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POTATO STORAGE SYSTEMS  
IN THE MANTARO VALLEY REGION OF PERU

Robert W. Werge

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POTATO STORAGE SYSTEMS  
IN THE MANTARO VALLEY REGION OF PERU

by

ROBERT W. WERGE  
Anthropologist

Socioeconomic Unit  
Centro Internacional de la Papa  
Lima, Peru

ABSTRACT

This report describes farm-level potato storage practices in the Mantaro Valley region of Central Peru. The information is based on a study carried out in September and October 1976 as part of CIP's socioeconomic research on post-harvest technology. The study forms part of CIP's overall research on storage and processing technology which aims at designing improved systems for developing countries.

Part I of the report describes how farmers make decisions about post-harvest technology, especially about storage. Alternatives open to farmers, such as sale, processing and home consumption, are discussed. All farmers in the region are found to store part of their potato crop, principally for seed and home consumption. Producers who store ware (consumer) potatoes for later sale at a higher price--the principal motive for storage in developed countries--are rarely encountered.

The percentage of the crop stored by a producer varies inversely with the amount of land planted in potatoes; small farmers store a much larger share of their crop than large farmers, cooperatives or communities. Large scale storages exist in communities and cooperatives where land is farmed in common, but where the members of these organizations farm individual plots, they store potatoes from their own fields individually.

Part II of this report describes the variety of storage units found in the Mantaro region. These are presented as three main types:

house storages, outbuildings and field storages.<sup>1</sup> In keeping with individual control over storage, the farmer's house is the preferred storage location because of its convenience, security, and design. Outbuildings are utilized by large growers (including cooperatives and communities).<sup>2</sup> In general, outbuildings are multipurpose, being used to store other crops and implements. Permanent structures designed specifically for potato storage are rare in the region and have almost always been built under government sponsorship. Existing government-built potato storages in the region are currently under-utilized for that purpose. Field storages are known to farmers in the region but are rarely utilized except in the higher elevations above 3,700 meters.

Part III discusses the possibilities for improving potato storage technology in the region. It is recommended that farm-level research be undertaken to measure the efficiency of presently utilized and alternative technologies, both from the technician's and the farmer's point of view. Several recommendations are made for the most appropriate types of potato storage in the region and suggestions are made for the diffusion of improved types.

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- 1 Outbuildings are defined in this report as any building apart from a house where potatoes or other crops are stored. Field storages are defined as storage units, either above or under the ground, built outside of a house or building.
  - 2 The communities referred to here are those which have land that is farmed collectively by the members of the community and that produce crops utilized for the benefit of the community.

## INTRODUCTION

The objective of this study is to describe why and how potatoes are stored in the Mantaro Valley region of Central Peru. The answer to the "why" question leads to a discussion of the system of post-harvest utilization and farmer decision making. The answer to the "how" question leads to a discussion of the physical characteristics of storages. In answering both questions, the range of storage practices is emphasized and, when possible, specific practices are identified with types of producers.

This study was undertaken because little or no written information currently exists on the topic of indigenous systems of potato storage for any area in the developing world. Such information is vital if the resources of CIP and developing countries are to be effectively mobilized in the improvement of storage practices. Attempts to directly transfer the storage technologies of Europe and North America to areas like the Mantaro Valley have not been successful, in part because the functions and types of storages being utilized by farmers have not been understood. It is the author's belief that current practices can serve as a basis for improvement if farmers and technicians can be brought to work together on the problem.

Another major reason for undertaking the present study was to begin to develop a relatively cheap methodology for accessing farmer needs and resources in the area of storage and processing. CIP and national institutions are often called

upon to design improved storages for regions in which little is known about current storage practices. Those practices must be known if an improved storage system is to be successfully integrated into the economy and culture of the region. It is the author's belief that similar studies can be carried out by national social scientists as a baseline for potato storage projects in other parts of the developing world.

### METHODOLOGY

A few methodological problems deserve mention because they are common to socioeconomic investigation in the Peruvian Sierra and in other developing areas (ADC 1976; Alers 1970). Because data were collected in late October of 1976 when potatoes were being planted, few seed storages could be observed in use. In addition, many farmers were hesitant to show their house storages since one of the functions of house storage is to prevent outsiders from finding out how much food is being kept. Empirical verification of farmers' statements was, therefore, often difficult to make. Questions were asked about the harvest in March-June 1976, which meant that several months had elapsed and farmers had to rely upon their memories. Reliable quantitative data were difficult to get owing to farmer suspicions, the lack of record keeping, and the use of traditional measures which can not be easily translated into terms commonly used in the agricultural literature.

In order to overcome these problems, two interviewing methods were employed. The first method, key informant interviewing, was carried out with individuals having a broad knowledge of potato production in the region.<sup>1</sup> These individ-

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<sup>1</sup> Key informant interviewing is discussed in Pelto, P. 1970 Anthropological Research. N.Y. Harper and Row. pp. 95-98.

uals included officials in the Ministerio de Alimentación, farmers with a wide network of contacts in the region, and foreign technicians. Farm visits were made in the company of ministry personnel, usually of the sectorista level, to farmers who practiced the different types of storage techniques previously described to me.<sup>1</sup> During this phase, it was important to learn the terms used by farmers for different types of storages, since these often had Quechua names. Unless reference were made to these specific terms, farmers would not volunteer information about them, since the farmers assumed that an agricultural investigator would not be interested in indigenous practices. During these first weeks, work focused on describing the range of practices found in the region and little quantitative data was collected. By the end of the fieldwork period more than 70 farmers and officials had been interviewed.

During the last two weeks of study, a second method of interviewing was employed. Structured interviews were held with 20 farmers to gather preliminary quantitative information on their storage practices. The survey was carried out with the help of a local agricultural engineer. Farmers were interviewed as they worked in their fields. A written questionnaire was not used; the farmers' responses were written down only after the conversation had been terminated. This technique minimized the farmer's suspicions and allowed for a freeflow of information.

Farmers were asked about the previous harvest of Feb.- June 1976 and questions centered around two main concerns:

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1 Three levels of ministry officials were interviewed, those who worked at the zonal, agency and sector level. The sectoristas in general had much greater contact with farmers than did the officials working on the zonal or agency levels.

