Staff

We may say that those having administrative control over a mechanization program should have a knowledge of the capabilities of the machinery in the field. Very often it happens that the administrative personnel are quite ignorant about performance rates, machines' requirements, the servicing necessary to keep them running, transportability and such other matters pertaining to tractors and implements. A technical adviser can be of great help to officials in seeing that departmental regulations and instructions are in accordance with feasibility.

If a large-scale program is intended, the sending of one, two or more government officers to study mechanization in other countries will provide them with the background needed for the effective discharge of their duties.

Field managers and supervisors will, in the first place, be selected for their managerial and supervisory capacities. They should, of course, have more than that; they must be thoroughly conversant with the machines they have in their charge and all the work that machinery does. Furthermore, they must have a practical knowledge of crops and all of the operations of production from seed bed preparation to harvest, storage, and marketing.

The training of this personnel can be worked out at the Pan American Agricultural School. The graduates from this School are remarkably prepared and more than able to achieve a very good performance of their duties.

Training Farm Machinery and Tractor Operators

No soldier goes into battle until he knows how to use the weapons he is armed with. He is given training for several weeks or months, depending on the complexity of the arms he has to handle, until he is thoroughly acquainted with the construction, care and use of them. If he is not fully trained, he will be a danger to his comrades and an undue expense to his country.

It is just as important that the man who is to operate modern power machinery is also fully trained. Knowing where to put the fuel and how to start a tractor is not enough. He must understand and regularly attend to much more than that; otherwise, he, too, is a danger and a liability.

Before a tractor is put on the land, the man who is to drive it should attend a training course. For this purpose, it may happen that the dealers undertake to provide some instruction, but it is better for the government to arrange suitable classes in close cooperation with the manufacturers' representatives. The financing, staffing and equipping of training centers is, of course, controlled by various circumstances, and no useful purpose would be served by attempting

here to envisage all of them and put forward suggestions how to provide for them. There are, however, minimum requirements, which can be discussed here.

The form that tractor training should take depends on the knowledge already possessed by the trainees, the instructors available, the time that can be given to the task, and the facilities that exist. The same applies to the men who operate combine-harvesters and all the other field machines, as well as to farm mechanics and servicing men.

Assuming that all in the class are novices, the instruction is best divided into three sections:

a) elementary talks;

b) demonstrations around machines; and

c) field work.

a) Elementary talks

For these, some kind of lecture room is needed in which pupils can sit and see the instructor, the pictures and diagrams, portable machine components he has collected and any films and lantern slides obtainable.

The talks should be extremely simple, designed only to explain principles, construction and functions of machinery that are not susceptible of elucidation without diagrams and such visual aids. It should be remembered by the instructor that very few in the class will make much out of a complicated diagram of a sectioned tractor, carburetor

or other component, and he should take steps to make these diagrams clear.

Movies, film strips and slides add to the interest of the proceedings, and many of these are most educative as well.

b) Demonstrations

Tractors, plows, mowers, cultivators and other machines, the handling of which it is the purpose of the class to learn, should be assembled in convenient places, where a reasonable degree of comfort can be enjoyed, such as protection from the sun, rain and dust. It is most important that the numbers in a class around the machine be no more than will allow every man to see what the instructor is demonstrating.

Eight to ten is a large enough group; if more are in the class it is difficult for the instructor to insure that each pupil sees and understands all the details that are being shown and explained.

c) Field work

The best place to teach tractor driving is in the field. It is not always possible to do this where actual work is proceeding; nor is it desirable when novices are at the wheel. A few acres of unused but reasonably level land near the teaching center can be made into an ideal initial training ground. Straight and twisting roads, gateways and obstacles can easily be imitated by means of pegs and

string, bricks or small mounds of soil. On such a ground driving can be practiced, at first with no implements attached, and later with a complete outfit.

Starting, field servicing, turning, backing, hitching implements and even plowing, cultivating and drilling can be done, or simulated sufficiently to impart the amount of skill that will enable trainees to go into a field and not seriously damage the soil or crops.

No more than two pupils should be assigned to each instructor and tractor in the early stages of the training. When learners have to stand about waiting for their turn on the driver's seat they are apt to become bored and sometimes undisciplined.

It often happens, however, that there are not enough instructors to take care of all the trainees attending a course. This shortage can be mitigated by having some of the class working elsewhere attending demonstrations or opening up and examining machines. Another way out of the difficulty is for the instructor to select particularly apt pupils, and as soon as they attain some competence in driving they can put real beginners through the first stages of starting and steering a tractor.

Land plowed by one group of trainees can be harrowed and rolled, and then plowed again by the next group; thus it is not essential that the training field shall be large enough for each pupil to have a piece of unplowed ground on

which to practice. All the cultivation operations can be taught in this way, and jobs like drilling and fertilizer distributing also lend themselves to this form of treatment. Much can be learned on the same site about mowers, reapers and combine-harvesters, but the very nature of mowing grass ahd harvesting cereals makes it impossible to simulate these operations fully.

