PN-AAQ-914
ISN 36616
931.82

Improvement of Postharvest Grain Systems

Grain Storage, Processing and Marketing

Report No. 95

June 1984

PERU'S GRAIN MARKETING INFRASTRUCTURE: CHANGES NEEDED TO REDUCE POST-HARVEST LOSSES

KSU
KANSAS STATE UNIVERSITY

FOOD & FEED GRAIN INSTITUTE
MANHATTAN, KANSAS 66506

PN AAQ 914

REPORT SUMMARY

Title of Report/Publication: Peru's Grain Marketing Infrastructure: Changes Needed to Reduce Post-Harvest Losses

Authors: Walter Heid, Jr., and Harold Stryker

Period of Report/Publication: May 29 through June 21, 1984

Project Title: Improvement of Postharvest Grain Systems

Contract Number: AID/DSAN-CA-0256

Contractor: Food and Feed Grain Institute, Kansas State University, Manhattan, Kansas

SUMMARY STATEMENT

Production of the major Peruvian cereal grains, rice and corn, is increasing primarily because of an effective policy aimed at development of the Selva Region. While production is rapidly increasing, farmers have not been given assistance in methods of maintaining grain quality following harvest nor have they been given incentives to market high-quality grains. Neither has the marketing infrastructure provided for quality maintenance. Thus, post-harvest losses are increasing equally as rapidly as production.

Serious post-harvest losses occur because of: (1) post-harvest, pre-market practices that lead to mold and sprout damage, (2) poor road conditions that delay the transport of grain out of the Selva Region, and (3) the lack of adequate drying capacity in off-farm market facilities. By 1985 the marketing system is also expected to experience a serious shortage of storage capacity.

Post-harvest losses can be sharply reduced if the team's suggestions are acted upon. Specifically, the team recommends the following: the nation should make every effort possible to (1) improve the road system between major production and consumption areas, (2) establish a hands-on extension demonstration project to teach producers how to cut their grain quality losses through improved methods of harvesting, stacking, shocking, on-farm drying, and storage using low-cost, affordable technology, (3) develop and implement of a grading system that will provide motivation for farmers to produce and market high-quality grain, (4) conduct a feasibility study to determine the most economical location of market infrastructure growth, on the coast or in the Selva (just because production increases are occurring in the Selva does not mean that expansion of drying and storage capacity should be located in that region), and (5) provide technical assistance in the design of new drying-storage capacity.

PERU'S GRAIN MARKETING INFRASTRUCTURE: CHANGES NEEDED TO REDUCE POST-HARVEST LOSSES

Prepared by

Walter Heid, Jr.
and
Harold Stryker

for the

AGENCY FOR INTERNATIONAL DEVELOPMENT
UNITED STATES DEPARTMENT OF STATE

AID/DSAN-CA-0256
Improvement of Postharvest Grain Systems

at the

FOOD AND FEED GRAIN INSTITUTE
Kansas State University
Manhattan, Kansas 66506

Charles W. Deyoe, Director

CONTENTS

	Page
EXECUTIVE SUMMARY	vii
INTRODUCTION	1
Request and Team Composition	1
Specific Objectives	1
Agenda	2
GENERAL PROBLEM	5
RICE	11
Consumption	11
Production	13
Selva (Jungle) Rough and Milled Rice	18
Coastal Rough and Milled Rice	20
Present Market Infrastructure for Rice (ECASA)	21
CORN	25
Production	25
Selva (Jungle) Yellow Corn	31
Coastal Corn	36
Present Market Infrastructure for Corn (ENCI)	37
RECOMMENDATIONS	39
Transportation--An Urgent Short-Term Problem	40
Disposal of Low-Grade Rice	42
Divert Trucks to Jungle Region	43
Coordinate Imports and Domestic Grain Flow	43
Expand Storage, Drying, and Milling Capacity	44
Location of Future Storage, Drying, and Milling Capacity	47
Government's New Role	48
Grading System for Rough Rice and Corn--Badly Needed	53
Milled Rice Grading System Change	57
Millers' Milled Rice Storage Contracts Too Rigid	58
Trend Toward Bulk Handling	58
On-Farm Extension Demonstration Projects	58
FOLLOW-ON STUDIES	61
Choice of System	61
Expansion of Market Facilities	62
On-Farm Extension Demonstration Projects	63
APPENDIX	65

ACRONYMS AND ABBREVIATIONS

CIPA - Centro de Investigación y Promoción Agropecuaria

ECASA - Empresa Comercializadora del Arroz, S.A.

ENCI - Empresa Nacional de Comercialización e Insumos

FFGI - Food and Feed Grain Institute

MA - Ministry of Agriculture

MT - Metric ton

USAID - United States Agency for International Development

ACKNOWLEDGEMENT

The team extends special acknowledgement to Ms. Estila Mazzini, interpreter and special assistant employed by USAID, for her excellent work.

DEFINITIONS

Insolation - Incoming solar radiation (usually measured in terms of Btu's per m^2)

Marketing system - The structure of the industry (the number and size of firms, the assembly, processing, and distribution stages, and the types of participants--private, cooperative, and government)

Market process - The flow of products, price discovery, risk assumption, quality maintenance, and the form, location, and time utility dimensions

Turnover - The number of times grain may be put in and removed from a given storage space within a year's time

EXECUTIVE SUMMARY

The two-man team from the Food and Feed Grain Institute, Kansas State University, spent four weeks in Peru, May 29-June 21, 1984, at the request of the Minister of Agriculture and USAID. The team assessed the rice and corn marketing system, concentrating on its capacity to preserve the quality of the 1984 crop. The team was also requested to study the longer-term market infrastructure needed to handle expanding production and to reduce excessive post-harvest losses.

Production, much of it located on the North Coast and in the Selva Regions, must be moved long distances to market. Rapidly expanding production in the Selva Region requires the simultaneous development of a market infrastructure. Peru's entire grain marketing system could benefit from a new policy that rewards producers and processors of high-quality grain. The team observed practices not conducive to good quality both in the post-harvest, pre-market period and within the existing marketing process. Recommended solutions are made accordingly.

Short-run solutions focus on the large 1984 harvest. First and foremost is the long-standing problem of transportation between the Selva jungle and the population centers along the coast. A good road system is essential for the entire economic development of any region or country. It is vital for the movement of all commerce and for national security, including food security. The two should not be separated. A new approach to this perpetual problem seems essential. Therefore, the team recommends that the Minister of Agriculture work closely with the Minister of Transportation and others in the Peruvian government to obtain emergency assistance for clearing, repairing, and maintaining the Selva roads and the Pan-American Highway.

Second, several tons of milled rice, not fit for human consumption, are presently in one or more ECASA storage locations. This grain should be immediately moved into livestock feed or other channels, freeing valuable storage for the new harvest. This practice will also slightly reduce the need for export corn.

Third, the practice of renting private storage space should continue. If, however, rented space is no longer available, then plans for using tarpaulins or plastic covers should be made. Outside storage should be very temporary assuming that the roads are quickly opened.

Fourth, as soon as the roads are open, some rough rice and corn should be transported to the coast for milling and storage. Space for both is available in the Chiclayo and Trujillo areas, where no short-term crisis appears to exist.

Long-term solutions are of greater importance to the Minister of Agriculture and Peru in pursuit of objectives to reverse the country's dependency on imported food. Furthermore, along with the expansion of domestic production and the need for major growth in the marketing system, comes the opportunity to improve the marketing infrastructure. Improvements in the infrastructure that encourage the production and marketing of higher-quality grain and reduce post-harvest losses will also greatly increase the country's ability to feed its growing population.

First, the Peruvian grain marketing system should be more responsive to the need for growth and provide incentives for the production and marketing of high-quality grain. To accomplish these goals the team recommends a more active role by private enterprise and a more concentrated effort by government in a quasi-public-private system. Also, the team recommends an expanded role by government in providing ancillary services. For example, a rough rice and corn grading system should be placed into use by the government as soon as possible.

These changes represent a major departure from the present marketing system and therefore must be carefully planned and implemented.

Second, expansion of the critically-needed drying, storage, and processing capacity should be well planned to include the optimum location of facilities to minimize quality losses and to include appropriate new technology that will not greatly increase the costs of marketing. The team recommends that the Minister of Agriculture seek immediate technical assistance for this project since expansion of capacity is crucial for the 1985 harvest and beyond.

Third, the team recognizes that a high percentage of the quality loss at present is recurring in the post-harvest, pre-market period and that no marketing system can restore grain quality once it has deteriorated. The team, experienced in farming as well as marketing, concludes that this problem exists simply because no effort has been extended to show producers how to take care of their grain and at present there is no economic incentive in the marketplace to encourage them to do so. Producers could be shown how to cut their losses through improved methods of harvesting, stacking or shocking, on-farm drying, and storage using appropriate, affordable technology. Thus, the team proposes that a "hands-on" extension-type demonstration program be initiated as soon as the grading system is placed in use, preferably prior to the 1985 harvest.

USAID and FFGI stand ready to assist the Minister of Agriculture, if he and his staff decide to act upon the team's recommendations.

INTRODUCTION

Request and Team Composition

The USAID mission in Lima, Peru, requested the assistance of two specialists to assess grain and rice drying and storage needs resulting from a large 1984 harvest and develop an emergency storage plan.

Under a cooperative agreement with USAID/Washington, FFGI provided USAID/Lima with two specialists, Dr. Walter G. Heid, Jr., agricultural economist, on leave from the Economic Research Service, U.S. Department of Agriculture, and Mr. Harold B. Stryker, engineer and private consultant.

Specific Objectives

According to a memorandum from Dr. David Bathrick, Agriculture and Rural Development Officer, USAID/Peru, to Dr. Harlan Shuyler, S&T/AGR/AP, USAID/Washington, requesting infrastructure assistance to study post-harvest loss, dated 4/17/84, the Peruvian Minister of Agriculture was concerned that an inefficient infrastructure for storage and drying was available. The Minister sought alternative solutions.

Specific stated objectives were:

1. Compile production and consumption data
2. Assess the number, size, location, and condition of present drying and storage infrastructure
3. Determine drying and storage infrastructure and equipment/hardware needed to address anticipated shortfall
4. Recommend the most cost effective and rapid alternative to provide additional storage or other infrastructure equipment as needed
5. Make the other observations and recommendations concerning grain drying and handling storage and transportation

Agenda

The first two weeks were spent in Lima gathering data pertinent to the assignment, meeting with government officials, visiting rice and corn handling and distribution facilities in Lima, and other related activities.

Major contacts included:

USAID: Mr. David Bathrick, Agriculture and Rural Development Officer, and Mr. David Flood, his assistant

INIPR: Mr. Carlos Palamina, Mr. Luis Zavaleta, and Mr. George Naderman

U.S. Agricultural Attaché: Mr. Ken Murry and Dr. Julio Castillo

Minister of Agriculture Office: Sr. Francisco Ramírez, Advisor to the Minister, and Sr. Juan Pio Silvio, Director of Services (some ECASA members were also present)

ECASA: Ing. Fernando Arellano, President of the Directorio, Ing. José Hurtado, Manager of Processing Division, Ing. Guillermo Ramírez, Manager of the Merchandising Division, Mr. Walter Reuter, Manager of the Transport and Import Division, Mr. Gonzalo Rodríguez, Manager of the Storage Division

ENCI: Ing. Ricardo Fort, General Manager, Ing. Felix Paz, Storage Manager, Ing. Jorge Trujillo, Vice Manager of the Import and Export Division

Rice Millers Association: Sr. José M. Benítez Vargas

Agrario Bank: Ing. Romulo Grados Fuentes, Manager of Central Planning

Problem Identification

By the end of the two-week period it became obvious to the team that two schools of thought existed on

1. The role of ECASA and ENCI

2. The location of primary grain deterioration

USAID and the U.S. Agricultural Attaché's understanding of the situation and needs differed from that of the Minister of Agriculture. The former were under the impression that ECASA and ENCI were to be phased out and that the crop quality problem was on-farm. The latter informed the team of long-range

agency plans for ECASA to solve quality problems which occurred primarily off-farm. Even within the Peruvian grain marketing infrastructure there was no agreement as to the quality problem. Both initial market storage points and post-milling were cited. However, by the end of the second week the major problem focused on the post-harvest, pre-market period, especially in the Selva jungle area.

A meeting with Ing. Romulo Grados, Manager of Central Planning, Agrario Bank, added a broader perspective to the team's assignment. Not only were short-term marketing problems of concern, but also the Minister's office was concerned with the need for capital investment on the coast and in the Selva jungle--the need for private investment to provide the added infrastructure needed to service the planned increase in production. Ing. Grados was extremely interested in low-cost, low-technology drying and other equipment for the rice and corn sectors. He also expressed interest in a food security program for Peru. (Peru is a member of the Andean Pact.)

It is worth noting that as the team met with various levels of the rice and corn marketing industry, it observed a sense of frustration--the problem was never at the point of inquiry. We are in general agreement with a statement that was made during our visit in a production area: "The problem is all in Lima. Lima has a big population requiring long-distance movements of grain and Lima makes policy that offers no incentive to market high-quality rice and corn."

Field Observations

The team's third week was spent observing actual situations. Approximately three days were spent in the Selva jungle and three days on the North Coast. The team visited the offices of ECASA, ECNI and CIPA; Dr. Ed Puber, Co-Leader of CIPA's rice experiment project in and around Tarapoto; ECASA and

ENCI storage facilities; ECASA and private rice mills; and several producers of rice and corn.

The first-hand evidence coupled with the team's understanding of the marketing infrastructure obtained during the first two weeks provided the team with a basis for its recommendations.

Wrap-Up

In the final week the team prepared its report, including a preliminary executive summary which was presented to USAID and the Minister's Office prior to departure. The team also had opportunities to meet with Ing. Fernando Arellano, President of ECASA, and two members of the MA's office on the final day of its visit.

Because the team was unable to visit field locations in its second week, it did not have adequate time to hold additional productive discussions with responsible government officials. Thus, its recommendations do not have the full benefit of this valuable follow-up dialogue. The team, however, trusts that the Minister of Agriculture understands this difficulty.

Furthermore, information showing the capacity of all grain processing and handling firms, supposedly registered with the Minister's office, were not received as requested. Thus the team was unable to fully measure the industries' capacity, nor to gain a full understanding of present flow patterns.

GENERAL PROBLEM

Peru, like other developing nations, faces the serious problem of feeding a rapidly expanding population. The present birthrate is about 2.5 percent annually. Peru's population was 17 million in 1981. At its current growth rate the population will reach the following levels by the date indicated:

1985 .	18.8 million
1990	21.2 million
2000	27.2 million

Economic pressures caused by this rapidly growing population coupled with inflation make it highly desirable for Peru to stress for self-sufficiency, thus improving its balance of payments and minimizing its foreign debt.

The Minister of Agriculture, realizing the urgency of the situation, launched a major regional development project in the Selva jungle. The potential of that region for food and feed production is enormous according to projections. However, if the region is to realize its potential the entire marketing infrastructure must be extended to it. This includes facilities for handling all products produced, a full array of inputs and services required in the production-marketing process, as well as a reliable transportation system to connect the region with the coast.

The climate of the region is unique. The combination of abundant sunshine and frequent rains creates both problems and opportunities, not heretofore dealt with in Peru. Given the proper attention and technical services, production from that region can make an important contribution to Peru's food and feed needs. Preservation of quality and road improvement appear to be the top priority item needing resolution.

On the map, Figure 1, the Selva jungle region surrounds Tarapoto in the Orient. Major areas of established rice and corn production are in the jungle region and along the North Coast from Lima to Piura. Other parts of Peru produce lesser amounts as will be shown later.

Figure 2 shows the general region of production expansion. A more detailed map showing roads securing the area will be shown later.

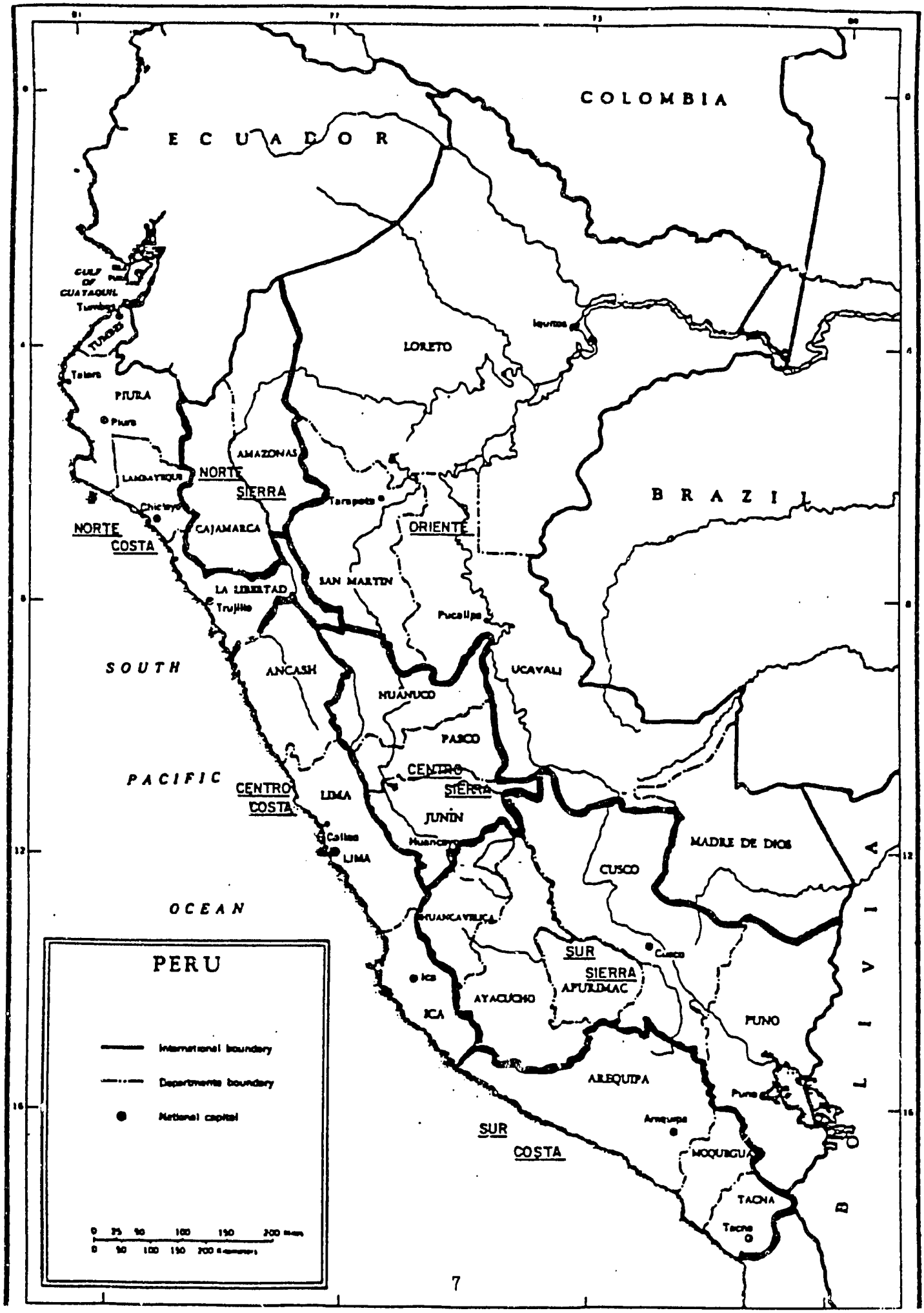
In the country of Peru there are two distinct harvesting and marketing conditions for rice and corn, tropical and arid.

High humidity, unpredictable rain, transportation problems for trucks due to unavoidable mud and rock slides may at times segregate a section of a highway for days. At the time of this report as many as 300 trucks were isolated on a highway over which rice and corn are normally transported to the main consumption zones along the coast region of Peru. The mud and rock slides over the mountain and valley roads cannot be avoided. The soil and rock formations in the mountain area are very unstable.

The other major production zones are along the coast where rice, corn, and sugar cane are produced by gravity irrigation augmented by a canal system from rivers.

In the Coastal Region the harvest coincides with seasons of little, if any, rainfall. Grain dryers in the Coastal Region are not required at this time. Presently there are several small rice combines in use. Since a trend to combine harvest may be developing, the government of Peru may soon be confronted with the decision to move the rough rice to a rice plant at approximately 23 percent moisture and then stage dry to produce a superior quality of rice. The alternative is to permit the rice kernel to dry on the plant to the 15 percent moisture range before combining. Permitting rice to dry on the uncut plant is conducive to soft chalky rice kernels that shatter when milled.