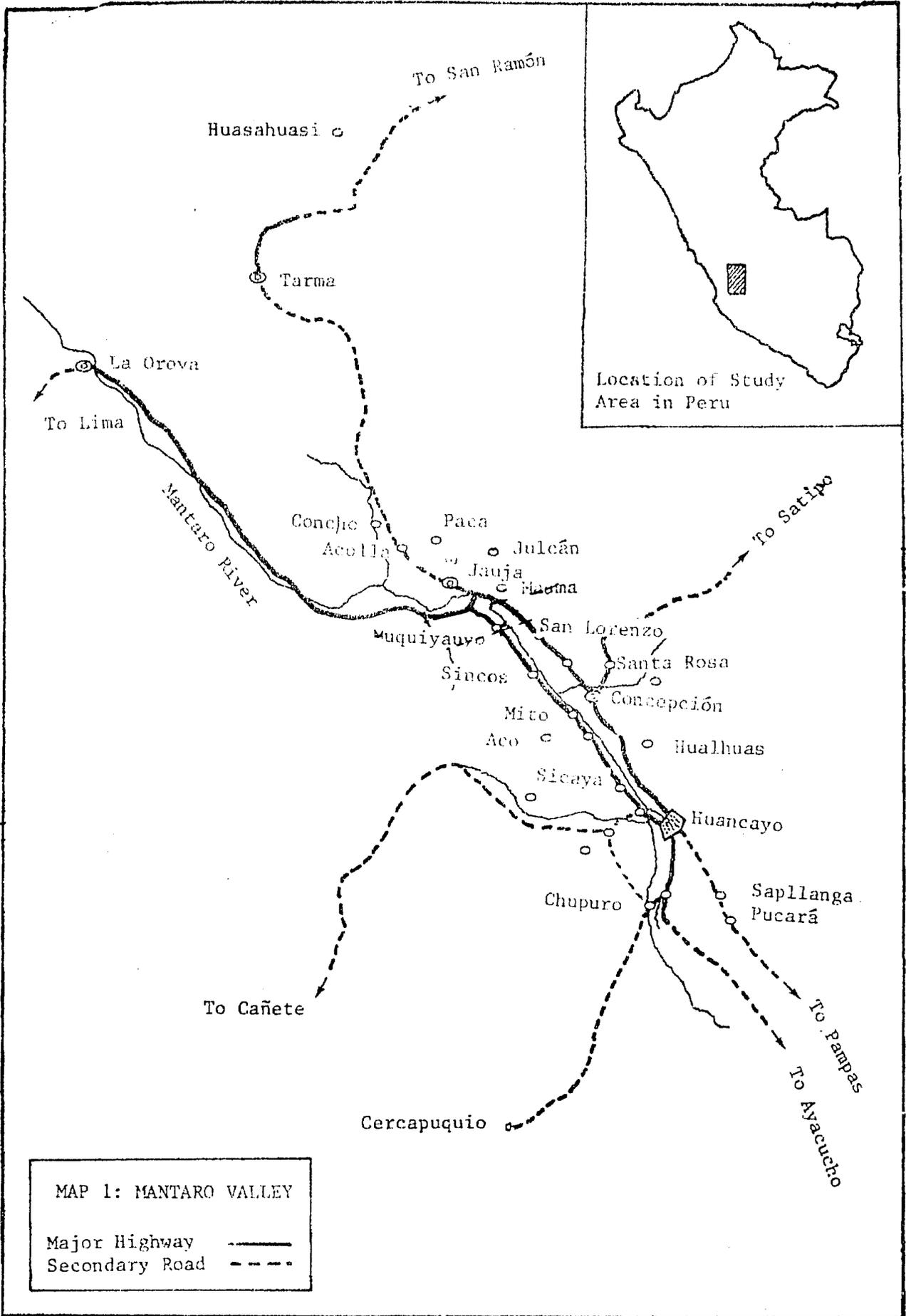
1. What amount of potato production was stored, sold, processed or utilized in other forms by the farmer?
2. What type of storage was utilized by the farmer?

Because of time limitations only farmers located close to the road were selected. Map 1 shows the area in which these interviews were carried out.

### THE STUDY AREA

The Mantaro Valley region exhibits many of the characteristics of a much wider area of potato production in the Peruvian Andes. These characteristics include a cool climate with distinct rainy and dry seasons, an agriculture with subsistence as well as commercial purposes, generally unstable prices for agricultural products, a land tenure pattern characterized by minifundios (very small holdings), a division of holdings into numerous small fields scattered over a range of altitude in order to take advantage of different ecological conditions, a mixed farming system with several crops (including potatoes, maize, barley, and wheat) and animals, and the presence of off farm employment in mines, artisan activities and tertiary occupations in Lima, Huancayo and other towns.

The Mantaro Valley is unique, however, in being the most progressive agricultural region in the Peruvian Sierra. Its development has been based on proximity to Lima markets, the building of good railroad and highway connections to the Coast, and the presence of nonfarm employment which generates capital for investment in agriculture. The special cultural and economic characteristics of the region have been intensively studied in a number of monographs and articles which provide a background to the present study. A further consideration



In choosing to work in the Mantaro Valley region was the presence of CIP facilities near Huancayo, largest city in the region. Proximity to these facilities minimized logistical problems and permitted a sustained interaction with CIP agricultural scientists working on the design of improved storage and processing systems. (For more information on the Mantaro Valley itself, see Appendix A and Bibliography).

The Mantaro region is a major producer of potatoes in Peru. It is located in the department of Junin where 22% of all cultivated land is devoted to potatoes. In 1972 potatoes were produced on 18,000 has. in the three provinces of Huancayo, Jauja and Concepcion which comprise the Mantaro Valley. The average yield is low -- only 2.6 T/ha -- but there is much variation between capital intensive seed farms which obtain up to 35 T/ha. and farms in marginal areas where yields may average only 2 T/ha.

The agricultural calendar gives an indication of the length of time during which seed and ware potatoes are stored in the region. Planting begins in late August and extends through the beginning of December, being concentrated in the months of October and November. The harvest begins in late February or March, and ends in June. The usual storage period for seed extends for five months from May-June through October - November. Farmers try to minimize the period they store seed potatoes by keeping the last tubers harvested for this purpose. Ware potatoes kept for home consumption are stored for longer periods of time; farmers who plant potatoes to meet subsistence needs attempt to store potatoes from the last harvest in one year to the first harvest in the next, a period of eight or more months.

PART I

FARM-LEVEL DECISIONS ON POTATO UTILIZATION  
IN THE MANTARO VALLEY REGION

In this section, a brief description is presented of how a farmer decides to store or otherwise utilize his/her harvest.<sup>1</sup> The farmer's main alternatives at harvest are outlined and survey results are given which indicate the relationship between alternative uses and the amount of potatoes produced by growers.

At harvest a farmer decides between the major alternatives for the crop: sale or exchange, storage for ware or seed purposes, and processing. Each of these alternatives, in turn, contain further options. A diagram of these choices is presented in Figure 1. The farmer's choice between these alternatives is the outcome of his/her overall strategy, that is, whether he/she is aiming primarily at subsistence or commercial production. The strategy is the result of weighing various factors such as the farmer's past experience, available resources (land, labor, inputs, capital), alternative crops, non farm employment, probable yield and price, and market opportunities.

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1 It should be remembered that women in the Peruvian Andes play a very critical role in agriculture where they often control their own fields, provide a large amount of labor, sell the crop, and are responsible for storing potatoes for family consumption. These activities are of particular importance in the Mantaro region where men are frequently absent performing wage labor in the mines and towns.

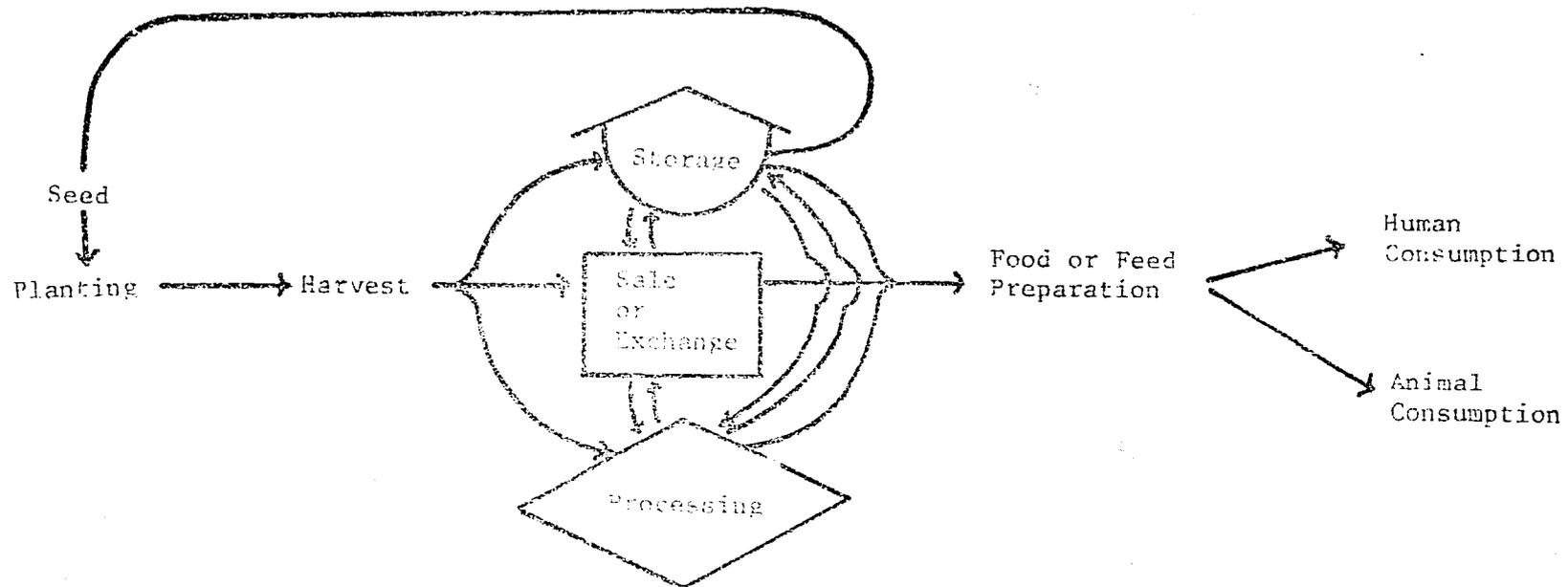


Figure 1: MAJOR ALTERNATIVE USES OF THE POTATO

Long before planting, the farmer has a strategy for the eventual utilization of the harvest. This strategy is made evident through a series of production decisions, such as the choice of varieties and the amount of land prepared. However, the strategy is subject to change during the growing season. For example, in a year of relatively high prices for potatoes, a farmer may sell part of his production in the Huancayo market even though it had been destined for his own household's consumption. Likewise a farmer with a heavily diseased crop may make papa seca instead of selling fresh potatoes as originally planned.