It must not be thought that this practice-field method of instruction will entirely take the place of actual field operations - no trainee can be passed as competent until he has done the work where the crops are grown - but it does get over the generally insuperable difficulty of finding farms and taking the classes to them throughout their training period.

Talks, demonstrations and field work should be planned so that the one supplements the others at the right time in the training.

Nearly all would-be tractor drivers show an impatience to be at the wheel as soon as possible. If the opportunity to do so is long delayed in a course, full attention by the pupil to the other aspects of the training may be indifferent. It is therefore a good idea, at the very beginning, to let every trainee try his hand at driving, the instructor arranging matters so that the learner soon gets into some kind of minor trouble. The instructor can, surreptitiously bring a machine to a standstill, by cutting off the fuel

supply, shorting the ignition, or in other ways. This teaches the beginner the necessary and salutary lesson that there is more to tractor driving than sitting at the wheel and steering.

Tests at the end of the course to assess the competence of the trainees should be held. It costs little to print and issue certificates to those who quality, and when these certificates become universally recognized by employers, and lead to better jobs, they do much to promote keenness during the training.

Following is a suggested syllabus of a farm machinery course.

Suggested Syllabus of Farm Machinery Course

Sequence of Instruction

Division into days and weeks can be done to suit the periods of the year when the courses are held.

Although a progressive sequence is set out, as is necessary for efficient instruction, the syllabus is reasonably elastic and can be modified somewhat to suit local facilities.

Hour	Class	
1st	L*	General arrangements. Explain the scope of the course; how instruction will be given; the time table; rest periods between classes. Obtain details of each trainee. Tell them about the tests to be held during and at the end of the course and about the Certificate of Competence to be awarded to those who reach a certain standard.
2nd	D	A talk around a tractor, briefly explaining the general layout - the engine, gear box, fuel tanks, steering, wheels. Point out the carburetor, magneto, air-cleaner, oil pump, radiator, etc., saying in a few words the functions of each and that they will be gone into in greater detail later.
3rd-4th	F	Each man to ride a tractor for a short period with an instructor or assistant instructor, to get the feel of the machine and to satisfy the urge to get up and drive.
5th	L	How the internal combustion engine works. Have various engine components on desk.

*Abbreviations: L - lectures or talks indoors
D - demonstrations around the appropriate machines.
F - work with tractors and machines in the field, during which trainees will drive tractors and handle implements and machines.

Hour	Class	
6th	L	Continuation. Operation and timing of valves. Pistons, rings, connecting rods, crankshaft. The four strokes. The flywheel and conversion of piston action into rotary motion.
7th	D	Show the working of an engine around a partly stripped one, pointing out the valves, cams, pistons, etc., and touch on the elements of lubrication.
8th-10th	F	Driving in the field. Arrange for tractors to stop after a short period (by shorting the ignition, turning off the fuel and in other ways) to bring home to the learner that a knowledge of the whole tractor is essential.
11th	L	The elements of the carburetor.
12th	D	Use of spanners, tightening and loosening nuts; damaged and dirty screw threads.
13th	L	Fuels and vaporization. Temperatures of evaporation.
14th	D	Examination of carburetors.
15th-17th	F	Driving tractors, each team to refuel, adjust carburetor and start up.
18th	L	Fuel supply, cleanliness, filters, choked jets. The elements of air-cleaners.
19th 20-21st	D	Examination of fuel systems and air-cleaners. Stripping carburetors, fuel lines and servicing air-cleaners.
22nd	L	The magneto; its function and the main components.
23rd	D	Examination of magnetos.
24th	L	Further details of magnetos. Setting the points; cleaning the distributor; timing. Spark plugs; cleaning and adjusting.
25-26th	D	Adjusting magnetos and plugs.

Hour	Class	
27-29th	F	Driving tractors - along straight lines and turning through gaps. Reversing. Lanes and turnings to be marked out on the field with pegs and string.
30th	L	The cooling system.
31st	D	Examination of the cooling system on different tractors.
32nd	F	Filling and draining radiators.
33rd	L	The elements of lubrication.
34th	D	Examination of lubrication systems.
35th	L	More details of lubrication. Oil and grease; nipples; engine lubrication, changing oil.
36-37th	D	Draining engines, gear boxes, etc.; checking oil levels; greasing.
38th	F	Driving. Refueling, filling radiators, checking oil levels; greasing.
39th	F	Driving with towed loads.
40-41st	F	Driving with loads; turning, reversing and steering through gaps. Getting a wheel out of a hole.
42nd	L	The clutch.
43-44th	F	Removing the cylinder head and replacing.
45th	L	The gear box and transmission.
46th	D	Examination of open gear boxes and transmission.
47th	L	The steering system of wheel tractors.
48th-51st	F	Driving and plowing.
52nd	L	Wheels and tires. Care of tires.
53rd-54th	D	Fitting tires and inflating.
55th	L	Ballasting tires and tire grips.

