Improvement of Postharvest Grain Systems

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EVALUATIONS OF TRAINING NEEDS AND GRAIN HANDLING FACILITIES OF CNP, AND CIGRAS RESEARCH PROJECT IN COSTA RICA

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REPORT SUMMARY

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SUMMARY STATEMENT

Under the auspices of the AID Cooperative Agreement, the Food and Feed Grain Institute provides assistance to the Center for Investigation of Grains and Seeds (CIGRAS) in postharvest research and development. Likewise, through USAID/Costa Rica the Institute provides technical assistance and training in grain postharvest systems to the Consejo Nacional de Produccion (CNP). Terms of reference for the KSU team to Costa Rica cover both of the above activities. Specifically the team was requested to:

1. Assist in revising the project proposal on "Analysis of Postharvest Systems for Grains and Pulses in Costa Rica", previously prepared by CIGRAS in cooperation with the Food and Feed Grain Institute (FFGI), Kansas State University.

2. Evaluate professional training needs and plan training programs for CNP facility managers and CNP headquarters personnel.

3. Review and evaluate a proposed additional grain handling and storage facility development plan at Barranca by CNP.

4. Review and evaluate a proposed new grain handling and storage facility development plant at La Rita by CNP.

Based on the KSU team review and evaluation in collaboration with CNP, CIGRAS, USAID, and MIDEPLAN, recommendations are presented for (1) CIGRAS research project, (2) training for CNP personnel, (3) grain handling facility enhancement at Caldera and Barranca, and (4) additional grain handling facilities at La Rita.

EVALUATIONS OF TRAINING NEEDS AND GRAIN HANDLING FACILITIES OF CNP, AND CIGRAS RESEARCH PROJECT IN COSTA RICA

Prepared by

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Richard Phillips
Carl Reed

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

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I. TERMS OF REFERENCE FOR KSU TEAM

Terms of reference for the KSU team of Dr. D. S. Chung, Dr. Richard Phillips and Mr. Carl Reed were:

1. To assist in revising the project proposal on "Analysis of Postharvest Systems for Grains and Pulses in Costa Rica", previously prepared by CIGRAS in cooperation with Food and Feed Grain Institute (FFGI), Kansas State University.

2. To evaluate professional training needs and to plan training programs for CNP facility managers and CNP headquarter personnel.

3. To review and evaluate a proposed additional grain handling and storage facility development plan at Barranca by CNP.

4. To review and evaluate a proposed new grain handling and storage facility development plant at La Rita by CNP.

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II. PROCEDURES FOLLOWED AND SUPPORT RECEIVED

A. Itinerary in Costa Rica

Jan. 23 (Sun.) Dr. D. S. Chung -- Traveled from Manhattan, Kansas to San Jose.

Jan. 24 (Mon.) Dr. D. S. Chung -- Discussed TDY objectives and available information sources with Mr. Frank Heilemann, USAID/San Jose. Visited CIGRAS and disscused the project proposal on Postharvest Grain Systems in Costa Rica with Dr. Miguel Mora, Director de CIGRAS. Also met with Mr. Ronald Jimenaz (a former KSU graduate), CIGRAS and Mr. Gabriel Rengifo, FAO, postharvest grain preservation specialist (a former KSU graduate).

Jan. 25 (Tue.) Dr. D. S. Chung -- Drove to Barranca, Puntarenas and Caldera with Mr. Rolando Flores and Mr. William Barrante, Consejo Nacional de Produccion (CNP). Observed a grain handling, drying and storage facility of CNP* located in Barranca, a grain unloading pier at Puntarenas port, a new port facility and a proposed new site for port grain handling facility at Caldera.

Jan. 25 (Tue.) Dr. Richard Phillips and Mr. Carl Reed -- Traveled from Honduras to San Jose.

* A proposed new site for grain storage facility

Jan. 26 (Wed.) Discussed TDY objectives and terms of reference for the KSU team with the Ministry of Planning Officials (MIDEPLAN), CNP personnel, CIGRAS and USAID mission/San Jose personnel (Mr. Lenard Kornfeld, Mr. Carlos Salano, Mr. Rolando Flores, Mr. William Barrante, and Mr. Frank Heilemann), and planned a KSU team's program in Costa Rica.

Worked on the revision of the project proposal on "Analysis of Postharvest Systems for Grains and Pulses in Costa Rica" with CIGRAS and CNP group.

Jan. 27 (Thu.) - Jan. 28 (Fri.) Worked on the revision of the project proposal on "An Analysis of Postharvest Systems for Grains and Pulses in Costa Rica" with CIGRAS and CNP groups.

Jan. 29. (Sat.) Drove to Guacimo, Guapiles and La Rita with Mr. Rolando Flores of CNP. Observed a grain handling, drying and storage facility at Guacimo, a grain buying station and ear corn drying project by FAO located at near Guapiles, and a proposed new site for the grain storage facility at La Rita.

Jan. 30 (Sun.) Completed the revision of the project proposal by CIGRAS.

Jan. 31 (Mon.) Presented the revision of the project proposal on Postharvest Grain Systems in Costa Rica to the Minis-

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try of Planning Officials and USAID Mission/San Jose personnel for their review and approval.

Reviewed short-term and long-term professional training needs for CNP personnel. Prepared a tentative sch[illegible]d program for in-country short course on gr[illegible]ge and management.

Feb. 1 (Tue.) Reviewed a proposed plan for a new port grain handling facility at Caldera and evaluated grain importation via Pacific ports versus Atlantic ports with CNP personnel.

Feb. 2 (Wed.) Reviewed a proposed plan for grain handling and storage facility at Barranca with CNP personnel.

Feb. 3 (Thu.) Evaluated a proposed plan at Barranca, and reviewed a proposed plan for new grain storage facility at La Rita.

Feb. 4 (Fri.) Reviewed and discussed the KSU team's evaluation and recommendations on CNP's proposed projects, CNP's training needs and CIGRAS's revised project proposal with first, Mr. Rafael Rosano, Mr. Frank Heilemann, and Mr. Lenard Kornfeld, USAID mission/San Jose, and then, with Mr. Carlos Solano of MIDEPLAN, Mr. Alejandro Silva and Mr. Rolando Flores of CNP.

Finally, reviewed and discussed the KSU team's evaluation and recommendations on the proposed

projects mentioned above with minister and vice-minister of Ministry of Planning, and USAID mission personnel.

Feb. 5 (Sat.) Dr. D. S. Chung -- Left San Jose for U.S.

Feb. 6 (Sun.) Dr. Richard Phillips -- Left San Jose for Honduras.

B. Field Trip to Barranca, Puntarenas and Caldera

On January 25, Mr. Rolando Flores and Mr. William Barrante of CNP accompanied Dr. D. S. Chung of Kansas State University to Barranca, Puntarenas and Caldera to observe CNP's grain handling, drying and storage facility and port facilities. Upon our arrival at CNP's Barranca facility, we met Mr. Rafael Villanvicencio, Manager, Barranca facility.

a. Barranca grain storage facilities

The facilities at Barranca are the major grain handling and storage facilities for CNP's domestic and imported grains handling operations. It is reported that the total amounts of both domestic and imported grains handled through the Barranca facilities were 100,387 MT in 1980/1981, and 93,093 MT in 1981/1982. A projected estimate of grains to be handled through the Barranca facilities in 1982/83 is about 222,215 MT, of which 176,074 MT is estimated to be imported grains. They consist of two physically separated bulk grain handling facilities (Plant 1 and Plant 2), two warehouses for sack storage, rice mill, seed processing plant and cold storage facility. A

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general schematic layout of Barranca facilities is shown in Figure 1. The decriptions of Barranca facilities are tabulated below:

1. Storage Capacity

Plant	Type	Capacity, MT
Plant 1	Bolted steel bins	10,000 (33 bins)
Plant 1	Rice mill and warehouse	4 T/hr (theoretical)
Plant 2	Working bins	3,000
Plant 2	Corrugated steel bins	10,000 (6 bins)
Plant 2	Warehouse	3,000
Plant 2	Warehouse	3,000

2. Drying Capacity

Plant 1	20-13% (Moisture reduction)	150 T/day
Plant 2	20-13% (" ")	700 T/day
Plant 2	18-13% (" ")	100 T/day

3. Receiving capacity

Plant 1	200 T/8 hrs
Plant 2	700 T/8 hrs
For Imported Grains	100 T/hr

4. Ship unloading capacity

Vacuvators (3 units)	1300 T/day

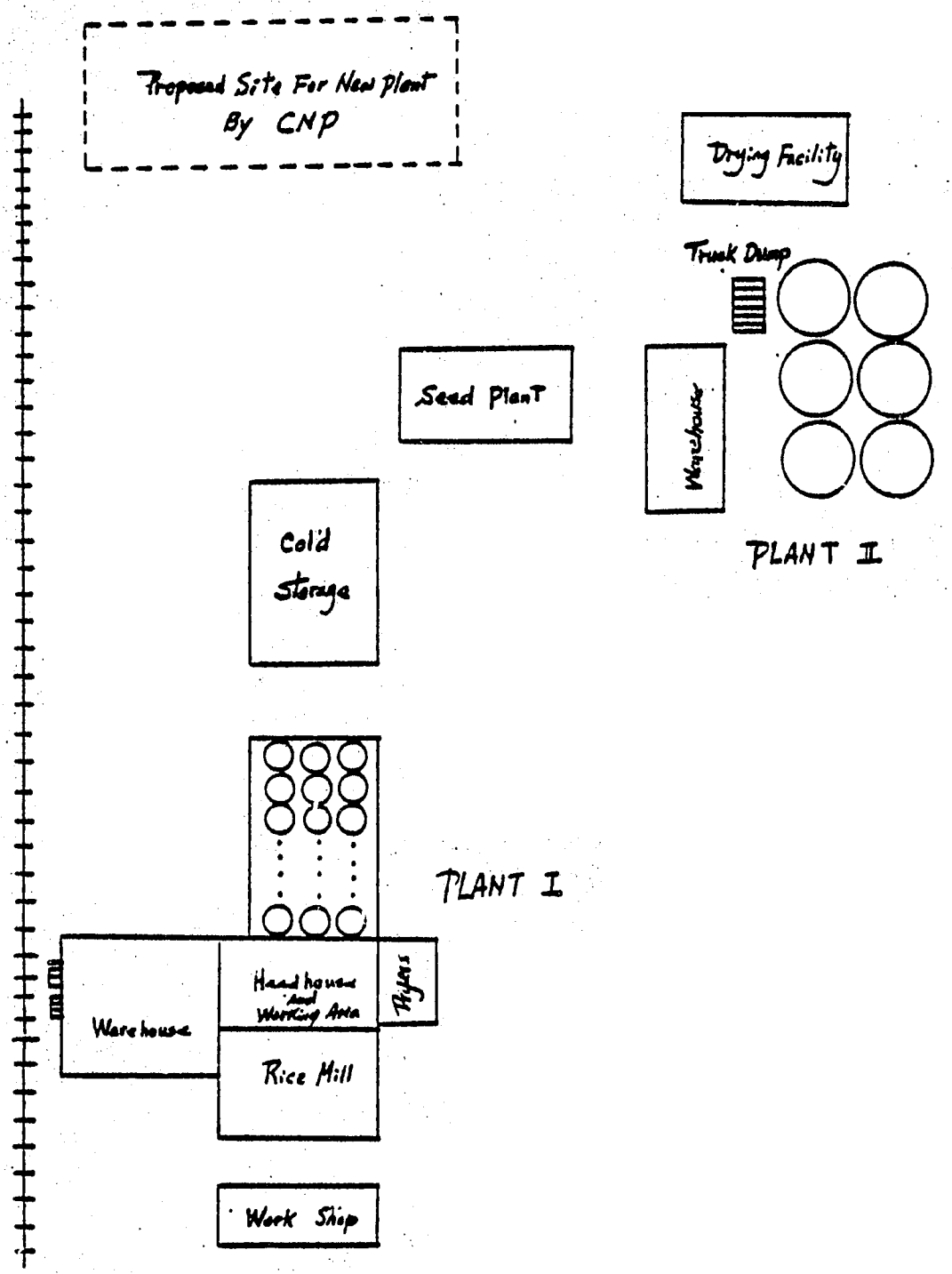

Figure 1. A General Schematic Layout of Barranca Facilities

b. Puntarenas and Caldera

It is reported that the total amount of wheat, corn, grain sorghum and beans imported by Costa Rica was 196,249 MT in 1981/1982, and the projected amount of the total feed grain, beans and wheat is estimated to be 186,074 MT. Of the 196,249 MT of imported grain in 1981/1982, 147,078 MT of imported feed grains and wheat were recieved mainly through Puntarenas and some Caldera ports in 1981/1982, the remainder through Limon and Quepos ports. It is projected that about 176,000 MT of imported feed grains and wheat are expected to be received through the Puntarenas and Caldera ports in 1982/1983.

Although the Puntarenas port facility is old and obsolete for grain unloading, a major portion of grains is still handled through the Puntarenas port. In fact there is no permanent facility for grain unloading and surge storage capacity. The pier with two berths at Puntarenas can only handle a maximum of 15,000 T freighters. Three units of vacuvators are used to unload grains from a ship directly to box cars (30 T/box car), and then grains are transported to the Barranca facility or flour mills. It should be noted that a rail system is the only means of transporting grains from the Puntarenas port to the designated destinations. A new proposed port grain handling facility at the Caldera port is greatly needed in Costa Rica in order to receive and load out grains efficiently.

The unloading capacity of the three vacuvators is estimated to be 1300 MT/day. It takes about 8 to 10 days to unload grain from a 12,000 T freighter. A demurrage charge at the port is estimated to be about $10,000/day in 1983. Though the distance between the Puntarenas port to the Barranca facility is only about 15 Km, a turn around time for rail cars (10 box cars) is estimated to be 3 to 4 hours mainly because of the slow unloading capacity at the Barranca facility.

The port at Caldera is recently constructed facility. The pier at the Cladera port is capable of handling one-20,000 T freighter, and 2-10,000 T freighters at the same time. However, no port grain handling facility exists. A plan was made by CNP to build a port grain handling facility (10,000 T storage capacity) at the Caldera port by moving the metal bins (20 units, total capacity of 10,000 T) presently located at the CNP headquarters in San Jose.

The proposed site for a port grain handling facility at the Caldera port is located about 100 m from the pier. The distance between the port to the Barranca facility is about 12 Km. A grain handling facility can be built at the proposed site to load out grains easily by rail and truck. A new proposed port grain handling facility at the Caldera port is urgently needed in Costa Rica for efficient handling of imported grains. Also, this facility can be used for exporting grains from Costa Rica.

Several problems observed during the field trips are:

1. Inefficient rail car unloading facility at Barranca.

2. Very low capacity of grain receiving equipment (bucket elevators) at Plant 1 of the Barranca facility to accomodate inflow of imported grains. Therefore, a smooth grain movement through the system is hindered, and quite often incoming imported grains are diverted to open areas in warehouse, resulting in grain quality deteriortion and poor housekeeping practices.

3. No dust control systems at grain receiving and working areas exist at Plant 1.

4. Difficulty in keeping a good housekeeping practice at Plant 1.

5. Inefficient grain load out system at Plant 1.

6. Plant 1 and Plant 2 are physically separated too far apart to manage the complex effectively by one general manager.

7. The proposed new site for a grain handling and storage facility at the Barranca complex is also too far apart from Plant 1 and Plant 2 for efficient operation and management.