Figure 1. Grain Production Zones



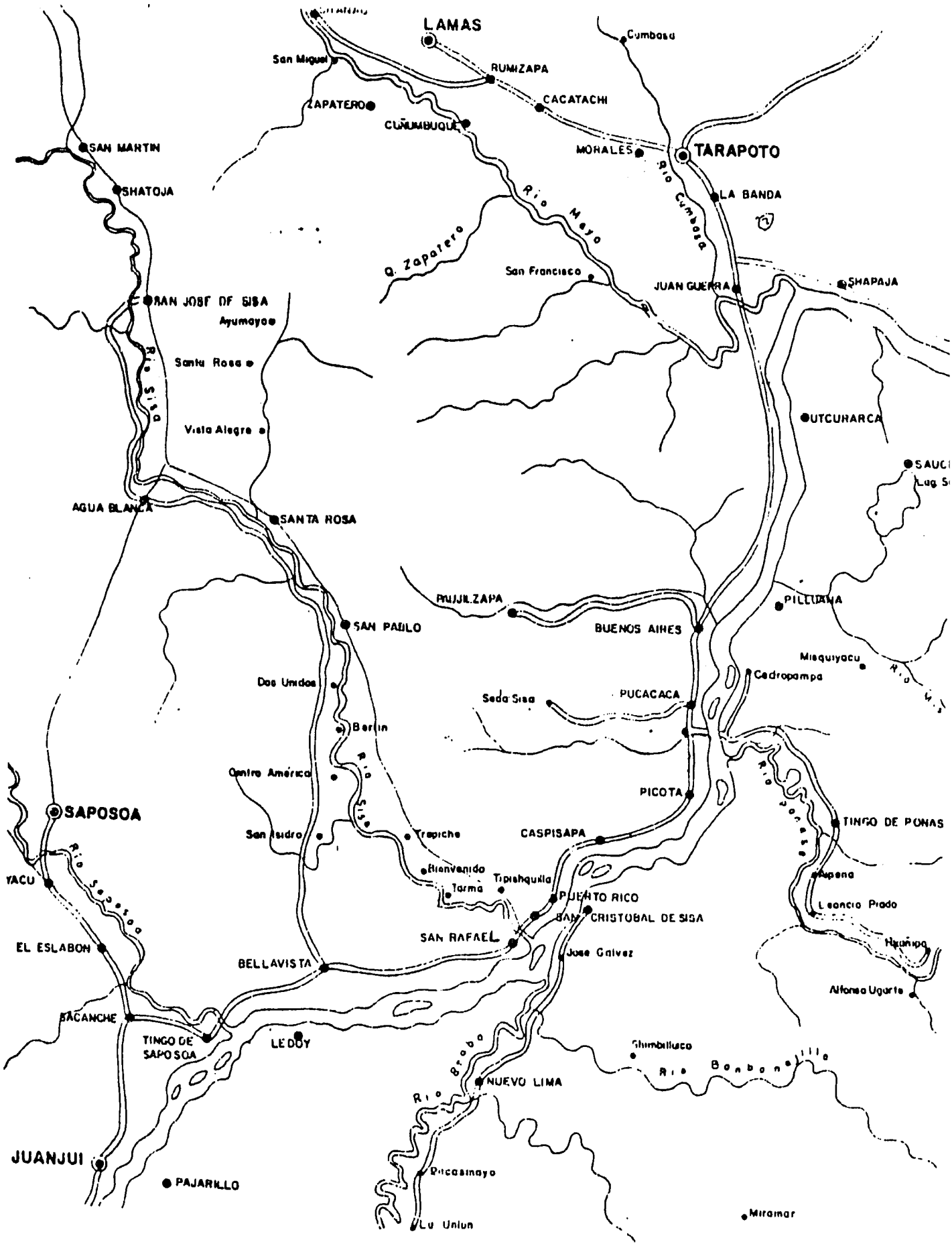


Figure 2. Tarapoto Area

Since the majority of rice in Peru is consumed by low-income families, any additional cost in harvesting or milling associated with producing a graded, superior quality rice that reflects a higher price to the consumer must be avoided if at all possible. Therefore, rice graded by size, length, or eye appeal is not considered essential at this time.

It is, however, urgent that immediate changes be made to market milled rice and whole kernel corn that has not been exposed to mold, insect damage, and rodent contamination at any point from the time the grain is removed from the mature parent plant to the time it reaches the ultimate consumer. Typically, the team found that the harvested grain had a musty odor. A musty odor is an absolute indicator that at some point, from harvest to market, the grain is subjected to heating and mold, either before it leaves the farm or in the marketing system.

RICE

Rice, next to potatoes, is the major food crop and major crop produced in Peru. Its area and production (1983-84) in relation to other major crops, is as follows:

	Area (ha)	Production (MT)
Potatoes	200,900	1,654,200
Rice	189,500	852,500
White corn	157,200	445,800
Yellow corn	185,800	199,200
Cotton	96,280	180,910
Wheat	113,600	128,700
Onions	3,360	100,980
Beans	52,530	49,110
Sorghum	13,860	46,780

Consumption

Milled rice consumption, according to the U.S. Agricultural Attaché's report dated May 5, 1984, totaled over 500,000 MT in each of the last four years.

The supply-distribution pattern for rice, shown in Table 1, reflects an 85 percent increase in production from 1970 to 1984 or a situation in which production has just about kept pace with consumption needs. Per capita consumption and total consumption of rice increased in the last decade (1974-84)--per capita consumption up 34 percent, total consumption up 74 percent.

The Association of Rice Millers estimated that total Peruvian rice consumption in 1984 would be 600,000 MT or 50,000 MT monthly. The 1984 harvest of rice was estimated at 1,028,400 MT (rough rice) or 709,596 MT milled rice, given a 69 percent mill yield. Therefore, the 1984 harvest should exceed domestic demand by 109,596 MT.

Previous Page Blank

TABLE 1

Balance of Supply, Utilization and Consumption of Nutrients in Milled Rice at the National Level

1970 - 1984

	Supply					Utilization												
										Human Consumption								
												Net Availability			Per Capita/Day			
													Per Capita					
Year	Production MT	Imports MT	Exports MT	Donations (D) and Difference in Stocks (E) MT	Apparent Internal Demand	Shrinkage MT	Propagation or Reproduction MT	Animal Feed MT	Industrial Use MT	Gross Availability MT	Waste MT	Total MT	kg/Year	gr./Day	Calories Number	Protein gr.	Fat gr.
1970	408,360	15,324	-	(D) 3,126 (E)- 98,939	327,871	6,557	-	-	-	321,314	-	321,314	24.355	66.727	240	4.1	0.5
1971	379,918	-	221	(D) 1,005 (E)- 86,603	294,099	5,882	-	-	-	288,217	-	288,217	21.242	58.197	209	3.6	0.4
1972	327,982	41	-	(E) 34,837	362,860	7,257	-	-	-	355,603	-	355,603	25.483	69.836	251	4.3	0.5
1973	326,760	21	53,264	(E) 56,176	331,693	6,634	-	-	-	325,059	-	325,059	22.652	62.060	223	3.8	0.4
1974	336,081	73	6,547	(E)- 11,980	317,627	6,353	-	-	-	311,274	-	311,274	21.099	57.805	208	3.5	0.4
1975	365,048	77,665	-	(E)- 89,555	353,158	7,063	-	-	-	346,095	-	346,095	22.828	62.542	226	3.8	0.4
1976	387,882	70,066	-	(E)- 70,124	387,824	7,756	-	-	32	380,036	-	380,036	24.403	66.858	240	4.1	0.5
1977	403,927	-	-	(E)- 25,236	378,691	7,574	-	-	81	371,036	-	371,036	23.204	63.573	228	3.9	0.4
1978	318,075	26,192	-	(E) 42,770	387,037	7,741	-	-	29	379,267	-	379,267	23.106	63.303	227	3.9	0.4
1979	381,071	150,952	-	(D) 1,716 (E)- 139,164	394,575	7,892	-	-	6	286,677	-	386,677	22.950	62.877	226	3.8	0.4
1980	285,852	225,816	-	(D) 3,157 (E) 64,258	450,567	9,011	-	-	-	441,556	-	441,556	25.530	69.946	261	4.3	0.5
1981	484,218	136,782	-	(D) 2,408 (E)- 129,864	493,544	9,821	-	-	-	483,673	-	483,673	27.242	74.635	268	4.6	0.5
1982	527,360	56,847	-	(D) 178 (E)- 77,464	506,921	10,138	-	-	-	496,783	-	496,783	27.257	74.677	268	4.6	0.5
1983	542,341	95,352	-	(D) 557 (E)- 119,419	518,831	10,377	-	-	-	508,454	-	508,454	27.180	74.465	267	4.5	0.5
1984	754,480*	21,035	-	(E)- 223,495	552,000	11,040	-	-	-	540,960	-	540,960	28.178	77.200	200	4.7	0.5

*Preliminary

Source: Special Stat. Bul. on Cultivation of Rice in Peru 1970-84, April 1984.

Production

Table 2 shows that the Coastal Region produced nearly 70 percent of Peru's rice in 1984. It also shows the early effects of the Selva jungle project. The area harvested in 1984 was double the area harvested in 1978. Projections suggest further increases.

Rice production, rough rice storage, and milling capacity by department is shown in Table 3. Milling capacity was based on an 8-hour day. Capacity is adequate for current needs in every department if the milling hours are increased to 10 hours per day. In practice the mills operate at 16 hours per day during peak harvest times. Thus only in the Selva where rapid production increases are planned should milling capacity be a problem in the near future.

Rough rice storage presents a greater problem. Temporary space currently is leased from a variety of sources in the expanding Selva area. With higher temperatures and humidity associated with rains in the Selva, rice quality maintenance in storage is a greater problem than it might be on the coast.

Trends in Production

Peru rough rice production data shows an increase of almost 33,000 MT annually, Figure 3. Approximately 20,000 MT of this increase is occurring in the Selva Region.

The trend line based on 1974-1983 production places national 1990 production at 998,000 MT and 1994 production at 1,130,000 MT (it should be pointed out that 1984 production was expected to be abnormally high at 1,110,000 MT).[1]

---

[1]Although abnormally high production places a stress on the market's storage and other capacity, planners must base their decision on expected trends. It is better to have excess production than chronic excess capacity.

TABLE 2

Production, Yield and Surface Area of Rough Rice by Natural Region

1970 - 1982

Year	National					Coastal					Selva				
	Production		Yield	Surface Area		Production		Yield	Surface Area		Production		Yield	Surface Area	
	MT	%	kg/ha	ha	%	MT	%	kg/ha	ha	%	MT	%	kg/ha	ha	%
1970	586,721	100	4,180	140,395	100	420,680	71.70	4,995	84,240	60.00	166,041	28.30	2,957	56,155	40.00
1971	591,111	100	4,010	147,340	100	428,491	72.49	4,850	88,370	59.98	162,620	27.51	2,758	58,970	40.02
1972	482,326	100	4,086	118,045	100	340,223	70.54	4,909	69,310	58.71	142,103	29.46	2,915	48,745	41.29
1973	483,471	100	4,104	117,805	100	351,923	72.79	4,775	73,705	62.57	131,548	27.21	2,983	44,100	37.43
1974	494,237	100	4,270	115,755	100	364,956	73.84	4,825	75,645	65.35	129,278	26.16	3,223	40,110	34.65
1975	536,835	100	4,383	122,480	100	405,696	75.57	5,056	80,240	65.51	131,139	24.43	3,105	42,240	34.49
1976	570,415	100	4,284	133,165	100	426,431	74.76	4,884	87,305	65.56	143,984	25.24	3,140	45,860	34.44
1977	594,010	100	4,421	134,356	100	459,018	77.27	5,207	88,157	65.61	134,992	22.73	2,922	46,199	34.39
1978	467,758	100	4,093	144,274	100	316,340	67.63	5,140	61,547	53.86	151,418	32.37	2,872	52,727	46.14
1979	560,399	100	4,263	131,445	100	384,809	68.67	5,544	69,410	52.81	175,590	31.33	2,830	62,035	47.19
1980	420,371	100	4,382	95,939	100	243,997	58.04	6,072	40,182	41.88	176,374	41.96	3,163	55,757	58.12
1981	717,481	100	4,744	151,213	100	512,627	71.45	6,145	83,418	55.17	204,854	28.55	3,022	67,795	44.83
1982	775,529	100	4,581	169,413	100	525,903	67.81	5,752	91,431	53.97	249,626	32.19	3,201	77,982	46.03
1983	797,560	100	4,086	195,196	100	490,200	61.46	5,000	98,049	50.23	307,360	38.54	3,164	97,147	49.77
1984*	1,109,549	100	4,630	239,664	100	770,250	69.42	5,724	134,560	56.15	839,299	30.58	3,228	105,104	43.86

*Preliminary

Source: Special Stat. Bul. of Rice Cultivation, Peru 1970-84, April 1984.

TABLE 3

Rice Production, Rough Rice Storage, and Milling Capacity by Department

Department	Production 1983/84[1] MT	Production 1984[2] MT	Storage 1984[3] MT	Milling Capacity[3] T/Day[4]	Milling Capacity[3] Days Milling
Tumbes	19,000	23,500	23,850	122	193
Piura	150,000	160,000	148,903	688	233
Lambayeque	190,000	280,000	151,790	766	366[8]
Pacasmayo	116,000[6]	160,000	146,000[6]	480	333
Ancash	12,000	26,000	71,500	71	366[8]
Areguipa	86,000	81,500	97,085	464	176
Cajamarca	61,000	73,000	79,640	263	278
Amazonas	66,000	63,000	59,900	187	337
San Martin	77,200	86,500	78,500	362	239
Huanuco	7,200[7]	700	-	16	44
Cuzco	2,400	1,700	1,700	10	170
Loreto	24,200	56,000	38,750	222	252
Ucayali	6,200	12,000	8,130	95	126
Madre de Silos[5]	2,600	4,000	2,450	12	333
Total	819,800	1,028,400	908,198		

[1]U.S. Agri. Attaché estimates.

[2]Assocation of Rice Millers estimates.

[3]Minister of Agriculture estimates.

[4]Assumes 8-hour day.

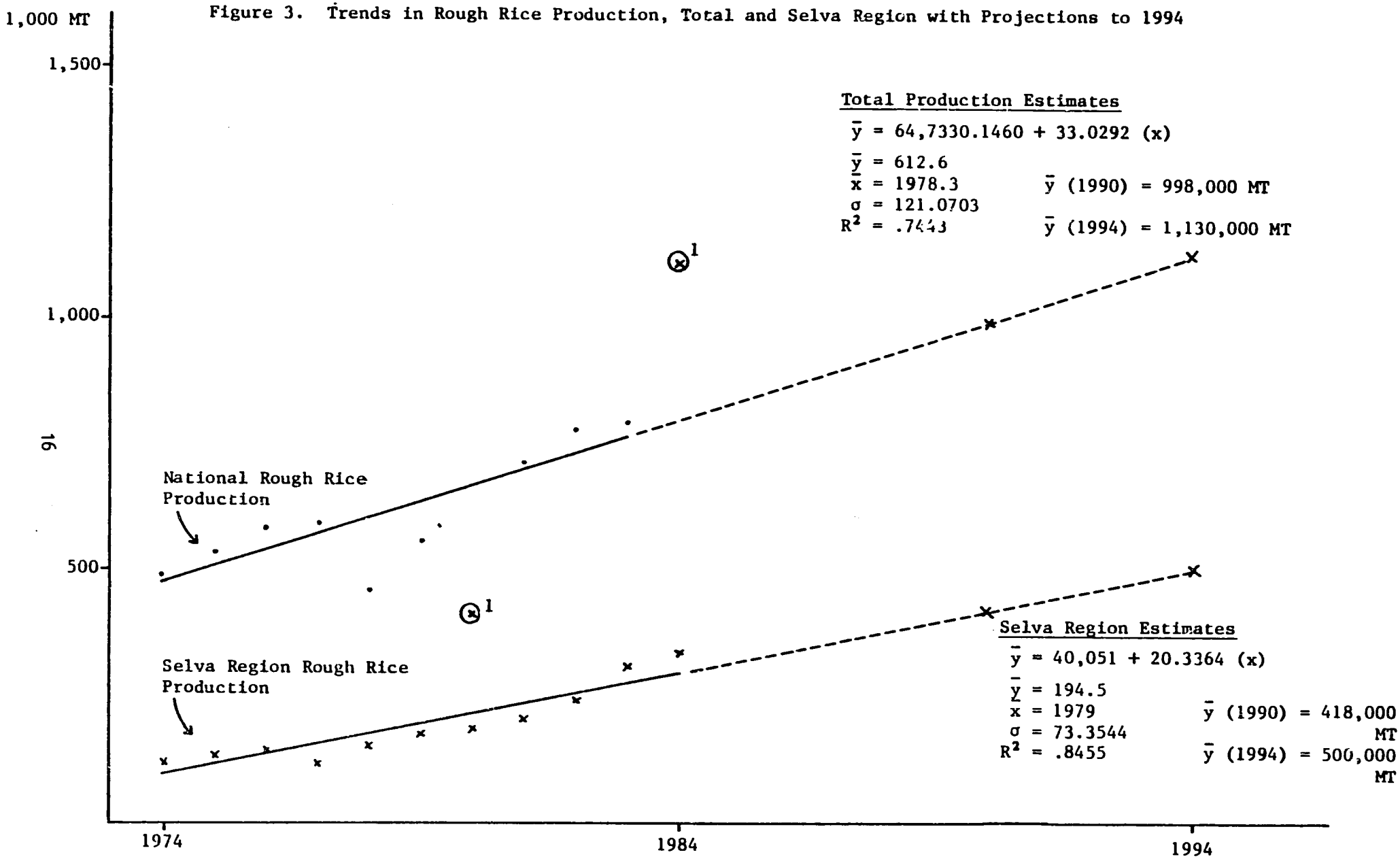
[5]Includes Ayacucho and Puno Departments.

[6]Listed as La Liberdad

[7]Includes Pasco and Junin Departments.

[8]Give 10-hour day, rice can be milled in 292 days. (Rice may also move between departments to release milling overcapacity.)

Figure 3. Trends in Rough Rice Production, Total and Selva Region with Projections to 1994



[1] 1980 and 1984 National rice production not included in analysis.

The trend line, based on 1974-1984 production, places Selva Region 1990 production at 418,000 MT and 1994 production at 500,000 MT. Assuming these projections are reasonably accurate, nearly half the 1994 rough rice production would occur in the jungle. If government policy continues to promote jungle rice production this estimate may only be one-half the actual production by 1994. Pulver predicts 137,000 hectares of rice in the Selva by 1994. At 7 MT per hectare yield, production could reach nearly 1,000,000 MT. Plans for an adequate market infrastructure must be closely coordinated with projected production.

Variations in Annual Rice Production

Over the 11-year period 1974-1984 the range in production countrywide was from 420,000 MT in 1980 to 1,110,000 MT in 1984. Mean production, excluding the two extreme years, was 612,600 MT. The R^2 was .74; the standard deviation, 121,000 MT.

For the Selva Region annual production was less variable. It ranged from 129,000 MT in 1974 to 339,000 MT in 1984. The steady increase in production during the 11-year period resulted in an R^2 of .85 and a standard deviation of only 73,000 MT.

Projected Storage Needs

Production data for the 11-year period, Figure 3, show only a slight upturn in 1983 and 1984. Conservative estimates place the need for additional capacity to store and mill rough rice at 330,000 MT by 1994. More liberal estimates suggest a total capacity increase of about 830,000 MT with most needed in the jungle if it is decided to store and mill rough rice in that location.

Selva (Jungle) Rough and Milled Rice

ECASA buys all of the rough rice production, then assigns the rough rice to ECASA mills, cooperative mills and private mills on a quota basis. The producer is informed where he should deliver the rough rice.

Observation of the team in the Tarapoto area of paddy rice harvest indicated the need for improvement in rice harvest practices. Rice was cut by hand, placed in small piles or spread out on the ground to dry. When dry, it was threshed by machine or by flailing the rice plants against rocks to remove the rough rice. This system may be satisfactory if there is sun and no rain. However, the team observed a producer lifting his cut rice plants (which had partially dried) from mud and water and carrying it to the paddy dikes so the rice stems and heads could dry, if there was sunshine. The cut rice had become inundated because of "unexpected" rain, yet unexpected rains were normal in this mountain valley near the river. We were told the reason for the inundation was because the paddy was not drained. However, rain would damage any rice heads laying on the ground. This observation did not appear isolated as in other paddies the team observed moldy, sprouted rice being fed in threshers.