At the harvest, the crop is usually divided by variety and graded by size. Farmers who grow traditional varieties may prefer to keep them mixed together in the same manner in which they are planted and simply grade according to size. Four sizes are usually utilized in the grading, the largest tubers form grade one and the smallest form grade four. The fourth grade is known as chancho (pig) or desecho (waste), though "waste" is a misleading translation since even the worst tubers are somehow utilized, especially on small farms. This fourth grade is normally processed or given, as its name implies, to the pigs. The actual size of each grade is not absolute but varies with the farmer and harvest in any particular year.

Grading is related to the use to which the tubers are put, and the pattern of use varies between farmers. For example, a small farmer who produces potatoes principally for subsistence grades his production as follows: 1) home consumption/small scale sale in the local market, 2) seed, 3) home consumption, 4) animals/papa seca. On the other hand, a large commercial farmer

near Huancayo who produces for the market grades his production: 1) sale to Lima, 2) sale to Lima, home consumption, and partial payment to workers, 3) seed, 4) gift to permanent workers.<sup>1</sup>

Each of the main alternatives open to farmers will now be described in turn.

### SALE

Farmers who produce some of their potatoes for the market, usually sell the largest and best tubers (grades 1 and 2) immediately at the harvest. Immediate sale is most commonly accomplished in the field, that is, the buyer purchases the crop directly from the farmer who may even leave the actual harvesting to the buyer. In the case of ware potatoes, the buyer is usually an intermediary who takes the produce to the wholesale market in Lima. In the case of seed potatoes sold to the Coast, the buyer will more often be a coastal farmer or an agent making the purchase on behalf of a coastal farmer.

Farmers have the option of taking their ware potatoes directly to Lima, paying the transportation costs and receiving a higher price than would be paid in the field. Some 25% of the potatoes sold at the wholesale market are brought by the farmers themselves (IICA 1974:45). Based on preliminary data it appears that medium sized farmers, growing between two and ten hectares of potatoes, are most likely to take their potatoes to Lima. Larger farmers are too busy managing their own farms to take time to travel to Lima on a regular basis

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<sup>1</sup> This gift is utilized by the workers for their own consumption, animal feed, or processing.

during the harvest; even those owning their own truck may seldom use it to take produce to Lima. Smaller farmers, on the other hand, are afraid to deal in the wholesale market for fear of being tricked and exploited by the buyers. Small farmers are usually unable to establish the personal connections to wholesalers which medium and large sized growers enjoy. A further option open to farmers is immediate sale in the local markets, especially Jauja and Huancaayo, but these markets can absorb only a small amount of the total production.

### EXCHANGE

In more isolated areas where the cash sale of potatoes is not highly developed, part of the crop may be exchanged for meat, corn, wool, or other products not produced by the farmer. Workers at the harvest may also be paid in potatoes in lieu of cash; potatoes may also be presented as a gift to relatives or neighbors who help in the harvest.<sup>1</sup>

### STORAGE

If potatoes are not immediately sold, exchanged or given away, they are stored. Potatoes may be stored for a variety of purposes, the most important of which are seed, on farm consumption, sale, animal feed, and processing (when the processing does not occur as soon as the harvest is accomplished). The following paragraphs discuss these functions in turn:

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<sup>1</sup> The best account of exchange and non market distribution of potatoes is found in Enrique Mayer's thesis, Reciprocity, self-sufficiency and market relations in the Central Andes of Peru (1974).

Seed. Almost all farmers try to store part of their harvest for seed in the following year. Seed is usually stored from the end of the last harvest until the first planting in the following year. At the time of planting in the Sierra there is a high demand for seed, owing to understorage, losses, and the desire to obtain new stocks. Some farmers, therefore, store an amount of seed greater than their own needs in order to sell at a good price to other growers in the Mantaro region.

On-farm consumption. All growers store some part of their production for subsistence purposes. On large production units, such as cooperatives, potatoes are kept for workers' families. For small farmers, subsistence is the most important purpose of their agricultural activities. Traditional potato varieties are usually preferred by farmers for their own consumption and even highly commercial farmers who grow the most recently released varieties such as Yungay and Cusco may cultivate a small field of traditional varieties strictly for their own household consumption.<sup>1</sup>

Sale. Farmers may store part of their potatoes for later sale in the year. This normally occurs on a small scale with the wife or husband selling to middle men by the arroba (11.5 kilos) or the wife selling small piles at local weekly

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<sup>1</sup> Traditional varieties are contrasted to a number of modern varieties, developed by plant breeders and others, which have been introduced to the region over the past few decades. Traditional varieties are referred to by farmers as comunes (common), papas de la mesa (table potatoes), and papas de regalo (gift potatoes)--the last two terms suggest the farmers' culinary preference for these varieties.

markets. The wife, being the person in charge of the household food supplies, frequently makes the decisions about when and how much to sell. When potatoes are stored for sale, generally the decision to sell them is determined by household cash needs, rather than by market prices.

Large and medium farmers may hold their crop for a month or two waiting for a rise in the price, but the practice appears to be very limited in scope. Trustworthy information on this storage practice is difficult to obtain, owing in part to Peruvian laws against speculation, which make storage illegal. However, my interviews have convinced me that the law is not generally enforced and that even without the legal prohibition potato storage would not be an attractive form of price speculation for potato growers. Most farmers with whom I spoke said they seldom stored to obtain a higher price because of the risk involved--namely that the price might not rise enough to cover storage costs and loss in weight and quality or that the price might even fall. Furthermore, farmers who utilize bank credit had to make their loan repayment at harvest time, making storage for sale at a later date unfeasible.

Animal feed. Most spoiled potatoes which are selected out of stored ware potatoes are fed to pigs as the need for feed arises. Potatoes are boiled before being fed to the animals. On most small farms, pigs fattened partially on potatoes are grown for sale rather than household consumption. The farmer's household generally maintains cuyes (guinea pigs) for its own meat supply. I did not encounter a single farmer who fed potatoes to cattle.

### PROCESSING

Two types of potatoes are used for processing: (1) spoiled and very small potatoes from the harvest, of both traditional and modern varieties, and (2) bitter potatoes (Solanum juzepczukii and Solanum curtilobum) which can only be eaten when processed into chuño due to the high content of glycoalkaloids (Christiansen 1976). Since processing is usually done with family labor in June or July, potatoes may be stored a month or two before being processed. Chuño and papa seca are the principal products made by processing potatoes; they are produced both for on farm consumption and sale. Most papa seca is produced for sale in the Lima market, and is eventually consumed in the coastal dish carapulca. Some farmers on the valley floor send a part of their potato production to family and friends at higher altitudes who make chuño from the potatoes in exchange for 50% of the product. One interview was carried out with a farmer living at 3,800 meters who exchanged one arroba of chuño for one arroba of maize produced at lower altitudes. Starch (almidón) is made in only a few households in the region.