8. No grain conditioning and quality monitoring systems exist at Plant 1.

9. No rail siding and grain unloading and loading system for rail cars exist at Plant 2.

10. The Puntarenas port is too old and obsolete for grain unloading purpose.

11. A maximum of only 15,000 T freighters can be served at the Puntarenas port.

12. No areas for renovation or modernization of a grain handling facility exist at the Puntarenas port.

13. No truck transport is possible at the Puntarenas port.

14. Conditions of box cars utilized for grain transport are poor and they are inefficient systems for grain unloading.

C. Field Trip to Guacimo and La Rita

On January 29, 1983, Mr. Rolando Flores of CNP accompanied Dr. D. S. Chung and Dr. Richard Phillips of Kansas State University to Guacimo and La Rita to observe a regional grain handling, drying, and storage facility of CNP at Guacimo in the Huetar Region (Atlantic side) and a proposed new site for a regional grain handling and storage facility at La Rita.

The facility at Guacimo was built in the 1940's (exact year not known) for primarily handling, shelling and drying corn produced in the Huetar Region. Since the original plant was built, four additional grain dryers, working bins, handling equipment associated with grain drying, and a warehouse were added to the old plant.

The present plant contains electric generators, a corn sheller (capacity: 20 T/hrs), 5 grain dryers (total capacity: 15 T/hr), working in bins, a cleaner, grain handling equipment (auger, bucket elevators; etc.), a truck scale and sack scales. In addition, there are about a 1000 T capacity warehouse, grain grading laboratory and offices. The plant is equipped to receive grains by both truck and rail. The plant now serves the entire Huetar Region, receiving shipments of ear corn in sacks directly from CNP's buying stations.

Several observations made in conjunction with plant operations are:

a. The plant is located in the center of the city (due to the outgrowth of the city over the years).
b. Disposal of corn cobs (air pollution).
c. The plant layout is too congested, especially the corn shelling and drying areas (fire hazard).
d. The corn sheller is old, and inefficient for a current and future needs (the effective life of the sheller is used up).
e. Poor dust control system (fire hazard and air pollution).
f. Poor housekeeping around the sheller (fire hazard, and grain quality preservation).
g. Small land space prevents easy truck turn around.
h. No land space for future expansion.

En route to La Rita, we stopped at a grain buying station (CAMPO 2) located near Guapiles. The station consists of an office with grain grading devices, a truck scale and a warehouse with about

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a 400 T capacity. Our team also briefly stopped at an agricultural experiment station where a FAO corn drying project is being conducted using a corn crib for ear corn.

A proposed new site in the Huetar Region with 40 hectares land for a regional grain handling, drying and storage facility is located at La Rita. La Rita is strategically located near Guapiles, one of the transportation centers in the Heuter Region. However, no access roads to and from the site currently exist. The only way to get into the site is to cross the railroad track which runs along a boundary of the site. At present, the site is completely underdeveloped.

D. Organizational Support

We acknowledge with gratitute the generous organizational support given by CNP, MIDEPLAN, CIGRAS, and USAID mission/San Jose during our two-week stay in Costa Rica.

We especially thank Mr. Frank Heilemann, Mr. Lenard Kornfeld and otner USAID/San Jose personnel for information, transportation and other services provided us through USAID while in Costa Rica.

Our special acknowledgment is given to Mr. Rolando Flores of CNP and other CNP personnel for accompanying us to field trips, for assisting us in reviewing and interpreting proposed plans at Barranca and La Rita, and for assisting us in revising the project proposal on postharvest grain systems in Costa Rica and in formulating professional training programs for CNP personnel.

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We also thank Dr. Miguel Mora, Director of CIGRAS for his support and other CIGRAS personnel's assistance given in revising the project proposal on postharvest grain systems in Costa Rica.

Finally, we express our sincere appreciation to the Costa Rica Minister and Vice-Minister of Planning their keen interest in our activities and for giving us the opportunity to debrief our activities and findings to them.

III. IDENTIFICATION AND REVIEW OF KEY ISSUES

Several key issues impact planned improvements in grain handling and storage facilities of the Consejo Nacional de Produccion (CNP). Those addressed by the Kansas State University consultant team include (1) importation of PL 480 and other grain via Pacific ports versus Atlantic ports, (2) role of CNP versus the private sector in grain handling, (3) linkages between the port facility and the inland terminal in the Chorotega Region, (4) factors affecting corn shelling and drying in the Huetar Region, and (5) need by CNP analysts for professional training.

A. Importation Via Pacific Versus Atlantic

Questions have been raised regarding the relative economies of importing wheat and feed grains via Pacific ports versus Atlantic ports because of Panama Canal charges for importation through Pacific ports. The consultants worked with CNP analysts to develop the cost comparison summarized in Table 1.

Representation total ocean freight from Gulf of Mexico points amount to $7.76 per MT more to Costa Rica via Pacific ports than via Atlantic ports. The difference reflects three more days at sea plus charges for loaded and empty return through the Panama Canal. Total freight charges to Pacific ports in vessels with gross loaded weight of 20,000 MT or more are calculated at $22.60/MT compared to $14.85 to Atlantic ports. For smaller ships typically used for free market procurements, the comparison is $24.26/MT versus $16.15/MT. Weighting of 95 percent in large ships (to reflect PL 480 shipments) and 5 percent in small ships yielded the costs shown on the first line of Table 1.

Offsetting the differences in ocean freight are higher costs through the Atlantic ports such as Limon for port charges, handling labor, and internal transport. Based on 16,000 MT cargo with gross ship weight of 20,000 MT, ship

Table 1

Comparative Costs for Importation via Pacific and Atlantic Ports

(US$/MT)

Type of Cost	(1) Pacific Ports	(2) Atlantic Ports	(3) Difference (1) - (2
Ocean freight	22.68	14.92	7.76
Port charges	3.78	9.00	-5.22
Handling labor at port	.67	1.22	-0.55
Internal transport:			
Rail	7.62	13.82	-6.20
Truck	13.70	19.45	-5.75
Combined:			
Internal rail	34.75	38.96	-4.21
Internal truck	40.83	44.59	-3.76

[1]Includes roundtrip charges through Panama Canal and 95 percent of shipments in large vessels. (Gross loaded weight of 20,000 MT or more.) Other factors favoring Pacific ports include:

1. Saving of internal transport time of more than 50 percent, with corresponding reduction in quantity and quality loss.

2. More favorable climate for grain storage (about 1 meter less rainfall/year).

3. Less labor problems and reduced risk of interruption by strikes.

4. Substantial saving in construction and installation cost.

Conversion at $1.00 = $40

length of 300 meters and an average of 20 days in port, total port handling charges come to $5.22/MT less for the Pacific ports. The calculation is as follows:

Item	Pacific	Atlantic
Pilot charges	$ 3,940	$ 6,200
Port fees	52,140	128,760
Tug charges	4,400	9,000
Combined	$60,480	$143,960
Total/MT (16,000 MT)	$3.78	$9.00

Labor rates for dock workers favor the Pacific ports because those at the Atlantic ports reflect banana exportation. Current rates for grain are 1.25 Colones for 46 kilograms ($0.67/MT) at Pacific ports and 2.25 Colones per 46 kilograms ($1.22/MT) at Atlantic ports.

The internal transport costs shown in Table 1 reflect existing freight rates contracted by CNP from the Atlantic (Limon) and the Pacific (Caldera) to the San Jose area. The Pacific port advantage is $6.20/MT for rail shipments and $5.75/MT for truck shipments.

When various sources of cost for importing are combined, the net advantage favors the Pacific ports by $4.21/MT if internal rail shipments are used, and by $3.76/MT if internal truck shipments are used from the ports. To these concrete cost differences favoring use of Pacific ports can be added (1) saving of internal transport time of more than 50 percent with corresponding reduction in physical loss and quality deterioration of grain during transport, (2) more favorable climate for grain storage (about one meter less annual rainfall) on the Pacific side, (3) fewer potential labor problems and reduced risks of interruption by labor strike, and (4) substantial saving in construction and installation costs for port facilities if constructed on the Pacific side.

B. Role of CNP in Grain Handling

Confusion seemed to exist in Costa Rica regarding the projected role of the Consejo Nacional de Produccion relative to the private sector in grain handling. Issues in this regard are clarified in the recent stated policies of CNP's Board of Directors in "Politicas and Instrucciones, 1982/1986" of November 1982, which indicate that "the objective is to buy and sell sufficient volumes of basic grains to protect producers and consumers. Although the percentage of total production needed to achieve this goal is difficult to quantify, CNP will be aggressive in its procurement programs, striving to raise its procurement share of rice by 10 percent over that if of the last two years and to maintain shares equal to or higher than last year for corn, edible beans, and grain sorghum." The CNP serves as sole importer for PL 480 wheat and feed grains to serve the privately-owned flour mills and feed manufacturers.

On the basis of established policies and the market shares realized by CNP over the past two crop years, projected procurement volumes are based on the following percentages of national net production:

Rough rice	22 percent
Edible beans	72.3 percent
Corn	31.1 percent
Grain sorghum	62.7 percent

Projected handling volumes of imported wheat and feed grains at CNP port facilities are based on 100 percent of projected imports of these commodities.

Following those by CNP analysts, projected average annual growth rates in domestic production are 2.3 percent for rice, 3.8 percent for edible beans, 3.5 percent for corn, and 9.6 percent for grain sorghum (see Table A-1, Appendix). Projected annual growth rates in imports are 4 percent for wheat and 5 percent for feed grains (yellow corn and grain sorghum).

C. Linkages between Planned Caldera Port Facility and Barranca Terminal

Although different sources of funding for the two are contemplated, the planned port facilities at Caldera are closely linked to planned expansion and modernization of CNP's grain terminal at Barranca. As now planned, the Caldera port facility would include rapid ship unloading facilities as well as rapid loading facilities to both rail and truck. Storage capacity would be limited to that needed for "surge" space to permit continuous unloading when transport equipment is not available for direct loading while ships are in port. The surge storage capacity at the Caldera facility would be emptied to rail and truck for direct shipment to private flour and feed millers prior to docking of the next ship.

The planned enhancement of the terminal at Barranca includes rapid rail unloading facilities as well as added storage capacity so that it can serve as the storage and distribution terminal for imported corn and feed grains brought in through the Caldera port facility. In the future it might also serve as the supplying facility for exports in bulk of brown or cargo rice through the Caldera port.

The close operating link to exist between Caldera and Barranca requires that the two facilities be fully balanced. Rail loading rates must be balanced with ship unloading rates at Caldera and with rail unloading rates at Barranca. Both surge storage capacity at Caldera and distribution storage capacity at Barranca must be balanced with these receiving and loading rates. Designs and layouts at the two facilities must reflect the operating linkages. In addition, the capacities, design and layout after enhancement at Barranca must serve the combined purposes of that terminal, including bulk handling of rough rice and domestically-produced feed grains plus the imported wheat and feed grains, as well as bag handling of edible beans and white corn.

For these reasons the Kansas State University consultants reviewed plans and made suggestions regarding the proposed Caldera port facility as well as the proposed enhancement at Barranca. It is hoped that the approach taken will facilitate early commitment of funding for Caldera as well as help expedite the enhancement at Barranca with PL 480 funds.

D. Factors Affecting Corn Shelling and Drying in the Huetar Region

When the Kansas State University consultant team arrived in Costa Rica some confusion existed as to the type, design, and capacity of facilities proposed at La Rita by CNP, and the relationship between the proposed facilities and those in operation at CNP's white corn shelling and drying terminal at Guacimo. The latter facility now serves the entire region, receiving daily truck shipments during the marketing season of ear corn in sacks directly from CNP's buying stations. The Guacimo terminal has adequate receiving, grading, shelling, drying, storage and loading equipment to handle projected corn procurement volumes from the region.

The problem with Guacimo is not that it is the wrong kind and size of facility, but rather that its location and layout have been made obsolete by economic development affecting the Huetar Region. It is bypassed by the modern electric railroad serving the region and by the modern highway under construction to connect San Jose with the region's heartland. The basic plant was designed many years ago to receive by rail, leaving access to truck receipts only by tight turning and backing in. The city of Guacimo has grown around it, adding further to congestion, and bringing increasing pressure to have it moved for reasons of nuisance and health hazard. Corn cob disposal is an ever increasing problem. The dryers, modern truck scale, flat warehouses, and much of the other equipment are in good condition and could be relocated.

In recognition of the need, CNP has acquired the 40-hectare site at La Rita adjacent to the new railroad and one kilometer (via undeveloped access road) from the outlet of the super highway under construction. It is at the logical location and represents a good site for the future corn shelling and drying terminal to serve the total Huetar Region. At this time the site is completely undeveloped, and will require grading, drainage, access road, rail siding, etc., before a grain terminal can be constructed. Fortunately, if this work is started soon, a new terminal at La Rita can be in operation by the time the direct highway is completed. In the meantime, the old and congested Guacimo plant can continue to serve Huetar corn producers as it has for many years.

E. Need for Professional Training of CNP Analysts

The development of new and enhanced grain handling facilities will not fully achieve desired goals unless parallel efforts are made toward professional development of CNP's human resources. The planned short course training for facility managers described elsewhere in this report is designed to enhance the operational and administrative skills of CNP's facility managers. It is not designed to provide professional training in engineering and agricultural economics needed to enhance the productivity of CNP analysts who direct project feasibility studies. Specialized master's degree training is required to meet this need.

Kansas State University consultants were surprised and pleased by the keen interest in rigorous analytical techniques on the part of CNP counterparts, and by their willingness to work long over-time hours with the consultants to help apply these techniques. The staff analysts are experienced and dedicated, and in position to benefit greatly by scholarships for specialized master's degree training in the USA. Several of them have requested information on this kind of graduate training.

IV. REVISED PROJECT PROPOSAL ON "ANALYSIS FOR THE POSTHARVEST SYSTEMS FOR GRAINS AND PULSES IN COSTA RICA"

In June of 1980, a Cooperative Agreement was signed between the University of Costa Rica UCR) and Kansas State University (KSU). This document provides for the Food and Feed Grain Institute (FFGI) of KSU and Centro pra Investifaciones en Granes y Semillas (CIGRAS) of UCR to initiate a coopertive postharvest program of research and training under tropical conditions.

Under the above agreement, a service of KSU team was requested by CIGRAS to assist in drafting a project proposal on "Analysis of the Postharvest Systems for Grains and Pulses in Costa Rica" in August, 1981. A copy of the project proposal drafted by the KSU team and the CIGRAS team is included in the Appendix as a reference. The scope of work for the original proposal was divided into three major phases: (1) description of the postharvest systems, evaluation of losses, degree of efficiency, and effectiveness of the systems; (2) development of recommendations to improve the postharvest systems; and (3) evaluation of the impact of implemented recommendations. The duration of the project was originally proposd to be 3 years and the budget of $405,900 was prepared for only the first two years. The project proposal was submitted by CIGRAS to USAID mission/San Jose for funding. However, the project proposal approval has been pending for sometime.

In late 1982, CIGRAS has modified the original proposal and resubmitted it for funding under the agreement between the Government of Costa

Rica and the Government of the United States of American - PL 480, Title I. The proposal was only to study descriptions of the postharvest systems in Costa Rica and to develop test methodology of grain loss assessment. The duration of the project was proposed to be one year and the total cost of $165,000 was requested. After a review of the project proposal by the Ministry of Planning and USAID mission/San Jose. Several questions on objectives, and roles of CNP on the project have been raised.

