THE TRADITIONAL AGRICULTURAL SYSTEM OF HACIENDA VICOS

- An Analysis of Agricultural Production in the Andes Mountains of Peru

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I INTRODUCTION

Those concerned with the rapid transformation of traditional agriculture in developing nations need to know intimately the nature of traditional agricultural systems. For these tenacious operating systems are the base from which changes in agriculture must begin. In particular, knowledge of the resources used, the institutions which facilitate production, and the economic results are required in order to effectively design and carry out rapid agricultural development.

This study outlines a traditional hacienda system prevalent in the Andes mountains of South America. It provides data on the resource base, the crop production practices, the yields, and an analysis of how the Indian and Patronal economies are integrated in this essentially manoral agricultural system.

The history of Hacienda Vicos is similar to many. At an earlier time ownership of the hacienda was deeded to the Public Benefit Society of the nearby City of Huaraz. This society is a quasi public organization which owns many haciendas. Society's role is to rent out the land it owns to the highest bidder in order to obtain money for worthy public projects, such as hospitals.

Cornell University became involved with Vicos for research purposes. With financial support from the Wenner-Gren Foundation of Anthropological Research and the Social Science Research Council, Professor Holmberg sought a location in Peru where studies of culture and Applied Science could be undertaken. In January, 1952, the Cornell-Peru Project took control of the hacienda from the previous renter under a five-year contract. By the summer of 1954, a number of anthropological base-line studies had been conducted including a census. The only real agricultural change introduced by the project up to this time was the improved potato production system described later. Thus the agriculture of the Indian community and the manoral organization of the hacienda were, in 1954, representative of the traditional condition of agriculture at Vicos.

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*A revision of a paper written in 1954 entitled "Agricultural Production on Hacienda Vicos--Description and Analysis of a Hacienda Agricultural Society in the Andes of Peru". The report is based on a study conducted at Vicos during July and August, 1954. It was made possible by a grant from the Cornell-Peru Project of the Department of Sociology and Anthropology, Cornell University under the direction of the late Professor Allan R. Holmberg.

II BACKGROUND

Hacienda Vicos, a 35,000 acre community, is situated in an Inter-Andean valley of north-central Peru. (Fig. 1)

Its social organization in 1954 was, with good reason, likened to that of a medieval European manor. Approximately 1,900 Indian tenants (over 350 families) lived on subsistence plots scattered over the large area. The patron, or landlord, of the hacienda, has a written contract with the Indians. This contract obligates each peasant family to provide three days of labor a week to the patron, in exchange for the right to occupy small tracts of land, on which the family may grow food crops and raise animals. All the land of the hacienda is owned or rented from another owner by the patron. No land is owned by the Indian farmers. Traditionally, any Indian who wants land, and agrees to work his labor tax of three days per week, will receive a minimum of three fields, one for each of the major crops: corn, wheat, and potatoes. An Indian who enters into this relationship with the patron is called a peon. The heads of all families which have the use of lands by virtue of such agreement are, accordingly, peones. There were about 250 of such individuals on the Hacienda Vicos in 1954. If a peon does not provide the required labor, the patron has the right dispossess him. If he wishes, he may give a favorite Indian additional land. Thus the patron is able to keep an extremely powerful grip on his Indian tenants.

The patron's role has historically been conceived of as paternalistic; in many ways, the peones regard him as their master. In their petty disputes and disagreements he is invariably called upon to act as judge. While the power of the patron over the lives of his peones is nominally limited by the Peruvian Government, the only national laws extending to the hacienda in 1954 were those dealing with criminal behavior. To some extent, the traditions of the hacienda limit the patron's power to organize and operate it as he wishes, but his control is, nevertheless, like that of a feudal lord, nearly absolute.

The hacienda organization has been in existence for so long that it is taken quite for granted by the Indians. It has its origins in the earliest history of settlement in Peru. Immediately following conquest, the Spanish set into operation a system to exact tribute from the Indians. This system, known as the encomienda, involved "a fiduciary commission of labor of the Indians to a white colonist who is their trustee."[1/] During the sixteenth century most of the rich areas in Peru became included in the network of the encomiendas. This system did not give the colonists the right to take any lands operated by the Indians, but in the years that followed, particularly during the revolutionary period, title to much of the land in Peru was acquired by Spaniards who felt that at a distance of thousands of miles, they could safely defy the Crown, without fear of punishment. In this way the hacienda system developed, with the Indians continuing to give a labor tax, no longer as tribute, but as rent for the land that they are using. This labor tax is the basis of agricultural operations.

[1/] Kubler, George. The Quechua in the Colonial World. Handbook of South American Indians, Vol. 2. Smithsonian Institute, U.S. Government Printing Office, 1946, pp. 331-410.

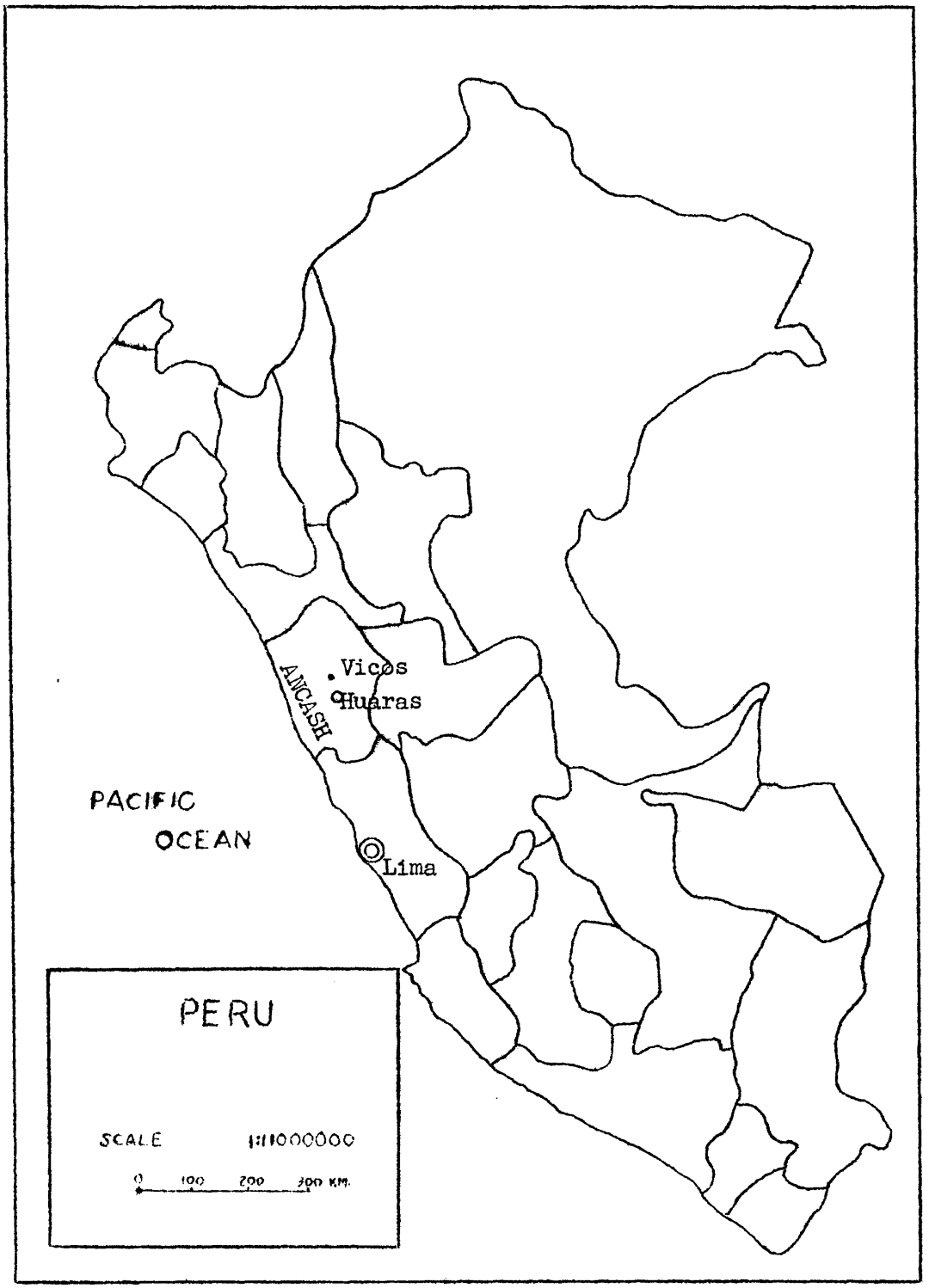


Figure 1. MAP OF PERU SHOWING LOCATION OF VICOS IN ANCASH PROVINCE

III THE RESOURCE BASE

A. Location and Topography

Peru is characterized by three major physiographic and corresponding climatic regions. A flat desert zone runs along the Pacific coast for most of the length of the country. It varies in width from a few hundred feet, where the mountains rise almost out of the sea, to about fifty miles in some areas where it extends up the river valleys. The coastal strip is, on the average, ten to fifteen miles in width. To the east of the desert lowlands, and parallel to the coast line, lie the Andes. The broken mountain chain rises abruptly from the desert. The peruvian Andes average about 14,000 feet in altitude although their width seldom exceeds 200 miles. The eastern slopes of the mountains descent gradually to elevations of about 500 feet. This lower area, the montana, adjacent to the upper Amazon Valley, is the third major geographic region of Peru. It is almost entirely jungle.

Vicos lies in the inter-montane valley of the Santa River in the Andean region in north-central Peru. The slopes on either side of this valley are steep and rugged. In the area of Vicos, to the west the Cordillera Negra mountain range rises to about 14,000 feet. To the east of the Hacienda the Cordillera Blanca rises to an elevation of more than 18,000 feet. Vicos is in a tight side valley between these two ranges at an elevation of approximately 9,000 feet.

The Santa River is one of the more important rivers in Peru. It rises at Lake Conococha, 14,000 feet above sea level, and flows northward for about one hundred miles down the narrow valley, droppint finally to an altitude of 4,000 feet before it turns west to pass through a narrow canyon in the Condillera Negra. From here it flows to the sea, a distance of fifty miles.