Hour	Class	
56th	D	Demonstrating tire ballasting.
57-58th	F	Tire work.
59th	L	Tracklayers
60th	D	Examination of tracklayers.
61st	L	Tracks and steering; care and maintenance.
62nd-64th	F	Driving tracklayers.
65th	L	The diesel engine and injectors.
66-67th	D	Examination of diesel engines, etc.
68th	L	Storage and use of diesel fuel.
69th-72nd	F	Driving tracklayers with loads.
73rd	L	Servicing tracklayers.
74th	D	Demonstration of servicing.
75-76th	F	Practical servicing of tracklayers.
77th	L	Troubles of internal combustion engines.
78th	D	Demonstration of engine troubles.
79th	L	Plows.
80th	D	Talks around plows.
81st	L	Plow setting.
82nd	D	Plow-setting demonstration.
83rd-86th	F	Plowing and setting.
87th	L	Discs and cultivators.
88th	D	Examination of discs and cultivators.
89th-91st	F	Field work with discs and cultivators.
92nd	L	Seed-beds and drills.
93rd	D	Examination of drills.
94-96th	F	Tractors and drills in the field.
97-100th		Revision and test of competence.

IV. REASONS FOR FARM MECHANIZATION

Many people think that the principal object of using machines is to increase gross production. In fact, the most important effect is to increase production per man-hour of work. But this effect depends on the possibility of providing enough work for the machine to justify the cost of its acquisition and operation; where this cannot be done, the total productivity per farmer will be no greater, and at the same time the capital investment in equipment and the cash outlay on its operation will be far greater than where hand tools and animal-drawn implements are used. Nevertheless, in special circumstances mechanization may also increase production per unit of land.

The machine may sometimes, though by no means always, do the work better than other equipment, and its use may often result in more timely plowing, seeding, cultivating, irrigating, harvesting, and other operations. In many countries the time for these operations is strictly limited by natural conditions, and man - or animal - power is insufficient to plow land within the short season, to pump enough water for irrigation at the right time, or to cut and gather the crop before losses occur from rains or from the shattering of over-ripe grain. This advantage may even partly offset

the lack of full work for the machine. It is well known that a delay of a week or two at the proper time of planting or harvesting crops can greatly decrease production per acre and per farmer. The use of Diesel engines for power to pump water for irrigating rice in the lower Yangtze River delta of China is an example of work that could not be done by hand in the optimum period of supplying water to rice. These engines operate locally-made traditional pumps which have been adapted by the addition of a belt wheel.

Machinery can increase production in another way. When tractors replace animals as a source of farm power, crops and crop by-products formerly fed to draft animals, can be used for salable animals which supply meat and other food and raw materials. The loss of farm manures, which is one of the immediate disadvantages of mechanization, can also be obviated in this way.

There is a great deal of drudgery in traditional farming, and for this reason farm boys in many countries are more and more unwilling to stay on the farm. Plowing, cultivating, and irrigating require a tremendous amount of human and animal energy. All these operations can be done with relative ease by the use of power machinery, if fields are not too small or irregular. Likewise, the harvesting and threshing of crops can be accomplished with much less effort than is required in using the sickle, the cradle, and the flail, and in winnowing the grain.

Farm mechanization can play an important role in releasing manpower for employment in other enterprises, such as industries, transportation, business, and the various professions. Even the introduction of compulsory education may require the use of labor-saving devices so that the children can be freed from farm work to attend school. Mechanization will also enable fewer workers to maintain and even increase the supply of food for urban workers and of raw materials for factories, a development that is essential to the growth of industry and other activities made possible by the release of farm labor.

Where its use is justified, therefore, machinery may enable the farmer to extend his operations and to increase his gross production while reducing his labor and costs per unit of production. This will permit him not only to improve his standard of living but also to bring about farm improvements which will further increase his income.

Types of Machinery and Equipment

In selecting machinery and equipment, full consideration must be given to the topography and physical conditions of the land on which it is to be used, the general type of farming practiced and the crops grown, and the facilities for moving power units and implements between machinery station, farmstead, and field. In the growing of crops there are certain field operations to be carried out and the

implements must not only be adapted to use with the tractor selected, but they must satisfactorily perform these operations. Since a tractor is usually used in the growing of more than one crop there will be certain implements which will be used with all the crops, and other implements may be special and used in connection with only one crop.