Upon request by the Ministry of planning and USAID mission/San Jose, the KSU consultant team assisted in revising the project proposal under a review with Dr. Miguel Mora, CIGRAS and Mr. Rolando Flores, CNP. The instructions given to the KSU consultant team, CIGRAS and CNP by the Ministry of Planning and USAID mission/San Jose was to revise the project proposal which is to be completed within 15 to 18 months, with a budget request of $150,000 to $170,000.

Based on extensive review of the original proposal drafted in 1981 and discussion among us, two alternative plans were prepared. Alternative I is : (1) to study a description of the postharvest systems (both on-farm and off-farm); (2) to evaluate grain market performance (both private and public sections); (3) to conduct an on-farm grain loss assessment; and (4) to conduct an off-farm grain loss assessment (only public sectors). The duration of the study for Alternative I is proposed to be 24 months, with an estimated budget for Alternative I as indicated in the Appendix.

Alternative II is to study only the first two items in Alternative

I. The duration of Alternative II is proposed to be 15 months, with an estimated budget of $173,910. A copy of the revised project proposal for Alternative II is included in the Appendix. The FFGI's contributions under FFGI-USAID/W Coopertive Agreement for the revised project for Alternative II is given in the table below:

FFGI's Contribution Under FFGI-USAID/W Cooperative Agreement on CIGRAS' Grain Postharvest System Study

KSU Team	Specialists	Approx. Date	Task	Activity	Man-day
	Grain Storage Specialist	April 1983	Planning	On-Farm Description	15
A	Grain Marketing Economist	April	Planning	Off-Farm Description	15
	Market System Economist	April 1983	Planning	Evalution of	15 45
B	Market System Economist*	June 1983	Policy Review	Evaluation of Market Performance	15
	Grain Storage Specialist	Jan 1984	Analysis	On-Farm Description	15
C	Agr. Engineer	Jan 1984	Analysis	Off-Farm Description	15
	Market System Economist	Jan	Analysis	Evaluation	15 45
	Grain Storage Specialist	May 1984	Review of Recommendations & Report	On-Farm Description	15
D	Grain Marketing Economist	May 1984	Reveiw of Recommendations & Report	Off-Farm Description	15
	Market System Economist	May 1984	Review of Recommendations & Report	Evaluation of Market Performance	15 45

Total: 150 man-days or 5 man-months

* This trip will be coordinted with KSU Ag. Engineer's trip for finalizing the in-country training program for CNP

The revised project proposal for Alternative II was tentativley approved by the Ministry of Planning at the meetings held on January 31, 1983.

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Finally, the KSU consultant team strongly feels that the funding for conducting items 3 and 4 in Alternative I at some future date is essential for improving the postharvest systems and reducing grain loss in Costa Rica. In addition, the results from such a study can be extended to others developing countries for grain loss reduction programs and efficient grain marketing system development.

V. PROPOSED TRAINING PROGRAMS FOR CNP PERSONNEL

The grain storage and marketing systems in Costa Rica encompasses highly skilled individuals in the following areas: 1. business and financial management of warehousing/merchandising firms; 2. technical management of grain handling, drying, storage and processing facilities; and 3. establishment of government policies and programs for optimum marketing system development. Training in each of the above areas is essential to the success of any program to improve Costa Rica's grain storage and marketing system in the next few years.

Based on our review and discussion on CNP's current programs and proposed projects with several CNP personnel, it is more evident that training programs in each of the above areas are definitely needed in order to effectively carry out and improve the CNP's grain storage and marketing programs. The three types of training programs are proposed: 1. In-country short course on grain storage and management; 2. Intensive short course on grain storage and marketing to be held at Kansas State University; and 3. Formal degree programs (M.S. or Ph.D. degree) in the areas of Agricultural Engineering and Agricultural Economics at Kansas State University.

The three types of training programs proposed are briefly summarized below:

A. In-country Short Course

1. Tentative Title: Grain Storage and Management

2. Purposes: Training of CNP's plant managers, assistant managers and laboratory technicians and private sector personnel on grain storage and management.

3. No. of participants: 20-25

4. Date: September, 1983

5. Duration: 2-week (min.)

6. Locations: CIGRAS, San Jose, Costa Rica

7. Cooperators:

    FFGI (KSU)

    AID/W. - S/T Bureau

    CIGRAS

    CNP

    AID/San Jose

8. Subject Matters:

    Fundamentals of Grain Storage

    Grain Handling Equipment and Their Operations

    Grain Drying and Aeration

    Equipment Maintenance and Safety

    Warehousing Management - Sanitation and Inventory Control

    Sampling, Inspection and Grading

    Grain Loss Evaluation

    Fundamentals of Grain Management

    Grain Storage Facility Planning

Rice Milling

9. Methods of Instruction: Lectures, laboratory exercise, equipment use, demonstrations, field trips, practical problem solving, quizes and exams.

10. Instructors:

KSU	CNP	CIGRAS
Engineer	Flores	Mora
Grain Quality Specialist		
Ag. Economist		

11. Training Manuals: Prepared by FFGI-USAID/W, Spanish

12. Translation equipment: FFGI

13. Translators: CNP and CIGRAS-USAID/San Jose

14. Certificates: FFGI

15. Logitic support: USAID/San Jose

16. FFGI Instructors support: FFGI-USAID/W Cooperative agreement

The course plan will be finalized by June 15, 1983.

B. Intensive Short Course at KSU

The Food and Feed Grain Institute at Kansas State University offers annually, a Grain Storage and Marketing Short course under Cooperative Agreement AID/DSAN-CA-0256, at Manhattan, Kansas, for eight weeks during the months of June, July and August. It should

be mentioned that a simultaneous translation of instruction in English into both Spanish and French is available for the above short course. Three or four engineers or agricultural technologists or economists carefully selected by CNP should be sent to the U.S. for such training. Full or partial funding for trainee may be obtained form USAID mission/San Jose.

C. Formal degree programs

Formal degree programs for either M.S. or Ph.D. degree in the areas of Agricultural Engineering (grain handling, drying, storage and processing) and Agricultural Economics (grain marketing, market system analysis, grain trade and policy, etc.) can be obtained at Kansas State University. Three or four engineers and three or four economists carefully selected by CNP should apply for admission to the graduate school, Kansas State University for their advanced studies. Funding for such trianing programs may be obtained from USAID mission/San Jose.

VI. EVALUATION OF PROPOSED EXPANSION AND MODERNIZATION AT BARRANCA

In addition to field trip and site visits to the area, the consultants were given full access to detailed project studies by CNP staff, including the CNP/Central Bank of Costa Rica study, "Project for Expansion and Modernization of the System for Storage and Conservation of Basic Grains," with annexes, of June 1981. This information plus supplemental analysis made jointly with the CNP staff form the basis for the consultants' recommendations.

A. Recommendations for Proposed Port Facility at Caldera

The Kansas State University team concurs with the economic need and justification for a new rapid-handling port elevator facility, and with the choice of Caldera as location for such facility. Of the seven alternative designs identified in the CNP/Central Bank study, none fully meets CNP's requirements, however. Four of the alternatives considered represent new facilities, two of concrete and two of steel construction (Table 2). One of the new facility designs includes 16 silos, each 9 meters in diameter by 12 meters in height, while the other includes 8 silos, each 14 meters in diameter by 14 meters in height. The other three alternatives (5, 5a, and 5b) involve moving the existing CNP steel structure of 20 tanks from San Jose to Caldera. Alternative 5 would place the existing tanks on concrete pillars 7 meters high so as to be able to unload them to rail or truck by gravity. Alternative 5a would place the tanks or shorter pillars (3.7 meters), and provide elevators and conveyors for unloading. Alternative 5b would provide underground unloading conveyors for the bins and elevation to two 50 cubic meter bins for unloading to rail and truck.

None of the alternative designs considered is suited to projected needs at Caldera. The facility is intended as a rapid-handling port elevator capable of unloading 20,000 MT of bulk grain in five days; it is not intended

Table 2

Summary of Alternative Port Facilities at Caldera
Considered in CNP/Central Bank Study

Item	Alternative Number						
	1	2	3	4	5	5a	5b
Type of material	Concrete	Steel	Concrete	Steel	Steel[1]	Steel[1]	Steel[1]
No. of silos	16	16	8	8	20	20	20
Silo dimensions (meters)[2]	9x12	9x12	14x14	14x14			
Capacity per silo (MT)	564	564	1,588	1,588	500	500	500
Total capacity (MT)	9,024	9,024	12,711	12,711	10,000	10,000	10,000
Cost of imported machinery ($1,000)	875.2	875.2	753.6	753.6	523.4	674.6	724.1
Estimated total cost ($1,000)	1,908	1,587	1,424	1,360	1,138	1,276	1,172
Foreign currency component (%)	53.65	63.69	56.20	63.58	60.42	65.71	68.61

[1]These alternatives include dismantling and re-erecting the existing CNP silos from San Jose.

[2]First figure is diameter and the second height.

as a grain storage terminal. Key requirements for the facility are dependable capacity of 250 MT per hour for ship unloading, elevating, and direct distribution to storage silos. It needs surge storage capacity which can be filled at the same rate (250 MT/hr), but emptied by gravity to rail hopper cars at a rate of 600 MT/hour. Special considerations in the design at Caldera include those serving as (1) surge storage capacity, (2) ship docking and unloading, (3) conveying to elevator leg, (4) elevating and distribution, (5) rail car spotting and loading, (6) truck loading, and (7) provision for unloading from trains and trucks.

Surge storage capacity is needed at the Caldera port facility so that trains can be loaded rapidly and ship unloading can continue while loaded trains are enroute to Barranca. If two 300-MT hopper-car trains are committed for the haul, and if each requires one-half hour to load, one-half hour to Barranca, one-half hour to unload, and one-half hour to return, then an average load out rate of 300 MT/hr can be maintained once the Caldera surge bins are filled. Total surge storage capacity at the port of about 25 percent of total ship cargo size is needed to make the system work. On this basis and 20,000 MT cargos, 5,000 MT of surge storage capacity is needed at the Caldera port facility.

For the working surge capacity, individual storage bins need to be small--no more than 500 MT each--so that at least 10 individual bins are available for different kinds and classes of grain. The bins need to be tall and narrow and hopper-bottomed for complete unloading. They need to be elevated and horizontally spaced so that one hopper car can be loaded from each of the ten bins at the same time. They need to be on extra strong foundation because it will be impossible to fill and empty them so as to distribute weight load on the foundation evenly. Because of the stresses the structure will be given,

only all new construction of concrete or steel should be considered. The existing steel tanks in San Jose can be used at Barranca much more safely than at Caldera.

Ship docking and unloading must be well-designed to permit rapid discharge around the clock, even in inclement weather. A realized continuous unloading rate of 225 MT/hr for 18 hours per day requires five consecutive operating days to empty a 20,000 MT cargo of wheat or feed grain. If a permanent dock and jetty can be constructed at the port, marine legs represent the most energy-efficient and dependable method for unloading at this rate. If the Caldera port authority will not permit a permanent jetty, then air-suction conveyors will have to be used, and the unloading system designed to make them as effective as possible. Three or four separate suction conveyors will be required, and they need to discharge to a single horizontal converyor belt serving the elevator leg. The system needs to be as rust-proof as possible, and designed for safe and effective use in rough weather at the port.

Conveying from dock side to the port facility headhouse will be accomplished most efficiently with a single high-capacity rubber belt conveyor. It should be enclosed for safety and protection from weather. Depending upon the difference in elevation from dock side to the pit serving the elevator leg, it may be partially or wholely underground at the upper end. It should be reversible so that the facility can be used to load vessels for export (unless other provisions are made in the facility design for this purpose).

Elevating and distribution to the surge silos can be accomplished by a single 250 MT/hr elevator leg and either gravity spouting or 250 MT/hr horizontal conveyor to the 10 silos. Because of the overall height needed for the facility, and the linear layout of the silos for simultaneous distribution to rail cars, a lower elevator leg plus horizontal conveyor is likely to be

more energy efficient. In either case, a distributor so that discharge can be made to two or more bins at the same time will add a great deal of operating flexibility of the facility. The design must be such that elevation and filling of silos will not be interrupted by the spotting, loading, and departure of trains and trucks.

The alternatives considered in the CNP/National Bank study do not reflect a system for weighing the imported grain. If inbound weights at the port are desired, then high-capacity hopper scales will be needed in the headhouse at at the point of discharge from the elevator leg. The alternative is a dynamic platform scale for weighing trains and trucks in and out. Because of the need to accommodate throughput of 250 MT/hr on a continuous basis, either alternative will add considerably to the capital cost of the facility.

Rail car spotting and loading facilities must be carefully planned so that a train of ten 30-MT hopper cars can be brought into place, loaded and pulled away in 30 minutes without interrupting the ship unloading process. If the ten surge storage silos are properly spaced horizontally and each is designed for emptying by gravity, then one rail car can be filled from each of the ten bins at the same time. Each rail car needs to be filled at a minimum rate of 60 MT per hour so that the entire train is loaded in 30 minutes. During this loading process, additional grain from the ship will continue to be added into the top of the surge silos.

If the surge silos are sufficiently elevated and properly hoppered, they can be completely emptied to rail or truck by gravity so that no conveyor system is needed under the silos. However, if the facility is to serve for export in the future, provision will need to be made for unloading from the silos to the conveyor belt serving dock side. It may be that this can be done by gravity from the silos nearest the headhouse, and that only these will

ever be needed for handling export grain. If so, then no horizontal conveyor system will be needed under the silos, even for exportation.

Truck loading can be accomplished with the same gravity system as that for rail. The only additional provision is needed for concrete paving over the rail siding so that the same area can be used for spotting trucks for direct gravity loading in bulk from the surge silos. There will be little need or opportunity to load trucks during the time when trains are being loaded for Barranca, but when a ship has been unloaded, remaining grain in inventory at Caldera can be loaded to trucks for flour millers and feed manufacturers.

Because of the lower freight rates the larger millers may prefer shipments by rail rather than truck, especially after hopper cars are brought into service. The proposed Caldera facility will be able to accommodate them; in fact, if hoppered trains are available in addition to the two needed for continuous service to Barranca, shipments to flour millers can be made during the time a cargo of wheat is being unloaded. It is reported that both flour millers have substantial bulk storage capacity for wheat (Harrinas, CA - 5,000 MT, and Molino de Costa Rica - 25,000 MT). If their receiving can be converted to rapid unloading of hoppered rail cars, they stand to save in freight costs and take some of the pressure from Barranca as the major storage point for imported wheat.

Provision for unloading from rail hopper cars and bulk trucks will be needed at Caldera if in the future the facility is to be used for bulk export of brown rice and/or other grains. This can be done by providing in the design for an underground hopper leading to the elevator leg (of say 50 MT capacity) covered by floor and grate which can be accessed by both rail and truck. Provision should be made in the design for the unloading pit and dumping area for handling grain exports.

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B. Projected Role of Barranca Grain Terminal

Located 12 kilometers from the Caldera port, the CNP grain terminal at Barranca is the logical place for receiving and storing the major portion of imported wheat and feed grains, and distributing these grains to Costa Rica's flour and feed millers as needed. A large portion of the wheat and yellow corn now imported via Puntarenas is handled through the Barranca terminal. This facility also handles an estimated 60 percent of CNP procurements of yellow corn and grain sorghum from domestic production in the Chorotega Region, and receives, stores, and mills a comparable portion of CNP rough rice procurements from the Region. Sacked white corn and edible beans from this region are handled at the Barranca terminal as well.