Vicos is situated in one of the many side valleys, to the east of the main Santa River Valley. The headquarters of the hacienda is 6.6 kilometers from the town of Marcara, which is in the center of the Santa River Valley. It is twenty-six kilometers north of Huaras, capital of the Department of Ancash. The valley in which Vicos is located is formed by the Marcara River, which rises to the east in the Cordillera Blanca and empties into the Santa at Marcara.

A rough dirt road follows the Marcara River and, about half-way to the hacienda, passes the Banos de Chancos, where there are hot springs and a resort hotel. The casa hacienda, or main headquarters building is at the head of a relatively flat alluvial terrace flanked by steep hills. The casa is located on one side of a plaza ("small square"), which is the center of Indian social life. A chapel and school, as well as other community buildings surround the plaza. The casa hacienda is situated in the eastern side of the land area which comprises the hacienda. This location is the center of the lowest, warmest, and most productive land. (See Map in Appendix).

The topography of the estimated total of 35,000 acres of hacienda lands is of two types, a mountainous region containing about four-fifths of the land, and lower "foothill region." In the foothills area there can be distinguished three sectors. Along the river, and near the casa hacienda (elevation: approx. 9,000 feet), are areas of relatively flat (less than 7 percent slope) alluvial land, which total about 45 acres. A second sector, containing more than half of the foothills area (about 4,000 acres), consists of steep, greatly dissected and eroded hills called cabeceras. This is the area which is most intensively cultivated. The hills rise abruptly in this sector from the narrow alluvial plain along the river. In this area 10 to 20 percent slopes are common, and there is much land with slopes greater than 20 percent. Directly east of the casa one may climb nearly 1,000 feet in less than a mile. Generally, this broken, eroded hill area rises about 1,000 feet from the Marcara River toward the mountains, the land then levels off to what constitutes the third topographic sector, a relatively flat plateau called the puna. The puna is composed of smooth, gently rounded hills, at an altitude of about 10,000 feet. It occupies somewhat less than half of the foothill region, or about 2,600 acres.

A mountainous area, with deep narrow valleys rises sharply from the puna. The mountains rise three or four thousand feet in a few miles. A few of the peaks are as high as 18,000 feet. A deep valley, or canyon, which cuts through this region, is known as the Quebrada Honda. From its source in the high mountains, the Marcara River flows through this canyon to the lower foothill region. There are a number of smaller side canyons, waterfalls, and other features of rugged terrain in this area.

B. Climate

The climate is temperate at Vicos the year round. Cool nights and warm days are the rule. At the casa hacienda there are only a few severe night frosts during the year. The midday temperature is normally above 70 degrees Fahrenheit. The great altitude of the hacienda (9,000 feet) is responsible for a rapid drop in temperature every night, the result being a usual diurnal fluctuation of about thirty degrees. Mean annual temperature is about 55°F. As for precipitation, June, July and August are almost completely dry while the remaining nine months provide about thirty inches of rain. During the wet months at Vicos the rains are quite irregular, often with unfortunate results for the hacienda production. For example, in 1953 the corn crop nearly failed because the rains were very late in coming. Appendixes I and II present recent weather data for Vicos and for the town of Huaras, fourteen miles away.

Regular readings of soil temperature at Huaras during April, May, June and July of 1954, at a depth of 40 inches, gave an average figure of 60°F. As mean daily air temperature does not vary more than ten degrees from 60°F. during the entire year, it is reasonable to assume that soil temperature, likewise, remains at about sixty degrees all year long.

Frost is a serious problem in certain areas. According to popular opinion, the greater the altitude on the hacienda, the greater the danger of frost. However, certain low areas are also known for high frost susceptibility, perhaps due to their limited air drainage. The extent of frost damage to the potato and corn crops is difficult to estimate. Also the months of greatest danger are not always certain. It appears from available data that June, July, August and December are the most probable months for frost. There was talk of damage to potatoes during the time that I was at Vicos, July and August of 1954, but I saw none. It is possible that disease is mistaken for frost damage. Also of possible relevance to the frost problem is a large temperature gradient, apparent between ground level and six feet above ground level. On many mornings during my stay the grass on the plaza was covered with small but definite ice crystals. However, the reading on a Taylor maximum-minimum thermometer suspended six feet above the surface never dropped below 37°F. These conditions may of course be peculiar to the relatively enclosed plaza.

In some years, the wind causes serious damage to the corn, wheat and quinoa crops.

C. Geology

Two major geological types characterize the hacienda, a mountainous area, consisting largely of acid igneous rock (including granite), and a lower foothill region, which appears to overlie sedimentary rock. Evidence for the geological character of the latter area includes a small coal seam just below the puna level, and the appearance, in several places, of limestone outcroppings; there are also protrusions of other bedded rocks in this region.

Glaciation has occurred within recent geological history. At the present time glaciers may be found at high elevations in the mountain valleys, extending as far down as 13,000 feet in a few places. This is not the greatest glacial advance, however, as proven by numerous terminal and lateral moraines found at lower levels. (see Map) Further indications of glacial action may be noted in the geological structure of the U-shaped Quebrada Honda in the upper part of the hacienda.

D. Soil

As might be expected in a locale of such rough and broken terrain, the soil pattern is very complex. This is particularly so in the eroded hill or cabeceras sector. Generally, in the foothill region, the soils are developed from residual materials, except for two areas where there are glacial deposits. There are, in addition, small strips of alluvial soil along the rivers and streams. In the mountainous region most of the soils are developed from glacial materials, as glaciers once covered most of this area. The Quebrada Honda contains a number of very flat canyon valleys, suggesting the existence of old lake basins.

In discussing the soils of the hacienda the following factors relevant to crop growth are considered: acidity, slope, erosion, stoniness, texture, level of organic matter, and nutrient content.

Surface soils in the foothill region are, for the most part, acid, about pH 5.3. In contrast, some of the soils of the lacustrine area in the Quebrada are nearly neutral (pH 6.7).

The steep quality of the terrain has already been mentioned. In one fairly typical area of about 200 acres, three-fifths of the land has slopes of over 20 percent; one-fifth has a slope of 10 to 20 percent, and the remaining fifth has a slope of less than 10 percent. Tractors would be of little use on such land. Some of the cultivated hills are so steep that even the use of oxen and plow is not attempted. I observed a man plowing with oxen on a slope as steep as 20 percent. The most acutely graded fields are worked by hand, with a short-handled hoe as tillage implement.

These steep slopes are the major cause of erosion damage, the most serious soil problem on the hacienda. The Indians on the hacienda have made only a few attempts to control erosion. Some terracing has been done by the Cornell-Peru Project, and it has succeeded in reducing erosion in a number of fields. The majority of fields, however, are marked by severe gullies. In some areas the "A" horizon has been completely washed away leaving a hard clay "B" horizon, which cannot be cultivated. The common Indian practice of rapid irrigation on steep slopes contributes greatly to the washing away of the organic matter in the surface soil.

Stoniness is a severe limiting factor in the use of some areas. For this reason, the moraine and outwash areas are practically useless for crop cultivation. However in one of these areas the soil has apparently proven, productive enough so that the ground has been cleared of stones as much as possible. Crops are planted between the numerous boulders which remain.

The dominant texture of the surface soils is silty and silty clay, often underlain at one or two feet by a heavy clay layer.

Turning to the level of organic matter in the soil, the normal rotation does not include a sod crop. After a few years of cropping, the fields of the patron are left fallow for one of more years. A few sparse weeds are the only cover that appear to come in naturally. The only additions ever made to the soil are manure, and occasionally guano fertilizer. Under these conditions, the amount of organic matter in the soil is low. Thus, the soil structure is poorer than it might be, and the release of plant nutrients is reduced.

In 1954 there was not a great deal of evidence about the extent to which plant nutrient deficiencies limited crop yields at Vicos. To consider this question, the soils of the hacienda are separated into four classes based on soil parent material. The largest soil class is derived from residual materials which cover most of the foothill area. In certain other areas organic soils predominate. The remaining two varieties are alluvial soils and highlime soils developed from lacustrine materials on the floor of the Quebrada Honda. Because of their great distance from the casa hacienda the Quebrada Honda soils have seldom been cultivated. It appears, however, that they may be very productive by hacienda standards.

The organic soils are thought to be productive, but the summer of 1954 produced only a fair crop of barley on the organic soil of Ismus field. The low yields might have been due to the low levels of phosphorous and potassium which are generally expected in such organic soils.

Of the remaining two, most important, classes of soils on the hacienda, the alluvial soils are thought to be more productive than the residual. Crops on both of these soils give a good response to guano fertilizer. (Total Nitrogen, 0.5 to 15 percent; P_2O_5; 10 to 25 percent) The guano delivered to Hacienda Vicos was declared to be 14 percent nitrogen. This was the only commerical fertilizer used on the hacienda in 1954. Manure is the only other fertilizer in widespread use. It is usually applied to the land by staking or herding animals on the field which is to be fertilized. One plot of ripe wheat most clearly illustrated the results of such a haphazard method of application. The wheat was, in most places, very short and thin; where the manure had been dropped, however, it was much denser and considerable taller. The crop thus appeared to be growing in clumps. This response to manure suggests a severe deficiency of fertilizer elements.

A soil sample taken from Atas Pampa, one of the better fields in the alluvial area, was tested at the Cornell University Soil Testing Laboratory. It showed organic matter at a level of 2.4 percent and a pH value of 5.35. Nutritiens were present in the following amounts on an acre basis assuming 2,000,000 pounds of soil: 1,050 pounds, calcium, 9 pounds of phosphorous, 190 pounds of potassium, 110 pounds of magnesium, and 115 pounds of manganese. A similar soil analysis of Caldwell Field at Cornell University, revealed the following values: 7,400 pounds of calcium, 1,160 pounds of phosphorous, 39,000 pounds of potassium, 14,200 pounds of magnesium, 3,560 pounds of nitrogen. Too much stake should not be put in these figures as the environmental factors surrounding the two soils are very different. Cornell soil, for example, is of glacial origin, while that of Vicos it is largely residual. Nevertheless, the low organic matter level of 2.4 percent in Vicos soil (as compared with about3.5 percent for Cornell) does support the thesis that this may be an important limiting factor, both in soil structure and in nitrogen supply. The low phosphorous level in Vicos is quite significant, particularly when it is remembered that generally only half of the phosphorous in soil is available for plant growth. A forty bushel corn crop or a twenty bushel wheat crop uses approximately 4 pounds of phosphorous. Similarly, only a samll proportion of the total potassium is available for plant growth. As a corn crop may require from 20 to 40 pounds of potassium, the Vicos soil would appear to be quite deficient.