### RELATION BETWEEN POST-HARVEST UTILIZATION AND FARMERS' POTATO PRODUCTION

A preliminary survey of 20 potato growers located in various parts of the Mantaro Valley region was carried out in order to determine the extent to which the post-harvest practices just described may be related to the amount of land planted in potatoes and to other variables. The survey results must be treated as rough estimates, subject to revision when a larger and more carefully selected sample of farmers can be surveyed.

Table 1 lists some of the characteristics of the surveyed growers. All but two of the growers are private farmers, but the term private farmer is taken to include the farmers who utilize individual plots assigned to them on communal land. Only one cooperative is included in the survey, though many cooperatives and communities were visited during the study period. Map 1 shows the area in which the survey was carried out.

Table 1 shows that 12 of the 20 growers produce both traditional and modern varieties of potatoes. The most widely grown improved variety is Mariva (12 growers) followed by Renovación (six growers). All farmers growing less than two hectares of potatoes grow common varieties, whereas only three of the ten growers with more than two hectares do so. This reflects the overriding concern of larger growers for commercial production of varieties which are high yielding and easily sold in volume in the Lima market. Smaller growers, concerned with subsistence as well as commercial production, are prone to produce traditional varieties on the basis of their superior palatability.

Table 2 indicates the relationship between the area seeded to potatoes on survey farms and utilization of the crop. Small, medium and large farmers exhibit different patterns of storage, marketing and processing. In terms of storage, small farmers with less than two hectares in potatoes store about 59% of their production while medium and large farmers store only 13% and 20% respectively. The largest part of this difference occurs in regard to the storage of potatoes for on farm consumption; on the average, small farmers store nearly 37% of their production for their families' consumption while medium and large growers store less than 3% for that purpose. Likewise small farmers store

Table 1: Selected characteristics of twenty producers in the Mantaro region.

Case number	Land tenure	Location	Variety planted		Area in potatoes ha.	Average Yield T/ha	Total Production T.
			modern	Tradi- dional			
<b>Small Farms (less than 2 has. in potatoes)</b>							
A	private	Huaricolca	Renovacion Mariva	X	0.2*	7.8'	1.6
B	private	Congas	Mariva	X	0.2*	6.4	1.3
C	private	Ricran		X	0.2*	8.2	1.6
D	private	Pachachaca	Renacimiento Renovacion	X	0.3	3.7	1.2
E	private	Pungray	Mariva Ticahuasi	X	0.3*	6.6	2.0
F	private	Tingo	Renovacion	X	0.7	2.6	1.8
G	private	Acolla	Mariva	X	1.0	6.6	6.6
H	sharecropper	Pachac	Renovacion	X	1.0	1.2	1.2
I	private	Pucara	Renacimiento	X	1.3	3.5	4.6
J	private	Chupampa		X	1.6	2.7	4.4
<b>Medium Farms (2-10 has. in potatoes)</b>							
K	private	Huancan	Mariva Ticahuasi		2.0	9.5	19.1
L	private	Chocon	Renovacion Ticahuasi		3.5	9.5	33.4
M	private	Pampas	Renovacion		4.0	17.9	72.0
N	private	Sacas	Mariva Renovacion	X	4.0	14.0	56.2
O	private	Acolla	Mariva Ranrahilca	X	5.0	14.8	74.2
P	private	Huasahuasi	Mariva Ticahuasi		8.0	1.9	16.0
<b>Large Farms (over 10 has. in potatoes)</b>							
Q	private	Tarma	Mariva Yungay		22.0	24.0	600.0
R	private	Huancas	Mariva Ticahuasi	X	45.0	4.3	196.3
S	private	Huasahuasi	Mariva Ticahuasi		50.0	12.6	630.8
T	SAIS	Cerro Blanco	Mariva Ticahuasi		100.0	14.8	1480.0

\* Amount of land has been figured on the basis of 1000 kilos planted per ha. when the farmer measured amount of potatoes planted in terms of amount of seed utilized rather than in terms of amount of land planted.

Table 2: Post-harvest utilization in relation to the amount of land planted in potatoes.

Case number	Area in potatoes ha.	Utilization of potato production (per cent of total potato harvest)						
		Stored		Sold		Processed	Animal Feed	Total
		ware	seed	ware	seed			
<b>Small farms (less than 2 has. in potatoes)</b>								
A	0.2	45	27	22	0	2	4	100
B	0.2	54	13	11	0	11	11	100
C	0.2	53	13	8	0	21	5	100
D	0.3	34	25	22	0	11	8	100
E	0.3	39	49	7	0	0	5	100
F	0.7	68	10	11	0	0	11	100
G	1.0	16	21	38	15	0	10	100
H	1.0	25	58	0	0	0	17	100
I	1.3	60	16	8	0	8	8	100
J	1.6	24	15	24	0	24	12	100
Mean		37	22	20	3	8	10	100
<b>Medium farms (2-10 has. in potatoes)</b>								
K	2.0	6	7	84	0	0	3	100
L	3.5	4	18	75	0	0	3	100
M	4.0	1	10	56	32	0	1	100
N	4.0	4	6	85	0	4	1	100
O	5.0	5	3	80	0	9	3	100
P	8.0	0	53	0	44	0	3	100
Mean		3	10	70	11	4	2	100
<b>Large Farms (over 10 has. in potatoes)</b>								
Q	22.0	1	7	37	55	0	0	100
R	45.0	1	25	25	47	2	0	100
S	50.0	12	16	48	24	0	s.n.	100
T	100.01	6	14	40	40	0	0	100
Mean		6	14	40	40	0.5	s.n.	100

more seed (22%) than do medium (10%) and large growers (14%). Since potatoes which are utilized for animal feed and for later processing are also stored, the percentage of potatoes stored by small growers is higher than indicated on the table. Small growers utilize a little more than 11% of their production for animal feed while this form of utilization is of little importance to medium and large growers. Likewise processing is more important for small growers who process about 8% of their total production, while medium growers process only 4% and large growers process less than 1%.<sup>1</sup>

The different patterns of post-harvest utilization can be clearly seen in the percentage of production sold at the harvest. Small farmers sell only about 22% of their harvest while medium and large growers sell 80% or more. Large growers sell a much higher percentage of their crop as seed (40%) than do medium (11%) or small (3%) farmers.

It is clear from this preliminary survey that small farmers proportionally store more, process more, and sell less potatoes than do medium or large growers. It appears, therefore, that the problems of spoilage and loss in storage affect more severely the small producer who aims at on farm consumption than the large and medium producer who aims at commercializing the greatest portion of his crop.

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1 The percentage of processed potatoes in total production on large holdings is masked by the fact that the spoiled and very small potatoes are given or sold to the workers. Some of these potatoes are processed by the workers, but the quantity has not been estimated.

SUMMARY OF PART I.

The farmer growing potatoes in the Mantaro Valley region is faced with a number of alternatives for disposing of his/her production. The most important alternatives are immediate sale or exchange, storage for on farm consumption and seed, and processing. A farmer's decision about utilization is based on an overall strategy aimed at subsistence or commercial production or a mix of both. A farmer's strategy is, in turn, the outcome of the resources available to him/her (land, labor, capital, and inputs), non farm employment, probable yield, and other factors.

In relation to the variable of amount of land planted in potatoes, farmers show markedly different utilization patterns. Most farmers sell some potatoes, but the larger the area planted to potatoes the larger the amount sold, both in absolute and relative terms. Conversely smaller farmers store a larger share of their production than do medium or large growers. Small farmers store their production principally for on farm consumption and secondly for seed. Potatoes destined for animal feed and future processing are also stored. Medium and large growers, on the other hand, primarily store potatoes for seed in their next planting and only store a minor percentage for home consumption; processing and animal feed are unimportant forms of utilization for medium and large growers who sell the great bulk of their production at harvest. Storing for sale at a higher future price, the most important reason for farm storage of potatoes in developed countries, is practiced on only a very limited basis by farmers in the region. Somewhat more common is the practice of selling potatoes as the need for cash arises within a small farmer household.