The existing facility at Barranca consists of two plants on the same site. Plant No. 1 includes the rice mill and a battery of 33 old metal silos with total bulk storage capacity of 10,000 MT which are used principally for storing rough rice for milling. The plant also has 3,000 MT of warehouse space which is used for work space and milled rice storage. Plant No. 2 includes six large metal silos with total bulk storage capacity of 10,000 MT which are used primarily for corn. As shown by Figure 1, the existing facility also includes several structures other than those directly associated with the two grain handling plants. Plant No. 2 is not served by rail at present, but rail access to it is contemplated as part of the Barranca grain terminal enhancement.

The future role visualized for the Barranca grain terminal includes (1) receiving imported wheat from Caldera for distribution to flour millers, (2) receiving imported feed grains from Caldera (yellow dent corn and grain sorghum) for distribution to the nation's poultry and livestock feed manufacturers, (3) receiving yellow corn and grain sorghum from CNP buying stations in the Chorotega Region for conditioning and distribution to feed manufacturers, (4) receiving

rough rice from the Chorotega Region (including the Tempisque River Irrigation Project) for conditioning, storage, milling, and product distribution (including possible future export), and (5) continued receiving, conditioning, and distribution of white corn and edible beans marketed by farmers in the Chorotega Region. The needed total handling and storage capacities at the Barranca facility, as well as the corresponding layout and design, depend upon quantitative projections for each of these fine functions. Such projections are reported in the following section.

C. Projected Handling Volumes at Barranca

1. Projected Annual Volumes

Projections of production of basic grains in the Chorotega Region through the 1987-88 crop year, together with corresponding volumes in the Barranca trade area and projected handled volumes at Barranca are shown in Tables 3 to 6. The projections are shown in metric tons before adjusting for farm losses and shrinkage through drying and cleaning.

Rice production in the region is projected at an annual increase rate of 2.3 percent, reflecting growth in domestic demand (Table 3). The production potential for rice is expected to increase more rapidly, but at relatively high production cost, so that projection of surplus over domestic requirements is not warranted. For the 1987-88 crop year, projected rice production for the Chorotega Region is 113,420 MT of which about 68,000 MT is in the Barranca trade area, giving projected handling volume for the Barranca terminal of about 15,000 MT.

Edible bean production in the Chorotega Region is projected to increase by 3.8 percent per year, reaching 7,697 MT by 1987-88 (Table 4), of which 4,618 falls within Barranca's trade zone. Projected edible bean volume handled at

the Barranca terminal reaches about 3,400 MT for that year. Corn production is projected at an annual rate of increased of 3.5 percent, reaching 11,200 MT for the region and 6,721 MT in the Barranca zone by 1987-88 (Table 5). Projected handling volume at the Barranca terminal reaches 2,090 MT for that year.

Grain sorghum production is projected at 9.6 percent per year, reaching by 1987-88 some 39,200 MT for the region and 23,500 MT in the Barranca trade zone (Table 6). Projected handling volume that year for the Barranca terminal is 14,750 MT.

Because Costa Rica produces virtually no wheat, projected import requirements for this grain are based on a 4-percent annual increase in total demand requirements (Table 7). Projected requirements for the 1987-88 crop year are 120,276 MT or 10,023 MT per month. Projected import requirements for yellow dent corn and grain sorghum are based on projected total requirements for feed grains to serve the nation's poultry and livestock feed manufacturers minus the projected domestic supply of these feed grains (Table 7). Total national demand is projected to increase at 5 percent per year, reaching 156,418 MT by 1987-88. Before adjustment for on-farm loss and shrinkage from drying and cleaning, national production projections for 1987-88 are 49,400 MT of grain sorghum and 99,520 MT of corn (Table A-1, Appendix). After adjustments, the projections are 41,674 MT of grain sorghum and 90,165 MT of corn. Based on 19.1 percent of corn production and all of the grain sorghum going for livestock feed, the total domestic supply for 1987-88 is 58,888 MT. This leaves 97,530 MT to be supplied by imports (Table 7).

2. Projected Monthly Volumes for 1987-88

Projected monthly (and even daily) volumes of receipts and shipments are needed in order to determine needed capacities for receiving, loading, and bulk storage at Barranca. Because the grain terminal functions primarily as

the point of assembly of grains during peak flows for later distribution as needed for processing, the monthly patterns of projected receipts at the terminal and monthly patterns of shipments from the terminal provide the basis for determining storage capacity requirements. Projected daily peak receipts and shipments establish required throughput handling capacities. The projected total annual 1987-88 volumes at Barranca are broken down by month in Tables 8 through 12. The monthly volumes for the critical months of November, December, and January are broken down on a daily basis in Table A-2 through A-4, Appendix.

Based on national monthly harvesting patterns from Table 3 of the Annex to "Postharvest System for Rice, Corn, Beans, and Sorghum in Costa Rica" by Rolando Flores and Gabriel Rengifo, projected monthly supplies of domestically-produced feed grains for 1987-88 are shown in Table 8. These values are subtracted from the projected monthly requirement of 13,112 MT to obtain monthly feed grain import requirements. In January and February when domestic supplies exceed demand requirements, the supplies are carried forward into the next month, and import requirements adjusted accordingly. Figures in the last column of Table 8 provide basis for total monthly feed grain import requirements as shown in Table 11.

Monthly harvest patterns of the basic grains in the Chorotega Region from the Flores-Rengifo publication provide basis for the projected monthly patterns shown in Tables 9 and 10. In this region corn and grain sorghum flow to market in two seasons (1) August-October and (2) January-April, but peak receipts come in January (Table 9). Projected receipts at Barranca for January 1988 include 8,327 of the total annual volume of 12,603 MT for the crop year. Shipments out to feed mnaufacturers follow the pattern of receipts until January when they become limited by monthly demand of 2,790 MT. This means

that monthly ending inventory balances of domestic feed grains are at zero through December, peak at 5,537 MT for January and then decline to 3,850 MT for February, 1,065 MT for March and zero thereafter. It is clear from this pattern that a minimum of about 6,000 MT of bulk grain storage capacity for domestic feed grains is required at Barranca.

The rice harvesting pattern for the Chorotega Region is such that 8,751 MT of the projected 1987-88 rough rice receipts at Barranca, or 66 percent, come during December (Table 10). New crop receipts start in October, build up sharply during November and December, and thereafter tail off rapidly. The rice mill can be operated at full monthly capacity from about October 10 until early August, but required rough rice storage capacity peaks at nearly 10,000 MT by the end of December. Ending inventories of rough rice remain at zero for August, September, and October but at substantial volumes for the rest of the year.

Simulated monthly patterns of receipts and shipments of imported grains at Barranca for 1987-88 are shown in Table 11. The table is based on projected monthly demands from Tables 7 and 8, and 20,000 MT cargos, 5,000 MT of which is stored in surge capacity at the Caldera port facility. For example in the case of wheat, a 20,000 MT cargo arrives at Caldera in August from which 15,000 MT is transferred (at the rate of 3,000 MT per day) to Barranca by rail. The remaining 5,000 MT is held temporarily in surge storage at Caldera, but shipped on to flour mills directly from the port during the same month. From the 15,000 MT received at Caldera, 5,023 MT also is shipped to flour mills during August to meet the total monthly demand of 10,023 MT (5,000 MT + 5,023 MT = 10,023 MT. Another 20,000 MT of wheat arrives at port in late September. In the meantime the August ending balance at Barranca of 9,977 MT has been virtually exhausted for supplying September needs to the flour mills.

Again from the late September cargo, 15,000 MT is transported by rail to Barranca and 5,000 MT remains temporarily at Caldera. The full monthly requirement for September is supplied to the mills from Barranca, 9,977 MT from inventory and the remaining 46 MT from the September shipment, leaving a September ending inventory at Barranca of 14,954 MT. No wheat is imported in October, the first 5,000 MT of monthly demand being met by the surge inventory (from the previous cargo) at Caldera, and the remaining 5,023 MT from the previous closing inventory at Barranca. Projected receipts, shipments, and closing balances of wheat for the remaining months can be traced in the same manner. It will be noted that about 15,000 MT of bulk storage capacity for wheat is needed at Barranca, and that this capacity essentially is full every other month.

The projected monthly volumes of imported yellow corn or grain sorghum for 1987-88 are shown in the last three columns of Table 11. Because of an opening balance in inventory at Barranca at the end of the previous July of 11,895 MT, the entire August demand of 10,398 MT is met from inventory, reducing closing inventory for the month to 1,497 MT. A 20,000 MT cargo of feed grain is brought into Caldera in late September, 15,000 MT of which is immediately shipped to Barranca by rail. The 4,431 MT of demand for imported feed grain is supplied from Barranca, leaving a closing inventory for September of 12,066 MT (1,497 + 15,000 - 4,431 = 12,066). The October demand of 11,678 MT is met by 5,000 MT of direct shipment from Caldera early in the month plus 6,678 MT from inventory at Barranca, reducing inventory at Caldera to zero and that at Barranca to 5,388 MT. Note that the required bulk storage capacity at Barranca for imported feed grains peaks at about 15,300 MT in November and approaches this tonnage again in July.

Projected 1987-88 monthly ending balances for the different grains at Barranca from the previous tables are brought together in Table 12. It will be noted that inventories of different grains peak in different months, so that if the facility is properly designed, the total storage capacity requirements is less than the sum of that for each grain. Peak inventories are reached in December for rice, September and November for wheat, January for domestic feed grains, and November for imported feed grains. For the facility as a whole, indicated inventories of bulk grain peak at 32,572 MT in January and are close to this peak in November, May, and July as well. Average monthly inventories are highest for the 3-month period November through January. This is the period chosen for testing capacity requirements on a daily basis.

3. Projected Daily Volumes for November 1987 through January 1988

The projected daily volumes of receipts, shipments and inventories of bulk grains at Barranca for the three consecutive tight months serve as basis for determining both handling rates and storage capacities at the facility. For example, the November projected daily patterns indicate that the facility must be able to receive and handle into storage some 3,220 MT per day (Table A-2, Appendix). It must be able to unload rail trains of both wheat and feed grains at the rate of 3,000 MT per day, but not at the same time. However, it must be able to receive up to 220 MT of rough rice while unloading either wheat or corn trains at the rate of 3,000 MT per day. Likewise, the facility must be capable of loading bulk grain to rail and/or trucks at rates up to 1,200 MT per day, but not during those very busy 5-day periods when 15,000 MT of wheat or corn must be unloaded. The peak storage inventory for November is not reached until the end of the month; at no other time during the month is total storage capacity under stress.

The projected daily volumes at Barranca for December show a somewhat different pattern (Table A-3). At a daily receiving rate of 400 MT, rough rice inventories are being increased each day. However, inventories of imported feed grains are being drawn down at the rate of 600 MT/day, and those of wheat also being reduced at this rate from the 19th day onward. The net result is that total bulk grain inventories at the terminal are being reduced throughout December, reaching a daily low on the 28th of about 23,000 MT. Receiving rates for rough rice are increased to 400 MT per day, but other throughput rates established by the November pattern are satisfactory for that in December.

January is the peak month for receiving domestically-produced feed grains, receiving at a rate of 500 MT per day (Table A-4). Because no imported corn or grain sorghum is handled during the month, no stress on handling rates is encountered during this time. Peak receiving rates for wheat are again encountered at the end of the month, contributing to peak total storage inventories at month end. Even though inventories of domestic feed grains increase each day, out shipments of wheat and continued milling of rough rice inventories cause daily inventories of combined bulk grains to decline until month end when another cargo of wheat imports is received.

4. Summary of Capacity Needs at Barranca

In summary, the projected volumes at Barranca indicate needed unloading capacity from rail hopper cars of 3,000 MT per day for both wheat and feed grains. Trains of 300 MT need to be unloaded in 30 minutes, or at the rate of 600 MT per hour. However, if there is unloading pit capacity of at least 300 MT, elevating and binning capacity of 300 MT/hr is sufficient because of the travel time of the trains from Caldera. In addition, the facility needs bulk receiving capacity by rail and/or truck of 400 MT/day for rough rice and of 500 MT/day for domestically-produced grain sorghum and yellow corn. It needs

loading capacity to rail and/or truck of 600 MT/day for wheat and 600 MT/day for feed grains, or a total of 1,200 MT/day. The facility can be operated so that this loading capacity does not have to be available at the same time that hopper cars are being unloaded at the rate of 3,000 MT/day.

These handling capacity needs are for grains in bulk and are in addition to capacity needs for handling grains in bags and/or flat warehouses, including white corn, edible beans, and milled rice. Projected volumes of corn and edible beans at Barranca are included in Table 4 and 6. Those for milled rice are derived from the rough rice projections in Tables 3, 10 and A-2 to A-4, using appropriate milling rates. It appears that existing handling capacities and flat warehouse storage capacities at Barranca for these grains are adequate to meet the projected requirements.

The needed additional bulk storage capacity at the Barranca varies from about 14,200 MT to 20,300 MT depending upon how effectively available space normally used for storing rough rice and wheat can be used for storing feed grains, and vice versa. If the two types of storage (at plant No. 1 and plant No. 2) can be used as perfect complements, then the total column of Table 12 is relevant. The peak monthly storage from this column is 32,572 MT in January. If this figure is increased by 5 percent for working space, we have 32,572 MT x 1.05 = 34,201 MT, which minus existing silo capacity of 20,000 MT, indicates needed additional space of 14,201 MT. At the other extreme, if there is no complementarity in use between the two plants (but perfect complementarity in use of storage space between rough rice and wheat, and betwee.. domestic feed grains and imported feed grains), then the figures from the two subtotals in Table 12 must be added. Thus, 23,100 MT + 15,272 MT = 38,372 MT, and this 1.05 = 40,291 MT or 20,291 MT of additional bulk storage capacity.

Even though the Barranca facility includes two bulk grain terminal plants with no conveyor system connecting the two (see Figure 1), the daily flows and inventory levels for November, December, and January in Tables A-2 through A-4 indicates some potential for complementary use of the two plants. For example, if the last 5,000 MT of the late January shipment of wheat could be stored in empty corn silos (and the 23,100 MT peak reduced correspondingly), then additional storage capacity for Barranca of about 16,500 MT would be adequate. Shipments of wheat from the corn silos could be completed before they are needed for imported feed grains. This cross use of storage facilities will complicate operation of the Barranca terminal somewhat, but would appear to be feasible if the facility is designed properly. On this basis, it is believed that additional bulk storage capacity of 16,000 MT to 17,000 MT at the two grain terminal plants at Barranca will be adequate. A workable combination appears to be an additional 10,000 MT at plant No. 1 to handle rice and wheat and an additional 6,000 MT to 7,000 MT at plant No. 2 to serve both domestic and imported feed grains. The specific recommendations in the following section reflect such combination.