In this respect, the following principles, quoted from "A Report on Agriculture and Agricultural Engineering in China (1949) should be kept in mind:

a. The tractor must be of a size and type adapted to the size of an enterprise. If the tractor is too small certain operations cannot be performed at the right time, and if too large it will be idle part of the time and uneconomical because of its extra cost.

b. Implements must be available for all of the necessary operations to be carried out with machinery. If row crops are to be grown, planters and cultivators are needed.

c. Machines should furnish a full load for the tractor to secure economical operation.

d. The machinery should be used as much as practicable in conducting an organized production program.

e. The machinery should have the necessary attachments for performing various operations under all conditions,

i.e., cultivators often require different types of soil tillage tools for different crops.

f. The tractor and implements must be properly cared for and kept in repair to maintain operating efficiency.

Classifying Farm Machinery

There are many types of farming enterprises like vegetable products, row crops, small grain, general crop production, specialty crops, etc. In making up a list of machines for a farming situation the implements may be separated into the following groups: (a) basic implements for any farming situation; (b) special treatment and tillage implements; (c) row crop implements; (d) small grain implements; (e) processing machines; and (f) miscellaneous equipment.

a. Basic implements for any farming situation include moldboard plows and disk plows, disk harrows, and spiketooth harrows. The implements in this group would include the common ones used for preparing seed beds for any of the crops.

b. Special treatment and tillage implements include middlebusters for planting on the ridge or in the furrow, for preparing beds for two or more rows, for opening temporary field drains, and for preparing irrigation and drainage laterals; soil pulverizers which are used only

when soil conditions are too cloddy or porous; mulchers for early cultivation and crust breaking; harrow-plows for certain seed bed preparation, terrace work, and moderate bedding operations; and other machinery used primarily for special tillage conditions.

c. Row crop implements are primarily adapted to row crop production, although a grain drill can be used to plant many row crops, but it is not termed a row crop implement.

d. Small grain implements include the equipment primarily limited to small grain production.

e. Processing machines comprise threshers, corn shellers, rice hullers, feed grinders, and seed cleaners. Small cotton gins as well as other machines could be included. The farm tractor during slack periods, like in the peak of the raining season, could furnish a source of power for processing farm crops and would make a profitable rural village enterprise. The crops produced on the farm usually can be marked advantageously when processed. In addition, custom work can be done for other farmers in the village.

f. Miscellaneous equipment mainly includes dusters and sprayers, fertilizer spreaders, wagons and irrigation pumps. The modern tractor on rubber tires can be utilized for farm-to-market hauling by using a rubber tired trailer with box body. This same vehicle is very useful in hauling supplies

to the farm, equipment and supplies to the field, and for hauling harvested grains.

Hand and Animal-Drawn Implements

Although our purpose deals primarily with the mechanization of farming operations, it is suitable to mention that, in circumstances where mechanization is not economically or practically feasible, the efficiency of farm operations can often be greatly improved by the use of better hand tools and animal-driven implements. The use of better materials, better design, and better workmanship will often increase production per man or per animal and even production per unit of area by reducing the time and effort required in various operations and improving the quality of the work done. It is estimated, for instance, that the use of better metal in the Chinese hoe would reduce the present labor of cultivating by 25 percent. The fitting of simple modern bearings to the wheels of farm carts may so increase their efficiency that the same loads can be pulled by half the number of horses or oxen. By replacing the wooden, steel-tired wheel on a common wheelbarrow by a modern rubber-tired wheel with roller bearings, it has been found that the same load could be moved with only one-third of the effort previously needed. There are hundreds of similar small changes that would increase the efficiency of existing equipment in Honduras.

There is available from manufacturers today a wide variety of one- and two-animal farm implements, consisting of plows, disk harrows, spike tooth harrows, middlebusters, cultivators, planters, drills, harvesting machines, vehicles, etc. A farm may be completely equipped with animal-drawn implements.

There are many kinds and types of animal-drawn implements and it is advisable to contact a manufacturer for full information before selecting specific implements. Plows, for example, are made in various styles and of several kinds of steel in order to work in different soil types under various conditions. There are animal drawn hill-side plows available for plowing on hill sides, which is of particular interest for the mountainous parts of Honduras. Thus, complete information should be available before ordering any implements. Likewise, the manufacturer should be furnished with complete information on climate, soil characteristics, topography, crops to be grown, harvest conditions, farming methods, and any special conditions or practices.

Garden Tractors and Implements

The garden type of tractor should not be overlooked in developing mechanized farming. This type, though smaller, has as many uses as a farm tractor. It is economical because of its low consumption of fuel and its lower first cost.

Garden tractors are used on farms in many parts of the world, especially in connection with the growing of vegetables and small fruit on soils that are easily worked. With one of these small and relatively inexpensive machines, one man can do the work of several men and can often do it better. Because of its mobility, it has a particular advantage in areas where farm communications are poor; it can be taken to fields that are inaccessible for the larger types of tractors and equipment. The attached implements such as plows, drills, planters, cultivators are simple and light.