## PART II

### TYPES OF POTATO STORAGES IN THE MANTARO VALLEY REGION

The previous section has established that potatoes are stored primarily for seed and on farm consumption, and to a lesser extent for processing, animal feed and future sale. The problem is now to describe how farmers store their crop. This section will describe several storage systems employed in the Mantaro Valley region. These will be grouped into three main types: house storages, outbuildings and field storages. After these systems have been described, survey results will be presented which relate use of a system to the amount of potatoes produced and stored by a grower. A short discussion of problems involved in improving the storages of the Mantaro Valley region follows this section.

#### HOUSE STORAGES

In the Mantaro region the most common place for potato storage is the farmer's own dwelling, which is itself designed for storage purposes. Stein has written about the Peruvian rural house, "the main economic function of the house is the storage of agricultural products and tools and it serves to shelter at least some of the animals as well. Its functions in sheltering people are almost secondary to these basic purposes... (1961:74)." The house is a convenient and secure place to keep produce. Within the house and the walled compound, potatoes and other assets can be kept from thieves (an important consideration in the Sierra) and from the evil eye (mal de ojo) of envious neighbors, while being kept close at hand for cooking and processing.

The basic house type in the Mantaro Valley consists of a one floor main building with an attic reached from the outside by a ladder. There is a kitchen attached to the house, some smaller buildings, and a wall enclosing all of these structures in a court yard. The construction is generally of adobe with tile roofs; more prosperous farmers may substitute galvanized tin for tile roofing. The house and other buildings are usually windowless.

When potatoes are brought to the house for storage at harvest time, the tubers have usually been separated and graded. Tubers destined for seed and ware purposes are frequently stored in different parts of the house. Table 3 shows that among 15 farmers in the survey who stored both seed and ware potatoes in their houses, 13 preferred to keep seed potatoes on the floor. Nine preferred, on the other hand, to keep their ware potatoes off the floor, either in the attic or on the top of rafters.

Table 3: Location of seed and ware potatoes stored in the house

Location	Purpose of Storage	
	Seed	Ware
On the ground	13	6
In the attic	2	6
On the rafters	0	3
Total	15	15

In responding to the question of why they kept seed potatoes on the ground floor, farmers gave two main reasons. First, the seed potatoes kept their shape (guarda su forma) on the ground, in contrast to tubers kept in the attic which become shriveled and dried out. Farmers could not explain how the shape was kept, other than that it was the result of contact with the earth.<sup>1</sup> A second reason given was that less handling is involved if the seed is kept on the ground floor since the tubers do not have to be carried upstairs.

Storage of ware potatoes in the attic appears to be related to culturally determined food preferences. Several farmers with whom I spoke made an important culinary distinction between types of ware potatoes. On the one hand, traditional varieties are boiled with the skin on (papas de sancochar). These traditional varieties are normally stored in the upper part of the house where dryness and air circulation cause them to shrivel up rapidly. Shriveled potatoes are known by a special term, papa dulce (sweetened potato), and they are considered by farmers as desirable from a culinary point of view. Potatoes which appear to be spoiled in comparison to fresh tubers are often preferred by farm consumers and, therefore, placement in the attic or rafters does not signify bad potato storage practices but rather a method of sweetening.

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<sup>1</sup> Presumably the ground being moist keeps the potatoes from dehydrating at the rate they would if stored in the attic.

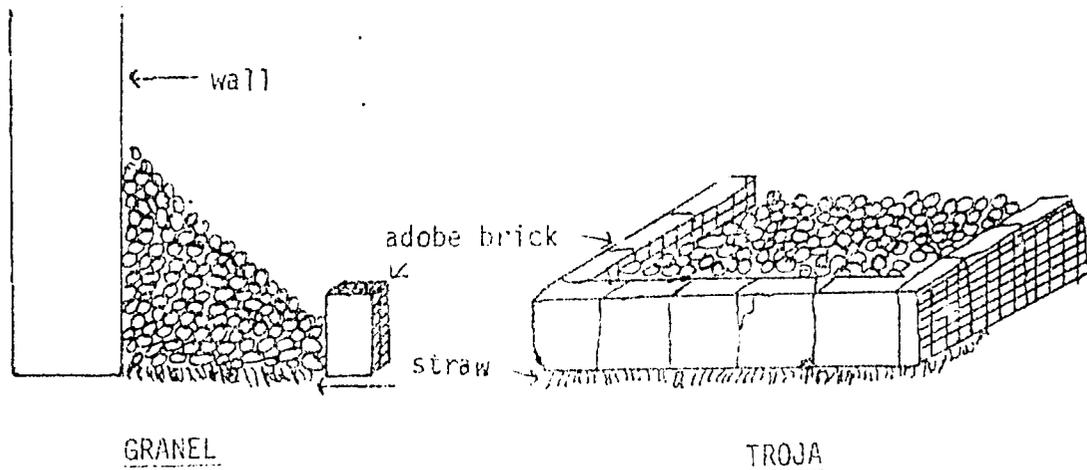
On the other hand, modern varieties, such as Renacimiento and Revolución, have the skin removed before preparation and are called peeling potatoes (papas de pelar). Peeling potatoes are considered best when they are turgid, and these varieties are most often kept on the ground with seed potatoes where moisture helps to keep them firm and makes them easier to peel.

Another factor affecting the farmers' decisions about locating storage within the house is the effect of light. Farmers attempt to keep ware potatoes away from light to prevent them from turning green. Since most houses are built without windows, light can be easily controlled. Within the house ware potatoes are frequently covered with straw or burlap sacks in case light does come in, for example, through an open door. There appears to be confusion as to the effect of light on seed potatoes; some farmers insist that seed be kept in a dark place while others allow indirect light to enter whenever possible.

Each of the main types of storages will now be described, beginning with house storages and then moving on to outbuildings and field storages.

1. Granel/Trojas. When seed potatoes are kept on the ground floor of the house, they are often put on a thin bed of straw or eucalyptus leaves. Retama (*Spartium junceum*) and muña (*Minthostachus mellis*), native plants believed to repel insect pests, are not widely used. Potatoes are left in piles (graneles) against the walls of the house and are kept in place by logs, adobe bricks or stones lined up parallel to the wall (see Sketch 1). The piles slope up to the wall where they may reach a height of one to one and a half meters.

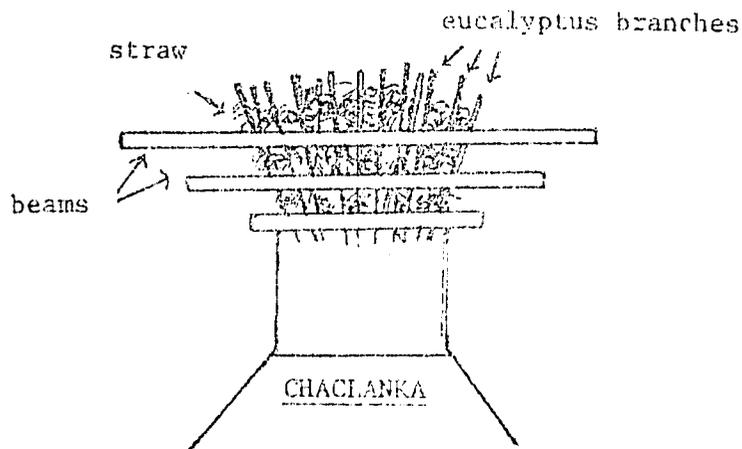
At times, small bins (trojas) are constructed from adobe bricks which give the piles somewhat more stability and keep the potatoes at a more even level.



SKETCH 1

2. Kawito. Several farmers I visited lived above 3,700 meters in houses made from stone instead of adobe. The stone house is a much older type of dwelling than the adobe houses described earlier which have been heavily influenced by Spanish domestic architecture. In small, circular kitchens built alongside the stone houses, low shelves are constructed on which potatoes can be stored above a layer of straw. The low shelf is known as Kawito. These shelves are necessary due to the fact that guinea pigs kept in the kitchen would eat food stored on the ground.

3. Altos. It has been mentioned that the attic of the house is an area in which ware potatoes are often kept. The potatoes are piled up as they are on the ground floor, with care taken to make sure they are kept away from any indirect sunlight so that they do not turn green. In order to avoid greening, piles of ware potatoes may be covered with sacks or straw.
  