D. Recommended Enhancement for the Barranca Terminal

The recommended enhancement of the Barranca terminal to serve projected needs is summarized by the proposed new layout in Figure 2. Rather than create a third plant somewhere on the Barranca site, it is recommended that both existing plants be expanded and enhanced, and that a circular rail spur line be extended to plant No. 2. Plant No. 1 would be remodeled completely by adding a new head house with fast elevating leg, and doubling existing bulk storage capacity by moving the CNP metal silos from San Jose to the site. Plant No. 2 would be expanded by adding rapid rail receiving with new elevator leg, and by adding four additional silos, each of the same capacity as the

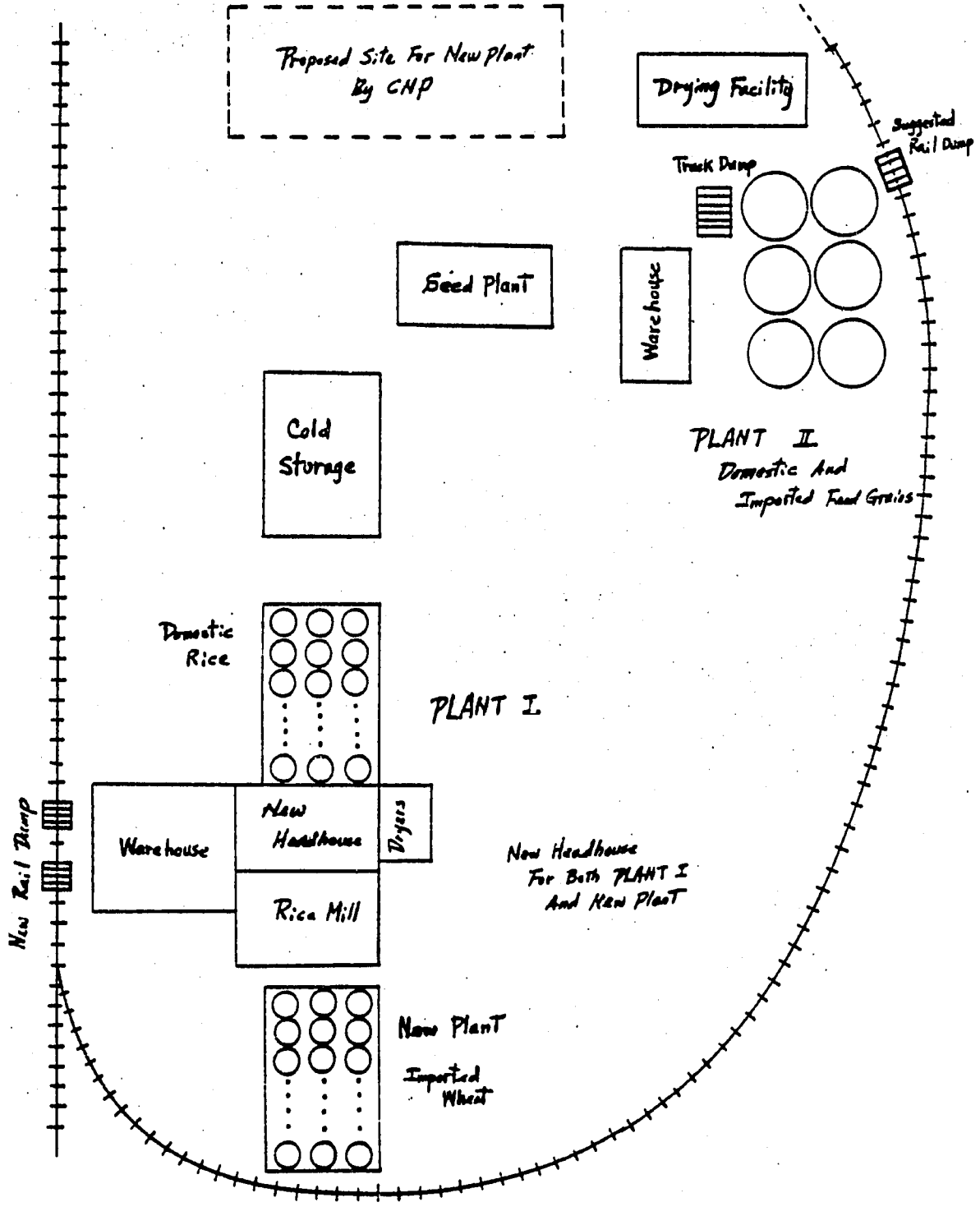

Figure 2. A Recommended Layout of a New Barranca Facility

existing six (Figure 2). Hydraulic truck dumps of 60 MT capacity are recommended at both plants.

As visualized, plant No. 1 would be used principally for rice and wheat. As is now the case, rough rice would be received from buying stations in the region by both rail and truck for cleaning and drying, storage, and milling. The existing metal silos and mill building would be used for rice, but the milling equipment would be up-graded to 5 MT/hour, preferably with separate stage hulling in order to produce brown rice for export. When not occupied by rough rice, these existing silos would be used for wheat. Wheat would be received by rail hopper cars from the Caldera port facility for short-term storage and distribution to the flour mills by both rail and truck. The 20 bins from San Jose would be re-erected on the other side of the new headhouse and used for wheat storage, adding 10,000 MT of silo storage capacity to this plant.

Plant No. 2 would be used for handling domestic and imported feed grains, and for "overflow" wheat. Domestic grain sorghum and yellow corn would be received in bulk by rail and truck from buying stations in the region for drying, cleaning, storage, and distribution in bulk to feed manufacturers by rail and truck. Imported yellow dent corn and/or grain sorghum would be received by rail hopper cars from Caldera for storage and distribution in bulk by rail and truck to feed manufacturers. The proposed four new metal silos at this plant would add about 6,700 MT of bulk storage capacity.

Recommended general specifications for additions to the two plants at the Barranca terminal are summarized below.

Plant No. 1

1. New headhouse, replacing existing one, to serve both existing and added silos, with elevating capacity of 300 MT per hour.

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2. Erection of the 20 metal bins from San Jose on the other side of the headhouse to provide 10,000 MT additional storage capacity, together with overhead conveyor for filling at the rate of 300 MT per hour, and conveyor below for emptying at the rate of 80 MT per hour.

3. Rail unloading pit for hopper cars with surge storage capacity of 300 MT and conveying capacity to the elevator leg of 300 MT per hour.

4. Hydraulic truck unloading platform of 60 MT capacity with conveying capacity to the elevator leg of 100 MT per hour.

5. Bulk loading facilities for both rail and truck at the rate of 100 MT per hour.

6. Rice milling capacity of 5 MT per hour, and capability of hulling and handling brown rice in bulk.

Plant No. 2

1. Extension of rail siding to the plant.

2. Construction of 4 new metal silos, adding bulk storage capacity of about 6,700 MT.

3. Rail unloading pit for hopper cars with surge capacity of 300 MT and conveying capacity to the elevator leg of 300 MT per hour.

4. Additional elevator leg of 300 MT per hour to serve rail unloading.

5. Additional conveyor capacity to the existing plus the new silos for filling at the rate of 300 MT per hour and emptying at the rate of 100 MT per hour.

6. Hydraulic truck unloading platform of 60 MT capacity.

Table 3

Projections of Rough Rice through 1987-88

(Metric tons, unadjusted)

Crop Year	(1) Chorotega Region Production	(2) Assigned to Barranca[1]	(3) Volume at Barranca[2]
1980-81	128,434	77,060	16,953
1981-82	95,071	57,024	12,549
1982-83	66,875	40,125	8,827
1983-84	95,593	57,356	12,618
1984-85	105,941	63,565	13,984
1985-86	108,378	65,026	14,306
1986-87	110,870	66,552	14,635
1987-88	113,420	68,052	14,972

Projected procurement percentages based CNP stated policies by Board of Directors in "Politicas and Instrucciones, 1982/1986" of Nov. 1982.

"The objective is to buy and sell sufficient volumes of basic grains to protect producers and consumers. Although the percentage of total production needed to achieve this goal is difficult to quantify, CNP will be aggressive in its procurement programs, striving to raise its procurement share of rice by 10 percent over that of the last two years and maintain shares equal to or higher than last year for corn, beans, and grain sorghum."

On basis of this stated policy projected CNP procurement shares are 22 percent for rice, 72.3 percent for beans, 31.1 percent for corn, and 62.7 percent for grain sorghum.

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[1]At 60 percent of Col 1.

[2]At 22 percent of Col 2.

Table 4

Projections of Edible Beans through 1987-88

(Metric tons, unadjusted)

Crop Year	(1) Chorotega Regional Production	(2) Assigned to Barranca[1]	(3) Volume at Barranca[2]
1980-81	2,790	1,674	1,210
1981-82	5,074	3,044	2,201
1982-83	4,324	2,595	1,876
1983-84	6,096	3,657	2,644
1984-85	6,882	4,129	2,985
1985-86	7,144	4,286	3,099
1986-87	7,415	4,449	3,217
1987-88	7,697	4,618	3,339

[1]At 60 percent of Col 1.

[2]At 72.3 percent of Col 2.

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Table 5

Projections of Corn through 1987-88

(Metric tons, unadjusted)

Crop Year	(1) Chorotega Regional Production	(2) Assigned to Barranca[1]	(3) Volume at Barranca[2]
1980-81	6,271	3,763	1,170
1981-82	9,173	5,504	1,712
1982-83	9,505	5,703	1,774
1983-84	9,761	5,856	1,821
1984-85	10,103	6,062	1,885
1985-86	10,456	6,274	1,951
1986-87	10,822	6,493	2,019
1987-88	11,201	6,721	2,090

[1]At 60 percent of Col 1.

[2]At 31.1 percent of Col 2.

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Table 6

Projections of Grain Sorghum through 1987-88

(Metric tons, unadjusted)

Crop Year	(1) Chorotega Regional Production	(2) Assigned to Barranca[1]	(3) Volume at Barranca[2]
1980-81	33,858	20,315	12,737
1981-82	23,434	14,060	8,816
1982-83	22,378	13,427	8,419
1983-84	27,172	16,303	10,222
1984-85	29,718	17,869	11,204
1985-86	32,639	19,583	12,279
1986-87	35,773	21,464	13,458
1987-88	39,207	23,524	14,750

[1]At 60 percent of Col 1.

[2]At 62.7 percent of Col 2.

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Table 7. Annual Projections of Import Requirements for Wheat and Feed Grains.

Year	Wheat[1] (MT)	Feed Grains (MT)		
		Total Demand	Domestic[2]	Import[3]
1981-82	96,920	112,958	40,177	72,781
1982-83	98,859	114,976	38,556	76,420
1983-84	102,813	124,711	44,470	80,241
1984-85	106,926	131,537	47,284	84,253
1985-86	111,203	139,074	59,609	88,465
1986-87	115,651	149,700	56,811	92,889
1987-88	120,276	157,344	59,814	97,530

1. Based on 4% annual increase except 2% increase for the year 1981/1982.

2. Based on projections from Table A-1, Appendix after application of factor for drying and cleaning of 0.9062 for grain sorghum and 0.8436 for corn, and assuming 17.92 percent of corn production used for livestock and poultry feed.

3. Based on 5% annual increase.

Table 8. Projected Monthly Feed Grains Demands, Domestic Supply and Import Requirements for 1987/1988.

Month	Domestic Supply (MT)	Import (MT)	Monthly Requirement (MT)
August	2,714	10,398	13,112
September	8,681	4,431	13,112
October	1,434	11,678	13,112
November	2,996	10,116	13,112
December	1,775	11,337	13,112
January	26,651	--	13,112
February	9,411	--	13,112
March	2,734	540	13,112
April	747	12,365	13,112
May	792	12,320	13,112
June	1,342	11,770	13,112
July	537	12,575	13,112
Total	59,814	97,530	157,344

Table 9

Projected Monthly Handling Volume of Domestic Yellow Corn and Grain Sorghum at Barranca, 1987-88

(Metric tons, after cleaning and drying)

Month	Receipts			Shipments	Ending
	Corn	Sorghum	Combined	(Combined)	Balance
Annual	205[a]	12,398[b]	12,603	12,603	
Aug	-	725	725	725	0
Sep	58	2,061	2,119	2,119	0
Oct	47	267	314	314	0
Nov	-	-	-	-	0
Dec	-	-	-	-	0
Jan	59	8,268	8,327	2,790[c]	5,537
Feb	26	1,077	1,103	2,790[c]	3,850
Mar	5	-	5	2,790[c]	1,065
Apr	10	-	10	1,075	0
May	-	-	-		0
Jun	-	-	-		0
Jul	-	-	-		0

[a]Table 5, column 3 for projected volume of corn x 11% yellow corn x adjustment factor for on-farm loss and drying and cleaning of 0.906.

[b]Table 6, column 3 for projected volume of grain sorghum x adjustment factor for on-farm loss and drying and cleaning of 0.8436.

[c]Project total national monthly requirement for feed grains for 1987-88 of 13,035 MT x fraction of domestic feed grain supply handled by Barranca of .214.

Monthly distribution of receipts based on monthly harvest patterns for Chorotega Region from Annex to "Postharvest System for Rice, Corn, Beans and Sorghum in Costa Rica" by Rolando Flores and Gabriel Rengifo.

Table 10

Projected Monthly Handling Volume of Rough Rice at Barranca, 1987-88

(Metric tons, after cleaning and drying)

	Receipts	Out for Milling	Ending Balance
Annual	13,180[1]	13,180[1]	0
Aug	-	426	0
Sep	-	-	0
Oct	892	892	0
Nov	3,441	1,318	2,123
Dec	8,751	1,318	9,556
Jan	-	1,318	8,238
Feb	34	1,318	6,954
Mar	62	1,318	5,698
Apr	-	1,318	4,380
May	-	1,318	3,062
Jun		1,318	1,744
Jul		1,318	426

[1]Table 3 projected volume received for 1987-88 x adjustment factor for on-farm loss, drying, and cleaning of 0.88031.

Monthly distribution of receipts based on monthly harvest patterns for Chorotega Region from Annex to "Postharvest System for Rice, Corn, Soybeans and Sorghum in Costa Rica" by Rolando Flores and Gabriel Rengifo.

Table 11

Projected Monthly Volumes of Imported Grains at Barranca Facility for 1987-88[1]

(Metric tons)

Month	Wheat Monthly Demand	Feed Grain Monthly Demand	Wheat			Corn & Sorghum		
			In	Out	Balance	In	Out	Balance[2]
Aug	10,023	10,398	15,000	5,023	9,977	-	10,398	1,497
Sep	10,023	4,431	15,000	10,023	14,954	15,000	4,431	12,066
Oct	10,023	11,678	-	5,023	9,931	-	6,678	5,388
Nov	10,023	10,116	15,000	10,023	14,908	15,000	5,116	15,272
Dec	10,023	11,337	-	5,023	9,885	-	11,337	3,935
Jan	10,023	-	15,000	10,023	14,862	-	-	3,935
Feb	10,023	-	-	5,023	9,839	-	-	3,935
Mar	10,023	540	15,000	10,023	14,816	-	540	3,395
Apr	10,023	12,365	-	5,023	9,793	15,000	7,365	11,030
May	10,023	12,320	15,000	10,023	14,770	15,000	12,320	13,710
Jun	10,023	11,770	-	5,023	9,740	-	6,770	6,940
Jul	10,023	12,575	15,000	10,023	14,724	15,000	7,575	14,365

[1]20,000 MT freights: 5,000 MT stored at Caldera port facility and 15,000 MT transferred to Barranca facility.

[2]Opening balance is 11,895 MT.

Monthly demand requirements from Tables 7 and 8.