E. Ecology and Natural Vegetation

According to the ecological classification made by Holdridge, Vicos may be identified with the Montane Moist Forest region. This region is defined by a mean annual temperature of 6 to 12 degrees Centigrade (42.8° to 53.6° Fahrenheit) and a mean annual precipitation of 500 to 1000 millimeters (20 to 39 inches), with an altitude range of 3,100 to 3,900 meters (10,300 to 12,800 feet) The Huaras long term data are: mean annual temperature, 11°C.; rainfall, 792 millimeters; altitude, 3050 meters. As the name of the region would suggest, ecologists believe that the area was once forested. However, with the present population pressure on both agirculture and wood for heating and cooking, little remains of any historic forest. High in the mountains, in largely inaccessible places there are a few patches of trees that have attained some size. The most successful tree in the valley recently is a species of Eucalyptus. It was introduced some decades ago, and now grows practically wild along the irrigation ditches. These trees grow rapidly, but their wood is heavy and hard and not very desirable.

On the uncultivated puna and several mountain pasture areas where there is abundant moisture wild grasses grow luxuriantly. On the steeper mountain sides, in the hedgerows, and in other undisturbed places, various types of woody brush have sprung up, usually bearing thorns.

F. Water Sources

Vicos is fortunately endowed with a continuous water supply, coming from glaciers which cover the upper mountain slopes to the east. An extensive system of open irrigation ditches and streams provides most of the inhabited area of the hacienda with water for household use and for some crop irrigation. Most of the area below the puna (including a large proportion of the cabaceras and alluvial areas) can be handled with the existing irrigation system. The major canal, on which possibly one-half of the hacienda depends, was delivering approximately 600 cubic feet of water per minute during July, 1954. Many of the irrigation canals on Hacienda Vicos were probably build before Spanish times; many, however, have been added since. The main canals are cleaned every year in May, under the direction of the patron.

At present, during the dry season, most of the water in the smaller streams and irrigation ditches is utilized. However, only a small proportion of the water in the Chancos and Marcara Rivers is used. The fast-flowing Marcara, alone, is capable of supplying water in a volume several times greater than that used by the entire hacienda at the present time for all purposes.

IV CROP PRODUCTION PRACTICES AND YIELDS

Crop production is the basis of the economy of Hacienda Vicos. The patron sells his crops for cash, and the peones live on what their fields will produce, with some supplemented income from the sale of animals. The three major crops at Vicos are corn, potatoes, and wheat. Also important are barley, habas (a broad bean), ocas (a tuber) and quinoa (millet).

Almost all families grow corn, potatoes, wheat, barley and broad beans. (Table 1) The cultivation practices for these crops will now be considered.

TABLE I. Number of Families Growing Each Crop (Census, January 1952, 365 families interviewed)

		Number of families growing
A.	Field Crops	
	Corn	358
	Potatoes	321
	Wheat (and rye)	356
	Barley	353
	Habas	338*
	Ocas	281
	Calabashes	209
	Quinoa (millet)	271**
	Ollucas	124
	Mashua	70
	Beans, Kidney	93
	Beans, Vari-colored	82
	Peas	84
B.	Grown in Family Gardens	
	Falcon	44
	Zapollo (squash)	15
	Onions	101
	Cabbage	130
	Lettuce	7
	Oregano	39
	Hot peppers (roccoto)	103
	Coriander	16
	Eucalyptus	169
	Capuli (choke cherry)	213
	Royan (Aliso; alder)	231

* often sown along with corn in the same field.
** quinoa is generally sown with other crops, rarely alone.

Preparation of the soil for planting is much the same for all crops. The land has usually lain fallow for several months, and, during that time, animals have benn allowed to graze freely on the stubble, in this way manure is also spread. Another common practice is to stake animals, on successive nights, at regular intervals over a field in order to spread manure. Sheep are kept for the same reason in portable corrals and are moved each day from section to section of the field. What remains of the previous crop stubble are sometimes burned off to make the ground easier to prepare.

If the ground is dry it may be irrigated two or three days before being worked. Oxen with wodden stick plows cross back and forth over the field, ususally plowing three different directions. The plows are of old European design, consisting, essentially, of a stick set at an angle and pulled through the ground. If there are many stones, or if the soil is heavy, the wooden plow will penetrate only about two inches into the soil; otherwise it may penetrate as much as three or four inches.

A field which is in sod must first be broken up by hand, as these wooden plows cannot cut through turf. A short-handled hoe, similar to a mattock, is used by the Indians for this purpose. After the initial hoeing the field is worked over a few more times by hand to break up the large clods before animal plowing is possible. If the turf is heavy, an attempt may be made to burn it. After this lengthy preparation the field is plowed for seeding.

As planting and cultivation practices differ somewhat from crop to crop, the following discussion will deal with each major crop separately.

CORN. A local "flour" corn variety is grown at Vicos almost entirely for human consumption. The ears are small, generally less than four inches in length. There has apparently been no selection for color, and a field may contain ears ranging from light yellow to brown and deep red. Some ears have a uniform kernel color pattern; others are mixed.

Corn is limited to the lower part of the cabeceras and lower alluvial areas. It is generally sown during the last four months of the year and is harvested in May or June. This growing season is dictated by necessity, because only during this period can the corn grow and mature with a minimum of danger from killing frost. The crop is not always dependable, and, in recent years, there have been a number of bad harvests; the last was in May 1954. At such times the stalks may not grow to a height of more than two or three feet. The factors which may be involved in these poor results are: a) late planting due to lack of rain, b) excessive rain, c) dry spring, d) cold spring.

Average corn crop yields reported by the administrator of the Cornell-Peru Project were 20 to 38 bushels per acre. (Table 2)

Recently, a variety of white flour corn, called "Cuzcanea," was introduced from Cuzco. It did very well the first year -- about double the local corn yield. The second year it did not do nearly as well, and the third year (1954) the yield was still poorer, not much better than the local corn. Other areas have had almost the same experience with the Cuzco corn.

TABLE 2: Average Corn Yields

	Increase (planting rate: 1.6 Bu/Acre)	Yield (in Bu/Acre)
Bad harvest	1-17	1-19
Average harvest	18-30	20-38
Good harvest	31-50	39-60

In planting, rows are made about 65 centimeters (26 inches) apart with a wooden plow. Kernels are then sown every 35 centimeters (14 inches) along these rows. If all plants grew, the stand density would be about 17,000 plants per acre. Very little guano is applied to corn. In one case in which I saw it being used the application was 100 pounds per acre. Brood beans are often mixed in with the corn, Squash, peas and beans may also be planted in the corn fields. Because the autumn rains may be irregular or not on time the corn fields must often be irrigated.

The plants are weeded once or twice in the first two or three months after they have come up. Later they are hilled, to help support the young stalks against the wind. At harvest the ears are gathered, and the animals are allowed to graze on the stalks. Occasionally, a portion of the stalks may be stored in trees for fodder later in the year.

POTATOES. Before the Cornell-Peru Project began in 1952, the Vicosinos were growing two kinds of potatoes, the common or "Warko" potato, and a fast-growing variety called "Choucha." The Project introduced three new improved varieties going under the names "Paltack," "Tarma," and "Casablanca." At the same time, the use of spray, much more guano fertilizer and new methods of cultivation was begun on a relatively wide-spread basis. With superior potato varieties and enormously changed agricultural practices the crop yield was about twice as large as that of the "common" potato with traditional methods of cultivation. DDT and copper-compound insecticides, as introduced by the Cornell-Peru Project, were used as soon as insects appeared on the plants.

The fast-growing Choucha potatoes are harvested after about four months. As the yeild is always low, they are used mainly as an emergency crop when other food is short. The major potato planting season is from April to August, although some seeding is occasionally as late as November. These planting dates may be due to the need to fitting potatoes in with the corn season and the times of greatest food need rather than based on the conditions which would give the best potato crop. Average potato yields reported by the Project administrator were 60 to 120 bushels per acre. (Table 3)

TABLE 3: Average Potato Yields

	Increase (planting rate: 10 Bu/Acre)	Yield (in Bu/Acre)
Bad harvest	1-5	10-50
Average harvest	6-12	60-120
Good harvest	13-18	130-180

For planting, rows are made 70-90 centimeters (29-37 inches) apart. Seed is placed every 45 centimeters (18 inches) in the rows. This provides a maximum stand of about 12,000 plants per acre. The preferred seed is a whole potato weighing 50 grams (1.8 ounces).

The Project has introduced the use of guano for potatoes. The fertilizer is placed in the bottom of the furrow, between the seed potatoes. The amount generally used is half the weight of the seeding. Thus, if 12,000-50 gram potatoes are planted per acre, 600 kilograms (1,320 pounds) of guano is spread in the furrows.

By careful plowing along side of the open furrows the seed potatoes are buried under two to four inches of loose soil. After four to six weeks the potatoes show above ground, and if the season is dry this will be the time of first irrigation. From then on, the field is irrigated once a week unless there is rainfall. When the plants are about one foot high, the first weeding and hilling are done. At this time, guano is again spread in the rows (in the same amount as the first application) and is mixed with the soil in the hilling. After about two months, the potatoes are again hilled.

Harvesting takes place seven months after planting. The potatoes are dug by hand. As the Indians traditionally have had rights of gleaning after the harvest, there is a tendency for potatoes to be purposely left or buried in the field. This makes an accurate determination of the yeild difficult.