Paddy rice in the Selva is irrigated by pumping water from rivers then utilizing a system of canals for water distribution.

The quality of rough rice at all mills in the Selva was bad. All rice had a musty odor. At mills rough rice was not properly segregated by quality. Producers were paid the same for unlike quality. The rice mills made only a discount for moisture and impurities in rough rice.

The rice producer is not made aware that his rice is of poor quality. If it is extremely bad the rice mill could refuse to accept it but they do not. There is no incentive for the rice producer to sell a high quality when the price is the same for good quality and bad quality rough rice.

At the rice mills of ECASA and private mills, the rice dryers were operating. Equipment maintenance was satisfactory.

However this did not appear to be the case in 1984 in the Selva Region. (This problem was observed by one team member of Tingo Maria in March 1983.)

Wet rough rice dried just before milling has the advantage that the hull is dried as well as the outer part of the hard rice kernel while the inner part of the hard rice (endosperm) may have higher moisture due to lack of osmosis of water (moisture). This permits the husk of bran section to be brittle and the inner part to be more pliable with less chance of shattering (being broken) by the impact of shelling. This is a good method of milling if milled rice is to be consumed within several weeks. However if the milled rice has a moisture percentage above 12 percent there is a definite risk of quality loss if stored six months or more.

Seldom is milled rice placed in bulk storage. Therefore, it is to be further dried or aerated.[1] It is essential to dry and temper rough rice to milling-level moisture as soon as possible after harvest. Dried rough rice can be stored in bulk for long periods. It can be fumigated as required. If stored for several months, aeration systems of 1/4 cfm/bu should be provided. The milling should be delayed as long as possible to produce a clean, fresh milled rice free of insects. Often in long-term storage of milled rice in bags one can observe dead insects.

---

[1]Application of a wind aeration may be feasible along the Coastal Region but insufficient wind speeds exist in the Selva Region (see appendix).

High-quality rice can be produced and preserved in the Selva jungle but from farm through milling, training, and technical assistance is required. Increasing yields and production area only leads to a larger percentage loss unless quality control exists.

Coastal Rough and Milled Rice

The team had only the time and opportunity to observe rice farming and rice mills in the Trujillo to Chiclayo areas along the North Coast.

The "north" is the largest concentrated rice production area. All the rice is produced in large paddies that can be irrigated by a system of canals from diversion dams in rivers. (There may be isolated areas where water is pumped from the river.)

With the exception of excessive abnormal rainfall in 1983, the weather along the coast is dry at harvest.

The greatest percent of rice production and mills were cooperative. Cooperative production units were in the range of 450-700 ha each.

A very small percent is combine harvested at this point in time. The type of harvest as of 1984 was to cut the rice stem by manual labor then place the small untied parcels on the ground to dry. (The same procedure as in the Selva except the coastal area had more hours and days of sunshine with far less probability of rain.)

When it was determined that the rice stems were dry and the rice kernels were approximately 15 percent moisture the untied bundles were piled into very large untied bundles. These, then, were placed on men's backs and carried to a stack. These large bundles were carried for some 250 meters from the gathering area to a stack.

When time permitted a thresher, powered by tractor p.t.o., threshed the rice. Rough rice was placed in 70-kilo plastic woven bags and then placed in

temporary piles to await transportation to an assigned mill. Large cooperative farms marketed their rough rice through their own mills. (Rice threshers in the Selva were the same principle but much smaller and powered by a small stationary engine.)

In examining the "stacked" rice where musty rough rice was detected it was observed that the center portion of the stack had evidence of heating, perhaps caused by stacking when the rice stems were not dry. There seemed to be no method of stacking the rice in use whereby that the head portion might be less subject to weather or internal heating of the stack could be avoided.

If the farmers would be receptive to technical assistance the team concluded that the stacking method could be improved by more control of the high-moisture stems placed in the stack, perhaps a different alignment of the rice heads and stems in the stack or placing a type of ventilation in the center of the stack to prevent heating.[1] The stacks were approximately 11 meters in diameter and 2 meters in height. Since all was hand labor no doubt experience determined the diameter and height of a stack. However, customs can be changed if a more practical (economical) method can be demonstrated.

Present Market Infrastructure for Rice (ECASA)

Currently ECASA purchases all rice from producers. All producers are paid one price assuming a grain moisture level and foreign matter percentage. No grading system exists. The price is set by the Minister of Agriculture. A special incentive is paid to Selva farmers to encourage production in that area.

---

[1]For both corn and rice systems of shocking used in the United States before the days of combines could be used to prevent post-harvest, pre-market loss. A team member observed rice being shocked and hung to dry on in-field pole racks in Japan.

Until 1984 varieties were unidentifiable at the mill. Long- and medium-grain rice therefore were mixed. Beginning in 1984, the variety if known is shown on the document prepared at time of receipt at the mill. Variety improvement work by CIPA was being conducted to some degree with ECASA.

Rough rice storage and mills are usually combined facilities. ECASA runs and operates some. Other are owned and operated by cooperatives or private enterprise. Rough rice receipts are tested for moisture with equipment that is seldom calibrated. Although the team observed honest attempts at moisture determination, it seriously questions the accuracy of equipment.

In most cases rough rice was segregated by moisture prior to milling (high moisture is a major problem to millers only in the Selva). Rice receipts both in the Selva and the coast regions showed signs of poor quality. In the Selva rain and high humidity were both factors. No artificial drying equipment was observed on farms. Rice was often above 13 percent moisture when marketed. Producers were also not observed to be taking advantage of this abundant solar energy to dry their rice. On the coast farmers have less problem with rain at harvest but stacking practices sometimes result in heat damage in the center of stacks when high rice is piled. Rice tends to be marketed immediately after harvest in the Selva, but sometimes stacked for weeks on-farm on the coast.

Drying capacity at collection points in the Selva, the fast-growing production region, is inadequate. As a result quality suffers. Storage capacity in the Selva appeared to more adequate than the team anticipated, with rented space taking up the slack. However, bad road conditions could create a shortage by year's end.

ECASA directs rough rice to mills via a quota system. Therefore, some mills on the coast were operating only 9 months per year. Managers of mills visited in the Selva unanimously concluded that they had capacity to mill the

the 1984 crop. Millers may be underestimating the size of the 1984 crop. According to Ed Pulver, CIPA Co-Director, production in the Selva Region is expected to grow as follows:

	Hectares
Present	26,000
Short run (1-3 yrs)	58,000
Long run (5-10 yrs)	137,000

Likewise the rice crop on the coast is expected to respond dramatically from the 1983 flood-damaged crop. For example, in the Chiclayo area the 1984 crop is estimated at 250,000 MT (51 hectares) up from 132,000 MT (28 hectares) in 1983.

ECASA takes possession of all milled rice within 60 days of milling. Because of the magnitude of the Lima population relative to the rest of the nation the major distribution channel is to Lima and the major storage point in Lima. Milled rice coming from the Selva is often stored in Chiclayo or Trujillo and other points on the way to Lima.

Millers, other than ECASA, are paid for milling rice. Occasionally, but not recently, some millers are paid premiums for producing supreme rice.

However, because of serious shortages in production in the early 1970s, the use of milled rice grades (extra, supreme, and common) were discontinued.

Wholesalers and retailers with permits from ECASA obtain rice from the ECASA milled rice storage points. The price (subsidized) is set by the Minister of Agriculture.

Observation: ECASA's facilities appear to be well managed. However, a lack of artifical drying capacity in the Selva could be a problem in 1984. Managers of ECASA's storage facilities should be commended for their attempts to segregate rough rice by moisture content and for their mill management.

ECASA also has an adequate grading system for milled rice although not currently in use. ECASA administers an infrastructure that given certain changes could service the entire grain industry. Recommended changes will be discussed later.

CORN

Production

Yellow corn production is centered along the coast, primarily the northern coast, and the San Martin Department located to the northeast of Lima. The Lima Department leads all others in area harvested and corn production. However, sizable volumes, Table 4, are produced in the La Libertad, Ancash, and Piura Departments.

Incentives for the development of agriculture in the high Selva jungle region have resulted in a big production increase. The following data show production changes by region from 1977 to 1981. Corn production increases in the Selva Region continued through 1984.

Region	Production (MT) 1977	1981	Change (%)
North Sierra	25,378	41,120	62
North Coast	151,563	86,782	(43)
Central Coast	249,915	137,165	(45)
South Coast	5,162	3,307	(36)
Central Sierra	25,601	12,594	(51)
South Sierra	8,289	15,626	89
Selva	37,386	93,953	151
Total	503,294	390,547	(77)

Competition from rice, cotton, and other crops caused the area of corn production to decline in the coastal area. Reasons for the decline are at least threefold: (1) the price of corn relative to cost of production discourages production, (2) the demand for rice is growing and rice prices have been held at lower levels than other food items, Table 5, and (3) the dramatic shift in acreage away from the high-yield regions of the Central and North Coast toward the low-yield regions of the North Sierra and Selva. Production on the North Coast, according to King of North Carolina, dipped from 80 percent of the national total in 1977 to 57 percent in 1981.[1]

---

[1]Production was low countrywide in 1980-83 because of adverse weather.

TABLE 4

Corn Storage Capacity Used by ENCI Compared to 1983 Production[1]

Department	Under Roof	Outside	Total	Area of Storage	1983 Production
	MT			m^2	MT
Tumbes	540	-	540	550	600
Piura	6,600	12,800	19,400	20,220	25,500
Lambayeque	9,500	15,000	24,500	26,119	18,000
Cajamaru	1,700	680	2,380	6,900	22,000
Amazonas	2,000	-	2,000	10,000	16,200
La Libertad	12,350	10,000	22,350	38,725	53,200
Ancash	6,200	17,500	23,700	19,067	32,000
Lima	3,650	8,650	12,300	11,817	112,000
Ica	19,930	68,850	88,780	52,355	22,000
Arequipa	6,650	18,050	24,700	32,781	3,500
Moquequa	265	-	265	188	400
Tacna	700	5,000	5,700	10,257	1,800
Huanuco	4,900	18,500	23,400	13,254	5,000
San Martin	21,200	2,300	23,500	57,570	76,000
Junin	13,805	14,685	28,490	26,503	11,000
Ayacucho	270	480	750	712	4,000
Cuzco	5,500	-	5,500	26,060	12,000
Puno	3,000	-	3,000	12,500	2,200
Loreto	5,850	500	6,350	25,048	10,200
Ucayali	1,750	-	1,750	4,532	13,300
Total	126,360	192,995	319,355	395,158	440,900

[1]Because corn is harvested in every month of the year storage space does not need to equal production. In fact, if roads were improved, storage turnover rates should increase, further lessening the need for additional space.

TABLE 5

Relative Prices of the Principal Food Products in Metropolitan Lima

1970 - 1983

Year	Rice	Bread	Noodles	Potatoes	Sugars	Beans	Oil
1970	100.00	99.43	111.48	46.14	64.21	150.00	174.77
1971	100.00	99.43	112.73	45.00	64.21	161.70	210.11
1972	100.00	99.43	117.27	58.07	64.21	177.39	215.11
1973	100.00	99.43	124.66	69.55	64.21	193.52	225.80
1974	100.00	118.37	140.15	51.80	53.50	185.04	189.39
1975	100.00	109.10	138.54	73.67	42.87	187.41	189.30
1976	100.00	117.14	130.93	51.76	54.91	169.63	188.07
1977	100.00	108.09	186.71	73.25	65.92	196.25	190.97
1978	100.00	133.73	176.01	50.96	77.88	294.19	258.11
1979	100.00	121.60	162.52	58.93	83.39	186.74	254.68
1980	100.00	111.21	141.21	94.47	84.48	234.18	204.95
1981	100.00	142.16	168.27	76.78	131.74	360.42	314.71
1982	100.00	122.02	136.01	82.02	108.22	249.10	285.45
1983	100.00	153.66	200.08	147.21	136.98	298.22	357.10

Source: Special Stat. Bul. of Rice Cultivation, Peru 1970-84, April 1984.

Corn production from 1972 to 1983 was:[1]

Year	Production (1,000 MT)	Year	Production (1,000 MT)
1971	287.1	1978	381.8
1972	205.6	1979	430.0
1973	233.7	1980	300.0
1974	231.6	1981	397.4
1975	324.4	1982	398.2
1976	430.2	1983	460.0
1977	457.9		

Corn production and area harvested in 1983 is shown by department, Table 6.[2] Production in the Selva zone shows that it represented a major shift in the percentage of corn produced in the Selva jungle and thus the growing importance of that region.

Year	Production (1,000 MT)	Percent of Total
1977	37,386	7.4
1983	87,400	19.6

The older established yellow corn production area because of its no-growth posture no longer required capital investment to expand storage and handling facilities.

Trends in Corn Production

Peru corn production data shows an increase of about 14,000 MT annually. A trend line, based on 1974-83 production, places 1990 production at 554,000 MT and 1994 production at 610,000 MT, Figure 4. Most of the increase is expected in the jungle region.

---

[1]Two attributes of time series data like these and those for rice are important to market planners: (1) the trend and (2) the variation. Planners should make lasting provisions for developing a marketing systems capacity based on the trend. Only temporary provisional plans are needed to deal with annual increases in production that are above the expected (trend).

[2]Totals for 1983 differ because of differing sources of information.

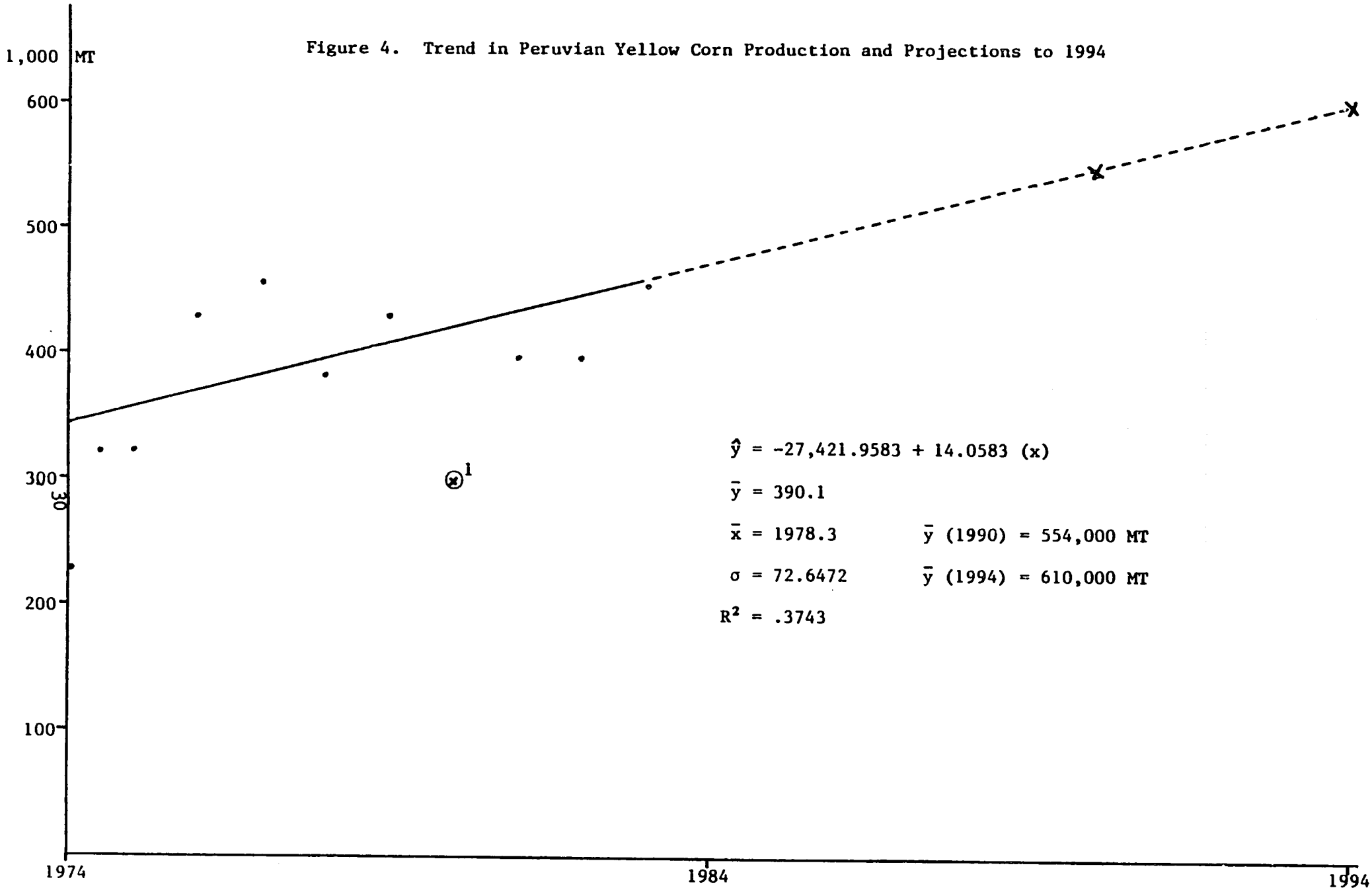
TABLE 6

Corn: Area Harvested and Production, 1983

Department[1]	Area 1983 hectares	Production 1983 MT
Tumbes	200	600
Piura	8,500	25,500
Lambayeque	6,000	18,000
La Libertad	14,000	53,200
Ancash	8,000	32,000
Lima	25,000	112,000
Ica	6,000	22,000
Arequipa	1,000	3,500
Moquegua	150	400
Tacna	600	1,800
Cajamarca	10,000	22,000
Amazonas	6,500	16,200
San Martin	38,000	76,000
Huanuco	2,500	5,000
Pasco	1,800	3,300
Junin	5,000	11,000
Ayacucho	2,000	4,000
Apurlmac	250	400
Cuzco	6,000	12,000
Puno	2,000	2,200
Loreto	6,000	10,200
Ucayali	7,000	13,300
Madre de Dios	700	1,200
Total	157,200	445,800

[1]Includes three more departments than Table 4. Thus, total is slightly greater.

Figure 4. Trend in Peruvian Yellow Corn Production and Projections to 1994



[1]1980 production not included in analysis.

Variations in Annual Corn Production

Over the 10-year period the range in production was from 232,000 MT in 1974 to 460,000 MT in 1983. The mean yield was 390,000 MT. With an R^2 of only .37 we can expect production to range with 73,000 MT of the expected two-thirds of the time (= 72,647).

Projected Storage Needs

This total projected storage capacity should grow at about 14,000 MT per year to keep pace with need. The linear trend projection shown in Figure 4 seems certainly adequate for planning purposes, since no surge in production is observed in recent years.

Selva (Jungle) Yellow Corn

Estimates of ENCI storage space show that it is likely to be inadequate in the near future if not at present, Table 7. However, as previously mentioned, production is spread throughout the year, with no more than about 15 percent occurring in any one month, the turnover of storage could be several times per year. Thus the space problem is not as critical as it appears. Furthermore, an undetermined amount of space is leased from private owners and other public agencies. Grain turnover is limited by two factors: (1) the Selva region must link with the remainder of the marketing system thus the flow may not allow for a rapid turnover and (2) the inadequate road system limits turnover and, in turn, increases the amount of storage needed.

Table 8 shows the location of present corn storage facilities, their capacity, type of storage, ownership, and products in addition to corn handled.[1]

---

[1]Private enterprise can handle fertilizer and other farm supplies and market several products just as can ENCI.

TABLE 7

Corn Production in Tarapoto Area, 1980-83, and 1984 ENCI Storage Capacity

Location	Storage Capacity	Production 1980	1981	1982	1983
		MT			
Tarapoto	3,000	8,742	9,482	13,163	6,699
Picota	4,000	2,031	5,587	8,916	7,232
Puerto Rico	600	4,518	3,721	5,583	3,825
San Pablo	1,000	-	-	-	4,123
Chazula	1,000	-	-	1,180	1,079
Juanjui	3,000	8,134	8,984	9,916	8,318
Saposoa	1,000	2,189	2,593	3,633	3,134
Moyobamba	1,500	1,936	2,954	4,992	3,976
Yurimaguas	1,000	-	-	-	1,742
Rioja	1,000	-	-	-	-
Total	17,600	27,550	33,321	47,383	40,128

Source: ENCI Regional Office, Tarapoto.