4. Chaclanka. The chaclanka is a specially constructed platform which fits across the rafters of the ground floor room. The platform is made from eucalyptus poles covered with a thin layer of straw, over which the potatoes are spread (Sketch 2). Only ware potatoes are kept in this type of storage whose advantages are said to be the darkness in which the tubers can be kept and the fact that insects, drawn out of the potatoes by the smell of the eucalyptus, fall to the ground and cannot reinfest the tubers.



SKETCH 2

## OUTBUILDINGS

Private growers, cooperatives, and communities in the Mantaro Valley region who store potatoes in quantity utilize outbuildings constructed away from the house. Only a very small percentage of production units in the region have such facilities, but I visited a large number (15) not represented in the final survey because they had a type of storage unit in which CIP and the Peruvian government have considerable interest. The majority of these outbuildings are used for keeping seed potatoes from the harvests of May-June to the planting in October-November. Ware potatoes stored with the seed potatoes are usually kept for workers' consumption. Only two of the fifteen outbuildings I visited were designed and constructed specifically for storing potatoes, and neither of the two had been used during the last year.

Eleven of the fifteen outbuildings visited are constructed from adobe, the basic building material of the Central Sierra. Two are constructed from brick and cement and two are rough constructions made of wood. Thirteen have roofs of tile, and two have tin roofs. Twelve outbuildings are enclosed on four sides; three facilities are converted stables with one side open.

Five of the storage facilities have windows, over which empty sacks are, sometimes hung to prevent the direct entrance of sunlight. In all the outbuildings, some light filters in through spaces between the roof and walls and through the roof itself which is not always in good condition. All have earth floors. Smaller facilities consist of a series of joined rooms; the larger ones are usually one large open space.

Most outbuildings used for potato storage are multipurpose, in the sense that they are also used to store tools, other crops and agricultural inputs of various types. One community uses the auditorium of the local health clinic to keep their seed potatoes; this is the cause for some friction with the public health nurse. The use of converted stables by the largest potato growers in Huancayo also reflects the need for flexible arrangements. Given the uncertainty brought by a rapidly changing agrarian economy and by land reform, farmers are hesitant to invest in specialized storage facilities. One large grower who rents over 150 has. for growing potatoes said that he modeled his new storehouse on a stable in case dairy cattle would become more profitable than potatoes in the Valley.

In the outbuildings potatoes are kept in piles on beds of straw. If many tubers must be stored in a limited space, piles are made deep (one and a half to two meters) meaning that tubers on the bottom often sprout before those on top where greater light inhibits sprouting. Farmers cite this unequal sprouting as a problem, especially with new precocious varieties such as Mariva.

There are two major warehouses built by the government in the Mantaro region. An adobe one was constructed near Jauja in the 1960's by SIPA and is now operated by the University in Huancayo (UNCP). The building contains a series of 19 wooden bins made from narrow eucalyptus boards. These bins are built 25 cm. off the floor to permit circulation of air through the potatoes. The bins are three meters wide, two meters high and two and a half deep. Potatoes are stored in piles in the bins according to variety. The agent in charge of the warehouse estimated the cost of constructing each bin

at S/.4,500 at Nov. 1976 prices. The potatoes stored there are used in the university's own experiments and breeding work and are also sold to farmers at planting time.

A major potato storage facility consisting of 14 storehouses was constructed in Quiulla outside of Oroya in 1972 and is run by EPSA (Empresa Pública de Servicios Alimenticios). These storehouses are made of brick and cement and stand alongside the Central Highway. Each storehouse contains eight rooms cooled by a forced night air system. These facilities are the most advanced potato storages in the Mantaro region, from a technical point of view. However, potatoes have not been stored in them profitably. At present, a few of the units are used to store rice while the rest are virtually empty. In 1976, potatoes occupied only part of one unit.

The storages were originally designed to regulate prices in the Lima potato market by buying potatoes from farmers in the region when low prices prevailed at harvest and selling to Lima when the price rose later in the year. The storages were filled with ware potatoes the first year, but the tubers were not sold, either because the anticipated price rise did not materialize or because of management problems. According to several informants, the persons in charge of the deposits attempted to sell their ware potatoes as seed to the farmers in the area during the next season. This precipitated a lawsuit brought by the Ministerio de Alimentación in Huancayo which was eventually heard in the local court in Jauja. But by this time, most of the potatoes had rotted and, according to several informants, were dumped into the Mantaro River.<sup>1</sup>

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<sup>1</sup> Storage facilities for potatoes similar to the ones at Oroya were also constructed in the early 1970s at Anta in Cusco and Juliaca in Puno. I visited these storages in early 1977 and found them to have a similar history, that is, after a first year of storing potatoes with very poor results, they have not been used for that purpose again.

Another storage facility built specifically for ware potatoes was constructed by a large private grower who is also a wholesaler with his own stall in the Lima market. He built a large adobe building in the compound of a local farmer, perhaps to evade charges of speculation. Previously he had rented rooms in farmers' houses for storing part of his crop until he could sell at a more advantageous price.<sup>1</sup> Though the farmer-wholesaler has used this storage in past years, in 1976 he did not store any of his production there.

### FIELD STORAGES

A small number of farmers use field storages in the Mantaro Valley region for keeping potatoes either in or on the ground. These storages are most commonly found at higher elevations. Seed potatoes are kept in these storages for the five months between harvest and planting and ware potatoes for shorter periods. This period corresponds to the dry season when there is little danger that the field storages would become waterlogged or flooded.

1. Poqullo/hueco. This type of storage is made by digging a hole in the ground, lining it with straw, putting in the potatoes, and covering with straw and dirt. This type of storage is practiced in many parts of the world

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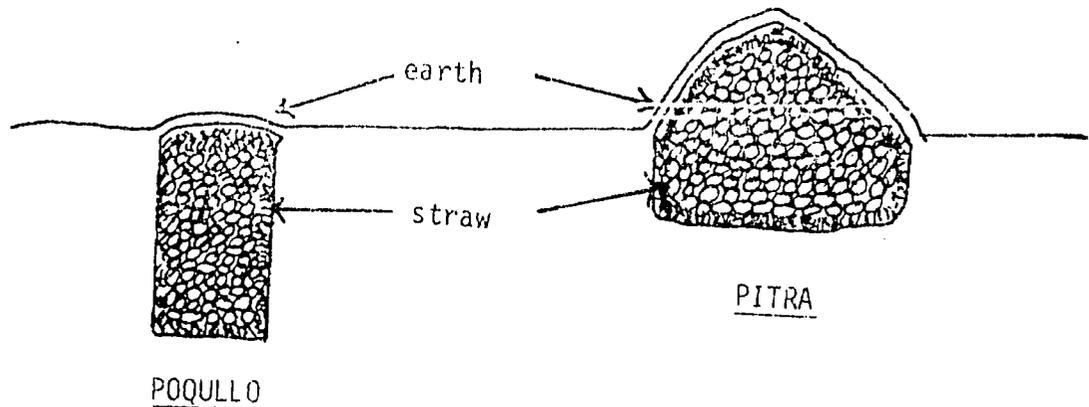
1 This farmer-wholesaler is a very large producer who annually rents a large amount of land in the Mantaro region. It is his position as a major wholesaler of potatoes in Lima which allows him to hold off this crop from the market in some years until a more favorable price situation arises than that prevailing at the harvest. As a wholesaler, he has excellent and up-to-date knowledge of price changes as well as direct access to retailers, both of which other large producers lack.

from Nepal to England. Field storages may have been once more widespread in the Mantaro region; several farmers told me that they used to store seed in this manner but that they had discontinued the practice. They explained that the need to select potatoes carefully in order to avoid spoilage required too much labor input.

This type of field storage is most commonly found at higher elevations. Above 3,000 meters some farmers dig holes one to one and a half meters deep and one meter wide to store seed potatoes. The straw used to line the pit is ichu (*stipa ichu*), the grass most common in pastures lying close by these high potato fields. The holes are dug near the harvested field to avoid the trip to and from the farmer's house which is often located some distance away. One farmer explained that she left her seed potatoes in the ground storage because, not having horses to carry the load, the five kilometer trip between house and field was too arduous. Several farmers mentioned that it is possible to store ware potatoes in field storages but none of them currently did so. However, I did see potatoes kept in these storages for animal feed.