WHEAT. A variety of wheat known as "Florencia aurora" is commonly grown in Vicos and in most of the Santa Valley. It is a non-bearded wheat, with some susceptibility to orange kernel rust. A common bearded wheat is often sown with it. This local variety seems to have a much greater resistance to orange rust. Another bearded variety, with a bluish head is sometimes grown.

As Wheat requires dry weather for harvesting, planting is arranged, so that the six-month growing period will end during the summer season. Planting thus occurs from December through April. Wheat is occasionally sown at other times as an emergency crop.

Average yields, according to the administrator, are 8 to 15 bushels per acre. (Table 4)

Rough calculations for the Patron's 1954 crop on three fields give the following figures: 1) Lichapampa, 7 bu/acre; 2) Punco Corral, 12 bu/acre; 3) Rodinurana (a steep and eroded field), 2 bu/acre.

TABLE 4: Average Wheat Yields

	Increase (planting rate: 1 Bu/Acre)	Yield (in Bu/Acre)
Bad harvest	1-7	1-7
Average harvest	8-15	8-15
Good harvest	16-22	16-22

Seed is broadcast in planting, sometimes with guano, which is also broadcast. The field is plowed lightly to cover the seed. If plows are not available the ground may be covered using hand tools. Irrigation is used only when necessary. Hand weeding is begun, as a rule, one month after planting. At harvest time the wheat is cut with a sickle and is carried in bundles to a smoothed bare space of hard ground for thressing. This process is accomplished by beating with sticks or be hearding horses on top of the piled bundles of wheat. Winnowing is done by throwing the straw, chaff and grain into the air, letting them be separated by the breezes.

BARLEY. Barley is grown for both human and animal consumption. Often it is used to fatten pigs. There appears to be only one major type of barley cultivated, a six-row variety. I did see, however, a few patches of hooded barley. The crop is planted from December through March in order that maturation will be reached during the dry season after a growing period of six months. Guano is sometimes used as fertilizer during planting. Crop yeilds, according to the administrator, are about the same as for wheat. Cultivation practices for barley are about the same as for wheat. It is also threshed and separated in approximately the same manner.

RYE. Rye is grown both on hacienda fields and on individual family plots. There is only one variety, which is planted October through January. It is harvested some eight or nine months later during the dry season. Under good conditions this crop grows very tall; I saw a small patch with heads six feet above the ground. According to the administrator, the yeilds are about the same as those indicated for wheat, and it is generally cultivated in the same manner.

BROAD BEANS (Habas). The broad bean looks like a lima bean. It is recently introduced legume crop. Because of its high protein content it is potentially an important item in the diet. Severe damage by disease however has resulted in a nearly complete crop failure at Vicos in 1954.

Broad Beans are planted in the Fall (September to November) and harvested about eight months later.

According to the Project administrator average yeild was 7 to 15 bushels per acre (Table 5).

TABLE 5: Average Habas (broad bean) Yields

	Increase (planting rate: 1 Bu/Acre)	Yield (in Bu/Acre
Bad harvest	1-6	1-6
Average harvest	7-15	7-15
Good harvest	16-27	16-27

Broad beans are generally sown mixed with corn in the corn fields; occasionally they are grown in pure stands. Cultivation practices are similar to those followed for corn. There is only one weeding, however. At harvest time the whole plant is cut and then threshed in a fashion similar to wheat.

TAURI. This native legume is a variety of lupine. The peas are white and poisonous (unless soaked in water). Tauri is sometimes planted by the patron and grows for ten or twelve months before it is ripe. According to the administrator, an average crop should increase yield over seed by a factor of 15-20.

Tauri is often planted on poor fields. It is sown in furrows which are then covered by plowing. The crop is irrigated only if it needs water badly. Little care is required by tauri; it is neither weeded nor fertilized. After harvesting with a sickle, the peas must be threshed out.

OCA, ULLUCO AND MASHUA. The oca is an elongate yellow-orange carrot-shaped tuber, stubby, and irregular. The ulluco has small, perfectly spherical tubers, with a maximum diameter of about two inches of many different colors, including red, purple and green. Mashua, another tuber, looks much like the oca but it is naturally bitter and must be exposed to the sun before it can be eaten. These three tubers are generally planted on the more distant and unirrigable fields such as, in special areas of the puna. The seed is planted in July and August at a depth of about two inches and remains in the dry ground, sometimes for months, until rain comes. Harvest takes place, as a rule, nine or ten months after the first rain. Apparently,the main reason for growing these crops is their certainly of some yield as they are quite disease and drought resistant.

OTHER CROPS.

Quinoa. (Chinopodium quinoa) This is a millet. Many of the families grow a little of it for their own needs.

Alfalfa. It is grown in small patches to feed guinea pigs.

Peas. A number of families grow this crop. One successful field was fairly acid (pH 5.4).

Beans. Often cultivated with corn.

Squash. This crop is grown in the corn fields or in family garden patches.

The following crops are also frequently cultivated in Indian garden patches: Alfalfa, Arracacha, Cabbage (a leafy tree type which does not form a head), Capuli (choke cherry), Coriander, Culantro, Gewa, Kishpiya, Lettuce, Onion, Rakon (or Uacon), Rokoto (a red hot petter), Perejil, and Zapallo (squash). The following crops were growing in the Patron's Garden: Artichoke (two varieties), Beets, Broccoli, Carrots, Celery, Head Cabbage (two varieties, one smooth and one rought leaved), Leeks, Spinach, Strawberries (do not produce much fruit), and Tomato (not very successful; easily killed by the frost). The Herbs grown in the garden patches were as follows: Achira, Borraja, Chincha, Laurel, Manzanilla, Mint, and Oregano. Flowers growing partly wild in the Hacienda garden included: Cala lily, Geranium, Galdiola and Roses.

In addition the following fruit trees were growing in the Patron's garden:

Alligator pear,
Apple,
Bitter orange,
Capuli (choke Cherry),
Granadilla,
Lemon,
Lima,
Limon "agria",
Limon "dulce",
Lucumas,
Manzana,
Mora,
Peach (diseased),
Pear,
Quince and
Tuna (opuntia).

V. LIVESTOCK AND ANIMAL HUSBANDRY

Livestock are also of major importance on Hacienda Vicos. In pre-Columbian times the llama was the major domesticated animal in the Andes. Now, sheep have replaced the llama for wool production and mules, donkeys and horses have replaced it as beasts of burden.

The distribution of domesticated animals among 365 Vicos families in January 1952 was as follows.

TABLE 6 : Number of Families with Each Type of Animal.

Type of animal	Number of families having
Chickens	351
Dogs	332
Cows	324
Sheep	320
Guinea pigs	306
Pigs	292
Goats	122
Oxen	95
Cats	69
Bulls	64
Horses	40
Burros	38

Care of the larger animals consists primarily in seeing that they are staked or fenced in at night and that they have some kind of feed or grazing during the day. Customarily, a woman or child drives the family livestock to a fallow field or grassy area, remains with the animals for the day, and returns with them in the late afternoon. At night, cattle and donkeys are staked, sheep and goats are herded into movable thornbush corrals, and pigs are kept in a stone sty.

1. HORSES. Horses are used primarily for riding by mestizos and, to some extent, as pack animals, but are never used in agricultural work. As pack animals they carry 175 to 200 pounds. There are more than two hundred horses on the hacienda, most of them wild in mountain grazing areas. These animals are the descendants of pack and riding horses brought into the area at various times since the Spanish conquest. They are quite variable in conformation, some being leggy, high and then, while others are extremely low and stocky. Even the heaviest of these Andean breeds, however, are considerably lighter than the European work horse.

A few horses are tamed and broken each year. As they have been raised on very rugged terrain they are quite surefooted and make excellent mounts. Twenty-six Indians owned horses in 1951.1/

1/ Vasquez, Mario C., La Antropologia Cultural y Nuestro problema del Indio, Peru Indiguia Vol. II, Nos. 5 and 6, June 1952.

2. MULES. Many of the pack trains that pass through the hacienda use mules. None of the Indians, raise or keep any of these animals.

3. BURROS. In 1951, 38 Indians owned donkeys. According to Vasquez, they are used as pack animals and carry 150-175 pounds.2/ When they are not being used they are kept in the mountain grazing areas.

4. CATTLE. The cattle now on Hacienda Vicos were introduced about seventy years ago. In 1950, 80 per-cent of the families owned at least one head, and one family had approximately 100 cattle; 63 persons had oxen, one individual owned seven pairs.3/ During 1950, 100 cattle owned by an outside company were pastured in the grazing areas. In 1954 it was estimated that there were approximately 4,000 cattle on the entire hacienda. All of these were owned by Indians.

The cows are fairly small and light and produce little milk. Few cows give more than two quarts at the morning milking. The bulls and oxen are also rather slight. Castration is practiced only if the animal becomes ill-tempered. Cattle are kept in the lower, inhabited area of the hacienda as long as there is forage available. When this food source gives out in the dry season, all animals that are not being milked and are not needed for plowing are grazed in the uplands or in the Quebrada Honda.

5. SHEEP. About 90 per-cent of the Vicosino families own sheep, keeping, on the average, 10 to 12 head. Thus there are probably more than 3,000 sheep on the hacienda. The animals are generally small and emaciated. The mixed flocks of black and white sheep are said to produce little wool of poor quality. Most lambs are born in March, during the rainy season.

6. GOATS. These animals are kept by a few families, primarily for meat. They become a great nuisance at times by eating growing crops.

7. PIGS. Most families keep pigs. They are fattened to be eaten at a fiesta or to be sold for cash. The pigs on the hacienda are mostly of one variety, which is black, thin and lanky with a razor back. This breed is slow growing. A Danish farmer in the valley said that it took four times as long to grow the local black pigs to market weight as it did to his own English breeds.

8. CHICKENS. A few chickens are found in the dooryeard of most Indian houses. Eggs and meat are sold for cash. The hens must scavenge for their food, and egg production is low. The birds are of many different strains and vary greatly in conformation. The hens generally incubate during May and June. Periodically, the chicken population of the hacienda is wiped out by disease.