The following table lists some of the common garden tractors' sizes with implements, and also gives the normal capacity under average conditions.

Small Garden Tractor - 1 to 2 1/2 H.P.	Capacity, Acres per hour
Plow, 6 in.	.10
Disk harrow, 2 ft., 6-12" disks	.40
Cultivator, 1 row (variable width), 1 ft.	.20
Planter, 1 row (variable width), 1 ft.	.15
Mower, 2 ft., cutter bar	.40
Large Garden Tractor - 5 H.P.	
Plow, 10 in.	.20
Disk harrow, 4 ft.	.80
Spike tooth harrow	.80
Cultivator, 3 row (variable width), 3 ft.	.50
Planter, 3 row (variable width), 3 ft.	.40

Fertilizer, attachment	.40
Mower, 3 ft. cutter bar	.60

Rotary Tillage Garden Tractors

Rotary plow, 6 in. cut	.08
Rotary tiller, 18 in. cut, 5 H.P.	.15

Farm Tractors and Implements

Tractors and related machines have been developed to suit the conditions prevailing in the countries of their origin, with sometimes, modifications made for overseas requirements. A multiplicity of types has therefore grown up and the uninstructed buyer is at a loss to know which is suitable, and too often he is wrongly advised by a plausible salesman.

Many potential owners are misled by the notion that nothing but a crawler will do; that diesel engines and nothing else must be the power unit; that steel tractor wheels cannot be thought of when pneumatics are on offer; that the more expensive self-propelled combine-harvesters are preferable on every count to those hauled by tractors, and so on.

Tractors suited to the needs of each farm can be chosen from many makes and types, ranging in power from 8 to 30 drawbar horsepower and in seasonal working capacity from 24 to 60 hectares per tractor. No set formula can be

be followed in determining the most suitable drawbar horsepower, for horsepower requirements depend upon size of farm, texture of soil, and general characteristics of farming.

While wheeled tractors of more than 30 horsepower and heavy crawler tractors have their definite place for heavy field work, such as deep plowing, terracing, and land clearing, they are usually not suitable for ordinary farm work because of their high original cost and high cost of operation.

Crawlers have characteristics that at first sight render them more desirable than wheeled tractors, i.e. they have a greater brake horsepower to drawbar horsepower ratio, that is, more of the power developed by the engine is available for pulling; marshy land can be cultivated without the tractor sinking in; crawlers are often better than wheels on steep banks, and they can negotiate rough country with ease. On the debit side, however, they are more expensive; they are not so good for haulage and similar road work, nor for inter-row cultivation, and cannot be used economically on small fields; and the maintenance costs of keeping the tracks in good condition are high - very high indeed, on sandy soils.

Diesel engines have several merits, such as high thermal efficiency; the fuel they burn is not volatile and the losses by evaporation are therefore negligible; an electric ignition system and carburetor are not needed and oil dilution in the

crankcase is slight. But thermal efficiency is not, as a rule, of great interest to the farmer; the fuel injector and pump on a diesel are high precision components, quite beyond the capacity of the most skilled driver to set or repair, whereas he can make field adjustments and carry out repairs and replacements on magnetos and carburetors. Diesel fuel, too, needs careful handling in that the smallest traces of dirt and other foreign matter will soon bring the engine to a standstill.

In selecting any wheeled tractor, and before purchasing large numbers, field tests should be made to determine the suitability of tire equipment. On some land, steel wheels with spade and angular lugs will operate most efficiently, while in other conditions wheels with rubber tires will be much more efficient. Rubber tires are especially to be preferred where machines have to be driven over a hard-surfaced highway from one field to another. On some soils, also rubber tires give more pulling power than steel wheels. In operating any tractor equipped with rubber tires, the specifications and recommendations of the manufacturers of the tires should be closely followed to ensure long life and satisfactory service.

Pneumatic tires for tractors and field implements, fertilizer distributors and drills, combine-harvesters and binders, moldboard and disk plows, centrifugal and barrel pumps, hammer mills and plate grinders, threshers, mounted

and trailed implements, cultivators and harrows, all these and many types that have been developed for special jobs must be assessed in the light of the work to be done and the conditions that prevail in the particular farming situation. Machines should be simple, durable, and as light in weight as is consistent with efficient performance. Equipment should be easily attachable and detachable in the field with a minimum loss of time between jobs.

Maintenance and Servicing of Machinery

A vital part of successful mechanization is that the machines should be kept in good running order; the maintenance and servicing of machinery should, therefore, be organized by experienced persons. In executing agreements for the import of machinery the Government should make sure that the contract with the manufacturer provides for spare parts and service that will assure good performance of the machinery purchased.