At lower altitudes, large shallow pits are dug by at least one farmer for the storage of seed potatoes. One large farmer in Sicaya stored over 150 T.M. of seed in a series of circular pits which measured four meters in diameter and were 50 cm. deep. The potatoes were placed in a mound several meters high on top of barley straw which lined the pits; each mound held 30 T.M. The mound was covered with straw and earth. The tubers

are placed in storage in April and taken out in October (see Sketch 3).



SKETCH 3

This same Sicaya farmer clearly distinguished between varieties which could be stored in the field and those which had to be stored in a new outbuilding he had constructed. Varieties stored in the pits include Renovación and Renacimiento, chosen because they are less precocious than other new varieties. He also said that field storage has the advantage that the potatoes do not lose their weight (no baja su peso), though the tubers I saw taken out of the storage had long sprouts which were picked off by workers in preparation for planting. He overcame the disadvantage of the high labor input by paying the wives of his field workers very low wages to select potatoes for storage.

Another use of this type of field storage is as a temporary storage for the few large farmers who want to hold their production off the market for one or two months in anticipation of a price increase. Temporary field

storages represent a small investment in labor and capital, and farmers say that the potatoes do not require a strict selection when stored for so short a period of time. It is difficult to say how widespread the use of temporary field storage is; only one farmer interviewed said he had used a field storage for this purpose in 1976. He said he had done so previously only when the price was very low because a decrease in weight and quality would easily offset an increase in price.

2. Shunto. At higher altitudes, potatoes are sometimes stored for several months by simply laying them out in a field in the puna (high grass land) covered with ichu straw. The straw is arranged in the form of continuous peaks which eventually turn black and form a waterproof cover. Ichu is used as thatch on the roofs of the poorest and most isolated farmers in the Mantaro Valley region.
3. Chosa. Small huts are constructed to store potatoes in some communities near the town of Huasahuasi. The roof is made with straw and around the hut poles are staked to keep out animals. Trenches are dug around the hut to keep water from accumulating. This type of storage may be an adaptation of the field storage to a geographical zone which receives rain on a year-round basis. Normally, the field storages in the Mantaro area are utilized during the dry season when no rain falls which might cause damage to the potatoes.

### RELATION BETWEEN TYPES OF STORAGE AND POTATO PRODUCTION

This discussion of house storages, outbuildings and field storages has presented the major types of storage used in the Mantaro Valley region. Using data from the survey of 20 farmers, Table 4 has been constructed to point out the relationship between the type of storage and the amount of potatoes produced by a grower. This table indicates that there is a strong relationship between the area planted in potatoes and the type of storage used.

House storage is by far the most common manner of keeping potatoes. All farmers planting less than four hectares of land utilized storage space within the house. Of the farmers with more than four hectares, less than half store in the house; the others store their potatoes in outbuildings or, in one case, a field storage. Of the 20 farmers, 16 used the house for part or all of their potato storage needs.

One reason for the relationship between a large amount of area planted in potatoes and non house storage is that larger growers need more space not only for potatoes, but also for tools, inputs, and other crops. Hence, they make a greater investment in outbuildings than do small farmers whose needs are met by the typical house construction. When the time for storing potatoes comes, outbuildings are utilized and may even continue to be utilized if the grower no longer grows potatoes in large quantities.

Table 4 also reveals that outbuildings are utilized only by farmers with more than eight tons of potatoes to store. Eight tons may serve as a kind of

Table 4: Storage practices in relation to the amount of potatoes produced

Case number	Area in potatoes ha.	Amount Stored		% of total production stored	Type of storage	
		ware T.	seed T.		ware	seed
<b>Small farms (less than 2 has. in potatoes)</b>						
A	0.2	.7	.4	72	House	House
B	0.2	.7	.2	67	House	House
C	0.2	.9	.2	66	House	House
D	0.3	.4	.3	59	House	House
E	0.3	.8	.9	88	House	House
F	0.7	1.2	.2	78	House	House
G	1.0	1.0	1.4	37	House	House
H	1.0	.3	.7	83	House	House
I	1.3	2.8	.7	76	House	House
J	1.6	1.0	.7	40	House	House
<b>Medium farms (2-10 has. in potatoes)</b>						
K	2.0	1.0	1.4	13	House	House
L	3.5	1.4	5.9	22	House	House
M	4.0	.7	7.5	11	Outbuil.	Outbuil.
N	4.0	2.1	3.1	10	House	House
O	5.0	3.5	2.0	8	House	House
P	8.0	.9	8.4	53	- -	Field
<b>Large farms (over 10 has. in potatoes)</b>						
Q	22.0	6.0	44.0	8	House	House
R	45.0	2.8	50.0	26	Outbuil.	Outbuil.
S	50.0	80.0	100.0	28	House	Outbuil.
T	100.0	80.0	200.0	20	Outbuil.	Outbuil.

threshold which forces the farmer to begin to utilize buildings apart from the house. Those with lesser amounts to store use some form of house storage, though one farmer who stored 50 tons utilized his house, a rambling two story adobe building with over 20 rooms .

### SUMMARY OF PART II

The most common place for potato storage is the farmer's own house, for reasons of security and convenience. With the exception of the chaclanka, there is no fixed place in the house used for potato storage. Storage space within the house is multipurpose; when the potatoes are not being stored, something else is kept in their place.

Within the house, distinctions are often made between storages which are appropriate for seed and for ware potatoes. These distinctions are based upon the perceived characteristics of potatoes. Seed potatoes need to keep their form and handling should be minimized. Ware potatoes need a dark place and should not be allowed to turn green. Consumer preferences for common varieties which have been allowed to sweeten also play an important role in determining where ware potatoes are kept.

Potatoes are usually kept from direct contact with the ground by a layer of straw or other material. This provides for some circulation of air under the pile. Plants like muña and retama which are said to help eliminate insects math, appear to be used by only a few farmers except in years when insects math pose a particularly serious problem. Farmers commonly utilize

more easily available eucalyptus whose smell they believe also repels insects.

Outbuildings are constructed by large growers (including communities and cooperatives) in the Mantaro Valley. These producers generally grow more than four hectares of potatoes and store more than eight tons of tubers either for seed or ware purposes. Outbuildings are generally built of local materials and are multi-purpose in nature. For over ten years, the University of Huancayo has operated a more sophisticated building, using wooden bins, but this design has not been copied by farmers in the region.

While outbuildings are utilized for seed and ware potatoes on larger farms, it is not common for them to be used for storing ware potatoes for sale. The EPSA storage in Oroya illustrates the difficulties of storing ware potatoes even with excellent technical facilities.

Field storages are used on a limited scale, either to store ware potatoes for short periods or to store seed potatoes. These storages are made feasible by the fact that the normal storage period in the Mantaro Valley (April - October) is a time when there is no rain. The main disadvantage noted by farmers who have used field storages is the high labor input for selecting tubers when the potatoes are to be stored for an extended period of time. Another disadvantage is that in most areas, field storages must be guarded constantly against widespread theft of crops.

PART III

IMPROVEMENT OF POTATO STORAGE IN  
THE MANTARO VALLEY REGION

To date, attempts to improve storages used by farmers in the Mantaro Valley region have been based on the assumption that presently used storages are inadequate, in that they show a high percentage of weight and quality loss in the tubers when compared to tubers kept under ideal conditions. In this final section, two problems involved in improving storages are discussed, namely the lack of data on the performance of present storages and the different perception of storage problems by farmers and technicians. Finally, some suggestions are made for ways in which improvements in storage practices might be made.

It is generally assumed by technicians and agricultural engineers that storages used in the Mantaro Valley region are backward and inefficient.<sup>1</sup> Loss estimates made by Ministry officials for a typical five-month period range from 20% to 50%. However, apparently no tests have ever been carried out to measure the weight and quality losses characteristic of the types of storages described in the preceding section. Since no point of comparison with existing storages exists, it is very difficult to determine the benefits from improved storages.