Table 12

Monthly Ending Grain Balances for Barranca, 1987-88

(Metric tons)

Month	Rough Rice	Imported Wheat	Subtotal	Corn & Grain Sorghum Domestic	Corn & Grain Sorghum Imported	Subtotal	Total
Aug	0	9,977	9,977	0	1,497	1,497	11,474
Sep	0	14,954	14,954	0	12,066	12,066	27,020
Oct	0	9,931	9,931	0	5,388	5,388	15,319
Nov	2,123	14,908	17,031	0	15,272	15,272	32,303
Dec	9,556	9,885	19,441	0	3,935	3,935	23,376
Jan	8,238	14,862	23,100	5,537	3,935	94,72	32,572
Feb	6,954	9,839	16,793	3,850	3,935	7,785	24,578
Mar	5,698	14,816	20,514	1,065	3,395	4,460	24,974
Apr	4,380	9,793	14,173	0	11,030	11,030	25,203
May	3,062	14,770	17,832	0	13,710	13,710	31,542
Jun	1,744	9,740	11,484	0	6,940	6,940	18,424
Jul	426	14,724	15,150	0	14,365	14,365	29,515

Rough rice balances from last column of Table 10.
Imported wheat balances from Table 11.
Domestic yellow corn and grain sorghum balances from last column of Table 9.
Imported corn and feed grain balances from Table 11.

VII. EVALUATION OF PROPOSED NEW FACILITY AT LA RITA

The Hueter region is considered as one of the promising agricultural crop production regions in Costa Rica. Projected corn, rice and bean production figures by sub-regions in the Huetar region till the year 1991/1992 are presented in Tables 13, 14, and 15 respectively. The recent addition of a modern electric railroad and secondary roads in the region, and the modern major highway under construction to connect San Jose with Guapiles would definitely improve grain movement within the region and between regions.

Currently, CNP operates six buying stations in the Huetar region and one regional corn shelling and drying facility at Guacimo serving the entire Heutar region (see Figure 3). However, the Guacimo facility became old and obsolete for serving the region. The city of Guacimo has grown around the facility, adding further to congestion, which brings increasing pressure to have the facility moved for reasons of nuisance and air pollution. Corn cob disposal is an ever increasing problem at the facility. In addition, no land space for expansion and modernization of the facility is available at the present location. The recently built, modern electric railroad and the modern highway under construction to connect San Jose with the Huetar region do not pass through Guacimo.

For the above reasons, CNP prepared the proposal to establish a new regional grain handling and storage facility at La Rita to replace the Guacimo facility. The KSU consultant team reviewd the above proposal, and agrees with the justifications given in the proposal for establishing a new regional facility to serve the entire Huetar region. The 40-

hectare site at La Rita, recently acquired by CNP is a good site for the future regional corn shelling and grain drying facility for the Huetar region, and is at a logical location because the site is adjacent to the new railroad and about one kilometer from the outlet of the highway under construction.

The proposal is in a quite preliminary stage. It appears that the sizing of the facility was based on an over-optimistic rice production projection and procurement program by CNP in the region. Table 16 contains the CNP's projected rough rice, bean and corn procurement volumes from the Huetar region, which was based on 80% procurement of grains and beans produced in the Huetar region (Source: "Informe Preliminar Del Profecto "Plant La Rita").

It should be noted that the projected percent procurement, based on established policies and the market shares realized by CNP over the past two years, are 22 percent for rough rice, 72.3 percent for beans, and 31.1 percent for corn (based on national net production). Also note that Table 14 for projected rice production is based on an average annual growth rate of 6 percent rather than the 3 percent national average growth rate estimated by CNP analysts.

The sizing of facilites needed in La Rita, analyzed by CNP, was based on the assumption that the projected volume of 30,000 MT (the base year of 1987/1988) would be handled annually in the La Rita facility by CNP. However, it appears that the above projected volume is an unrealistic figure because it is based on 80 percent procurement of the total grain production in the Huetar region by CNP (see Table 16). Our brief

analysis shows that only the projected volume of 11,662 MT (corn, 8526 T; rice, 1795 T; and beans, 1,305 T) would be handled annually at the La Rita facility, if national projected percent procurement figures established by CNP analysts are assumed. Even if a 40% procurement target for corn, 22 percent for rice, and 72.3 percent for beans are realized, the projected volume to be handled at La Rita is estiamted to be 14,112 MT of corn, rice and beans (corn, 11,012 T; rice, 1795 T; and beans, 1305 T). Therefore, it appears that capacities of equipment and facilities needed at the La Rita terminal would be reduced to at least on half of those sized in the preliminary plan prepared by CNP.

The KSU team recommends that more vigorous and detailed analysis be conducted for sizing of facility at La Rita, and the facility needs at La Rita be designed, based on the revised analysis. The plant should be equipped with corn shelling, rice milling and drying facilites. Also, bulk grain storage bins and a flat warehouse for sack storage of milled rice and beans should be installed for short-term storage. In desinging the plant at La Rita, designers should consider the relocation of the grain dryers, the truck scale, the flat warehouse and other equipment which is in good condition from the Guacimo plant.

Since the site at La Rita is completely undeveloped our team recommends that, for the first stage of plant development, all the civil works such as land grading, draining, access road, rail siding, etc. be started as soon as possible before the grain terminal is constructed. In the meantime, the Guacimo plant can continue to serve the Huetar region. For the second stage, we recommend the preparation of foundation, building construction, relocation of the dryers, truck scale, flat warehouse and

other equipment from the Guacimo plant, and equipment and facility installment be started at a later date. However, the plan should be made such that the new terminal at La Rita can be in operation by the time the direct highway linking San Jose and Guapiles is completed.

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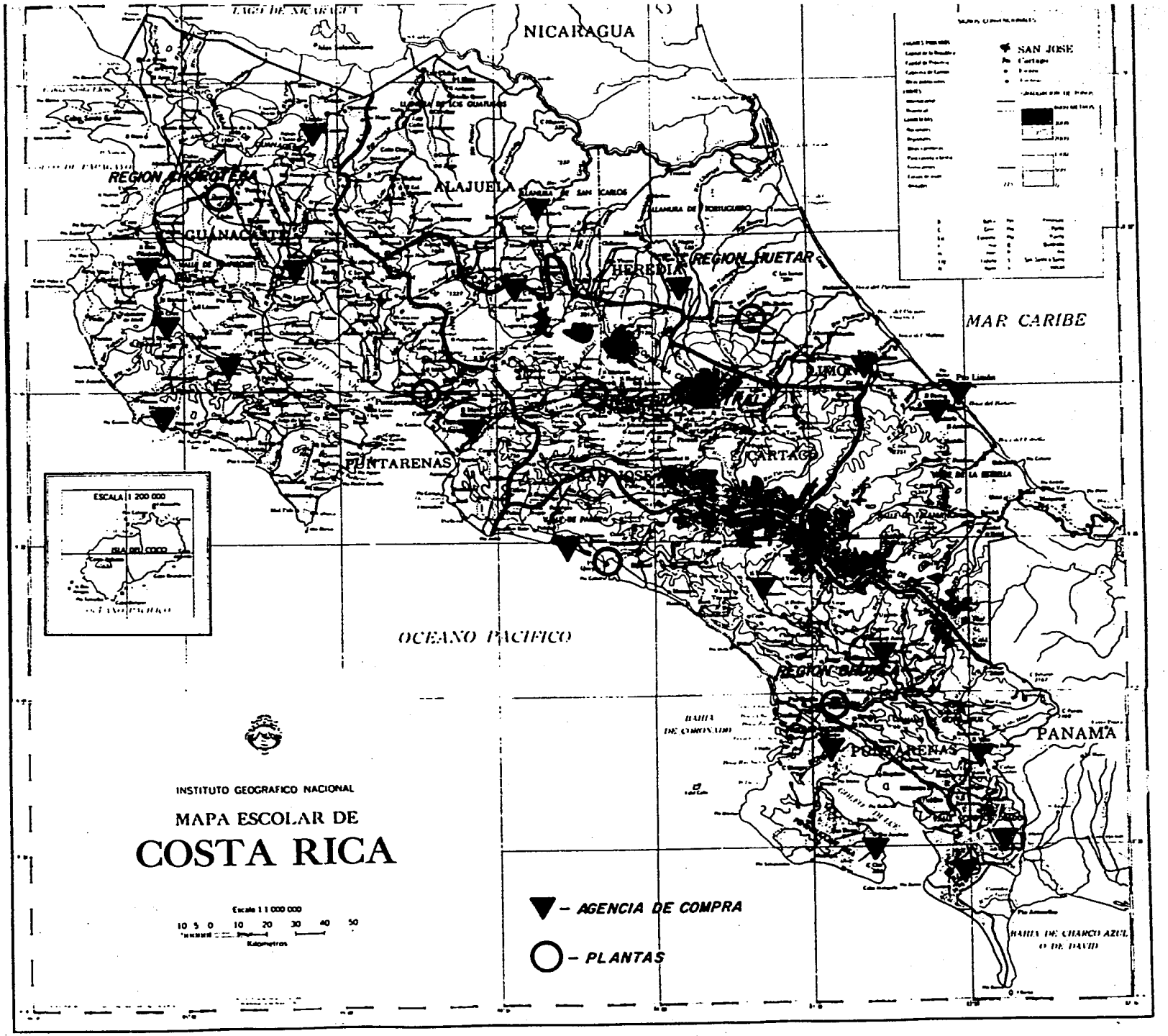

Figure 3. Locations of Regional Grain Storage Facilities and Buying Stations Operated by CNP.

Table 13. Annual Projections of Corn Production in Metric Tons by Sub-Regions in the Huetar Region.

	Guapiles-Guacimo		Limon-Bataan		San Carlos		Sta. Rosa De Cutriz		Total Region Huetar	
Year	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
1981-1982	19,404	16,370	4,167	3,516	1,662	1,402	332	280	25,565	21,568
1982-1983	19,636	16,566	4,217	3,558	1,682	1,419	336	283	25,871	21,826
1983-1984	19,883	16,774	4,270	3,602	,703	1,437	340	287	26,196	22,100
1984-1985	20,226	17,064	4,344	3,665	1,732	1,461	346	292	26,648	22,482
1985-1986	20,382	17,195	4,377	3,693	1,746	1,473	349	294	26,854	22,655
1986-1987	20,637	17,411	4,432	3,739	1,767	1,491	354	298	27,190	22,939
1987-1988	20,895	17,628	4,487	3,786	1,789	1,510	359	301	27,530	23,225
1988-1989	21,158	17,849	4,544	3,833	1,812	1,529	362	306	27,876	23,517
1989-1990	21,421	18,072	4,600	3,881	1,834	1,548	368	309	28,223	23,810
1990-1991	21,688	18,297	4,658	3,929	1,857	1,567	372	314	28,575	24,107
1991-1992	21,960	18,526	4,716	3,979	1,881	1,587	376	317	28,933	24,409

Table 14. Annual Projections of Rice Production in Metric Tons by Sub-Regions in the Huetar Region.

	Guapiles-Guacimo		Limon-Bataan		San Carlos		Sta. Rosa De Cutriz		Total Region Huetar	
Year	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
1981-1982	691	395	3,962	2,267	929	531	112	65	5,694	3,258
1982-1983	733	420	4,204	2,405	985	564	119	67	6,041	3,456
1983-1984	780	446	4,473	2,559	1,048	600	126	72	6,427	3,677
1984-1985	825	472	4,728	2,705	1,108	634	133	76	6,794	3,886
1985-1986	879	503	5,037	2,882	1,181	675	141	81	7,238	4,141
1986-1987	932	534	5,345	3,058	1,253	717	151	86	7,681	4,395
1987-1988	991	567	5,679	3,249	1,331	762	159	91	8,160	4,669
1988-1989	1,052	602	6,029	3,450	1,413	808	170	97	8,664	4,957
1989-1990	1,117	639	6,401	3,662	1,500	858	180	103	9,198	5,262
1990-1991	1,172	670	6,715	3,842	1,574	900	189	109	9,650	5,521
1991-1992	1,243	711	7,125	4,077	1,640	955	201	115	10,239	5,858

Table 15. Annual Projections of Bean Production in Metric Tons by Sub-Regions in the Huetar Region.

	Guapiles-Guacimo		Limon-Bataan		San Carlos		Sta. Rosa De Cutriz		Total Region Huetar	
Year	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
1981-1982	103	100	202	195	662	638	206	198	1,173	1,131
1982-1983	120	117	237	228	775	747	241	232	1,373	1,324
1983-1984	143	137	280	270	917	884	285	275	1,624	1,566
1984-1985	145	139	286	276	937	903	291	281	1,659	1,599
1985-1986	149	143	292	281	956	922	297	287	1,694	1,633
1986-1987	151	146	298	287	977	942	304	293	1,730	1,668
1987-1988	158	153	311	300	1,019	982	317	305	1,805	1,740
1988-1989	162	156	318	306	1,040	1,003	323	312	1,843	1,777
1989-1990	166	159	324	313	1,062	1,024	330	318	1,882	1,814
1990-1991	169	163	331	319	1,084	1,045	337	325	1,921	1,852
1991-1992	172	166	338	326	1,108	1,068	344	332	1,962	1,892

Table 16. Annual Projections of the Total Grain Procurement in Metric Tons by CNP from the Huetar Region[1].

	Rough Rice		Bean		White Corn		Yellow Corn		Total	
Year	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
1981-1982	4,556	2,607	979	944	15,953	13,458	4,499	3,796	25,987	20,805
1982-1983	4,829	2,763	1,149	1,108	16,144	13,620	4,554	3,842	26,676	21,333
1983-1984	5,143	2,942	1,357	1,308	16,346	13,790	4,610	3,889	27,456	21,929
1984-1985	5,434	3,109	1,385	1,335	16,629	14,029	4,690	3,957	28,138	22,430
1985-1986	5,794	3,313	1,414	1,363	16,756	14,136	4,726	3,987	28,687	22,799
1986-1987	6,145	3,516	1,444	1,392	16,967	14,314	4,705	4,037	29,341	23,259
1987-1988	6,512	3,726	1,507	1,453	17,178	14,492	4,845	4,087	30,042	23,758
1988-1989	6,931	3,965	1,537	1,482	17,395	14,675	4,906	4,139	30,769	24,261
1989-1990	7,359	4,210	1,570	1,514	17,612	14,858	4,967	4,191	31,508	24,773
1990-1991	7,719	4,416	1,603	1,545	17,816	15,031	5,025	4,239	32,163	25,231
1991-1992	8,191	4,686	1,637	1,578	18,055	15,233	5,093	4,296	32,976	25,793

1. Based on 80 percent procurement of the total grain production in the Huetar Region.

VIII. RECOMMENDATIONS

Based on the KSU team review and evaluation in collaboration with CNP, CIGRAS, USAID, and MIDEPLAN, recommendations are presented for (1) CIGRAS research project, (2) training for CNP personnel, (3) grain handling facility enhancement at Caldera and Barranca, and (4) additional grain handling facilities at La Rita. Sections of the report relating to each recommendation are indicated in parentheses.