In general, the driver's duty is to operate the machine, not to repair it. Operating a machine includes, besides actual driving, hitching the implements to the tractor and such simple services as changing the oil. The driver should, of course, understand the engine, and if he is sufficiently skilled he may be able to make minor motor adjustments. But, in general, tractor drivers with limited experience should

remember the old saying, "A little knowledge is a dangerous thing" and if the machine fails to function or if repairs are needed, the job should be left to a mechanic. Unskilled tinkering is the source of much trouble and mechanical failure.

In this respect, a training school for mechanics should be established. Special equipment should be installed to give proper training on all types of repair. Competent instructors, trained if possible in the factory where the machines are made, should be provided. The service manuals issued by manufacturers for each type of machine should be closely followed, and should be translated where necessary and distributed to operators and mechanics in order to ensure their full use.

Field courses should be held several times a year to keep operators and mechanics up to date on all operating and mechanical changes. Such courses should be practical rather than theoretical. Minor points, such as the need for keeping proper clearance in the clutch pedal and the proper method of starting a tractor, should never be neglected in teaching. Simple precautions which will greatly extend the life of a machine should be stressed, such as using clean oil and fuel and making sure that spark plugs, distributor caps, and all wires are tight and free from dirt, oil and moisture.

V. SELECTION OF MODERN FARM MACHINERY FOR VARIOUS FARMING SITUATIONS

Under the present conditions of Honduras, mechanization of agriculture to the extent practiced in the United States is obviously impossible because of the high cost of imported agricultural machines and the lack of transportation facilities. However, some agricultural and industrial developments have already started and it will not be long before some significant results and improvements will be obtained.

In this section, a method for selecting tractors and farm machinery for various farming situations in Honduras is introduced. It is believed that the use of tractors and implements indicated in the following pages can be applied to a Honduran village situation, at the present time or in a near future. The operation and ownership of these machines can be managed either by individual ownership and doing custom work for others or by a cooperative method which was mentioned in section III.

Procedure for Selection of Farm Machinery

In selecting the most desirable agricultural machines for the various farming situations in Honduras, the following procedure was followed:

An Analysis of the Farm Enterprise

Such an analysis consisted of listing crops produced and acreages involved for four farming situations (Table 27) with the following characteristics:

Situation I - A family farm in the Siria valley.

Situation II - A family farm in the Catacamas valley.

Situation III - A farm in the Comayagua valley.

Situation IV - A farm in the Sula valley.

Selection of Tractor and Necessary Equipment.

In the selection of tractor and farm machinery for any farming enterprise, the principles already mentioned in Section IV, and quoted from "A Report on Agriculture and Agricultural Engineering in China" (1949) should be kept in mind.

Tables 29 to 31, together with machinery lists No. 1 and 2, were prepared primarily for illustrating how the machinery will fit into the production of crops under the various farming situations existing in Honduras. By the methods illustrated, it is possible to analyze any desired farming program for the selection of proper and adequate power and implements to perform satisfactorily the production and handling of crops.

In making a list of machinery for an individual farmer or farm or village situation, the method of selection would be similar, but only the machinery required for that particular enterprise would be shown. Great attention should be

TABLE 27

ANALYSIS OF FOUR FARMING SITUATIONS FOR THE SELECTION OF FARM MACHINERY

Situation	Acres in crops in each situation					Size farm acres
	Corn	Beans	Rice	Sugar-cane	Legumes for green manure	
I	10	5	10	5	10	40
II	20	10	20	10	20	80
III	30	20	30	20	30	130
IV	50	30	30	30	50	190

TABLE 28

ASSUMED PERCENT TIME LOSS FOR VARIOUS FARMING OPERATIONS

Operation	Tractor in Situation	
	I and II	III and IV
Plowing and disking	30	25
Cultipacking	25	20
Furrowing	35	30
Planting and cultivating	40	35
Harvesting	35	35
Miscellaneous	30	30

given to the soil, crop, and farming conditions in selecting machinery for a particular area. A tractor pulling a three-cottom plow in most lands of the United States would probably pull only one bottom of the same size in some of the hard soils of Honduras.

The rates of performance of machines indicated in Tables 29 to 31 were found by means of the following equation given by E. G. McKibben:

$$A = \frac{5280\ S\ W\ (100 - P)}{43560\ (100)} = \frac{S\ W\ (100-P)}{8.25\ (100)} \quad ; \qquad (1)$$

In this formula: A = actual capacity of machine per hour;
S = rate of travel in miles per hour;
W = width of machine in feet;
5280 = feet in one mile;
43560 = square feet in one acre;
P = percent of time lost due to interruptions.

If in formula (1), one percent of time lost is assumed, and width of machine is taken in inches, it is transformed to this simple one:

$$A = \frac{S\ W\ (100 - 1)}{8.25\ (12)(100)} = \frac{S\ W}{100} \qquad (2)$$

A rate of travel of three miles per hour in most cases, and the estimated percent time losses shown in Table 28, were used. As seen in this table, the time loss for various operations were taken much higher than those common in the

United States. The reason for this higher estimation of time loss was obviously the lack of experience of operators, the great distance between villages and farm machinery dealers, and the lack of transportation facilities.