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1 I had a great deal of trouble convincing local officials that I was interested in looking at storages employed by common farmers; officials inevitably wanted to show me advanced or large farmers' stores.

An important line of future research is the measurement of weight losses and quality change in currently utilized storages, such as those just described. Tests should be held under both experimental and farm conditions. Such data are necessary for a correct evaluation of the costs and benefits accruing from the introduction of a new storage practice.

Beyond the need for measurement of losses in local storages, it is important to consider the perception of storage problems by farmers in the region. The adoption of a new storage technique by farmers will depend in part upon whether or not they perceive storage losses to be grave enough to warrant an investment of time and capital. While expressing some preoccupation, particularly over the storage of new varieties like Mariva, farmers, in the region appear to be generally complacent about storage losses.<sup>1</sup> Two explanations might be given for this attitude. The first is that storage losses are not as high as claimed by technicians. This hypothesis, of course, could be tested by measuring and comparing losses under experimental and farm conditions.

The second is that storage losses are perceived in different terms by the farmer and the technician. A clear example of differences in perception was presented in the first section of this study. It was mentioned that old potatoes which appear

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1 I am speaking here of my impression from a number of conversations with farmers. Whether or not my impression is correct should be tested in a more formal way through a structured interview schedule or questionnaire.

to be shriveled, dehydrated and of poor quality are preferred by farm families because of their sweet taste. In this case, quality is a culturally defined term and the farmer and technician would disagree about what constituted a good quality tuber.

From these examples, it should be clear that the farmer's and the technician's definition of "loss" may differ considerably. Even if it can be shown that local storages result in greater dehydration and spoilage than improved storages, it will be important to determine how farmers perceive these "losses" within their own culture and opportunity cost framework.

If farmers are involved in testing storages, some of these perceptions can be incorporated into the research at an early stage.

Assuming that storage losses in local terms are large, and that farmers perceive them as great enough to warrant a change in their storage practices, what changes or improvements could be made? Putting the question another way, how can present practices help to guide research on improved storages for farmers in the region?

First, improved storages should be built from local materials, should be cheap, and should be multipurpose in design. House storages and outbuildings already in use are generally made of adobe; nothing more than straw and earth are used in field storages. These materials and the simple design of storages represent little capital or labor investment. This is a clear advantage for farmers who have little money to invest in improving storage facilities. Another advantage

of local storages is that farmers can utilize the space for other purposes when potatoes are not being kept. These advantages must be incorporated into the design of new storage systems if, indeed, they are to be perceived as improvements from the farmer's point of view.

Second, since the overwhelming majority of farmers in the region store potatoes in their houses, the best course for improving storage, and a novel one, would be to develop simple improvements in house storages. The house represents the family's control over its own production; it provides a convenient and secure place to keep potatoes. Given these advantages, it is doubtful that farmers currently using their house could be convinced to utilize a large common storage with other farmers.

In order to improve the conditions under which the great bulk of potatoes are stored in the region, a series of improvements designed for implementation in the house should be developed which would incorporate changes in terms of light, ventilation, handling and small constructions. The fact that different places in the house are used to store different types of potatoes points to a flexibility in using household space which would ease the introduction of new techniques. The fact also that there is disagreement among farmers as to, for example, the effect of light on seed potatoes, would make the presentation of principles for house storage a topic in which farmers would have an interest.

Third, while improvements in house storage should be a main focus, the development of a simple outbuilding for storing upwards of eight tons of potatoes for seed or ware purposes would have some direct application to large growers,

especially cooperatives and communities. Given the uncertainty about the direction of land reform in the Mantaro region, it is doubtful that private growers would find this a propitious time to invest in new storage facilities. The number of such outbuildings which could be constructed is limited by the small number of large non-private growers in the region. Nevertheless, for those with sufficient resources and interest, improved outbuildings could represent a practical and profitable investment on some holdings.

Fourth, more widespread use of field storages appears to be limited by the amount of labor needed for proper selection and the need to guard the storages against thievery. The fact that field storages seem to have once been used more widely than at present may mean that they are not well adapted to changing economic conditions in the region, such as the rising cost of labor. However, it is important to test these storages to see if they are as efficient as those few who use them claim. It may be that field storages would be better adopted in areas within Peru but outside the Mantaro region.

Fifth, changes in the system of post-harvest utilization, for example, encouraging farmers to store more tubers for sale, represent a much more difficult set of problems. Without major changes in the price cycle or the level of prices which farmers receive for their produce, it is doubtful that technical improvement in the storages will itself induce a radical change in the reasons for which potatoes are stored. In other words, it is doubtful that improved storage facilities, per se, will induce farmers to store potatoes in anticipation of future higher prices — the pattern in many developed countries and a goal desired by officials in some developing countries in order to even out price fluctuations and to stabilize the

supply of potatoes in urban markets.<sup>1</sup> At this point, it would be wise to concentrate upon improving storage methods for the purposes for which potatoes are currently principally being kept, namely on farm consumption and seed. There is a particular need for concentrating on these areas, given the problems which farmers are currently experiencing in storing new precocious varieties, such as Mariva, which break dormancy in storage much sooner than older varieties.

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<sup>1</sup> An earlier discussion of this problem from an economic standpoint in Peru is given in Sheperd (1969). Almacenamiento para productos agrícolas en el Perú. Lima.

APPENDIX A

INFORMATION ON THE MANTARO VALLEY

The Mantaro Valley is one of the most important and scenic intermontane valleys of the Peruvian Andes. The valley derives its name from the river which flows through it. The Mantaro River enters the valley above Jauja at 3,300 meters and drops about 200 meters before it leaves the valley below Huancayo. Around the valley are ranges of high mountains, the tallest of which, Huayta-pallana, rises to 5,557 meters. Huancayo, the capital of the department of Junin and the largest city in the valley, derives its name from that of the Huancas, the original inhabitants of the valley, who allied themselves with the Spanish against the Incas during the Conquest.

The weather in the valley consists of two distinct seasons, the rainy season which begins in late October and lasts through March and the dry season which fills the rest of the year. Frosts occur most heavily in May, June and July. The weather is, however, very variable; during the past growing season (1976-1977) for example, the rains did not come until January and were much below normal. Average annual rain fall is 720 mm.

The population of the valley in 1972 was 423,000 persons of whom more than 1/4 live in the city of Huancayo. The rest of the population lives in a series of settlements which lie at regular intervals on both sides of the Mantaro River. Small settlements are dispersed through narrow side valleys which lead down to the Mantaro River.

The Mantaro Valley is today one of the most developed areas in the Peruvian Sierra. A diversified economic base is built upon agriculture, mining, artisan trades, and commerce. The main impetus to the development of the area in the 20th century has been the establishment of railroad and highway connections to Lima.

The agriculture of the Mantaro Valley is a mix of animals and crops from both the New World (potato, maize, llamas and alpacas) and the Old World (wheat, barley, sheep and cattle). Crop production is oriented toward subsistence as well as sale in Lima and local markets. Only about 10% of the land in the valley is planted in crops in any one year. Of these 120,000 hectares, 11,000 are irrigated. About 80% of the land in the valley is devoted to natural pastures.

The most important crops in the Valley are potatoes (18,000 has.), barley (13,000 has.), maize (10,000 has.) and wheat (8,000 has.). Eighty per cent of the potatoes are grown on rainfed land, most of it on the sloping hillsides which surround the valley floor. According to the 1972 census, the average potato yield in the Mantaro Valley region was estimated at 2.6 TM/ha, but this may be considered a very low figure. Average yield is commonly taken to be about double that amount.

Farms in the Mantaro are generally small. Seventy three per cent of the holdings in the valley have less than two hectares of land. Farms are divided into a number of small parcels which are widely scattered to take advantage of different ecological conditions.

Potatoes are grown under a wide range of ecological conditions and technological systems. For example, it is still common in some communities to prepare potato fields by hand either with the pick or the chaquita (footplow), a tool which predates the Spanish conquest. Only rarely are potato fields prepared by tractor since most parcels are small and on slopes which are quite steep.

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