9. GUINEA PIGS. This animal is the main source of meat for the Indians of Vicos. Each family keeps a dozen or more guinea pigs inside their houses. They are fed greens and fresh alfalfa.

2/ Ibid.

3/ Ibid.

V. THE ECONOMIC ORGANIZATION OF HACIENDA VICOS

The economic organization of Vicos is based upon a merging of two distinct economies, that of the patrón and that of his Indian peones. The patrón rents the hacienda from the Peruvian government with the hope of making a cash profit from the sale of crops produced on hacienda fields. In order to grow crops for profit the patrón uses Indian labor. The Indians of Vicos, have a subsistence economy. In return for their labor, the patrón gives them land on which to grow their own food. The integration of these two economies is the base for the orgnization of the hacienda.

A. The Patrón's Economy

Hacienda Vicos is leased for 5 -year periods from the Beneficencia Publica, a branch of the Peruvian government. The rent in 1954 was 14,200 soles, or about $800 per year at 1954 exchange rates. With the payment of this rent the patrón receives control of a tract of more than thirty-thousand acres and all the Indians living within its boundaries.

The power of the patrón, over his lands and his peones, is almost absolute. However, in the development of the manorial system at Vicos, many customs and tacit working agreements have come into being. These customs tend to limit, to some extent, the power of the patrón. Any Indian, for example, should be permitted to become a peon on request. In return for his offer of labor, he is supposed to receive his three fields for corn, wheat and potatoes.

This system apparently worked well until the Indian population became so large that there were no more arable lands for the patrón to give away without relinquishing his own fields on which he grows cash crops. For many years most of the land operated by the Indians has been passed on within families, from father to son. If a peon of an originally contracting family did not provide his required labor to the patrón, all family lands could be taken and given to someone else. As a result through time an inequitable distribution of very scattered plots has developed. No matter how large or how small the land holding, each family must now provide the same amount of labor to the patrón.

1. LAND USE. The present output of Hacienda Vicos provides subsistence for 1,850 Indians and a surplus of agricultural products produced by the patrón for market. From the proceeds of the crop sales the patrón pays rent, the foreman's salary, gratification, and other upkeep expenses. The remaining income is profit.

In 1954 the Indian peones occupied and farmed about 4,000 acres, or more than ninety per-cent of presently cultivated land on the hacienda (Table 7). Their fields were located, for the most part, in the eroded hill or cabeceras area. The patrón farmed a large tract of alluvial land (43.0 acres) below the casa hacienda and numerous fields in the cabeceras region totaling another 370 acres. (Appendix III)

Of the remaining areas, most of the puna and practically all of the mountainous part of the hacienda, including the Quebrada Honda, were used, traditionally, by both the patrón and the Indians. Much of this land is rough and rocky and practically useless for tilling. However, most of the puna and some of the mountain areas are covered with grass, suitable for pasturing animals. In 1954 the Cornell-Peru Project did not keep any livestock, all of the grazing land was therefore, used exclusively by the Indians. For the privilege of grazing their animals the peones pay a nominal fee in the form of providing riding horses and oxen for the use of the patrón.

TABLE 7: Estimated Area of Hacienda Vicos
(Planimeter estimates made from an aerial photograph)

	Acres	Hectares
Alluvial plain (Operated by the patrón)	43.0	17.3
Cabeceras (Cultivated, inhabited area)	4,307	1,746
a) patrón's fields: 371.8 acres (150 hectares) b) Indian operated: 3,935 acres (1,590 hectares)		
Puna	2,580	1,590
Mountainous region (Including the Quebrada Honda)	28,000	11,300
Estimated Total Area of the Hacienda	34,929	14,103

2. LABOR SYSTEM. To work his lands, the patrón has the labor of about 250 Indian peones. Of these 160 work in the fields, usually Monday, Tuesday and Wednesday of each week. Any who miss work on the first three days are required to make up the lost time during the last three days of the week. The remaining 90 laborers have special jobs.

Field peones assemble at the plaza at 8:30 a.m. and are given their orders for the day. They may be told to prepare nearby fields for planting, or they may be given sacks of fertilizer or seed potatoes to carry to other parts of the hacienda. They work until 12:30, with two fifteen-minute breaks during the morning. At 1:30 work recommences, and there is one more fifteen-minute break before quitting time at 4:00 p.m. If the Indians have been ordered to appear at some distant field the work starts a little later in the morning. As payment for the use of grazing lands, all the peones who own oxen are supposed to bring them whenever they will be needed in the fields. On one day I observed thirty-six pairs of oxen plowing Rangra field.

The peon Labor is managed through a squad system. From every ten or twenty peones, one is chosen by the patrón to be a field foreman or mayoral. At the present time there are seven such foremen, each in charge of his own squad.

The large number of specialized jobs on the hacienda include the following. Ten gardeners work in the patrón's vegetable gardens, in shifts of five every other week. There are two guards who take turns keeping a 24-hour watch over the casa hacienda . Seven tapacos, or field guards, protect the patrón's fields; they are charged with supervising irrigation, scaring birds away and preventing the crops from being stolen. They remain in the fields all night as harvest time approaches. Another specialist stands at the portada or gate in the Quebrada Honda. He keeps a record of all traffic passing along the Quebrada trail and collects a small fee. Two Indians are paid to keep watch on the animals in the Quebrada. Still another job requires each peon to serve as mulero or stable man for a month, The mulero is on call 24 hours a day to get horses ready for the use of the patron. Before the Cornell-Peru Project took control of the hacienda, all unmarried or widowed women were obligated to one month's duty as housemaid, cook, or swineheard. This involved four or five women per month.

For the past eight years the peones have received a "gratification" for the work they do. Vicos was one of the first haciendas to give such a tip to its peones. On other haciendas it takes the form of coca leaf (a mildly narcotic herb). The basic amount is .60 soles per day. Those who have special jobs received more. The total cost of the gratification is now about 12,000 soles ($600) each year.

3. ORGANIZATION OF THE PATRÓN'S FARMING OPERATIONS. The Patrón's agricultural operations were supervised by a salaried manager. Before Cornell University took over the hacienda, he had two paid assistants. In 1954 the manager was a mestizo (person of mixed Spanish and Indian blood) who lived in a nearby town. He made nearly all important decisions about agricultural operations and the timing of agricultural work. If the patron is an absentee landlord the manager is usually given completely free rein, as long as he succeeds in maintaining a significant profit.

Planting and cultivation practices used for the various crops have been discussed already. However, the sequence of crops, where they are planted and why, needs to be considered further.

Before the Cornell-Peru Project took control of the hacienda in 1951, the former patrón had organized his production around flax growing, a venture that was not paying off. Thus, by 1954 the Cornell-Peru Project manager had had little more than three years to establish a new rotation of profitable crops. On the lower fields he has tended to use a potato-wheat-corn rotation. On the upper fields, an alternation of potatoes and cereals is the general rule, with fallow periods interspersed, and an occasional crop of habas or tauri. The time of planting and the succession of crops is based more upon considerations of available labor and the immediate economic returns than upon a knowledge of what rotations should be used to maximize the total produce and income over a long period. The rotations that are used by the manager are traditional and are probably based on the observation that growing the same crop on the same field every year produces less than when crops are changed annually. If there is a perferable rotation, the manager does not seem to be acquainted with it.

In the 1953-54 harvest year, this crop production system resulted in the sale of 90 tons of potatoes and 37 tons of corn. Smaller quantities of wheat and barley were marketed as well as some rye and habas.

4. MARKETING AND PRICES. Buyers from firms and markets in Lima and other food deficit areas of the coast come to the mountains to make their purchases in bulk. In three years from 1951 Vicos has become the second largest producer of potatoes in the Santa Valley. By 1954 it was well enough known to truckers and merchants that they would come directly to the hacienda. The manager, who had a good knowledge of prices, made all agreements with the buyers. The price of potatoes in Lima was highest in January, and the manager tried to harvest and sell as many potatoes as possible during this month. Some sales were also made to the nearby city of Huaras.

The prices of agricultural products reported by the hacienda administrator in the summer of 1954 are given in Appendix II.

B. The Indian Economy

The Indian economy is one of subsistence at a low level of living. This is due, primarily, to the population pressure on relatively poor land with almost static traditional agricultural technology. Food shortages occur often and are particularly severe when harvests fail. Food consumption is low throughout the year. This nutritional factor is undoubtabley one significant cause in a high infant mortality rate, estimated to be about 50 percent Houses are small, averaging 14 feet on the longest side. They are made of stone or adobe and have dirt floors. There is very little furniture. Hides and blankets are laid on the floor for sleeping. Indian clothes are usually made of homespun wool. Children and the poor are often in rags. Crops and livestock are the basis of a battle for survival. The crops are, for the most part, consumed directly, and the livestock is kept for sale in order to obtain needed supplies.

1. POPULATION AND LAND USE. The Indians live in houses widely scattered over the cabeceras region. The houses are generally found in groups of three to six, such groups being occupied by an extended family (a number of related nuclear families). In 1954 there were about 365 nuclear families and a total population of 1,850 thus there were 5.1 persons per neclear family.

The cabeceras area contains a total of 3,935 acres, about 60 percent or 2,360 acres, is cultivated. This suggests that the average nuclear family has about 6.5 acres of cultivable land, or 1.3 acres per person. (This calculation does not include the few Indian fields in the puna and other scattered areas.) A study of fifteen families in 1954, suggests an average cropland of 3.2 acres per nuclear family, As these families averaged 4.3 persons per family a figure of 0.75 acres of cropland per person results. Although both of the above estimates are rough, they suggest that there is about one acre of cultivated land per person.

It must be remembered, that the Indians have two other sources of income. The most important of these is the sale of livestock and livestock products which are produced on hacienda lands in the puna and the Quebrada Honda. A second source of income is the patron's gratification pay and other monies that might be received from day labor in Marcara or on nearby haciendas.