Tables 32 to 35 were prepared to show each month's work. With these tables, time required and time available for the various operations necessary in crop production can be considered and the machinery with the necessary capacity can be selected.

TABLE 29

ANNUAL HOURS OF USE OF TRACTOR AND EQUIPMENT IN SITUATION I

Operation	Equipment used	Acres covered	Acres per hour	Annual hours
Primary tillage	2-disk mounted plow	40	0.59	68
Secondary tillage	Tandem disk harrow 8-ft.	40	2.36	17
	Spike-tooth harrow 2-section 10 ft.	60	3.36	18
Special tillage and land preparation	Cultipacker, double-gang	25	4.5	6
	2-row rear-mounted bedder	5	0.70	7
Planting	Corn-planter, 2-row	25	1.5	17
Drilling	Grain drill 12x6	10	2.0	5
Cultivating	Corn cultivator 2-row	45	1.26	36
Harvesting*	Bean harvester	5	0.5	10
Processing**	Threshing, stationary 20 bushels per hour	10		19
	Corn sheller	10		40
	Seed cleaners			30
Miscellaneous	Duster and sprayer	25	2.0	13
	Hauling			60
Total tractor hours				346

*Bean harvester ownership warranted by doing custom work.

**Processing machines could profitably be used for custom work.

TABLE 30

ANNUAL HOURS OF USE OF TRACTOR AND EQUIPMENT IN SITUATION II

Operation	Equipment Used	Acres covered	Acres per hour	Annual hours
Primary tillage	2-disk mounted plow	80	0.59	136
Secondary tillage	Tandem disk harrow 8-ft.	80	2.36	34
	Spike-tooth harrow 2 section 10-ft.	120	3.36	36
Special tillage and land preparation	Cultipacker, double-gang	50	4.5	11
	2-row rear-mounted bedder	10	0.70	14
Planting	Corn-planter, 2-row	50	1.5	33
Drilling	Grain drill 12x6	20	2.0	10
Cultivating	Corn cultivator 2-row	90	1.26	72
Harvesting*	Bean harvester	10	0.5	20
Processing**	Thresher machine, stationary, 20 bushels per hour	20		38
	Corn sheller	20		80
	Seed cleaners			60
Miscellaneous	Duster and sprayer	50	2.0	25
	Hauling			90
Total tractor hours				659

*Bean harvester ownership warranted by doing custom work.

**Additional crop processing work can be obtained by doing custom work.

TABLE 31

ANNUAL HOURS OF USE OF TRACTORS AND EQUIPMENT

UNDER VARIOUS FARMING SITUATIONS

Operation	Equipment used	Capacity acres per hour	Annual hours use for situation	
			III	IV
Primary tillage	3-disk semi-mounted plow	0.7	185	271
Secondary tillage	Tandem disk harrow 8-ft.	2.8	47	68
	Spike-tooth harrow 4 sections 18 ft.	5.0	39	57
Special tillage and land preparation	Cultipacker, double-gang	5.5	15	20
	2-row rear-mounted bedder	0.7	29	43
Planting	Corn planter 2-row	2.0	40	65
	Grain drill 16 x 7	2.5	12	12
Cultivating	Corn cultivator 2-row	1.75	92	149
Harvesting*	Bean harvester	0.5	40	60
	Corn picker one-row	1.0	30	50
Processing*	Thresher machine, stationary, 25 bushels per hour		57	57
	Corn sheller		120	200
	Seed cleaner		100	140
Miscellaneous	Duster and sprayer		40	55
	Hauling		120	150
Total tractor hours			966	1397

*Bean harvester and corn picker ownership warranted by doing custom work.

**Additional crop processing work can be obtained by doing custom work and increasing the kinds of work done.

TABLE 32

MAN-HOURS REQUIRED EACH MONTH FOR VARIOUS PRODUCTION OPERATIONS IN SITUATION I

Operation	Man-hours required during month											
	Jan	Feb	M	A	May	June	July	A	S	O	N	D
Plowing					68							
Disking					17							
Harrowing					12	6						
Cultipacking					6							
Furrowing					7							
Planting					7	10						
Drilling						5						
Cultivating						5	21	10				
Dusting							13					
Harvesting								10				
Threshing											19	
Shelling												40
Seed cleaning								5			15	10
Hauling	20							10			10	20
Total man-hours	20				117	26	34	35			44	70