TABLE 8

Yellow Corn Storage Situation in the Tarapoto Area, Peru, 1984

Location of ENCI Office	Storage Location	Department	Products Stored	Under Roof	Outside	Total	Area M2	Tenure
Yurimaguas	Yurimagua	Loreto	M F Su	1,500	-	1,500	20,000	ENCI
Moyobama	Moyobama	San Martin	M F Sy	400	300	700	700	Pvt.
Tarapoto	Tarapoto	" "	M Sr Sy L	3,000	-	3,000	10,000	ENCI
Tarapoto	Bda. Shilcayo	" "	F	650	-	650	1,400	"
Juanjui	Saposoz	" "	M	1,000	-	1,000	NA	"
Tarapoto	Puerto Rico	" "	M Sr Sy	650	-	650	1,547	"
Junajui	Juanjui	" "	M Sr Sy	2,000	-	2,000	NA	"
Tarapoto	Picota	" "	M Sr Sy	6,000	-	6,000	3,300	"
Tarapoto	Chazuta	" "	M	1,000	-	1,000	NA	"
Tarapoto	San Pablo	" "	M	1,000	2,000	3,000	NA	"
Moyobamba	Rioja	" "	M (2)	1,000	-	1,000	NA	[1]
Total				18,200	2,300	20,500		

NA = Not available
(2) = Two modules
M = maize, F = fertilizer, Su = sugar, Sr = sorghum, Sy = soya, L = lacitoes

[1]Transfer business to ENCI.

ENCI sets the support price per kilo for a maximum of 18 percent moisture with a moisture discount to 14 percent. ENCI will not buy corn above 19 percent. This causes problems to producers if they have traveled a long distance to take advantage of the ENCI price and then are told that their corn is above 18 percent.

The warehouses of ENCI were filled to 2/3 capacity at Tarapoto. There was no evidence of limited capacity at the time of this report, however there is substantial corn production in the Tarapoto area, some of which will be ready for harvest in July. At that time ENCI may be required to rent space if truck transportation to the coastal region is still delayed by mud slides on the highways.

Observation: ECNI has a new Myer-Norton grain dryer at Tarapoto which has been on location for two years and not used. Its specifications are: Model 450, Serial 2736, 32 HP fan, 3 phase, 230 V, Burner 800,000 Btu minimum, 4,000,000 Btu maximum.

If an estimated 5 points moisture are removed it would have a capacity of 7 to 10 MT per hour, with propane fuel consumption of 15 to 20 gallon per hour. The gross error associated with placing the dryer at this location is that the fuel requirement is liquid propane which is not available at Tarapoto and in the foreseeable future will not be. Furthermore the dryer was placed in a very impractical location at the site with no method of filling the dryer. It is very evident that the grain dryer will never be used at Tarapoto because of the requirement for large quantities of liquid propane.

Observation: At the farm level the corn is harvested by hand, taken to the home of the owner where the farmer attempts to dry the corn by spreading the shucked corn on the ground. Some might be shelled by hand. Some corn is shelled by small hand or engine-powered shellers. Then an attempt is made to further dry it by placing the corn on cement or plastic. Corn shelled by hand

is free of small pieces of cobs. Most mechanical shellers do not have a screening device, therefore broken parts of cobs are abundant in the shelled corn. At one farm of 40 ha of corn (two crops per year) ear corn was spread on the ground to dry. It had gotten rained upon and was sprouting. Workers were hand-removing broken cobs from machine-shelled corn spread on plastic to dry. This farm is adjacent to a main highway which would be an excellent demonstration site for innovative methods of harvesting, shelling, and drying corn on the farm.

The team was informed by a feed mill operator that the protein of Selva jungle yellow corn of good quality was 7 percent to 8 percent, about the same as import corn. Some feed mills are buying direct from the larger producers.

Producers should be shown post-harvest, pre-market technology that would enable them to quickly harvest, dry, and prepare their corn for market, thus permitting them to repay high-interest production loans and improve their cash flow by having the option of early marketing.

On-farm corn dryers can be developed by using solar, wind, or burning trash, cobs, and wood. Blowers powered by small gasoline engines made in Peru can utilize the heat from the air-cooled engine as a source of supplemental heat. Technical assistance and experimentation will be required. When corn is delivered to ENCI it is tested. If it is 18 percent moisture or lower it is accepted but discounted for all moisture over 14 percent. It is also discounted for foreign material. Producers are given a certificate with their name and weight of corn which they present to the development bank for payment.

Observation: The government agency buying corn in the Selva jungle must have some system of drying corn to 14 percent from purchase made which may be as high as 25 percent, then discounts or an arrangement made with the producers so that they are aware that they are paying for the cost of drying as well as

receiving a discount for evaporated water. Producers should be given an incentive to dry their corn on the farm. This also gives producers the option to sell directly to the consumer. When producers sell to ENCI, ENCI should have simple, practical systems of drying. A ENCI manager of buying center expressed to the team the preference for a drying system with less machinery and grain augers, minimizing maintenance problems. Selva jungle corn must be dried as soon as possible to prevent growth of molds.

Maximum time for storage of shelled corn
before serious mold damage occurs

Days

Air temperature (°F)	Moisture levels 15%	20%	25%
70	155	16	6
60	259	27	10

Thus high moisture must either be artificially dried on-farm or off-farm in the Selva, or quickly transported out of the region and dried on the coast.

Feed mills expressed concern of possible aflatoxins in Selva jungle corn. One feed mill treated all Selva jungle corn with propionic acid as a precaution.

At one feed mill yellow Selva jungle corn was piled in bulk. It appeared to be of fair quality but upon close examination one could see mold growth. There was the definite odor of moldy corn.

Feed mills are not permitted to import corn. The feed mills must buy from producers, farmers, or ENCI. Thus they are required to buy the aflatoxin-suspect corn. Again it should be emphasized that the Selva corn must be dried to 14 percent as soon as possible to prevent mold damage.

Coastal Corn

Corn production in the coastal region is limited due to the need for canal irrigation. The competitive irrigated land use is for rice and sugarcane.

ENCI buys very little corn in the area. The greatest percentage is bought by feed mills and confinement poultry farmers. The dry coastal climate eliminates the need for mechanical drying. ENCI does have warehouse for imported corn in the area visited. The team observed no need for emergency or future expansion corn storage facilities to handle coastal production.

If a decision is made to transport high-moisture corn from the Selva then additional storage space, drying equipment, and aeration equipment would be advisable on the coast.

Present Market Infrastructure for Corn (ENCI)

Like for rice, corn producers are paid one price regardless of quality (Selva producers receive a premium). Thus there is no incentive for the production of high-quality corn. Furthermore, no technical assistance is being provided to corn producers for improving varieties. And as previously mentioned, no assistance is provided for post-harvest, pre-marketing management of corn.

Currently, ENCI administers the Peruvian corn marketing program. ENCI purchases about half the corn in the Selva, but none on the coast and other regions.

Quota systems established by ENCI set flows of domestic vs. import corn. By choice, end-users prefer in order: coastal-produced corn, imported corn, and Selva (jungle) corn. Quality is ranked accordingly.

Observation: ENCI facilities were unimpressive. On the Selva they lacked drying capacity and thus were incapable of properly storing high-moisture corn. On the coast ENCI facilities that were visited lacked the storage and handling facilities to cater to big poultry producers' needs. The producers, in general, felt that if ENCI (the government) used a grading system that it would help them to better operate their advanced feed formulation and management systems.

Observation: The large poultry and livestock producers are organized to handle corn in bulk. They receive imported corn, thusly, but must receive domestic corn from ENCI in bag.

Since most yellow corn is channeled into feed usage there appears to be no reason for the Selva corn being kept in bag after it is transferred to the coast. If the roads are open the marketing system has some flexibility with regard to drying location. Assuming a 3- or 4-day delivery from the Tarapoto area to the Chiclayo or Trujillo area, drying facilities can be either for bagged corn in the Selva or bulk corn on the coast.

Observation: If it were certain that the roads could be kept open at harvest, it is likely that corn between 14 percent and 18 percent could more economically be dried to safe moisture levels by use of bulk drying on the coast. The coast has the advantages of using wind as an alternative energy. (This observation will be treated as one of the team's recommendations.)

Observation: The corn marketing system still involves a mix of small and large producers (mostly small with regard to number) and a mix of small and large end-users (mostly large with regard to volume). The market is, however, evolving into an advanced system. No longer do the small 5-hectare or less farms produce a large percentage of the corn. No longer do small end-users account for a large percentage of the demand.

Observation: After observing ENCI in operation the team seriously questions its future role in the domestic corn marketing system--if the system might not be more efficient if left to private industry since private traders and feed manufacturers already have the infrastructure for buying and selling and handling corn.

RECOMMENDATIONS

The team found a number of areas in which the Minister of Agriculture can make adjustments in or additions to the rice and corn marketing infrastructure.

Some of the suggested changes will enable the present marketing system to accommodate the current large harvest, thus immediately minimizing quality loss. Other recommendations are longer-term. All recommendations are made with a keen understanding of the state of the economy and the urgent need of the Peruvian government to increase its agricultural production, using techniques and equipment appropriate for a developing country.[1,2]

The following recommendations are made according to urgency of their adoption. Time is perhaps too short to improve the quality or markedly increase the market's capacity for 1984 crops, but the team believes that real opportunities exist for increasing marketing capacity and building an infrastructure that will accommodate the crop of 1985 and beyond.

Longer-term recommendations are not as specific as the team would prefer because of uncertainties surrounding the grain marketing system. Does the MA desire to increase the role of private enterprise? What will be the future role of ENCI and ECASA? In other words, who will take responsibility and the opportunity for system expansion? Will the road system be improved? Is there interest in transporting high-moisture grain out of the Selva as soon as possible?

---

[1]Agricultural production is the backbone of the Peruvian economy. The government should not let it erode into chaos. If costs of production exceed the price of high-quality rice or corn it will not be long until production will decline, eventually supplying only the agrarian sector.

[2]No attempt was made by the team to assess the pricing system, nor the government's agricultural policy other than as it relates specifically to the marketing process.

Transportation--An Urgent Short-Term Problem

Transportation was found to be the major industry and government concern as the team made its inquiries. Although Peru's road system cannot be blamed for the primary grain quality problem, it definitely is the secondary problem. The quality of properly dried and stored grain would not be affected by the transportation delays which were mentioned previously. However, serious post-harvest loss occurs when high-moisture grain is held in high-humidity jungle storage or in trucks because of impossible roads.

Two mountain roads connect the jungle cropland area with the populous coastal area, Figure 5. One running between Olmas and Tarapoto is approximately 750 km in length; the other connecting Tarapoto and Lima through Tingo Maria is approximately 1,450 km in length. In addition to these two roads about 1,700 km of Pan American Highway connect the North Coastal Region with Lima. All are in bad condition and the team heard debate over which should be repaired.

The team will not enter this debate. In its estimation both routes to the Selva are important, not just for hauling grain but for all commerce to and from the region. A good transportation network is one of the basic requirements of all marketing systems. It is especially important in a country like Peru where great distances separate production and consumption. Problems related to transportation are much broader than agriculture and the MA's responsibilities. A good transportation system is essential for the entire economic development of any region or country. It is vital for the movement of all commerce and to national security, including food security. The two should not be separated.

Repair of the Pan American Highway has been slow following the 1983 spring flood. More than a year after the big flood numerous bridges and washes have

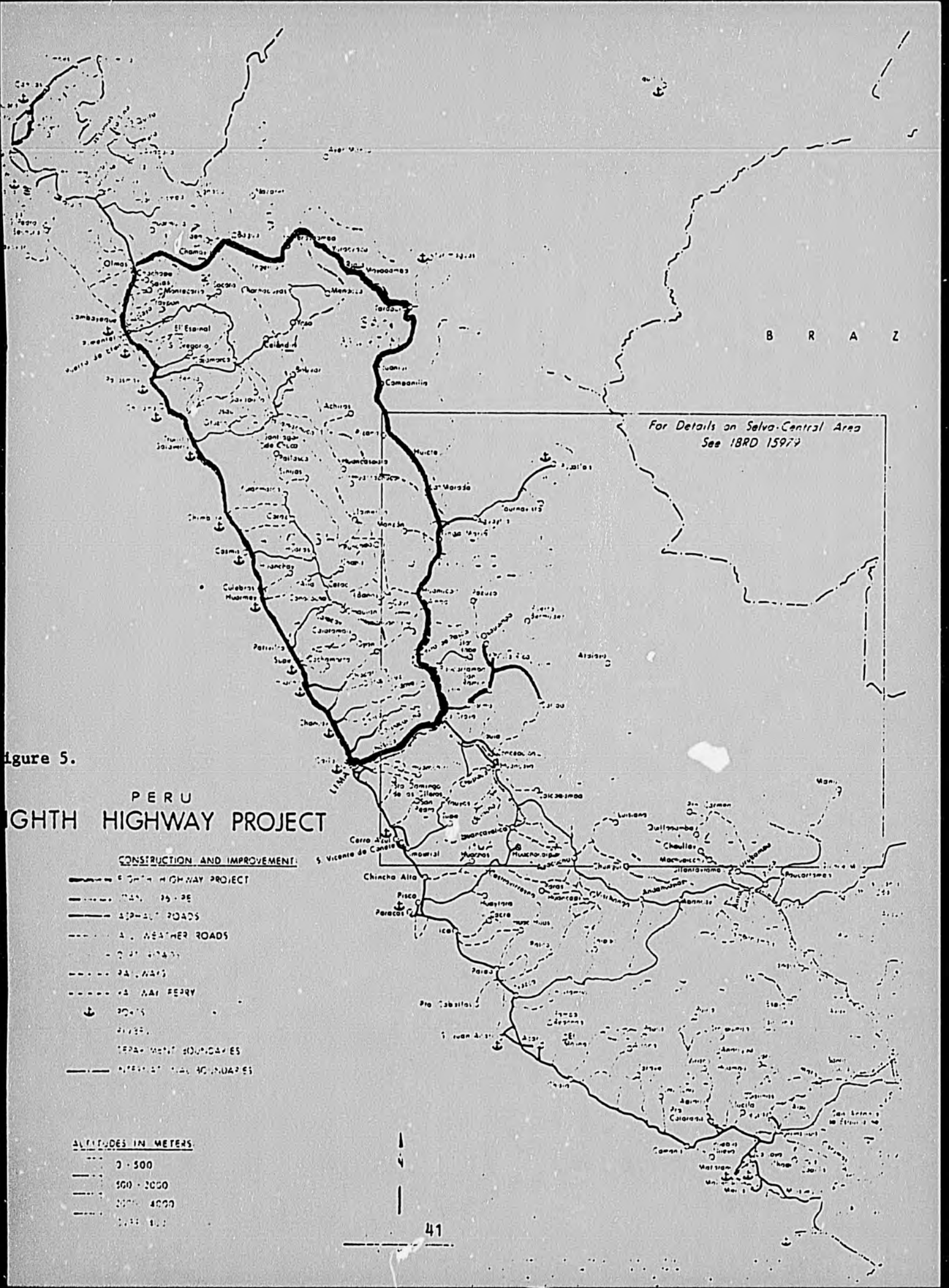

For Details on Selva-Central Area
See IBRD 15979
B R A Z
PERU
GHTH HIGHWAY PROJECT
CONSTRUCTION AND IMPROVEMENT
ASPHALT ROADS
ALL WEATHER ROADS
RAILWAYS
ALTITUDES IN METERS
0 - 500
500 - 2000
41

Figure 5.

not been repaired. Avalanches and mudslides on the roads to the Selva as well as soft spots are not being attended to with the rapidity necessary.

Obviously a new approach to the problem should be tried. If, as the team was told, the Minister of Transportation does not have the necessary funds or other resources, then who does? In some countries the military, trained in bridge building and road construction, is detailed to keep key highways passable. The use of otherwise unemployed hand labor is another alternative. A third avenue worth exploring is additional funds for highway maintenance from the World Bank. The procedure to follow, in this case, is for the Peruvian government to initiate a letter to the Latin American Transportation Division World Bank Offices, Washington, D.C., attention Mr. Jim Nauman, requesting assistance. A bank team will in turn study Peru's highway maintenance needs.

The team, recognizing the immediate and long-term need for a good road system, recommends that the Minister of Agriculture work closely with the Minister of Transportation and others in the Peruvian government to obtain emergency assistance for clearing, repairing, smoothing, and maintaining the Selva roads and the Pan American Highway.

As soon as the roads are passable both rough rice and high-moisture corn can be transported to the coast if 1984 capacity for storing and milling (rice) becomes a problem in the Selva.

Disposal of Low-Grade Rice

Rice not fit for human consumption should be moved into livestock feed channels before each new harvest. (This should be done immediately to make space for the 1984 harvest.) This practice will free valuable storage for the new harvest, hopefully of higher-quality rice. Also this practice will reduce the need for imported corn.

All low-grade rice should be inspected for aflatoxins. If it is infested, then it cannot be marketed for poultry feed. Such inspection relieves ECASA from liability and shows responsible management.

Divert Trucks to Jungle Region

Assuming that the road system is opened at least temporarily (between rains and mudslides), trucks should be diverted to the Selva Region. As much milled rice, corn, and even rough rice as possible should be transported out of the region in the next 6 months. Despite the big coastal rice harvest, millers assured the team that excess milling capacity will exist on the coast in 1984. Storage space, especially for corn, appeared adequate to handle much of the Selva production. Conditions for aeration appeared much better on the coast, although no drying equipment is available.

Coordinate Imports and Domestic Grain Flow

By the 1985 marketing year an effort should be made to avoid receipt of imported corn and milled rice during peak demands on coastal storage by domestic crops. The team understands the current situation whereby Peru takes delivery whenever the U.S. ships PL 480 grain. However, the team does not believe that this has to be the case. Nothing ventured, nothing gained. Persons responsible for obtaining PL 480 grain handled should explain Peru's space problem and arrange for receipt of shipments in other months. The U.S. does not ship all PL 480 grain in its last fiscal quarter.

Expand Storage, Drying, and Milling Capacity

The team considered the need to install drying equipment in the Selva for the 1984 remaining harvest, but because of logistics this option was not deemed feasible. For the same reason that rice and corn cannot be moved out of the region--road conditions--drying and aeration equipment cannot be moved in and installed in time to improve the quality of the 1984 crop.[1]

Nevertheless this equipment is needed as it has been for the past few crops and the need will be even more acute in 1985. Thus, the team highly recommends immediate planning for the next Selva harvest.

Suggested steps are:

No. 1 Choose 2-3 storage and milling facilities in the Selva in optimum locations for expansion.

No. 2 Plan the addition of drying capacity that is compatible with milling capacity and facility layout.

No. 3 Select alternative low-cost drying equipment for installation in these existing facilities by no later than December 1984.

If in the short-term storage space of 3 facilities were expanded by 4,000 MT each, the immediate space crisis would be solved.[2] The team recommends that this immediate expansion be added to existing ECASA facilities. (Longer-term expansion may be encouraged by private investment.)

As previously mentioned, Peru is occasionally blessed with above normal production. It's not wise management to build, buy, or construct for these peak periods; instead the system should be flexible to adjust and compensate for such pressure on the marketing system. Only expand capacity to service long-run trends in production.

---

[1]The team does not consider an air drop of heavy equipment to be a feasible alternative.

[2]An increase of 12,000 MT of storage space is considered adequate if roads are open at least part-time.

Longer-term plans for drying and storage space must be integrated into a receiving system. If the proposed economic study suggests that rice should be milled in the Selva then a complete storage-drying-milling systems should be designed for rice. A flow diagram for a rice assembly and milling center is shown in Figure 6.