2. CROPPING SYSTEM. The Indians grow the same crops grown by the patron, and several more. Corn, potatoes, wheat and ocas are the staple foods. Barley, rye, habas, tauri and some non-commercial crops, quinoa, ullucos and mashua, are also grown. Each Indian family has a vegetable garden, averaging, perhaps, ten yards square, where a few vegetables, such as tree cabbage and squash, are grown. Until the introduction of improved techniques of potato production by the Cornell-Peru Project, corn was the most important crop on Hacienda Vicos. The best land is still reserved for corn; it is generally grown near the Indians' houses, in the lower part of the cabeceras. The principal reason for limiting corn to lesser elevations is that the higher areas are excessively cold. This limitation necessitates a continuous corn rotation on many Indian plots, with only three months of fallow between the harvest in May and September planting.

There seems to be no generally consistent rotation of crops. On the lower fields where corn is not grown continously , potatoes often follow corn: potatoes are followed by wheat and/or barley. (Table 8) Periods of fallow of various duration are interspersed. This is about the same rotation as followed by the manager. What the Indians plant seems to depend upon tradition, how good the last crop was, and what food will be needed in the near future. Potatoes are sometimes planted immediately after the corn is harvested in May. The potatoes are then harvested in February, and wheat or barley can be planted -- and harvested in time to plant corn again in September.

In the puna and on other high fields away from the houses, where corn cannot be grown, various sequences of the other crops are planted. On some fields, particularly those that are unirrigable, ocas, ullucos and mashua are planted every year.

TABLE 8: Indian Rotation Practices. A example of a sequence on a farm.

	Plant		Harvest
Field 1a approx. 0.6 acres			
Barley	Dec.1952	-	June 1953
Corn	Sept.1953	-	May 1954
Field 1b approx. 0.6 acres			
Wheat	Mar. 1953	-	July 1953
Corn	Sept. 1953	-	May 1954
Field 2 approx. 0.5 acres			
Fallow	------		------
Potatoes	June 1954	-	Oct. 1954
Field 3 approx. 1.5 acres			
Potatoes	July 1953	-	Jan. 1954
Wheat	Mar. 1954	-	July 1954

Planting and cultivation practices of the Indians differ little from those used by the patrón, as described above. If a family does not have access to oxen and a wooden plow, all preparation and planting is done by hand with a short-handled hoe. Sticks, rather than horses, are used by the peones in threshing. For potatoes the Cornell-Peru Project has arranged to sell guano and spray to the Indians at cost; it also rents spray equipment, which the Indians have begun to use on their own plots. No Indian farmer had purchased spray equipment in 1954.

3. ANIMAL HUSBANDRY. Livestock plays a very important role in the economy of the Indians. Keeping animals is one major method of storing wealth. If there is a bad crop year, animals can be sold and the cash gained will help tide the family over until the following harvest. Thus, the number of animals an Indian owns is some indication of his economic condition and is, accordingly, a sign of prestige. One Indian, for example, owns over one hundred horses, few of which are ever used.

Some donkeys are raised for sale. Cattle are kept by many families. Oxen and bulls are used in the fields for plowing. Milk is sometimes sold fresh, but is usually made into cheese. Meat and hides are sold. Most families keep sheep in order to produce wool for clothes, grain bags, and ponchos, as well as meat and hides for market. Goats are sold for meat or are eaten on festivals. Pigs, are fattened primarily for cash sale. Chickens are kept for the production of eggs, which are sold. The meat staple of the Indians is guinea pig.

4. INDIAN FOOD CONSUMPTION. As a result of population pressure,poor land resources and weak agricultural technology, food is scarce on the hacienda. A nutrition survey was completed at Vicos, as part of a program of dietary investigations in Peru, by the Department of Nutrition of the Harvard School of Public Health. Vicos and Chacan (another hacienda) were chosen to represent rural communities in the Andes. According to this survey, the average number of calories consumed per day per capita is about 1,500, or just 70 per-cent of that recommended for good health (Table 9). In some periods, particularly after harvest, food is abundant. Vasquez says that May, June and July are the months of abundant food and that December, January and February are the months of greatest scarcity.1/ The Harvard Nutrition Survey samples were taken in July, 1952 and in February, 1953, and, contrary to Vasquez's suggestion, the calorie intake appears to be almost the same during the two periods of the year. However, the Nutrition Survey results may be influenced by the recent introduction of improved potato varieties by the Cornell-Peru Project.

Note should be made of the extremely low intakes of calcium and Vitamin A (carotene). All families in both samplings consumed less than 75 per-cent of the recommended amounts. The finely ground limestone rock eaten while chewing coca leaves and the carotene in the leaves themselves were not included in the Nutrition Survey reports however. It is possible that these sources may compensate somewhat for the otherwise very low intake of these two factors. The survey also found that corn, wheat, potatoes and habas are the most important foods, in terms of calories and protein. Animal sources provide 15 per-cent of protein intake. Calories come 80 per-cent from carbohydrates, 5-8 per-cent from fats, and 9-12 per-cent from protein.

Table 10 shows the change in importance of various major foods in the diet according to season. Note that potatoes completely dominate the diet in February. During that month they supply 38 per-cent of total calories and 31 per-cent of total protein intake.

5. MARKETING. Marketing takes place on Sunday morning, a custom familiar in many South American countries. Early Sunday morning, before it is light, the Indians start for Marcara with the products they wish to sell.

1/ Vasquez, op. cit.

TABLE 9. NUTRITIVE VALUE OF THE "TYPICAL" VICOS DIETS

Food	Avg. per person per day	Calories	Protein	Calcium	Iron	Vit. A 1/	Thiamine	Riboflavin	Niacin	Vitamin C
	gm.	gm.	gm.	mg.	mg.	I.U.	mg.	mg.	mg.	mg.
1st Survey, July '52 (40 Families)										
Barley	50	171	3.7	30	2.7		.17	.10	3.70	
Corn, dry	190	582	11.6	8	4.2		.91	.38	5.14	
Wheat	70	230	6.4	25	3.2		.21	.06	1.99	
Broad beans, dry	70	227	18.1	41	4.5		.30	.26	1.61	
Oca (tuber)	235	134	2.6	5	2.3	84	.05	.07	1.01	57.5
Potatoes	100	100	2.0	10	0.4		.17	.05	1.77	13.1
Sugar	5	20								
Lard	5	45								
AVERAGE INTAKE		1509	44.4	125	17.3	84	1.81	.92	15.22	70.6
AVG. RECOMMENDED INTAKE		2150	58.0	1000	10.1	3860	1.10	1.40	11.00	62.0
PERCENT OF RECOMMENDED		70	76	13	171	3	165	66	138	117
2nd Survey, Feb. '53 (37 Families)										
Corn	115	352	7.0	5	2.5		.55	.23	3.10	
Wheat	130	425	12.0	47	6.0		.39	.10	3.70	
Broad beans, dry	20	65	5.2	12	1.3		.09	.07	.46	
Potatoes	550	550	11.0	56	2.2		.94	.27	9.75	72.0
Cabbage	5	3	.2	16	.1	50	.01	.02	.08	4.9
Sugar	10	40								
Lard	5	45								
AVERAGE INTAKE		1481	35.4	138	12.1	50	1.98	.69	17.09	76.9
AVG. RECOMMENDED INTAKE		2155	59.0	1000	10.2	3890	1.10	1.50	11.00	65.0
PERCENT OF RECOMMENDED		69	60	14	120	2	180	46	156	120

1/ 1 mg. carotene = 1670 I.U. of Vitamin A.

Most of the marketing is done in the streets although some trading is also conducted at small stalls set into the ground floor of many houses lining the main streets. The townspeople are nearly all metizos. They have been to school, are able to read and write Spanish, and feel themselves quite superior to the largely illiterate Indian population of the area. The mestizo shopkeepers know the Quechua language, thus, the Indian is often at a disadvantage in mestizo stores because he does not understand Spanish, and because the shopkeepers are occasionally unscrupulous.

A third kind of market takes place some Sundays, when out-of-town buyers come into Marcara. They are usually looking for animals to ship to distant cities and towns.

Much of the actual exchange in the markets is by barter, animals for potatoes, potatoes for tools. As a result of this, it is very difficult to obtain any figures of total Indian sales through these markets during the period of a year. Vasquez has estimated that the Indians of Vicos sell 100 grown cattle during a typical year 1/. It is probable that the sale of animals and eggs represents the greatest single source of market income. Other products sold for profit include wool, charcoal, ice, vegetables and field crops. The products bought in largest quantity are salt, sugar, coca, aji (red pepper) and rice. Other products traded for are: fruit, bread, alcohol and kerosene, dyes, thread, tools and various articles of clothing.

In addition to their trade in Marcara, the Indians do some selling and buying in other nearby towns and haciendas. Many Vicosinos make at least one business trip a year to the mountain town of Chacas, two or three days away by foot.

C. The Efficiency of Present Agricultural Production at Vicos in 1954

In the following discussion, efficiency will be taken to mean the extent to which 1954 knowledge and production practices in the Andes of Peru were applied effectively to the resources of the hacienda. If the application of known techniques is as great as possible, production will be considered efficient. In other words, is an appreciable increase in production possible, given current agricultural practices?

1. The mountainous four-fifths of the hacienda contains pasture lands and a small amount of flat arable valley area in the Quebrada Honda. At the present time, the grazing areas are being exploited fairly completely. Much of the flat valley land of the Quebrada, however, is not being used for crop cultivation.

2. The remaining fifth of the hacienda, including the lowland alluvial, cabeceras, and puna areas, is being used, for the most part, efficiently, given present technology and social organization. The Indians farm most of their land as intensively as might be expected. Some of the fields operated by the patron might be further exploited without necessitating a significant change in the techniques of production.

1/ Vasquez, Mario C. Personal Communication.

3. In summary; some increase in production is possible on the areas cropped by the patrón and on the land in the Quebrada Honda. With present techniques little improvement is possible on the rest of the hacienda. Maximizing the use of available resources and knowledge probably would not increase production more than 25 percent. Thus it may be said, given the technology in use and the existing social organization, present agricultural production on Hacienda Vicos is fairly efficient.

VII. SUGGESTIONS FOR AGRICULTURAL DEVELOPMENT AT HACIENDA VICOS (unrevised)

A. The Basis of Approach

Prior to submitting a specific proposals for increasing agricultural production at Hacienda Vicos, the purpose for which this higher production is to be used must be discussed. The means of development has a very direct relationship to the end in view.