The KSU Food and Feed Grain Institute team recommends:

1. The revised CIGRAS research project proposal, "Analysis of Grain Postharvest Handling Systems and Market Performance in Costa Rica", Phases I and II, be approved for U.S. Public Law 480 Title I funding; Phases III and IV of this project be considered for funding in subsequent fiscal years (Section IV).
2. Three types of training programs for CNP facility managers and staff analysts: (a) in-country short course for CNP facility managers in September 1983, with support by CIGRAS, USAID, and KSU, (b) intensive short course at KSU for selected CNP facility managers during June-July 1983, (c) formal graduate degree training in agricultural engineering and agricultural economics for CNP professional staff analysts at Kansas State University and/or other appropriate U.S. universities. Funding for the recommended training programs be given priority consideration by USAID/Costa Rica (Section V A, B, C).
3. Development of a 5,000 MT new rapid grain handling port facility at Caldera, linked directly to Barranca by rail hopper-car trains, for importing PL 480 and other grains (Section VI A).
4. Both Plant No. 1 and Plant No. 2 at the CNP Barranca grain terminal be enhanced. Plant No. 1 for handling primarily rice and wheat, and Plant

No. 2 for feed grains, both domestic and imported. Recommended improvements at Plant No. 1 include (a) relocation of CNP metal silos from San Jose to add 10,000 MT of bulk storage capacity, (b) addition of new headhouse to serve the relocated plus existing Plant No. 1 silos, (c) rapid rail receiving capacity, (d) truck receiving hydraulic dump, and (e) enhancement of rice milling capacity (Section VI D).

Recommended improvements at Plant No. 2 include (a) addition of four new metal silos of similar capacity to those existing at this plant, for about 6,700 MT additional bulk storage capacity, (b) circular extension of rail spur and rapid rail receiving capacity, and (c) truck receiving hydraulic dump (Section VI D).

5. Available PL 480 Title I funds be authorized for development of grain terminal facilities at La Rita. A more rigorous and detailed analysis for sizing of facilities should be conducted and then available funds be used for access road, rail siding, site development, and civil works for new terminal to ultimately replace the Guacimo plant in serving the Huetar Region (Section VII).

APPENDIX

Table A-1

CNP Purchases as Percentages of National Production of Basic Grains for 1970-1982, with Projections to 1990

	Rough Rice			Corn			Bean			Grain Sorghum		
	Natl. Prod.	Purchases (MT)	%	Natl. Prod.	Purchases (MT)	%	Natl. Prod.	Purchases (MT)	%	Natl. Prod.	Purchases (MT)	%
1970-71	11,277	8,500	11.93	61,525	1,520	2.47	8,669	23	0.26	7,278	10	0.14
1971-72	52,756	36,614	41.63	64,696	2,562	3.36	10,308	3,766	31.68	11,887	631	5.31
1972-73	97,423	20,277	20.81	64,508	1,834	2.84	5,230	4	0.08	13,806	2	0.02
1973-74	116,881	32,653	27.94	87,037	1,279	1.47	4,792	1,885	39.34	16,419	1,203	7.33
1974-75	126,719	21,030	16.60	42,061	8,109	19.28	13,902	6,359	45.74	14,129	2,015	14.26
1975-76	195,636	88,912	50.60	91,745	14,863	16.20	16,212	6,193	38.20	19,780	3,897	19.70
1976-77	149,746	139,792	92.00	88,945	27,341	30.74	14,070	628	4.46	30,861	12,249	39.68
1977-78	168,621	139,221	82.56	77,524	24,504	31.61	14,019	3,953	28.20	40,986	16,946	41.35
1978-79	195,868	45,868	23.42	75,272	14,967	19.88	11,121	1,213	10.91	52,587	12,668	24.09
1979-80	236,843	22,356	9.44	65,102	13,446	20.65	11,504	241	2.10	33,650	13,291	39.50
1980-81	243,589	28,241	11.59	88,007	30,016	34.10	12,289	8,900	72.42	41,622	26,127	62.80
1981-82	202,037	10,072	4.99	82,628	22,304	26.99	16,312	3,419	20.96	30,552	21,550	70.53
1982-83	142,105	31,263	22.00	85,634	26,632	31.10	13,905	10,053	72.30	28,262	17,720	62.70
1983-84	203,130	44,687	22.00	87,933	27,347	31.10	19,600	14,171	72.30	34,404	21,571	62.70
1984-85	225,119	49,526	22.00	90,711	28,211	31.10	22,128	15,999	72.30	37,046	23,228	62.70
1985-86	230,297	50,665	22.00	95,000	29,545	31.10	23,544	17,022	72.30	40,000	25,080	62.70
1986-87	235,593	51,830	22.00	97,185	30,224	31.10	24,022	17,368	72.30	45,600	28,591	62.70
1987-88	241,012	53,023	22.00	99,520	30,951	31.10	24,655	17,826	72.30	49,400	30,974	62.70
1988-89	246,555	54,242	22.00	101,809	31,663	31.10	25,302	18,293	72.30	56,000	35,112	62.70
1989-90	252,226	55,490	22.00	104,151	32,391	31.10	25,964	18,772	72.30	60,000	37,620	62.70

Table A-2. Projected Daily Volumes and Balances for Barranco in November 1987 (Metric Tons).

Day	Wheat		Bal.	Imported Corn		Bal.	Dom. Corn & Sorg.		Bal.	Rough Rice		Bal	All Grains		Bal.
	In	Out	9931	In	Out	5388	In	Out	0	In	Out	0	In	Out	15,319
1	-	600	9331	-	600	4788			0	19	19	-	19	1219	14,119
2	-	600	8731	-	600	4188			0	19	19	-	19	1219	12,919
3	-	600	8131	-	600	3588			0	40	40	-	40	1240	11,719
4	-	600	7531	-	600	2988			0	40	40	-	40	1240	10,519
5		600	6931	-	600	2388			0	60	60	-	60	1260	9319
6	-	-	6931	-	-	2388			0	60	60	-	60	60	9319
7	-	-	6931	-	-	2388			0				-	-	9319
8	-	600	6331	-	600	1788			0	120	60	60	120	1260	8179
9	-	600	5731	-	600	1188			0	120	60	120	120	1260	7039
10	-	600	5131	-	600	588			0	120	60	180	120	1260	5899
11	-	600	4531	-	316	272			0	120	60	240	120	976	5043
12	-	600	3931	-	-	272			0	120	60	300	120	660	4503
13	-	-	3931	3000	-	3272			0			300	3000	-	7503
14	-	-	3931	3000	-	6272			0			300	3000	-	10,503
15	-	-	3931	3000	-	9272			0	180	60	420	3180	60	13,623
16	-	-	3931	3000	-	12,272			0	180	60	540	3180	60	16,743
17	-	-	3931	3000	-	15,272			0	180	60	660	3180	60	19,863
18	-	600	3331	-	-	15,272			0	180	60	780	180	660	19,383
19	-	600	2731	-	-	15,272			0	180	60	900	180	660	18,903
20	-	-	2731	-	-	15,272			0	-		900	-	-	18,903
21	-	-	2731	-	-	15,272			0			900	-	-	18,903
22	-	600	2131	-	-	15,272			0	210	60	1050	210	660	18,453
23	-	600	1531	-	-	15,272			0	210	60	1200	210	660	18,003
24	-	600	931	-	-	15,272			0	210	60	1350	210	660	17,553
25	-	-	931	-	-	15,272			0	210	60	1500	210	60	17,703
26	-	600	331	-	-	15,272			0	213	60	1653	213	660	17,256
27	3000	423	2908	-	-	15,272			0			1653	3000	423	19,833
28	3000	-	5908	-	-	15,272			0			1653	3000	-	22,833
29	3000	-	8908	-	-	15,272			0	216	60	1809	3216	60	25,989
30	3000	-	11,908	-	-	15,272			0	216	60	1965	3216	60	29,145
31	3000	-	14,908	-	-	15,272			0	218	60	2123	3218	60	32,303
Total	15,000	10,023		15,000	5,116		0	0		3,441	1,318		33,441	16,457	

Table A-3. Projected Daily Volumes and Balances for Barranca in December, 1987 (Metric tons).

Day	Wheat		Bal.	Imported Corn		Bal.	Dom. Corn & Sorg.		Bal.	Rough Rice		Bal	All Grains		Bal.
	In	Out	14,903	In	Out	15,272	In	Out	0	In	Out	2123	In	Out	32,303
1	0	0	14,908	0	600	14,672			0	400	60	2463	400	660	32,043
2	0	0	14,908	0	600	14,072			0	400	60	2803	400	660	31,783
3	0	0	14,908	0	-	14,072			0			2803	-	-	31,783
4	0	0	14,908	0	-	14,072			0			2803	-	-	31,783
5	0	0	14,908	0	600	13,472			0	400	60	3143	400	660	31,523
6	0	0	14,908	0	600	12,872			0	400	60	3483	400	660	31,263
7	0	0	14,908	0	600	12,272			0	400	60	3823	400	660	31,003
8	0	0	14,908	0	600	11,672			0	400	60	4163	400	660	30,743
9	0	0	14,908	0	600	11,072			0	400	60	4503	400	660	30,483
10	0	0	14,908	0		11,072			0			4503	-	-	30,483
11	0	0	14,908	0		11,072			0			4503	-	-	30,483
12	0	0	14,908	0	600	10,472			0	400	60	4843	400	660	30,223
13	0	0	14,908	0	600	9,872			0	400	60	5183	400	660	29,963
14	0	0	14,908	0	600	9,262			0	400	60	5523	400	660	29,703
15	0	0	14,908	0	600	8,672			0	400	60	5863	400	660	29,443
16	0	0	14,908	0	600	8,072			0	400	60	6203	400	660	29,183
17	0	0	14,908	0		8,072			0			6203	-	-	29,183
18	0	0	14,908	0		8,072			0			6203	-	-	28,183
19	0	600	14,308	0	600	7,472			0	400	60	6543	400	1260	28,323
20	0	600	13,708	0	600	6,872			0	400	60	6883	400	1260	27,463
21	0	600	13,108	0	600	6,272			0	400	60	7223	400	1260	26,603
22	0	600	12,508	0	600	5,672			0	400	60	7563	400	1260	25,743
23	0	600	11,908	0	600	5,072			0	400	60	7903	400	1260	24,883
24	0		11,908	0		5,072			0			7903	-	-	24,883
25	0		11,908	0		5,072			0			7903	-	-	24,883
26	0	600	11,308	0	600	4,472			0	400	60	8243	400	1260	24,023
27	0	600	10,708	0	537	3,935			0	400	60	8583	400	1197	23,226
28	0	600	10,108	0	-	3,935			0	400	60	8923	400	660	22,966
29	0	223	9885	0	-	3,935			0	400	60	9263	400	283	23,083
30	0	-	9885	0	-	3,935			0	351	58	9556	351	58	23,376
31	0	-	9885	0	-	3,935			0	-	-	9556	-	-	23,376
Total	0	5,023		0	11,337		0	0		8751	1,318		8,751	17,678	

Table A-4. Projected Daily Volumes and Balances for Barranca in January, 1988 (Metric Tons).

Day	Wheat		Bal.	Imported Corn		Bal.	Dom. Corn & Sorg.		Bal.	Rough Rice		Bal	All Grains		Bal.
	In	Out	9885	In	Out	3935	In	Out	0	In	Out	9556	In	Out	23,376
1	-	-	9885	0	0	3935	-	-	0	0		9556	-	-	23,376
2	-	600	9285			3935	90	90	0	0	60	9496	90	750	22,716
3	-	600	8685			3935	150	150	0	0	60	9436	150	810	22,056
4	-	600	8085			3935	293	150	143	0	60	9376	293	810	21,539
5	-	600	7485			3935	294	150	287	0	60	9316	294	810	21,023
6	-	600	6885			3935	500	150	637	0	60	9256	500	810	20,713
7	-	-	6885			3935			637	0		9256	-	-	20,713
8	-	-	6885			3935			637	0		9256	-	-	20,713
9		600	6285			3935	500	150	987	0	60	9196	500	810	20,403
10	-	600	5685			3935	500	150	1337	0	60	9136	500	810	20,093
11	-	600	5085			3935	500	150	1687	0	60	9076	500	810	19,783
12	-	600	4485			3935	500	150	2037	0	60	9016	500	810	19,473
13	-	600	3885			3935	500	150	2387	0	60	8956	500	810	19,163
14		-	3885			3935			2387	0		8956	-		19,163
15		-	3885			3935			2387	0		8956	-		19,163
16	-	600	3285			3935	500	150	2737	0	60	8896	500	810	18,853
17	-	600	2685			3935	500	150	3087	0	60	8836	500	810	18,543
18	-	600	2085			3935	500	150	3437	0	60	8776	500	810	18,223
19	-	600	1485			3935	500	150	3787	0	60	8716	500	810	17,923
20	-	600	885			3935	500	150	4137	0	60	8656	500	810	17,613
21	-	-	885			3935			4137	0		8656	-	-	17,613
22	-	-	885			3935			4137	0		8656	-	-	17,613
23	-	600	285			3935	500	150	4487	0	60	8596	500	810	17,303
24	-	285	0			3935	500	150	4837	0	60	8536	500	495	17,308
25		-	0			3935	500	150	5187	0	60	8476	500	210	17,598
26		-	0			3935	500	150	5537	0	60	8416	500	210	17,888
27	3000	138	2862			3935	0	0	5537	0	60	8356	3000	198	20,690
28	3000	-	5862			3935			5537	0		8356	3000	-	23,690
29	3000	-	8862			3935			5537	0		8356	3000	-	26,690
30	3000	-	11,862			3935	0	0	5537	0	60	8296	3000	60	29,630
31	3000	-	14,862			3935	0	0	5537	0	58	8238	3000	58	32,572
Total	15,000	10,023		0	0		8327	2790		0	1318		23,327	14,131	32,572

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TITLE

AN ANALYSIS OF THE POSTHARVEST SYSTEMS FOR GRAINS AND PULSES IN COSTA RICA

PURPOSE

To analyze the physical and economic aspects of the postharvest systems for grains and pulses, and to identify areas where recommendations may improve the systems and lead to self sufficiency where appropiate.

OBJECTIVES

The following major objectives are included within the scope of this project:

1. Prepare a descriptive analysis of the existing postharvest systems including all aspects involved in the movement of grains and pulses from the producer to consumer.
2. Quantitatively determine the extent of losses due to various agents of deterioration (such as insects, rodents, birds, molds, etc.) and to investigate mycotoxins (especially aflatoxins) within the post-harvest systems.
3. Evaluate the marketing performance of the postharvest systems in terms of efficient use of resources and effectiveness in meeting goals.
4. Develop recommendations to economically minimize identified losses and to improve market performance.

5. Evaluate the impact of implemented recommendations.
6. Increase technical, professional and informational postharvest capabilities of CIGRAS, and others involved in the postharvest systems.

BACKGROUND

In June of 1980, a Cooperative Agreement was signed between the University of Costa Rica (UCR) and Kansas State University (KSU). This document provides for the Food and Feed Grain Institute (FFGI) of KSU and Centro para Investigaciones en Granos y Semillas (CIGRAS) of UCR to initiate a cooperative postharvest program of research and training under tropical conditions. It enable both institutions to increase and maintain their technical capabilities of providing postharvest assistance for cereal grains and seeds. Further, it provides for FFGI cooperative support to CIGRAS in technical research and training in Costa Rica.

This proposal is presented as a cooperative project between the University of Costa Rica and Kansas State University in the investigation of the postharvest systems of Costa Rica. It is directed to identifing problems in the postharvest systems that contribute to grain and pulse losses and to develop means of reducing them.

Funding for this cooperative project will be share by CIGRAS and FFGI in the following manner:

1. Funding will be supplied from this project for available and additional

CIGRAS staff; necessary equipment and supplies; and needed logistical expenses for FFGI staff.

2. The FFGI will furnish administrative and technical support staff from KSU funds supplied under the centrally funded KSU/AID Cooperative Agreement AID/DSAN-CA-0256.

Planning, coordinating, implementation and publications will be shared on all phases of the project.