Total man-hours for the year: 346

TABLE 33

MAN-HOURS REQUIRED EACH MONTH FOR VARIOUS PRODUCTION OPERATIONS IN SITUATION II

Operation	Man-hours required during month										
	Jan	Feb	M	A	May	June	July	A	S	O	N	D
Plowing				56	80							
Disking				14	20							
Harrowing					24	12						
Cultipacking					11							
Furrowing					14							
Planting					12	21						
Drilling						10						
Cultivating						12	40	20				
Dusting							25					
Harvesting								20				
Threshing											38	
Shelling												80
Seed cleaning	20							10			10	20
Hauling	20							15			15	40
Total man-hours	40			70	161	55	65	65			63	140

Total man-hours for the year: 659

TABLE 34

MAN-HOURS REQUIRED EACH MONTH FOR VARIOUS PRODUCTION OPERATIONS IN SITUATION III

Operation	Man-hours required during month											
	Jan	F	M	A	May	June	July	A	S	O	N	D
Plowing				90	95							
Disking				20	27							
Harrowing					26	13						
Cultipacking					15							
Furrowing					29							
Planting					20	20						
Drilling						12						
Cultivating						20	52	20				
Dusting							40					
Harvesting								40				
Threshing											57	
Picking												30
Shelling												120
Seed cleaning	40							20			20	20
Hauling	30							20			30	40
Total man-hours	70			110	212	65	92	100			107	210

Total man-hours for the year: 966

TABLE 35

MAN-HOURS REQUIRED EACH MONTH FOR VARIOUS PRODUCTION OPERATIONS IN SITUATION IV

Operation	Man-hours required during month											
	Jan	F	M	A	May	June	July	A	S	O	N	D
Plowing				171	100							
Disking				48	20							
Harrowing					38	19						
Cultipacking					20							
Furrowing					43							
Planting					15	50						
Drilling						12						
Cultivating						40	60	49				
Dusting							55					
Harvesting								60				
Threshing											57	
Picking												50
Shelling	100											100
Seed cleaning	40	60						20			20	
Hauling	30							30			30	60
Total man-hours	170	60		219	236	121	115	159			107	210

Total man-hours for the year: 1397

List No. 1

Tractor, Implement and Attachments Required for Crop Production in Situations I and II

Tractor

Tractor with 20-25 rated drawbar horsepower, gasoline burning, adjustable front axle, front and rear weight, drawbar and swinging drawbar, universal mounting frame, spark arrester and muffler, belt pulley, power take-off, power shift wheels, choice of manual or hydraulic power control.

Basic Implements

2-disk mounted plow, 26-inch disk blades, with adjustable scrapers.

Disk harrow, 8 ft., tandem, 16-inch disk with scrapers, choice of smooth or cutaway disk blades depending on soil condition.

Spike-tooth harrow, closed end, 2-section with drawbar.

Special Tillage and Land Preparation Equipment

2-row rear mounted bedder, with rolling coulters.

Soil pulverizer, double-gang with tractor hitch.

Spring-tooth harrow, one section with drawbar.

Row Crop Equipment

Corn-planter, 2-row, choice for front or rear-mounted, with fertilizer attachment, runner opener; disk-type markers, bean attachment, and hill drop attachment.

Cultivator, 2-row, for corn and beans, choice of round-shank spring trips or spring teeth, and bean harvester attachment.

Grain drill, 12 by 6, single disk, double-run type of feed, marker, tractor hitch, power lift, covering chains, fertilizer attachment.

Processing and Miscellaneous Machines

Threshing machine, 20-in. cylinder, equipped for rice, beans and sorghum.

Row crop duster, tractor mounted, operated by power take-off.

Seed cleaner with assorted screens, elevator, pulley.

Corn sheller.

All-purpose farm truck, tractor hitch, wood or steel box, with auto type wheel and tires.

List No. 2

Tractor, Implement and Attachments Required for Crop Production in Situations III and IV

Tractor

Tractor with 30-35 rated drawbar horsepower, gasoline burning, standard four wheel type or tricycle type with adjustable front axle, front and rear weights, spark arrester and muffler, drawbar and swinging drawbar, belt pulley, power take-off, and hydraulic power control.

Basic Implements

3-disk semi-mounted plow, 26-inch disk blades, with adjustable scrapers.

Disk harrow, tandem 18-inch disk with scrapers, choice of smooth or cutaway disk blades depending on soil condition.

Spike-tooth harrow, close end, 4-sections with drawbar.

Special Tillage and Land Preparation Equipment

2-row rear mounted bedder, with rolling coulters.

Soil pulverizer, double gang with tractor hitch.

Spring-tooth harrow, 2 sections with drawbar.

Row Crop Equipment

Corn-planter (same as in List No. 1).

Cultivator (same as in List No. 1).

Grain drill, same as in List No. 1, except 16 x 7 size.

Corn picker, one-row wagon hitch, power take-off.

Processing and Miscellaneous Machines

See List No. 1 for equipment descriptions.

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