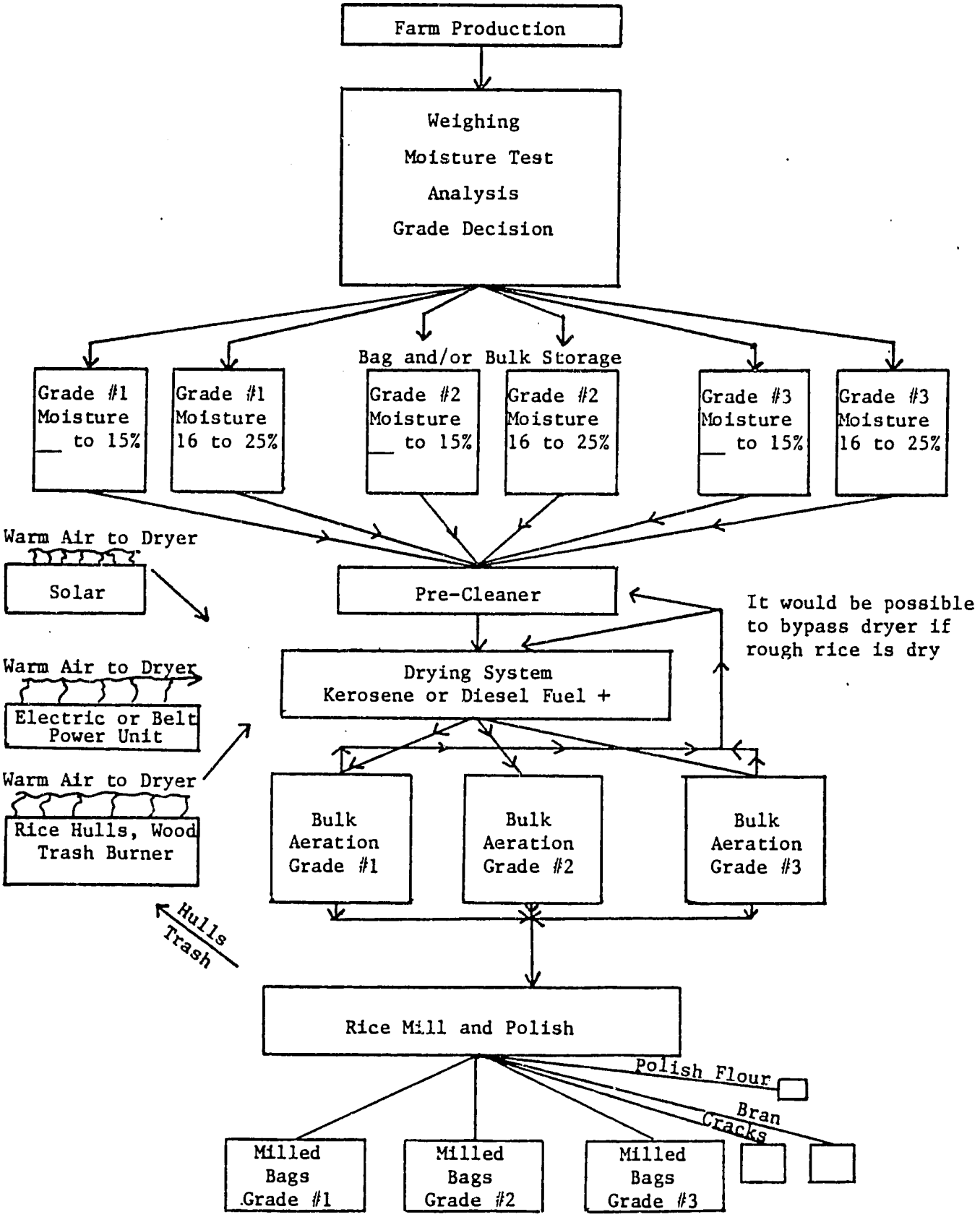
Given Pulver's statements for rice production, Selva storage should be increased by about 30,000 MT by 1986 and by 120,000 MT by 1988. Milling capacity in the region must be increased accordingly. This is a relatively short planning horizon considering the variety of obstacles that must be overcome to get the materials and equipment installed in the Jungle Region, not to mention administrative details. The 2-4 year planning horizon can only be met by dedicated effort.

Suggested steps are:

No. 1 An economic-engineering study for the Selva Region. This should be conducted by a 2-man team that can plan a complete storage-drying-milling system, including optimum locations. The system must be planned to be cost-effective, using low-cost drying equipment possibly utilizing processing wastes and other alternative fuel sources. The study should take no more than 2 months and be completed by December 1984.

No. 2 The study should include a step-by-step construction plan so that at least one-fourth of the planned capacity can be built and in use by early 1986. The team that is engaged to design the system should be consulted when specifications and bids for equipment are let. The team should monitor the progress of construction and equipment installation assuring a workable turnkey operation. The team should work closely with Peruvian economists and engineers so that the technical assistance given in the initial phase of system expansion can be duplicated in the latter expansion phase.

Figure 6. Rice Storage and Milling System Flow Diagram



The same system could be used for corn but eliminate bulk storage if desired. Capacity types of dryers and fuel to be determined by economic analysis.

No. 3 The final three-fourths of the total capacity should be on line by 1988, with local officials fully managing the project.

Technical assistance: Technical assistance for planning the appropriate growth path for the Selva grain marketing system and management training is available from FFGI. In addition to the choice of the most economical and efficient system, two other major considerations are an important part of the emerging Selva marketing infrastructure. They are: (1) the need to train personnel to properly use equipment and (2) development of a parts inventory (of pieces most likely to break or wear due to use and a quick method of parts delivery). For the latter it is important that the government or private entrepreneurs only invest in machinery and equipment for which parts and service are provided in the country. (The same advice goes for purchases of computers and periphery equipment used to administer agricultural policy, inventory control, or other related uses.)

Location of Future Storage, Drying, and Milling Capacity

Long-term storage, drying facilities, and rice mills do not have to be constructed in the jungle region just because rice and corn production is expanding in that region. Given an improved road system, grain can be moved out of the region immediately after harvest. Only enough storage space may be needed in the Selva for a load in-load out (handling) operation. In other words, since the grain must ultimately be moved to the coast, it may be most economical to move it to the coast for drying storage and processing.

Advantages of moving the grain to the coast are several. The coastal climate is more conducive to drying and aerating grain (lower humidity-lower temperatures). Both rough rice and corn could be dried and stored in bulk. Also, a market infrastructure is already in place, making it possible for the rice industry, in particular, to take advantage of economies of scale if larger

volumes of rice were stored and milled on the coast. Furthermore, the logistics of installing drying and milling equipment, and servicing the same, favor the coastal area.

The notion of promoting growth in the marketing system apart from growth in production should be studied before the government sinks capital or promotes private investment in the jungle. Thus the team recommends a feasibility study to identify the most economical location for future expansion of the rice and corn marketing infrastructure with emphasis on minimizing quality loss. This study should be completed before storage-drying-milling systems are designed, because drying and storage facilities may be different if designed for the coast instead of the jungle.

Government's New Role

Following visits to the major production areas the team met with officials in the MA's office, the Director of ECASA, and the USAID Agriculture and Rural Development Officer. As a result of these sessions the team concludes that all are interested in pursuing a path that would make the Peruvian grain marketing system more responsive to the current needs of its agricultural and consumer sectors.

A marketing system blessed with year-round production has the potential to be more efficient than one where all production enters the marketing channels in a 2-4 month period annually. Peru rice producers, for example, expect five crops every two years. Peru has greater potential for food self-sufficiency than most developing countries. With its population increasing at over one-half million annually it is imperative that the Peruvian government build the most efficient and responsive food marketing infrastructure possible. The opening of the new jungle frontier provides a unique opportunity for the MA to consider a more effective method of marketing rice and corn, particularly one

that will be responsive to the anticipated expansion that must accompany the growing need for production in Peru.

Problems with Current System

The current system whereby the government actively buys rice and corn from producers and wholesales all milled rice, type E, Table 9, has neither the capacity nor the infrastructure to service the anticipated production increases 1-5 years henceforth. The present system of side-by-side ECASA and ENCI storage and drying facilities is inefficient. The present system of issuing quotas and permits is not only an administrative burden, but also sets the stage for possible corruption. The current policy of paying one price for all qualities of products also is not conducive to efficient marketing. Government also sometimes finds itself with insufficient funds to pay its obligations to the private sector--millers and producers. This creates irreparable animosities. Furthermore, the present system whereby government is competing alongside private industry in the assembly and processing stages, creates so much uncertainty that private investment simply will not respond to the opportunities and needs of the market system.

Government at present appears to be so involved in the day-to-day marketing process that it has failed to provide the related infrastructure that characterizes developed systems. Government does not need to take title to or market grain in order to effect a workable efficient grain marketing system.

Quasi-Public-Private System

The team recommends, given the inadequacies of the present system and the current need for rapid industry growth, that the MA consider a new course.

The suggested new course is one that relieves the government of much of the administrative burden of day-to-day marketing activities as well as decisions concerning capacity (storage and mill construction). The recommended

TABLE 9

Some Alternative Marketing Systems Showing Role of Government and Private Enterprise

Types of Systems	Stages of a Production-Marketing System for Rice				
	Production	Assembly	Processing	Wholesale	Retail
A Nationalized	Pvt	Gov	Gov	Gov	Gov
B Government Dominated	Pvt	Gov / Pvt	Gov / Pvt	Gov / Pvt	Gov / Pvt
C 50-50 Joint Venture	Pvt	Gov / Pvt	Gov / Pvt	Gov / Pvt	Pvt
D Private Industry Dominated	Pvt	Gov / Pvt	Gov / Pvt	Gov / Pvt	Pvt
E Quasi-Public-Private	Pvt	Gov / Pvt[1]	Gov / Pvt[1]	Gov	Pvt
F Free Enterprise	Pvt	Gov	Pvt	Gov	Pvt
G Free Enterprise	Pvt	Pvt	Pvt	Pvt	Pvt

[1]Gov buys all rice from producers, but Pvt industry stores (assembles) and mills portion.

course does not remove government totally from the marketing process but rather concentrates its activity in two distinct and effective roles, wholesaling milled rice and providing ancillary services.

Government's suggested new role would result in the quasi-public private system illustrated by type F, Table 9.[1] The new system could be phased in over a 3-5 year period. Announcement of this policy change would free private investors of the uncertainties bonding the current system. With new confidence and possibly guaranteed loans to stimulate investment, private industry could be expected to provide the increase in both storage capacity and milling needed in the future.

From the team's experience it is safe to say that private investors will not only respond to capacity needs, per se, but to specific needs of the industry. For example, large-sized producers, both in the jungle and on the coast, are just at the point of switching from bagged to bulk handling.[2] Private industry, when this happens, will be prepared to receive rice in both forms. The competitive spirit of the free enterprise system should be expected to bring such changes as demanded. In other words, given the proper incentive and unobstructed opportunity, private enterprise can be expected to carry out the responsibility of providing an industry capacity in agreement with the volume of product to be marketed.

ECASA and ENCI storage and milling facilities can be phased out as private industry provides the needed capacity for rough rice and corn.

---

[1]Adoption of this quasi-public-private system represents the transition to a free enterprise system type G but maintains some government control which may be more appropriate for a developing country.

[2]Some jungle producers are interested in bulk on-farm drying systems and delivery of grain to market by paddy wagon or truck. At least 5 self-propelled combines were in use on the coast by 1984. The team viewed a Japanese TC-2710 Lanto valued at $60,000,000 that could combine 2 hectares per day. Rice from these combines will be bagged only as long as no bulk receiving facilities are available, then it will be marketed in the more efficient bulk method.

These facilities can be leased or sold to private enterprise or kept by the government for milled rice storage. The latter seems highly feasible in the Jungle Region because of the possibility of impassable roads. Some of the existing space should be devoted to space for quality laboratories and other administrative responsibilities associated with government's new role.

Government's Role in Grain Marketing Activities

The MA already has effectively transferred some of the day-to-day corn marketing activities to private industry at present. Not all corn moves through ENCI storage houses. However, it still buys some corn from farmers. Given its new role, all corn buying and selling activities and all handling and storage activities would be assigned to private enterprise.

In the case of rice, the team recommends that government continue to act as the wholesaling agent for all milled rice. This active role for government seems appropriate considering the critical importance of rice as a staple food in the country. It keeps government in a key position in the marketing system so that it can monitor the quality of the product and assure its equitable distribution to a land of primarily low-income people. Four very important advantages of the quasi-public-private system are: (1) it permits government to indirectly administer farm support prices and special regional incentive prices (to stimulate jungle production) by setting the price paid for milled rice, (2) it allows government to assure not only equitable distribution, as mentioned, but also distribution at a price consumers can afford to pay (a food subsidy program), (3) it enables government to regulate the flow of rice through the system in an orderly and efficient manner and to coordinate imports with the domestic supply-demand balance, and (4) it gives the government the opportunity to effectively administer an all-important food security plan--the opportunity to move from a transitory food security plan to a permanent one.

This role is unique in that government could continue to serve as the price discovery point in the rice marketing process. Advocates of a totally free enterprise system would suggest that this role also should be left to free enterprise. However, in a developing country like Peru, where incentives are used to stimulate production and inflation exceeds 100 percent, it seems to be a role performed best by government. Accompanying this role must, of course, be a monitoring system which will provide intelligence to policymakers concerning costs of production, handling, storage, and processing so that producers and private marketing firms are provided sufficient incentives.

Ancillary Services Role

Government can and should play a support role by providing the market infrastructure that private industry cannot provide. Government should administer the following: a grading system, quality laboratories, an inspection service, a weights and measures program, contract transportation, market news service, a producer price support and food subsidy program (as needed), and an ongoing extension and training program. These functions, of course, suggest the divisions or departments needed in the MA to effect this new infrastructure.

The team recommends that the MA request technical assistance for organizing each of the preceding ancillary services, placing top priority on a grading system and accompanying system of price discounts or premiums for rough rice and corn, equiping quality laboratories, and a weights and measures program.[1]

Grading System for Rough Rice and Corn--Badly Needed

The team believes that the use of a grading system for rough rice, along with road improvements and the installation of drying equipment, would result

[1]The team is aware of the potential problem of unfair payments to producers given government's reduced role. It's, however, believed that with the proper inspection and monitoring of buying and selling activities and producer education this problem can, in time, be solved.

in the greatest improvement in grain quality. Accordingly, the team recommends that the MA request technical assistance and place top priority on developing and implementing a grading system.

Justification follows: A marketing system should reward producers of superior-quality grain. At present, however, there is no incentive. Producers are paid the same price for high-quality rice and corn as for rice and corn that is moldy, sprouted, discolored, and has a musty odor. In fact, the present system used in Peru actually subsidizes the producers who market an inferior product.

The marketing system cannot correct mistakes made in the post-harvest, pre-market period. However, the system can create the incentive for improved post-harvest, pre-market grain quality management. Price incentives must reward the delivery of high-quality grain throughout the system. In Peru's case, a grading system at the assembly stage of marketing can accomplish two important objectives: (1) reduction of grain totally lost in the post-harvest, pre-market period and (2) improvement in the quality of grain marketed. Both will increase the supply vitally needed for food and feed, thus reducing reliance on costly imports.

Under the present system we know that serious losses occur and that the quality of some grain is very poor. Poor-quality grain is marketed because producers know they will receive the same price either way.

The type of grading system is less important than the objective of having one. The U.S. system which includes 6 or 7 grades for both corn and rice are shown in Tables 10 and 11. These complex grading systems are developed for the advanced U.S. grain marketing system. For Peru's internal needs, two or three grade levels may suffice, reference the Australian Fair Average Quality (FAQ) system.

TABLE 10

Grades and Grade Requirements for Rough Rice

Grade	Maximum limits of--						Color requirements
	Seeds and heat-damaged kernels			Chalky kernels			
	Total (singly or com-(bined)	Heat-damaged kernels and objec-tionable seeds (singly or (combined)		In long grain rice	In medium or short grain rice	Other types[1]	
	Number in 500 grams	Number in 500 grams	Percent	Percent	Percent	Percent	
U.S. No. 1	4	3	0.5	1.0	2.0	1.0	Shall be white or creamy.
U.S. No. 2	7	5	1.5	2.0	4.0	2.0	May be slightly gray.
U.S. No. 3	10	8	2.5	4.0	6.0	3.0	May be light gray.
U.S. No. 4	27	22	4.0	6.0	8.0	5.0	May be gray or slightly rosy.
U.S. No. 5	37	32	6.0	10.0	10.0	10.0	May be dark gray or rosy.
U.S. No. 6	75	75	15.0[2]	15.0	15.0	10.0	May be dark gray or rosy.
U.S. Sample grade							

[1]These limits do not apply to the class Mixed Rough Rice.

[2]Rice in grade U.S. No. 6 shall contain not more than 6.0 percent of damaged kernels.

TABLE 11

Grades and Grade Requirements for Corn

Grade	Minimum test weight per bushel	Maximum limits of--			
			Broken corn and foreign material	Damaged kernels	
		Moisture		Total	Heat-damaged kernels
	Pounds	Percent	Percent	Percent	Percent
U.S. No. 1	56.0	14.0	2.0	3.0	0.1
U.S. No. 2	54.0	15.5	3.0	5.0	.2
U.S. No. 3	52.0	17.5	4.0	7.0	.5
U.S. No. 4	49.0	20.0	5.0	10.0	1.0
U.S. No. 5	46.0	23.0	7.0	15.0	3.0
U.S. Sample grade	U.S. Sample grade shall be corn which does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 5, inclusive, or which contains stones or which is musty, or sour, or heating or which has any commercially objectionable foreign odor; or which is otherwise of distinctly low quality.				

Support prices set at just below costs of production with awards (premiums) for highest grades would quickly result in an improvement in grain quality, which would be reflected throughout the system.

In addition to administering a grain grading system, the MA's office should also establish quality laboratories in each production region for the purpose of servicing industry needs, monitoring use of the grading system, and handling appeals.

ECASA, for example, could perform other quality control functions including: (1) periodic calibration of scales, moisture meters, and other grading equipment currently used by all private traders, (2) laboratory services to check rice and corn for aflatoxins and other potentially harmful fungi, not detectable at marketing institutions, and (3) free moisture testing services to producers at harvest time upon request.[1]

As the need arises government also can develop the infrastructure for providing official grades, a warehouse bonding system, and "approved" storage space for grains.

Milled Rice Grading System Change

Peru has a well-defined system for grading milled rice. Three grades are specified: extra, premium, and common.

The current grading system for milled rice appears adequate given a few additional specifications. It is not currently used. The government's reasons for ordering the production of only common grade rice has merit in years of low production and supply. It should, however, consider the production of small percentages of premium grade rice depending on consumer demand. It is not economical to produce only common rice when Peruvian millers can produce supreme

[1]If government should change its role, relinquishing its present role in the assembly and processing stages, then these tasks must be considered to be within the daily responsibility of the performing government agency.

or extra grade rice and, on the other hand, import the more expensive rice equal to Peru's supreme grade.

The team further recommends that the milled rice grades be amended to disallow smutty or moldy kernels or odor thereof the unhulled kernels.

Millers' Milled Rice Storage Contracts Too Rigid

The 60-day limitation on storing milled rice at mills causes an unnecessary rigidity in the marketing process. At times millers may have space for longer storage, say toward the end of the harvest season when all storage space nearer to consuming areas is full. The team recommends that the 60-day restriction be removed and millers be compensated for longer storage when their space is needed.

Trend Toward Bulk Handling

Throughout the marketing system evidence of bulk handling is apparent. Future expansion of storage houses for rough rice and corn should be made with the flexibility and facilities to receive bulk grain. Given the incentive to produce a high-quality grain, large and innovative producers will shortly begin to dry their own grain. At the same time they will begin to delivery rice to mills in paddy wagons. The change could occur both in the Selva jungle and Coastal regions within the next 5 years. Small combines have been introduced in the Coastal Region and interest in on-farm drying exists in the Selva Region.

On-Farm Extension Demonstration Program

On-farm hands-on demonstration projects should be developed to dry grain using combinations of existing energy sources such as solar, wind, or the burning of refuse, cobs, wood, or any other alternative energy source that would not add to the cost to the consumer. Prevention of post-harvest losses and the costs of quality maintenance should offset the cost of drying and proper grain management.

The area needs and can only afford low-cost technology. Fortunately there are alternative energy drying systems that could improve the quality of rice and corn. Several types should be considered.

(a) Solar: reference: Heid, Walter G., Jr. The Young Solar Collector, An Evaluation of Its Multiple Farm Uses, AER 466, Economic Research Service, U.S. Dept. of Agri., May 1984.

Heid, Walter G., Jr. Solar-Assisted Combination Grain Drying, An Economic Evaluation, AER No. 453, ESCS, U.S. Dept. of Agri., May 1980.

Heid, Walter G., Jr., and Warren K. Trotter. Progress of Solar Technology and Potential Farm Uses, AER No. 489, Econ. Res. Serv., U.S. Dept. of Agri., September 1982.

Pierson, Hugh O. and Alipio Nahui. The Development of Solar Energy in Peru, SAND 81-0764, Sandia Natl. Lab., Albuquerque, N. Mex., June 1981.

Solar collectors should not be introduced in the Selva for corn drying without further study. Solar collectors are generally a slow-low temperature drying technique only operable in the daytime when the sun shines. When solar energy is needed the most it is least available.