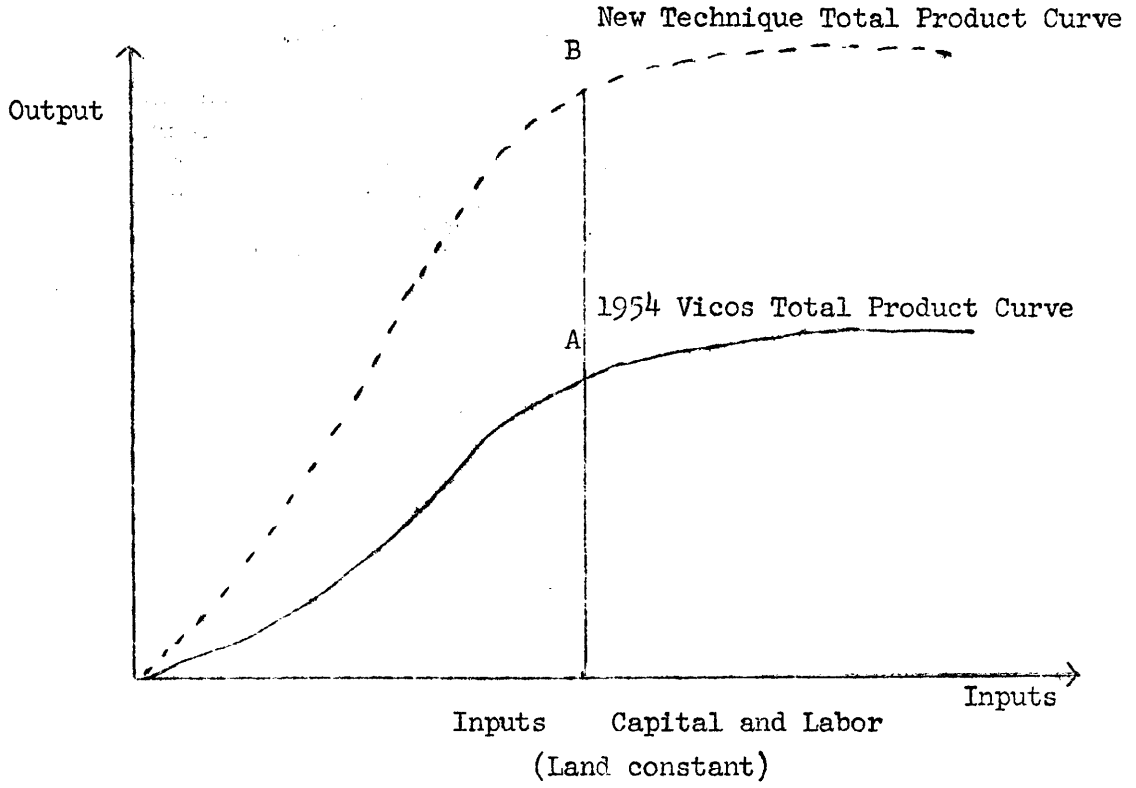
I will assume that the purpose of agricultural development at Vicos is, most immediately, to increase the Indian standard of living as rapidly as possible, without necessitating a decrease in the total amount of agricultural goods contributed by the hacienda (Indian and patrón) to the Peruvian economy. I will also assume the purpose of development in Vicos to be, in the long run, the maximizing of output and contribution to the economy of Peru, in a manner consistent with the play of normal economic forces.

The short-term proposals are made under the assumption that the present institutional organization of the hacienda, including the patrón and the labor tax, will be retained. This must be done for a number of reasons. Considerable agricultural development can occur by employing advantageously the present organization at Vicos. The patrón's economy can, in fact, be of direct benefit to the hacienda by bringing in and trying new agricultural techniques and equipment, thus teaching and serving as an example to the Indian peons. Another reason for not hastily abolishing the hacienda system is that by simply dividing the 415 acres of the hacienda land operated by the patrón among 1,850 peons, the Indian income will not be raised to any great extent. A final reason for framing the short-run proposals within the existing institutional arrangements at Vicos is that, due to the present nature of the political situation in Peru, there is little possibility of abolishing the hacienda system, even if it were desirable.

The long-run proposals look for the disintegration of the hacienda system as it is presently in operation at Vicos. The most important reason for changing the relationship between the patrón and the peon is not actually economic, but, ultimately, will have a very marked effect upon the entire hacienda economy. What is the reason? To put it simply: no people can develop their full potentialities, economic or otherwise, when they are subserviant, dependent, and continually deprived of taking initiative in concerns which are vital to their own welfare. The Indians must, eventually, be freed from the social and economic restrictions which the hacienda system imposes and which hamper their easy growth into modern life. The people must become independent of the hacienda, free to come and go and do as they please. Strangely, it may be the Indians themselves, at first, who will feel that they are losing something in their emancipation. In a sense, that is true; for their security will not be as great as before.

The foregoing is not to imply that it is necessarily desirable to divide up the lands presently operated by the patrón, when the hacienda

FIGURE 1: Hypothetical Production Functions for Vicos



Viewing the problem in another manner, an appreciable increase in production on the fixed land resource of the hacienda must be accompanied by a qualitative change in one or more of the resource factors mentioned above. Labor productivity, for example, might be changed by Indian education or by changing the social organization and the labor system. Capital productivity might be increased by introducing new implements or more productive animals. New techniques or methods of work may be introduced in the form of better crop rotations and planting schedules, or better irrigation practices. Experience in Production Economics shows that substantial increases in output can often be achieved more easily by changing the production function than by moving along it. In Figure 1, the new technique production curve for thehacienda (dotted line) shows a production function which might result, typically, from the use of new techniques or qualitatively improved labor and capital factors. To increase output appreciably on the hacienda, the aim must be to reach such a point as B on the new technique total product curve. In other words, holding land, capital, and labor constant, emphasis should be put upon changes in technique and organization to gain a significant output increase.

2) Erosion control. Much top soil and, hence, valuable organic matter is now being lost through erosion. More terracing is needed to stop the growth of gullies. Diversion ditches should be constructed in most fields. Proper irrigation techniques are required to prevent the soil from being washed away; often irrigation water is allowed to wash down over the fields in torrents.

b. crops

1) Emphasize the most profitable cash crop, which is, at the present time, potatoes. (A check should be made on the areas of Peru which might compete for the January and February potato market in Lima. It is possible that the Santa Valley has a potential natural monopoly in this market.)

2) Experiment with the use of lime and fertilizers, particularly those containing nitrogen, phosphorous, potassium and magnesium. Records should be kept of the responses of different crops and soils.

3) Determine a good rotation of crops, and use it. (Include a sod crop.)

4) Continue trying new garden and crop varieties on a small scale. Artichokes, for example, may be a commercial possibility on the Lima market.

5) Keep careful records, particularly of the planting rate, cultivation practices used, and yields obtained from each field.

6) Continue experimentation with insecticides, fungicides, etc.

7) Experiment with amount, frequency and technique of irrigation, particularly for potatoes.

c. livestock

1) Buy and keep a small number of top grade animals (beef cattle, milk cows and sheep). Demonstrate controlled breeding and controlled grazing by using shepherds and/or fencing. (Consider the practicability of electric fencing.)

2) Try to determine the possibility of disease control in poultry. Some attempt should be made to improve the breed by keeping a few top grade roosters.

3) Keep pack animals for transport to outlying fields.

d. other suggestions

2) Share-crop some of the patrón's fields that are not now being used to their fullest extent.

3) Establish a cooperative store, run by Indians if possible, to buy and distribute fertilizer and other agricultural supplies.

4) Set up a marketing organization to sell Indian products to large buyers. (This organization may be combined with the cooperative store.)

5) Introduce practical agricultural instruction (particularly with regard to new techniques) into the school curricula.

6) Hold an agricultural fair.

7) Encourage the Indians to plant and cultivate trees on the borders of their plots.

2. LONG-RUN CHANGES

1) Bring to an end the feudalistic agricultural organization of the hacienda. This will require the definition and consolidation of Indian lands, which should then be sold to the peons for a nominal price. A proportion of the grazing lands which they are now using should also be included in the sale. This will define the lands that the patrón (now in name only) has available for use. After reorganization, he will, of course, pay his workers.

2) Attract a portion of the Indian population away from agriculture and into manufacturing. The small area of arable land available cannot support all those on the hacienda. The loss of even a great number of agricultural laborers will not reduce production significantly, particularly if new farm techniques are being introduced as the cutback occurs. Local manufacture could include agricultural product processing, such as cheese and butter making or hand-weaving on improved looms. Non-agricultural cottage industries may also be developed (for example, tile, brick or pottery making.)

3) The Indian school should play an increasingly important role in the life of the hacienda, taking over the demonstration of animal breeding, new agronomic practices, and, perhaps, setting up model gardens. Agricultural subjects and homemaking should be emphasized in the school curriculum.

4) The patrón should continue to emphasize profitable cash crops and go into meat or wool production, as his land permits.

5) If the Quebrada Honda should prove valuable for crop production, a road should be built to the area.

APPENDIX I. WEATHER DATA, HUARAZ, ALT. 3050 METERS, COLLECTED AT COLLEGIA NATIONAL de LA LIBERTA for the MINISTERIO de AERONAUTICA, DIRECTION de COMMUNCACIONES y METEROLOGIA de AERONAUTICA
(Weather records kept since 1947 in Huaraz)

1953	Monthly averages Temp. - degrees centergrade Daily maximum	Daily minimum	Daily average*	Total rain millimeters	Lowest temperature Degrees centergrade	Average sunshine per day hours
August	24.4	3.9	14.14	1.0	0.0	10.6'
September	23.7	6.4	15.03	67.5	3.0	8.6
October	22.2	6.6	14.42	87.6	2.4	7.33
November	21.6	7.1	14.34	144.6	4.2	7.47
December	22.7	6.7	14.69	58.6	1.7	8.4
1954						
January	21.1	7.5	14.24	157.4	4.5	6.7
February	20.1	7.3	13.84	66.6	4.0	6.9
March	21.6	7.0	14.41	114,4	3.0	7.7
April	22.9	7.7	15.33	53.4	5.4	9.2
May	22.3	5.8	14.04	46.3	3.5	9.56
June	23.1	4.0	13.49	0.0	1.5	10.6
July	22.9	2.8	12.85	0.0	0.4	10.8
Year			14.24	797.4		

*Maximum + Minimum / 2

The highest rainfall in one day was 33.3 mm on the 26th of September.