While parts of Peru receive a high degree of incoming solar radiation (insolation) some coastal areas do not. In the Selva jungle insolation can be very high, but it is not consistent. Cloudy periods may last for several days especially in the rainy season, thus solar dryers could not be totally relied upon in the jungle area where corn is harvested every month of the year. CIPA officials and Mr. Ed Pulver expressed strong interest in rushing solar collectors into use in the Selva. The team does not wish to see producers saddled with inappropriate technology. Thus it recommends an engineering-cost study that takes the area's meteorological data into account before solar grain drying is suggested to corn producers. Personnel at the U.S. Grain Marketing Research Laboratory, Manhattan, Kansas, have been leaders in research and development of solar grain drying systems including low-cost home-made designs.

(b) Wood fire: in oil drums with adobe tray for drying grain

(c) Direct-fired heater and blower (reference appendix)

(d) Wind: A wind-powered aeration system for grain bins or closely-grouped sacks. The system employs a simple concept permitting the wind rotor to act as a means of harnessing the energy of the wind and as a centrifugal pump for drawing outside air through the stored grain. For bulk grain the wind system can successfully dry over 60 MT of corn or rice. Of course wind is most critical for this aeration method. A wind speed of 11 miles per hour (5 meters/second) is necessary. Contact: Windustries, Inc., 4210 Johnson Drive, Suite 100A, Shawnee Mission, Kansas 66205, telephone 913-432-1793.

The team's observations of tree deformation in the Coastal Region, based on the Griggs-Putman Wind Speed Index, suggests a mean annual wind speed of 12 to 19 miles per hour. This is sufficient wind speed to consider wind-powered aeration systems for maintaining rice and corn quality during storage. Wind energy could possibly provide low-cost aeration for high moisture jungle grain if a decision is made to move it to the coast as soon as possible after harvest.

CIPA officials indicated an interest in expanding their program to include technical assistance to producers in the post-harvest, pre-market period. Their primary interest is in the use of alternative energy systems--solar or wind. Other opportunities exist to reduce post-harvest losses on farms by erecting small slatted corn cribs, shocking corn and rice (like practiced in the U.S. in the 1930s and 1940s) or in the case of rice a system of bundling and then hanging the bundles on poles (like practiced in Japan in the 1950s).[1,2]

---

[1]Small slatted cribs appear to be an appropriate technology for corn producers to store ear corn (see appendix for design). There are similar cribs already in use in Peru by potato producers. In some cases joint use of such cribs may be possible. Personnel at the International Potato Center expressed interest in the joint use (potatoes and grain) of storage bins aerated by wind in areas not having electricity.

[2]At present it is a common practice for the producers to leave their crop lying flat on the ground until they are ready to thresh or stack as the case may be. This creates a quality problem once it rains and given year-round harvest in most regions some grain is bound to get wet and spoil.

FOLLOW-ON STUDIES

Special attention is invited to the following areas, believed by the team to be critical needs in the development of a workable grain structure in Peru. If Peru desires to reverse its trend toward dependency on imported food then it must provide the the motivation for farmers to produce grain and other crops. However, increasing production without providing an economic incentive to market high-quality grain and without providing the political climate for the development of a market infrastructure that is responsive to the country's needs, is fruitless.

Peru's rice and corn production marketing system is at a crossroads. An opportunity exists to greatly reduce post-harvest losses while the marketing system grows at an unprecedented rate in the next decade. The potential for new cropland in the jungle, use of new varieties, the application of new technology, and farm management practices is great. However, if this potential is to be realized, the marketing system and process must be improved to bring producers' and consumers' needs into closer harmony.

Technical assistance could enable the Minister of Agriculture to choose a more workable solution. Follow-on studies could provide this needed assistance in at least three closely-related areas:

Choice of System

Before decisions can be made concerning expansion of market capacity the role of government in the marketing process must be decided. With the assistance of a marketing systems analyst and a policy analyst proposed changes can be similated and plans made for implementation of the proposed quasi-public-private system.

Closely related to this detailed project would be the necessity to plan the new role of government in the marketing process, specifically in the

administration of a grading system, support-subsidy policies associated with the new system, and other ancillary services. Assuming that these changes should be phased into existence, this technical assistance could be ongoing for a period of 2-3 years.

Regardless of the system adjustments that might be made, the team again stresses the importance of implementing a grading system for rough rice and corn as soon as possible. Technical assistance should be sought not only to devise a system appropriate to Peru's domestic needs, but also to set up quality laboratories, a quality inspection service, and to train both industry members and farmers to use and understand the process. Preferably a grading system should be developed and used for the 1985 crops.

Expansion of Market Facilities

Whether expanded by government, private enterprise, or both, technical and economic assistance is needed to assure that growth in industry capacity is both rational and timely.

Specifically, two studies should be completed as soon as possible. The first should be an economic feasibility study which weighs the advantages and disadvantages of encouraging major market infrastructure growth on the coast vs. in the jungle. This study should consider the long-term ramifications of such decisions as well as the opportunity to reduce post-harvest grain losses.

A second study, following from the first, should be the design of storage-drying-milling facilities. This study should involve both an engineer and an economist, both having broad knowledge of systems design, appropriate technology and the use of alternative energy sources. Both of these short-term studies should be completed by late 1984.

On-Farm Extension Demonstration Projects

Flowing from the team's observations was the firm conclusion that the marketing system cannot perform miracles--it cannot turn spoiled grain into high-quality grain. The major post-harvest loss problem in Peru occurs before the rice and corn leave the farm, not afterwards. The team further concludes that the problem exists simply because no effort has been extended to show producers how to take care of their grain and at present there is no economic incentive in the marketplace to encourage them to do so.

The team proposes that a follow-on, hands-on, demonstration project could pay extremely high dividends. Producers could be shown how to cut their losses through improved methods of harvesting, stacking or shocking, on-farm drying, and storage using low-cost, affordable technology. This effort should start as soon as a grading system is placed in use.

USAID and FFGI stand ready to assist the Minister of Agriculture if he and his staff decide to act upon one or more of the team's recommendations or proposed follow-on studies.

APPENDIX

Previous Page Blank

The WINDUSTRIES 6 is a wind-powered aeration system for grain bins. It provides "grain cooling" for all types of grain i bins up to 5000 bushels capacity. Aeration of grain during the fall and spring prevents moisture migration and resultant spoilage. In addition, if ambient temperatures are low enough to permit the grain to reach 40°F (4°C) for 6 weeks, winter aeration will kill any insects infesting the grain.

Design and Operation

The WINDUSTRIES 6 employs a simple, novel concept permitting the wind rotor to act both as a means of harnessing the energy of the wind and as a centrifugal pump for drawing outside air through the stored grain. The aerodynamically shaped blades are actually hollow tubes. They are connected to a hollow hub which is mounted at the top of a hollow standpipe attached to the side of the bin. The standpipe connects to perforated tubing in the bin which permits entry of air from the surrounding grain mass. As the wind rotates the blades, centrifugal force throws the air in the blades out their open tips, creating suction ("negative pressure") in the hub, standpipe, and perforated tubing. Outside air enters the bin under the eaves, is drawn down through the grain, into the tubing, up the standpipe and into the hollow rotor where it is finally expelled from the ends of the hollow blades. The amount of negative pressure created by the WINDUSTRIES 6 is adequate to overcome the resistance of even the smallest grains (wheat, rice) to the flow of air.

The rotor is ruggedly made of extruded aluminum blades attached to a cast aluminum hub. The blades are aerodynamically designed to lose efficiency, or stall, at high wind speeds. These features eliminate the need for a separate mechanism to restrict rotational speed. The WINDUSTRIES 6 has two sets of bearings, one enabling the rotor to turn, and the other permitting the tail of the machine to yaw it into the wind. It has no other moving parts.

While the WINDUSTRIES 6 is designed to operate continuously, an optional gate in the standpipe can be opened to short circuit the flow of air and stop aeration. Alternatively, the blades can be tied off by hand.

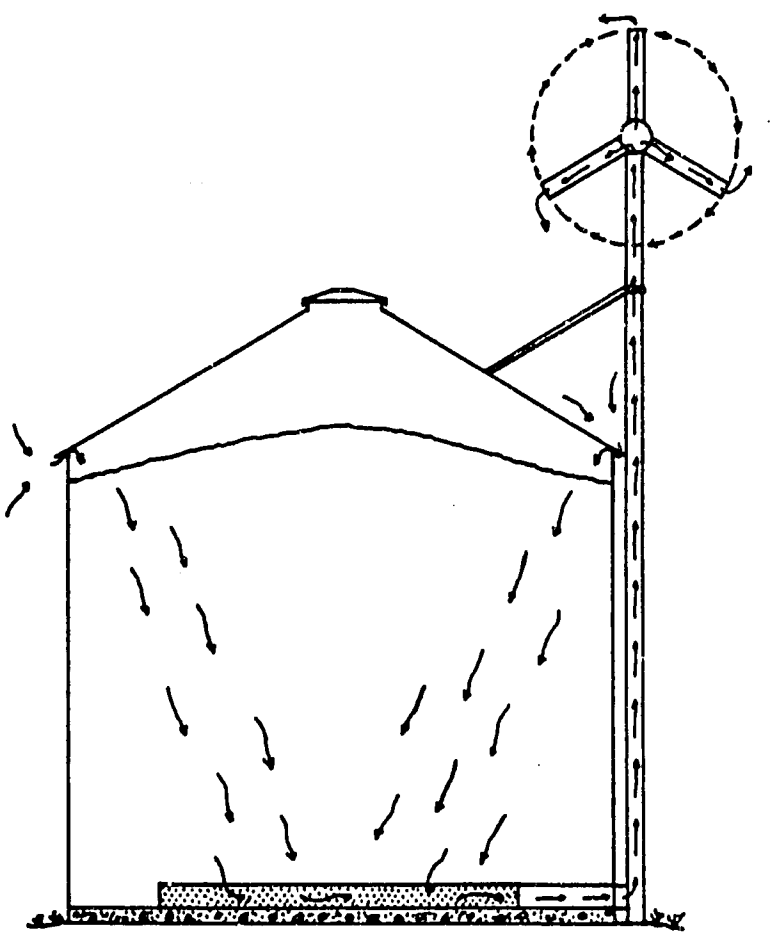
Previous Page Blank

Siting Requirements

The WINDUSTRIES 6 is a significantly improved version of a machine successfully tested for two years on an 18 foot diameter bin containing approximately 2,500 bushels of sorghum. The bin is located at a generally unobstructed site (the U.S. Department of Agriculture Grain Marketing Research Laboratory, Manhattan, Kansas) with average annual winds of approximately 11 miles per hour (5 meters per second). On the basis of information developed during these tests, the improvements should permit the WINDUSTRIES 6 to handle up to 5,000 bushels under similar conditions.

Estimated Price

The estimated price of the WINDUSTRIES 6 is $780.00 F.O.B. Kansas City, Kansas USA. This price includes $200.00 for the standpipe, perforated tubing and transition, which may be available locally.



WINDUSTRIES, INC.
4210 Johnson Drive, Suite 100 A Shawnee Mission, Kansas 66205 913/432-1793

THE DEVELOPMENT OF SOLAR ENERGY IN PERU

Hugh O. Pierson
Surface Metallurgy Division 5834
Sandia National Laboratories
Albuquerque, NM 87185

Alipio Ñahui
División de Energía
ITINTEC
Apartado 145
Lima, Peru

SAND81-0764
Unlimited Release
Printed June 1981

The Climate and Geography of Peru

Peru is a land of extremes, and the contrasts in its geography and climate are striking--from a fog-shrouded coast where it never rains, to glaciers and snow-covered peaks more than 6000 m high, to the intensely hot and humid jungle of the Amazon basin. Obviously the potential of solar energy varies greatly from one region to another, and for that reason, a brief review of Peruvian geography and climate is in order.

Peru can be divided into three sharply distinct zones ([redacted]).[2]

1. The coastal strip, wedged between the Pacific and the Andes, varies in width from almost nothing to more than 300 km in the north. Except for a few irrigated valleys, it is totally desert with essentially no rain ([redacted]). Although close to the equator, it has moderate temperatures because of the influence of the cold Humboldt current ([redacted]). The northern and southern coastal areas have relatively high insolation (solar radiation), but the central area, which has the capital city Lima, is usually cloudy--an unfortunate situation from the standpoint of solar energy because Lima is the hub of the country with more than 30% of the population and most of its industry.

2. The Andes are a long, high range of mountains extending more than 2000 km the entire length of Peru and varying in width from less than 100 to 300 km, with many peaks higher than 6000 m ([redacted]). More than half the population of Peru lives in the high mountain valleys. Here the climate is uniform, with temperature a function of altitude; monthly variations are very small (2° to 3°C), but diurnal differences can be much higher, possibly reaching 20°C. Insolation is always high

3. The Amazon basin is an extensive low, flat plain covered with a thick jungle; very few people live there ([redacted]). Temperature is usually high, and it rains all year, with maximum rainfall in January and February. Insolation can be very high, but it is not consistent. Cloudy periods may last several days, especially in the rainy season. In the Amazon basin (as in the Andes), the terms "winter" and "summer," with their implications of large climatic changes, are inappropriate. A more accurate terminology would be "wet" and "dry" seasons.

Economic and Social Factors

Several important economic and social factors tend to hamper the development of solar energy in Peru (and all the other Andean countries). Industrial capacity is limited. Many products whose availability is taken for granted in industrial nations are not produced locally and must be imported, often at high cost and with long delays. Any equipment must be designed with these restrictions in mind.

There is a general lack of technical personnel. Engineers and scientists are dedicated and very capable, but laboratories are few and poorly equipped.

On a more positive level, solar energy faces less competition from other sources of energy in Peru than, for instance, in the US. Networks for electricity cover only a fraction of the country; transportation is rudimentary; petroleum products and coal are sometimes difficult to obtain and usually expensive. Solar energy is often the only practical alternative. The various solar applications described in this report are classified on the basis of level of temperature and the corresponding degree of complexity. They were developed in Peru for the most part, usually under the coordination of ITINTEC, a division of the Ministry of Industries at Lima.

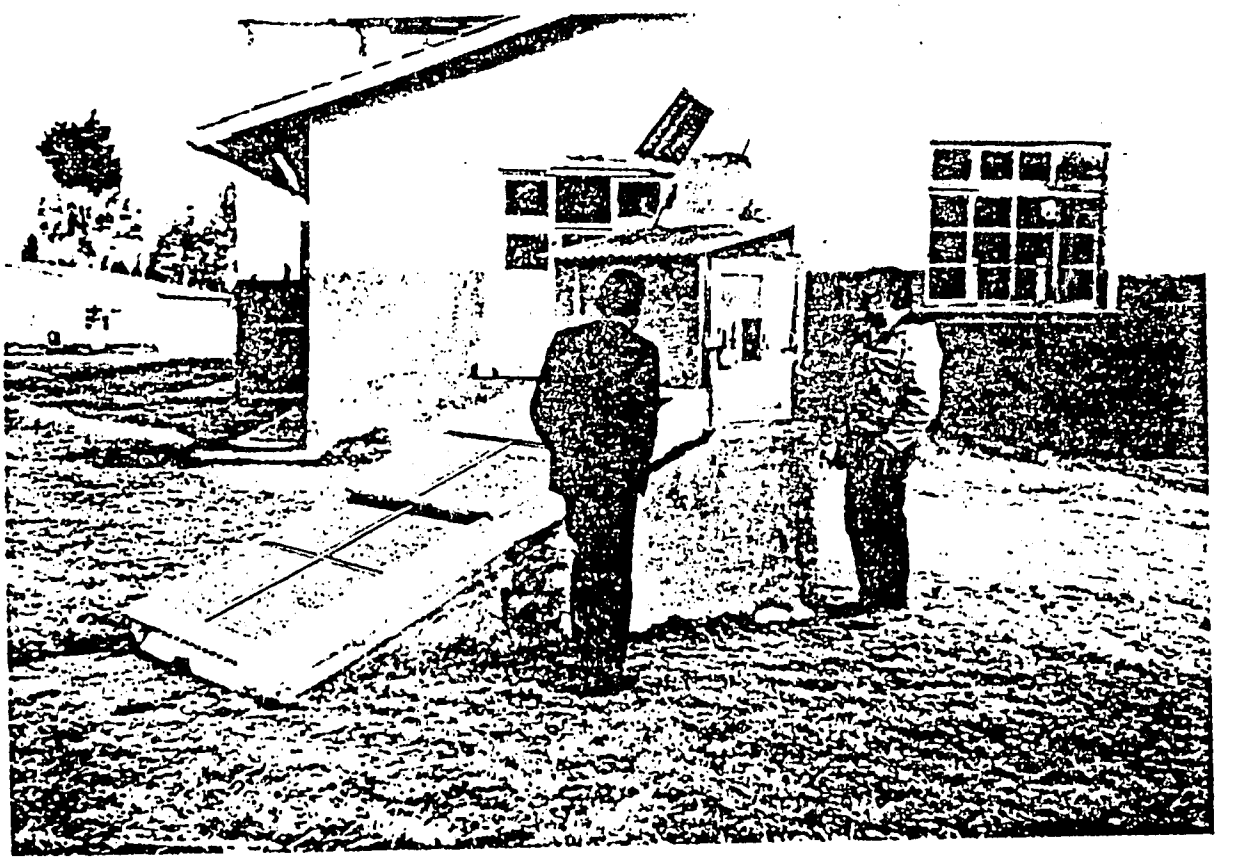


Figure 14. Solar Crop Dryer Near Huancayo

Peru imports large amounts of food--a major factor in the imbalance of the economy. Such imbalance could be considerably reduced if crop losses could be avoided. Peru has very few industrial crop dryers and relies almost entirely on direct drying by the sun. Very large losses are the result, particularly in the Amazon basin where sudden rains are frequent and transportation very inadequate.

Developing large-scale solar drying of crops such as yuca, corn, rice, and fruits should receive first priority. Solar drying may often be the best solution--and in many cases the only solution because competing sources of energy are not available. The technology of large-scale solar food drying is still experimental, however, and few designs have reached the commercial stage. Possibly the biggest technical hurdle is the need to provide adequate circulation of air. This may be done by combining solar with wind energy, or by using fans powered by photovoltaic panels.

The Young Solar Collector: An Evaluation of Its Multiple Farm Uses, by Walter G. Heid, Jr., National Economics Division, Economics and Statistics Service, U.S. Department of Agriculture. Agricultural Economic Report No. 466.

Summary

An efficient solar collector designed for multiple uses on the farm, including grain drying and home heating, has been developed by a Nebraska farm couple and the Small Farm Energy Project of the Center for Rural Affairs in Hartington, Nebr. The Young collector, named after its farmer-designers, performed successfully in 1979 and appears to be an attractive farm investment.

The collector performed efficiently, drying corn from 18.5- to 15-percent moisture in the fall of 1979. Attached to the Young farm home in the winter of 1979/80 for 4 months, the collector provided 20 percent of the total heating. More than 330 gallons of propane valued at $179 were saved in drying and heating.

This solar collector is portable, can be tilted to receive the maximum available solar radiation, and features a flexible airflow system. This combination of features makes the Young collector ideal for several diverse farm uses. It is simple to construct with used lumber and other materials commonly found around the farmstead. There are no prefabricated parts.

For grain drying, the collector and fan system can produce an airflow of 3,000 cubic feet per minute at 1.2 inches of static pressure and produce a temperature rise of 12°F at noon. For home heating, the collector produces 19,700 Btu per hour at noon, with a temperature rise averaging about 40°F.

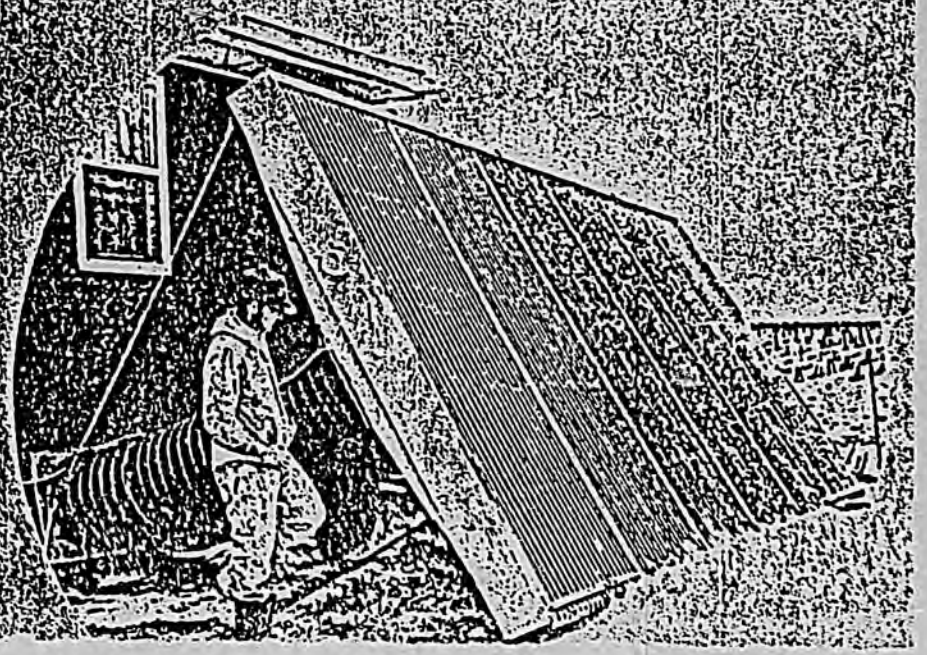
Investment in the Young collector, including the cost of a used four-wheel running gear, totaled $1,410, or $5.88 per square foot of collector surface. After deducting regular investment credit from this cost, net energy savings resulted in an 11.2-percent return on investment. Payback was estimated at 5.8 years for the collector, which has a 20-year expected lifespan. With such a short payback, the Young collector appears to be a safe system for lenders to finance and an attractive investment for farmers.

United States Department of Agriculture
Economics and Statistics Service
Agricultural Economics Report Number 466

The Young Solar Collector:

An Evaluation of Its Multiple Farm Uses

Walter G. Heid, Jr.



Plans Available

Construction plans for the Young collector may be purchased from the Small Farm Energy Project, P.O. Box 736, Hartington, Nebr. 68739. Specify "Portable Solar Collector Plans." The cost is $2 per set. The charge covers expenses only; the Small Farm Energy Project is a U.S. Government-funded nonprofit organization. The collector and its plans are not copyrighted. Information and specifications relating to this collector are within the public domain.

The Alvan Blanch Development Co. Ltd.
Reg office Chelworth, Malmesbury, Wiltshire, SN16 9SG, England

Directors: Alvan B Blanch OBE MInstPI LCE Durston BR Frier FCA J.Sanders GJ Sampson, JJ Blanch
LE Capell MIMH Regd in England No 507937 VAT Reg.No.137 422481

Our ref: LEC/NEB/EX13562 5th October, 1983.

Harold B. Stryker P.E.,
Harold B. Stryker & Associates,
Rising City,
Nebraska 68658,
UNITED STATES OF AMERICA.

Dear Sir,

We are pleased to note the interest you have shown in the Batch Driers which you have seen in Ghana, West Africa. There are a number of these Driers in operation throughout the world, particularly Ghana, Nigeria, Honduras and other areas of the world which are developing.

As you have observed the principle of the Drier is not to use elctrical controls as it is often very difficult in outlying areas to obtain electrical supply.

We are enclosing literature describing the range of Driers which we manufacture and the Batch Drier you have seen has been extended in models available. We are now able to supply three models of Batch Driers as follows: Model 2500, two ton batch drier for maize, measurement 2.2m x 2.76m , ex-works, unpacked price £2,605.00. Model 3500, 3.5 ton batch drier for maize, measurement 2.2m x 3.8m, ex-works, unpacked price £2,972.00. Model 5000, 5 ton batch drier for maize, measurement 2.2m x 5.5m, ex-works unpacked price £3,950.00.

We can offer larger batch driers if required but we do recommend that it is more simple to work with two units side by side, rather than one big unit. It is much easier for the user to control and often we have found the amount of grain coming into the Drier to be insufficient to fill larger units.

Any of these Driers can be made available for despatch within two weeks from receipt of confirmed order, and we find the simplest method of shipping these driers if quantities are involved is by using the 20ft shipping container as the packing method and the quantities of the driers depend on the size of driers to this unit, rather than going to the expensive form of packing of casing etc. Obviously single units or less than container loads do have to be packed in cases and crates which we will be pleased to quote you according to requirements.

Continued/...

Previous Page Blank

Literature describing the Driers is enclosed and you will no doubt appreciate the simplicity of design.

We are not currently represented in Peru, but we do have a sales agent in Ecuador, but he is not a stockist, and there is no difficulty in us selling through yourselves against the individual requirements of your clients.

The prices are quoted nett and do not include any commissions.

When you have had an opportunity of studying the enclosed literature, perhaps you would care to revert back to us.

We are also enclosing a copy of our company history, and a leaflet describing the full range of equipment which we manufacture.

Assuring you of our best attention at all times, we are

Yours faithfully,
THE ALVAN BLANCH DEVELOPMENT CO. LTD

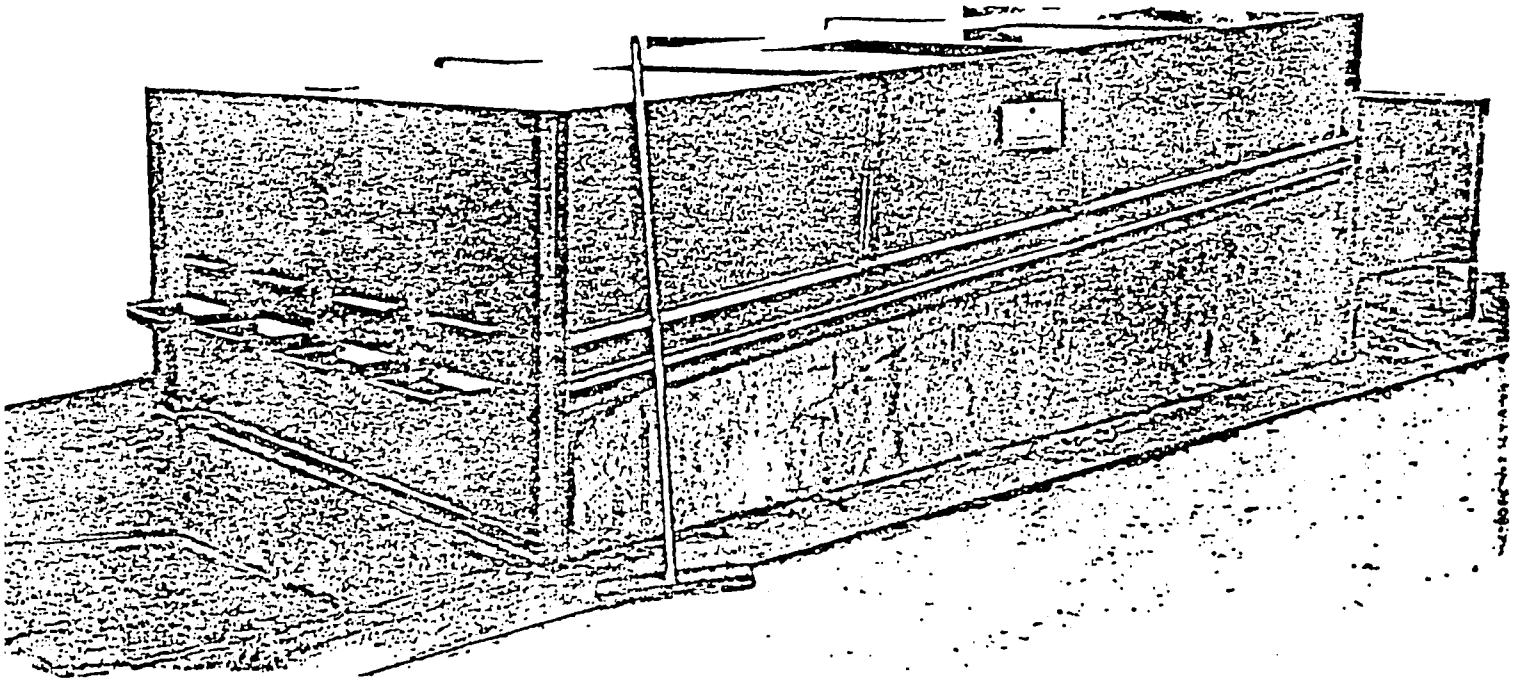
Norm Beach

pp L.E.Capell.
Export Sales Director.

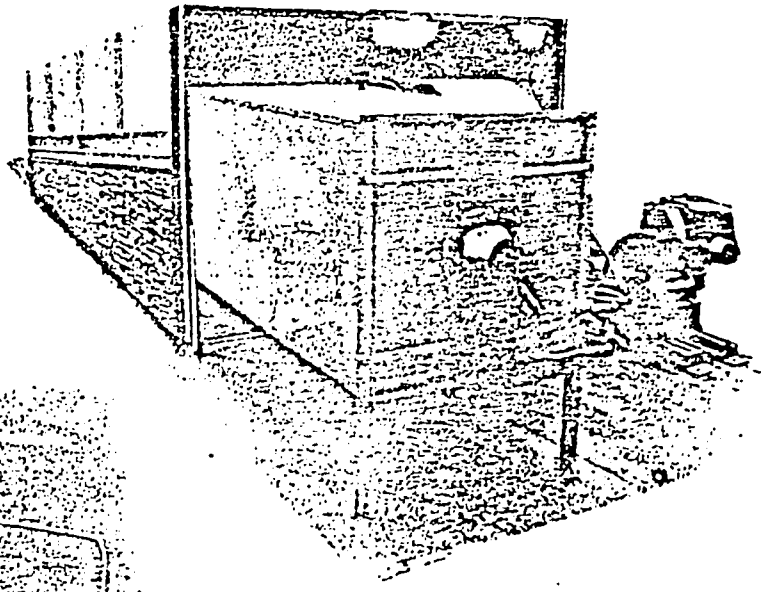
Enclosures:

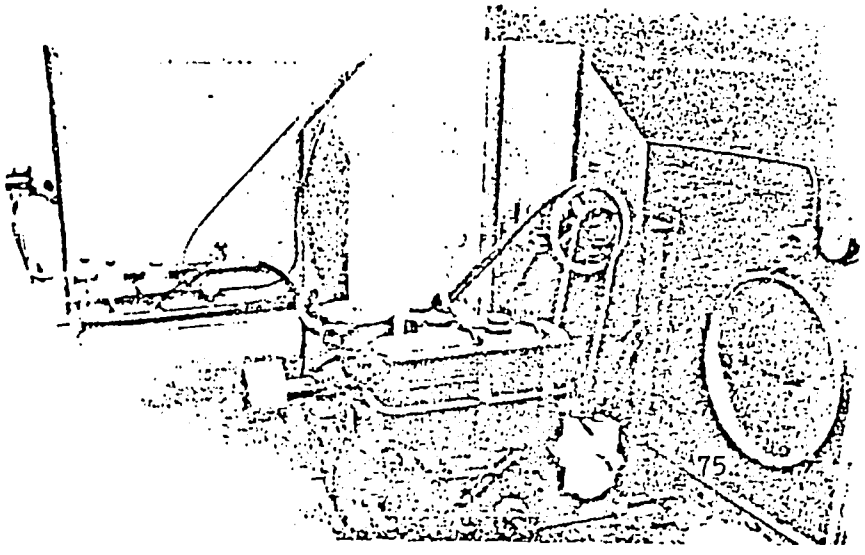
The Newum Dunum
Development Co. Ltd.
Chelworth, Malmesbury, Wiltshire, SN16 9SG, England
Telephone CRUDWELL (06667) 333 Telex ALVAN B G 44304

BATCH DRIERS



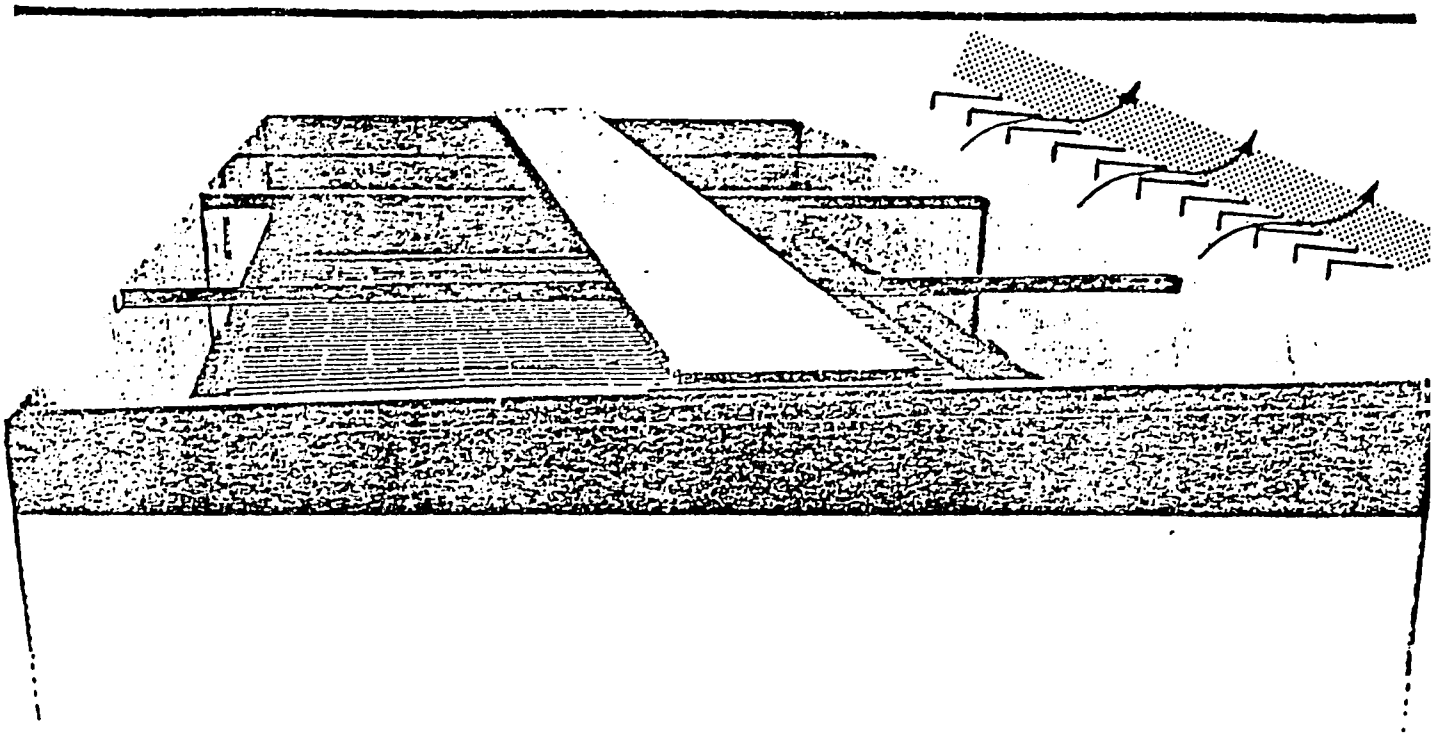
Suitable for all grains including Maize, Paddy and many other crops. Fan drive by Engine, Tractor or Electric Motor. Oil Fired Furnace standard but Furnaces for other fuels including Gas, Rice Husks etc., also available.





Example shown above has louvred bed area 18'0" x 7'0" (5.5m x 2.13m) which would hold 4 tons of Maize. (Filling, drying, emptying cycle approx. 3 to 4 hours for 5% moisture extraction.) Undersides of Plenum Chamber may be formed in bricks or blocks obtained locally or supplied in steel. Lower photographs show Oil Fired

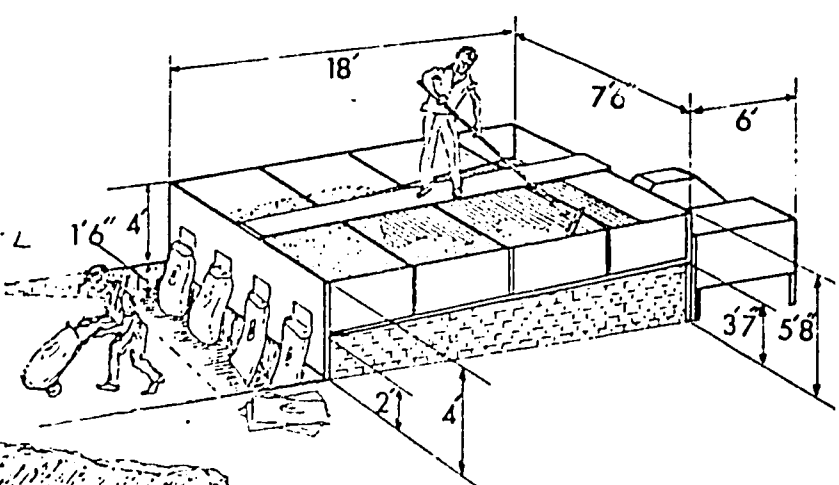
The ALVAN BLANCH
Development Co. Ltd.
Chelworth, Malmesbury, Wiltshire, SN16 9SG, England
Telephone: CRUDWELL (06667) 333 Telex: ALVAN B G 44304

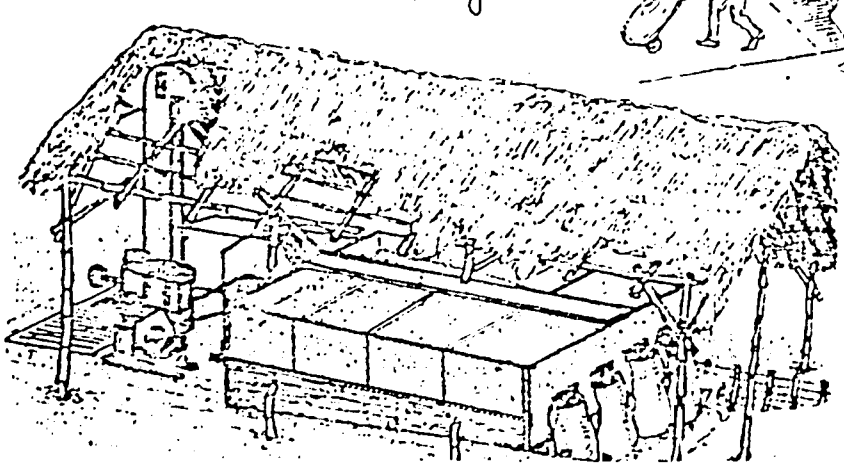


The famous Louvred Bed as fitted also to the range of Alvan Blanch Continuous Flow Driers (ask for separate Catalogue). Centre Catwalk to facilitate loading, levelling and unloading. Dried materials normally sacked off at lower level from the four outlets fitted with slides and sack holders. May also discharge into Conveyor and Elevating system for storage in bulk. (ask for separate catalogues). Many sizes of these popular Batch Driers available with complementary Fan and Furnace Units to suit individual applications. When asking for further details, please state crop. initial moisture content, final moisture content required, also quantity to be dried hourly and daily, local conditions of ambient temperature and relative humidity if possible.

TWO STANDARD MODELS
18' x 7'6" with a ST2 diesel engine
9' x 7'6" with a ST1 diesel engine

ST-2 is a LISTER DIESEL
2 CYLINDER (18-22HP ??)
Stephen





Drawings show typical application of Alvan Blanch Batch Drier with simple, locally constructed housing, Intake Pit and Feed Elevator (as alternative to hand filling from sacks). Many other sizes and arrangements available. Undersides of Plenum Chamber shown in locally obtained brick. May also be supplied in steel sheeting.