Avg. soil temp.

	25 cm	50 cm	100 cm		25 cm	50 cm	100 cm
April	17.5	18.2	17.5	June	15.3	16.3	16.3
May	15.9	17.1	17.0	July	14.7	15.5	15.4

APPENDIX II. WEATHER DATA, 1954, HACIENDA VICOS, MARGARA, ANCASH, PERU. ALTITUDE APPROX. 9,000 FT.

Taylor maximum-minimum thermometer. Screwed on inside of post on the porch on the second floor. The porch is on the south side of the house and receives no sunlight. Readings to be taken every morning.

1954	Temperature - Farenheit	
	Maximum	Minimum
July 3	73	46
July 4	73	44
July 5		42
July 6		
July 7	70	42 slight frost
July 8	71	41 slight frost
July 9	68	41
July 10	70	42
July 11	71	42
July 12	72	41
July 13	73	46 cloudy
July 14	71	45 cloudy
July 15	73	45
July 16	73	44
July 17	75	44
July 18	68	47
July 19	74	42
July 20	75	42
July 21	73	43
July 22	72	43
July 23	73	44
July 24	73	44
July 25	73	43
July 26	72	42
July 27	74	44
July 28	72	42
July 29	74	42
July 30	73	44
July 31	73	45
August 1	72 cloudy	44
August 2	72 cloudy	48
August 3	73	48
August 4	72	50
August 5		
August 6		46 no frost
August 7	68	46 no frost
August 8	73	43 frost
August 9	72	43 no frost
August 10	72	46 no frost

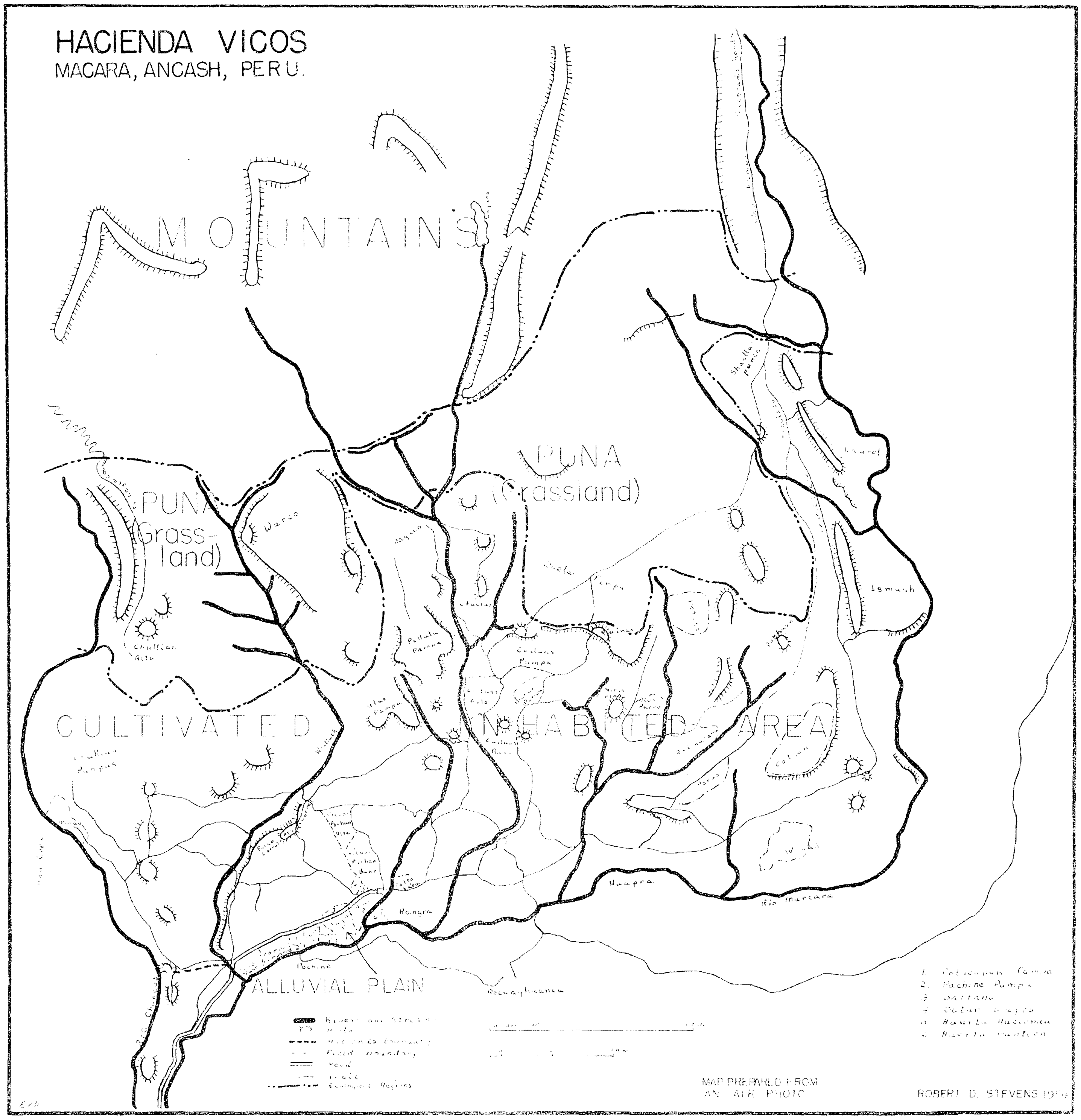
August 11	73	43
August 12	72	42 frost
August 13	73	42 slight frost
August 14	72	44 no frost
August 15	72	44
August 16	74	42 slight frost
August 17	74	43 slight frost
August 18	72	42 frost
August 19	72	42 frost
August 20	72	43
August 21	73	44
August 22	74	44
August 23	72	45 no frost
August 24	73	44
August 25	74	43
August 26		43 frost

Appendix III: The Patrón's Fields (Estimated Areas)

	Estimated Area	
Fields in the alluvial plain:	Acres	Hectares
Saco-Yaco	8.2	3.3
Companilla	6.2	2.5
Polaca pa pampa	1.5	0.6
Pochine pampa	1.0	0.4
Wasca pampa	3.5	1.4
Mester pampa	4.0	1.6
Kuyok	8.7	3.5
Atos pampa	9.9	4.0
TOTAL IN ALLUVIAL PLAIN	43.0	17.3
Fields in the cabeceras:		
Saltana	2.2	0.9
Batan wayta	1.7	0.7
Rangra	24.7	10.0
Palta-Kaka	2.0	0.8
Vicos pachan bajo	8.4	3.4
Vicos pachan alto	9.7	3.9
Alta corral	1.0	0.4
Punco corral	1.7	0.7
Ullmay	2.7	1.1
Chullian pampa	30 ±	12 ±
Wisllock	4.5	1.8
Utas pampa	9.7	3.9
Pillalu pampa	21.0	8.5
Lichcapampa (culluash	3.5	1.4
Atus pucro	16.3	6.6
Potaka	25 ±	10 ±
Rodinurance	8.4	3.4
Paras	12.9	5.2
Cotsan	22.5	9.1
Wiyas	13.0	5.3
Ismush	60 ±	24 ±
Laurel	7.2	2.9
Urancuncha	32 ±	13 ±
Schacllapunco	19.3	7.8
Wayoco	10.3	4.3
Irwa corral (Quekey pampa)	.7	.3
Puyhuan corral	1.7	0.7
Ricokaka	16.1	6.5
Huerta panteon	2.0	0.8
Huerta hacienda	1.5	0.6
TOTAL IN CABACERAS	371.8	150.0
TOTAL AREA OF PATRÓN'S LANDS	414.8	167.3

APPENDIX IV: Prices of Agricultural Products and Supplies on Hacienda Vicos and in Marcara as reported by the Vicos administrator.

	Price
CROPS	
Potatoes	
Weighting more than 50 gms	60-70 soles per 150 lb. sack
" 30 to 50 gms	40-50 " " " " "
" 15 to 30 gms	25-30 " " " " "
" less than 15 gms	20-25 " " " " "
Seed potatoes 40-50 gms	110-120 " " " " "
Dried Potatoes	50 " " 25 " "
Wheat	
Florencia Aurora variety	90-110 soles per 150 lb. sack
Common	60 " " " " "
Corn	
Cuzco	70 soles per 125 lb. sack (ear corn)
Common	60 " " " " "
Barley	40-50 " " " " "
Habas	90-110 " " 150 " "
Tauri	14 " 25 " "
OTHER AGRICULTURAL PRODUCTS	
Milk	1.20 soles per liter
Cheese (home made)	1.50 per 1/4 lb.
Eggs	0.40 per egg
Wool	120 soles per 25 lbs.
LIVESTOCK	
Hen	10-20 soles
Sheep or Lamb	60-70 "
Goat	40-50 "
Pigs (fattened about 200 lbs.)	800-1000 "
Pigs (small, 50 lbs.)	80-100 soles
Cow, bull or ox	25 soles per 25 lbs.
Burro	250 soles
Horse	500-600 soles
Mule	1,500 soles
AGRICULTURAL SUPPLIES	
Burned lime	180 soles per 800 kilos (1760 lbs)
Guano (17.34% Nitrogen) from Huaraz	0.49 soles per kilo (2.21 lbs)


HACIENDA VICOS
MACARA, ANCASH, PERU.
MOUNTAINS
PUNA (Grassland)
PUNA (Grass-land)
CULTIVATED
INHABITED AREA
ALLUVIAL PLAIN
Rio Marcara
MAP PREPARED FROM AN AIR PHOTO
ROBERT D. STEVENS