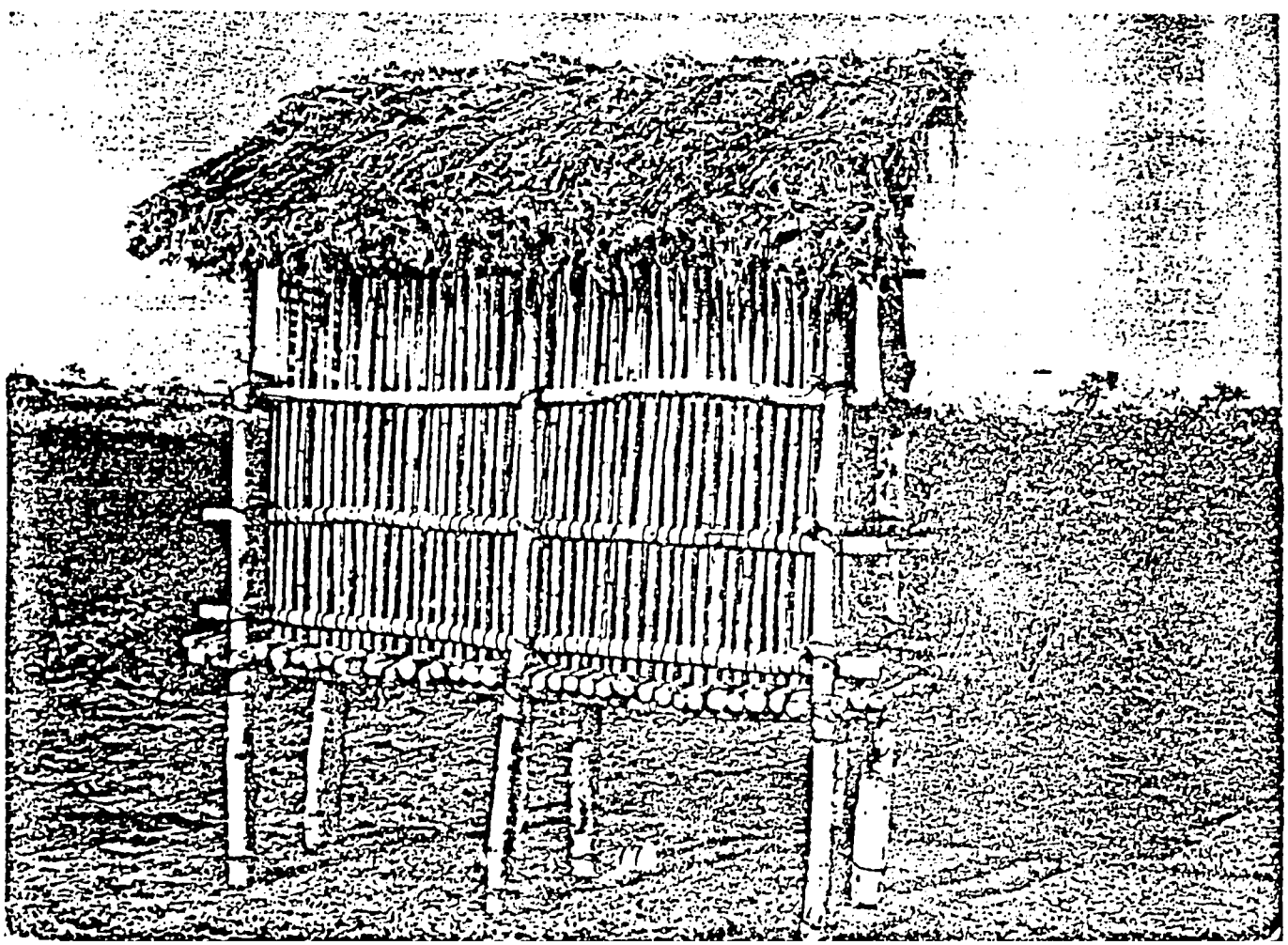
THE IMPROVED MAIZE DRYING AND STORAGE CRIB

Improved Traditional Methods

A farmer has to think about a lot of things before he can decide which type of drying method to use for his crop. Here are some of the considerations he must keep in mind:

- Does his present method work? If it does, why change it? If it does not work, why not?
- How much money will he have to spend for a new drying method?
- Would he be able to maintain a new drying machine? Could he fix it? Does he have enough time to operate it?
- Would the cost of the dryer be easy for him to get back because of better storage leading to more grain to sell?
- Would it be better to join a group of farmers and pay for the cost of a dryer with a group? Or does the farmer dry enough grain to make use of a dryer by himself?

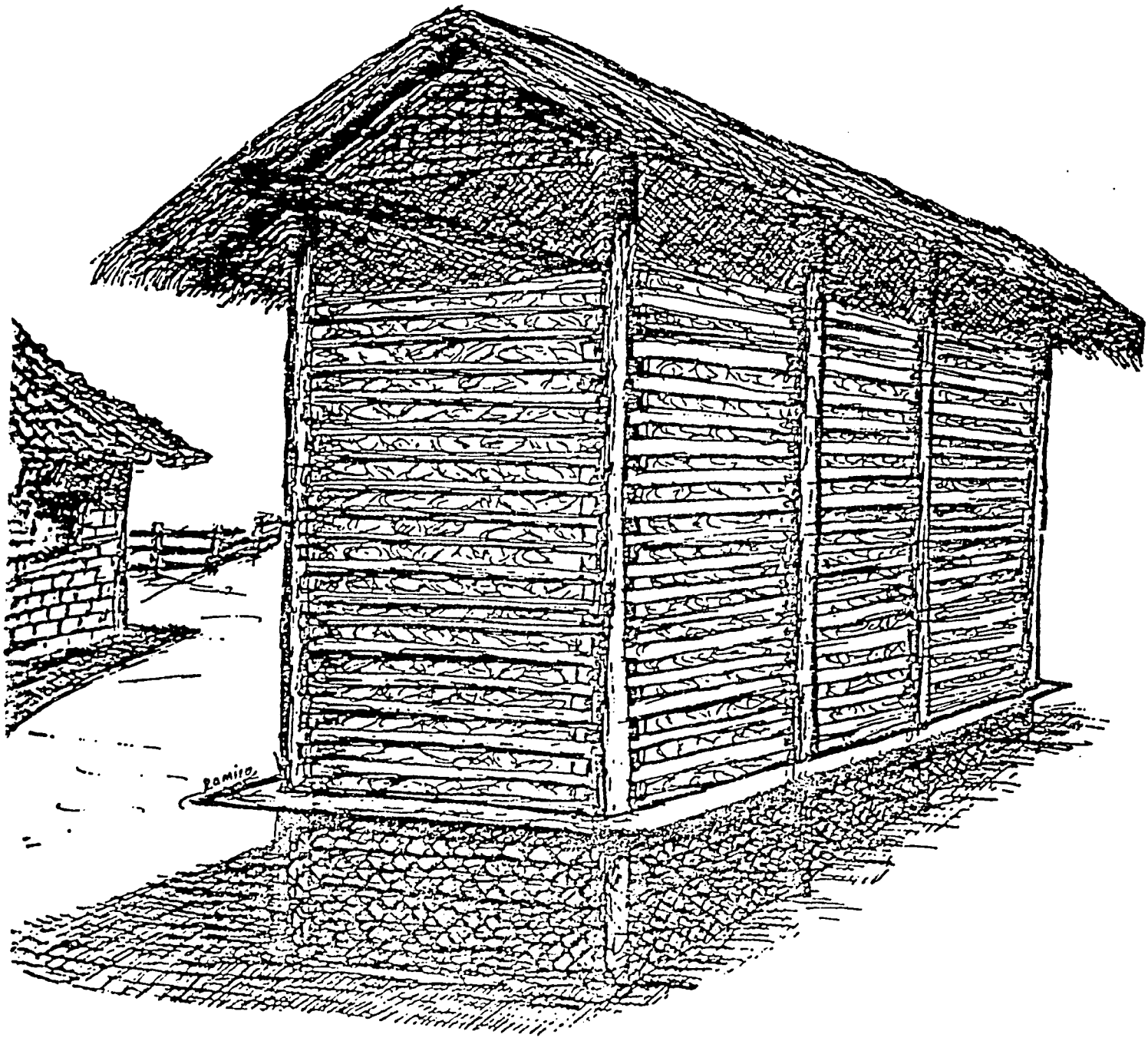
You will probably be able to help by offering alternatives. For many farmers, an improved method of crib drying for maize or sun drying for smaller, threshed grains, would be a step easily taken. Such a step would insure a much better crop.



CONSERVE SANO SU MAIZ

A-13

EN TROJAS



MINISTERIO DE AGRICULTURA Y GANADERIA

Sección de Productos Almacenados-Extensión

Managua, D.N., Nicaragua, C.A.

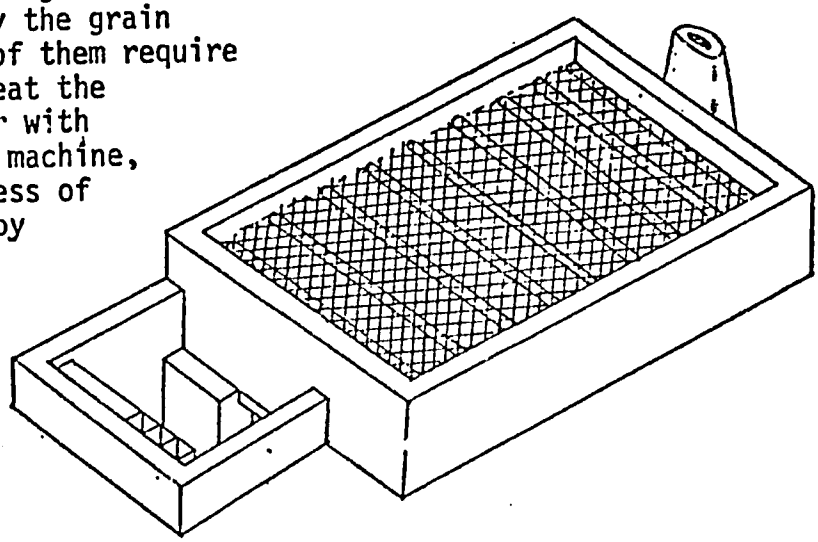
GRAIN DRYER MODELS

This manual already has talked about the need for drying of the grain.

Unshelled maize, rice, millet, or sorghum often is stored in cribs for further drying. The cobs, or heads, do not pack tightly. Because the cribs are open to the wind, air moves through the stored grain and dries it. Even so, storage in cribs is more effective in the dry season. The more humid air of the wet season may actually add moisture to the grain. In addition, insects and rodents can cause serious damage to unprotected grain stored in cribs for long periods.

Threshed grains, particularly those with small kernels like millet, dry very slowly during storage. The kernels pack tightly together. As a result, air cannot move easily through the grain. Such grains can be spread in thin layers in the sun for drying. If possible, the grain should be on a screen to let air enter the bottom. The grain should be tumbled (stirred) often and carefully. The grain kernels can crack if they are stirred too hard.

The newer drying methods described here use heated air to dry the grain. Hot, dry air is blown through the grain. These methods dry the grain quickly and well. Most of them require the burning of fuel to heat the air. This fact, together with the cost of building the machine, often limits the usefulness of drying machines for use by small farmers.



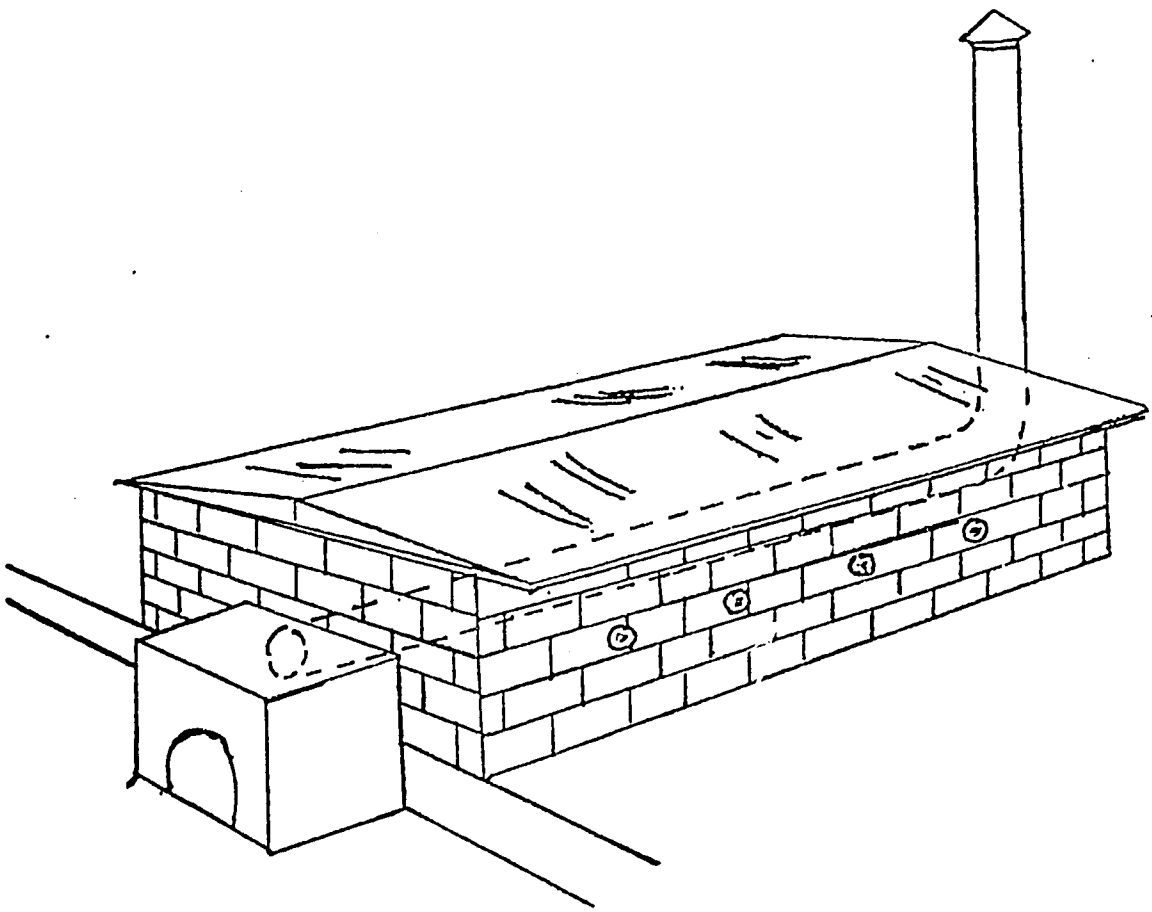
THE PIT OIL BARREL DRYER

MODIFICATION OF MODEL #2 SOLAR DRYER

A Dual-Purpose Solar/Fuel-Heated Dryer

It is possible to build solar dryers which can work on solar heat for most of the time, but which can, if necessary, be artifically heated during periods of heavy clouding or rain.

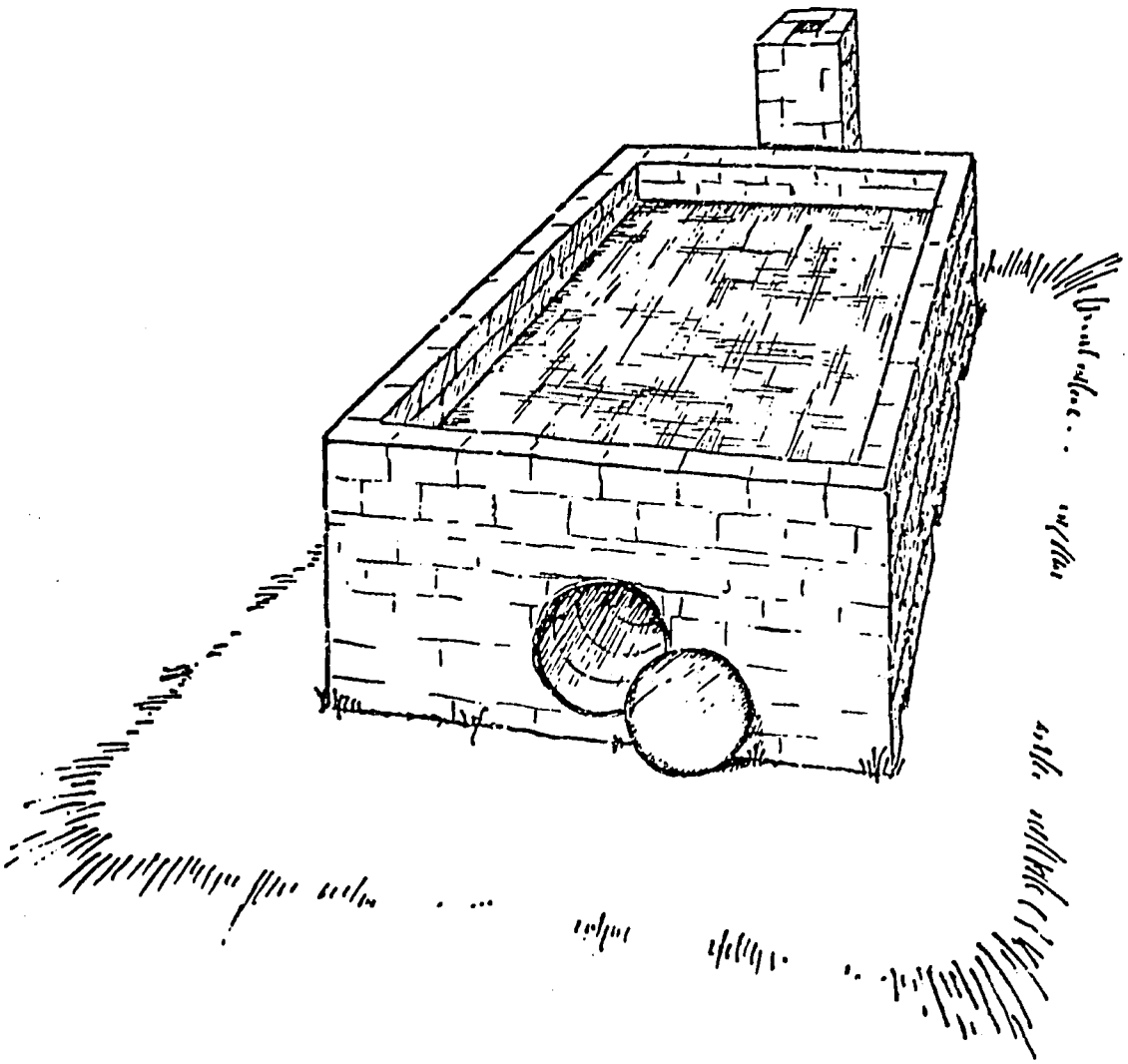
A modification of the Model 2 dryer will allow for this dual-purpose operation. This modification consists of building-in a metal flue pipe which runs through the length of the dryer. This pipe carries the heat from a firebox built at one end of the dryer. When drying has to be done in cloudy conditions, the fire can be lit to provide heat for drying.



Either one large, say, 11cm diameter pipe, or a number of smaller pipes can be used. When using smaller pipes, difficulties in constructing a manifold may arise. But it may be possible to adapt an exhaust manifold from an old gasoline or diesel engine for this purpose.

THE ONLY BASIC MODIFICATION NEEDED IN CONSTRUCTING THIS DRYER IS THAT THE WALLS MUST BE BUILT HIGH ENOUGH TO ALLOW THE FLUE PIPE TO PASS UNDER THE AIR-INLET PIPES.

A SIMPLE OIL BARREL DRYER



This design is based on material prepared in 1973 by the Institute for Agricultural Research at the Ahmadu Bello University in Zaria, Nigeria. It is similar to the Pit Oil Barrel Dryer, but it is easier to build. It rests on the ground so you do not need to dig any pits or trenches.

The drying grain is placed on a screen floor above four oil barrels fastened together. Warm air from the fire -- which is built in the front half of the barrel chamber -- passes through the barrels and out the chimney. This warms the air around the barrels, which rises through the screen floor and dries the grain.

Grain can be harvested without waiting for any drying in the field and during any weather (if you build a shelter over the dryer). Problems of insect and rodent damage during drying in fields or cribs are avoided. Construction materials are easy to find in most places.

A Simple Oil Barrel Dryer

It is better for a group of farmers to share in the building and use of this dryer. Make sure there is enough fuel in your area to operate the dryer. Firewood or maize cobs will work well. Placing a fan to force air through the barrels will reduce the amount of fuel needed.

Do not use this dryer to dry grain kernels you will use later for planting. It gets too hot.

In this plan mudblocks are used to make the walls. Hand-rammed earth may also be used without putting it into blocks first. You may substitute an available local material that will be as strong and resistant to wear and heat, such as burned brick. Sandcrete (cement and sand) or concrete blocks will crack with the heat. If banco (earth and water) is already used for construction in your area, the same high-clay-content soil will work well for the dryer. You may mix in cement with low-clay soil to build earthen walls.

This dryer is made with four barrels. You can build one with more or less barrels. If you make it too much longer you may have trouble getting a good draft from the fire going through them. You should also narrow the width of the dryer somewhat if it is longer, so as not to overload its heating capacity. You can make a shorter dryer wider. A smaller dryer might also be very useful to dry smaller fruit or vegetable crops.

READ THE INSTRUCTIONS THROUGH BEFORE YOU BEGIN

Tools and Materials

- 4 220-litre oil barrels
- about 375 mudblocks, each measuring 15 x 20 x 25cm
- wood to make a form for the mudblocks
- about 2m of heavy wire, to join the barrels
- 3 strips of small-mesh screen, each about 180cm long and a few centimeters wide, to cover joints between barrels
- a little cement and some sand to make mortar for sealing the joints between the barrels
- 13 6-10cm wide logs for drying floor supports. Cut them about 2m long, equal to the outside width of the dryer.
- 6 1/2 or 7 square meters wire mesh, for the drying floor
  OR
  about the same area of heavy woven mats, plus a total of 10m of wire mesh strips about 20cm wide