JUSTIFICATION

In the past 30 years Costa Rica has been unable to satisfy its needs as far as grains and pulses despite the increases in yield per unit area that have been shown to take place for most crops. Estimates indicate that 34% of the total maize production and 41% of the total dry bean crop remain at the farm for family use. Very often on farm storage structures are inadequate ofering poor protection against insects, rodents and molds; also in most cases the stored grain can not be fumigated or treated with safe chemicals that will help to minimize grain damage by such agents as those mentioned before. That situation forces the farmers to use chemicals such as chlorinated insecticides, a practice that should be discouraged because of the health hazards it creates to the for the most part unaware consumer. Survey of the current procedures can lead to more appropiate training and extention efforts as well as a reduction of postharvest losses.

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Air-drying of grains and pulses in most production areas in the country can not be achived due to adverse climatic conditions, this situation leads to the storage of grains with high moisture contents a condition which increases the possibility that molds capable of producing aflatoxins will become established turning the grain into a health hazard for humans and animals that may consume it. Costa Rica has very high rates of gastric and liver cancer to which toxins such as aflatoxin could be an important contributing factor.

Prevailing marketing schemes quite often force farmers to hold their grain at the farm for more or less long periods under conditions which do not provide for the adequate preservation of the grains. Marketing channels need to be studied and suggestions be made in order to improve and expedite the movement of grains from the production fields to the consumer. Poor and inadecuate transportation also contributes to the inefficient distribution of grains and pulses from the production areas to urban centers. The impact of more timely rural pickups and distribution of grains and pulses could contribute significantly the interest of the small farmers to produce for commercial marketing channels.

Port handling facilities in Puntarenas and Limón are inadequate to handle ocean grain shipments. Study of alternate means for increasing port handling facilities is needed to allocate resources on a cost effective basis if port facilities are to be improved.

The handling of grains and pulses in Costa Rica is generally done in bags as against bulk handling, for which there is no provition in the country through the marketing and handling channels. The practice of storing grains and pulses in bags becomes increasingly expensive and at the same time it provides for additional opportunities for losses to take place. The use of bags to handle grain makes it difficult to control storage conditions as well as to apply corrective measures in the event the grain lot became infested with insects and molds.

Rodent damage to grains is often mentioned as a cause for grain losses specially on grain stored at the farm; however, rodent damage is prevalent also in wharehouse storages and grain fields as well. Even though control methods are available little trained expertise exists to either assess or control rodent destruction of basic grains and pulses.

"Guesstimates" of grain and pulse losses in Costa Rica vary widely from 20 to 45%.

It is impossible to design efficient loss intervention strategies when such incomplete and inaccurate estimates vary so widely. More so, without knowing precisely where in the postharvest basic grain and pulse systems the losses are greatest intervention strategies could miss the important losse targets. It is then imperative to accurately assess postharvest losses in order to allow financial and human resources to be marshalled and focused at those points in the system where losses can be minimized economically.

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SCOPE OF WORK

To accomplish the project objectives, the scope of work is divided into three major phases: (1) description of the postharvest systems and evaluation of losses, degree of efficiency and effectivenes of the systems; (2) development of recommendations to improve the postharvest systems; and (3) evaluation of the impact of implemented recommendations.

I. Description of the postharvest systems and evaluation of losses, degree of efficiency and effectiveness of the systems.

A. Description of the postharvest systems

The postharvest systems will be analyzed descriptively from the time the grains and pulses are physiologically mature or imported until they are consumed. Information gained from such an analysis is essential in identifying points within the systems where loss, inefficiency and ineffectiveness are most likely to occur. This information will provide the basis for establishing priorities for further action.

1. Assemble, review and verify (where necesary) available information. This will include, but not be limited to: demographic, climatic and geographic data; production and consumption data for grains and pulses; marketing network data (such as on-farm and off-farm storage, transportation, merchandising, processing, etc.); and

public facilitating functions (such as laws and regulations, price policy, market information, etc.).

2. Prepare and publish an initial description of the postharvest systems based on available information.
3. Identify information deficiencies and gaps in the postharvest systems.
4. Gather information to eliminate gaps and deficiencies where practical within the scope of this project.
5. Identify the role of women in the postharvest systems.
6. Prepare and publish a final report describing the post-harvest systems.

B. Evaluation of losses

Losses due to various factors of deterioration, handling and storage practices, aflatoxins, etc. will be quantified, where possible, by measurement within the postharvest systems in the farm, commercial and government sectors.

1. Methodology will be selected on the basis of applicability and reliabity.
2. Loss measurement will be conducted throughout one year, country wide.
3. Points will be identified within the postharvest systems where losses warrant remedial actions.

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C. Evaluation of market performance

Market performance will be evaluated in terms of the degree of efficiency and effectiveness of the postharvest systems.

1. Determine the costs associated with accomplishing the necessary marketing functions (transportation, storage, merchandising, processing, etc.) to move commodities to the consumer.
2. Evaluate efficiency of individual marketing functions in terms of their expected versus measured costs.
3. Determine government policy objectives established for the postharvest systems.
4. Evaluate the extent to which the postharvest systems are meeting these objectives.

II. Development of recommendations to improve the postharvest systems.

Implementation of this project and information therefrom will be used to develop recommendations for:

A. Reducing losses within the postharvest systems.

B. Training individuals, groups, trainers, etc., involved in the postharvest systems.

C. Improving market performance.

D. Measuring the effect of specific recommendations.

III. Evaluation of implemented recommendations.

Implementation of recommendations cannot be predicted in advance since they are a matter of administrative and/or political decisions. However, a complete program to reduce losses and improve market performance should:

A. Determine the effects of recommendations implemented to reduce loss and improve market perfomance.

B. Determine the reasons for the measured effect of the implemented recommendations should be determined in terms of the economic, political and social environment.

C. Determine the necessity to modify recommendations.

BUDGET (24 month)

Personnel support	$144.000,00
Travel & per diem	55.000,00
Equipment & supplies	110.000,00
Documentation Service	25.000,00
Publications & outreach	15.000,00
Miscellaneous	20.000,00
Indirect cost (UCR overhead 10%)	36.900,00
Total...	$405.900,00

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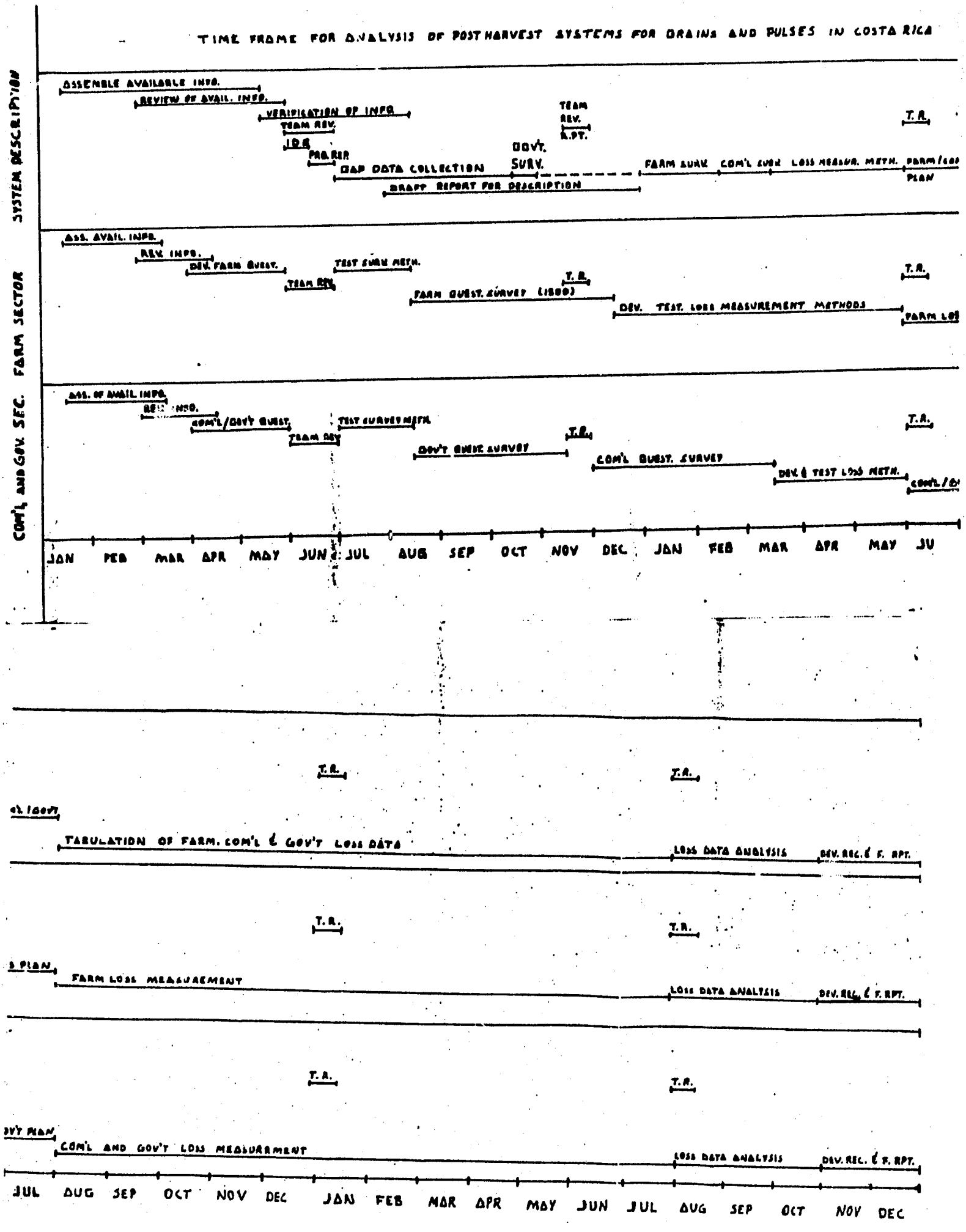
TIME FRAME FOR ANALYSIS OF POSTHARVEST SYSTEMS FOR GRAINS AND PULSES IN COSTA RICA



PLAN OF WORK

FOR ALTERNATIVE I

I. Description of Grain Postharvest Systems*

IA: On-farm

1. Pre-survey planning
   a. assemble existing information
   b. design questionnaire
   c. contract with Estadistica y Censo
2. Coordinating with census team during data collection
3. Handling data
   a. tabulate survey data
   b. analyze and interpret survey data
4. Developing report to describe on-farm postharvest system
   a. write report and recommendations
   b. reveiw and publish report

IB: Off-farm

1. Pre-survey planning
   a. assemble existing information
   b. design questionnaire
   c. train enumerators
2. Collecting data to define off-farm marketing system
3. Handling data
   a. tabulate survey data
   b. analyze and interpret survey data

* Wheat and sorghum - from production or importation to processor
Corn, beans and rice - from production or importation to retailer or processor.

4. Developing report to describe off-farm postharvest system

   a. write report and recommendations

   b. review and publish report

II. Evaluation of Grain Market Performance (Private and Public sectors)

1. Pre-survey planning

   a. assemble necessary information

   b. design format for collecting primary data

2. Examining market performance

   a. measure each market and service

   b. obtain services and cost associated with each function and operation

   c. review governmental policies and support and regulatory functions

   d. describe physical and intitutional infrastructure in marketing system

3. Analysing and interpreting data collected

4. Developing report and recommendations to evaluate performance of marketing systems.

5. Reviewing and publishing report

III. On-Farm Grain Loss Assessment

1. Pre-assessment planning

   a. review literature and methods

   b. select cooperators

2. Developing loss measurement survey

   a. plan field work

   b. train field assistants

3. Measuring losses

   a. measure physical losses

b. measure quality losses

4. Tabulating expeimental data

5. Analyzing and interpreting data

6. Developing report and recommendations

7. Reviewing and publishing

IV. Off-Farm Grain Loss Assessment (Public sectors)

1. Pre-assessment planning

a. review literature and methods

b. select buying stations

2. Developing loss measurement techniques

a. plan sampling work

b. train samplers

3. Measuring losses

a. measure physical losses

b. measure quality losses

4. Tabulating experimental dta

5. Analyzing and interpreting data

6. Developing report and recommendations

7. Reviewing and publishing

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SUMMARY OF ESTIMATED BUDGET FOR ALTERNATIVE I ($U.S.)

Component	Period (months)	Direct activity costs	In-counting costs (KSU)	Management costs	Sub-total	UCR overhead	Total
IA	15	40,500*	5,700	17,000	63,200	6,320	69,520
IB	15	34,100	5,700	17,000	41,500	4,150	45,650
II	15	24,000	5,700	34,000	66,700	6,670	73,370
III	24	94,300	5,700	27,200	127,200	12,720	139,920
IV	24	64,800	3,800	40,800	109,400	10,940	120,340
					GRAND TOTAL		$448,800

* Includes cost of contracting census work
Total budget does not include KSU-AID/W cooperative agreement contribution ($50.000)

SCHEDULE FOR PLAN OF WORK - ALTERNATIVE 1

COMPONENT	ACTIVITY	1983 Mar Apr May Jun Jul Aug Sep Oct Nov Dec	1984 Jan Feb Mar Apr May Jun	Jul Aug Sep Oct Nov Dec Jan
		1	2	3	4	
Description of Postharvest Systems	IA On-Farm	Pre-Survey Planning	Coordination with Census Team	Data Tabulation and Analysis	Report and Recommendations	
	IB Off-Farm	Pre-Survey Planning	Data Collection	Data Tabulation and Analysis	Report and Recommendations	
Evaluation of Market Performance	II	Pre-Survey Planning	Examination of Market Performance	Data Tabulation and Analysis	Report and Recommendations	
On-Farm Loss Assessment	III	1 Pre-Assessment Planning	2 Loss Assessment			3 Data Tabulation and Analysis / 4 Report and Recommendations
Off-Farm Loss Assessment	IV	1 Pre-Assessment Planning	2 Loss Assessment			3 Data Tabulation and Analysis / 4 Report and Recommendations

PROJECT UNDER THE AGREEMENT BETWEEN THE GOVERNMENT OF COSTA RICA AND THE GOVERNMENT OF THE UNITED STATES OF AMERICA - PUBLIC LAW 480, TITLE I.

PLAN OF OPERATIONS

1.	Title of project:	Analysis of grain postharvest handling systems and market performance in Costa Rica
2.	Purpose, objectives and justification:	Appendix 1
3.	Responsible party:	Centro de Investigaciones en Granos y Semillas (CIGRAS), Universidad de Costa Rica
4.	Director:	Miguel Mora, Ph.D. Director de CIGRAS
5.	Duration:	Fifteen months beginning with the date this agreement is signed
6.	Plan of work:	Appendix II
7.	Total Cost:	U.S. $173.910,00 Appendix III

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FINANCING

This project will be financed with funds provided to the government of Costa Rica by the government of the United States of America through Public Law PL 480, Title I.

LOCAL CONTRIBUTIONS

1. Local support will be handled through the Universidad de Costa Rica (UCR). Within the University CIGRAS will be the executive agency for this project.
2. UCR, at the request of CIGRAS, will employ the personnel and acquire the equipment and supplies necessary to the execution of this project. Costs incurred will be charged to this project. Equipment and supplies acquired with project funds will become property of the Universidad de Costa Rica for the use of CIGRAS.
3. CNP will collaborate to the extent possible in all phase of this project. As part of this collaboration CNP will designate a member of the CNP staff to cooperate full time with the Director of the project for the duration of this contract

OTHER CONTRIBUTIONS

The Wood and Feed Grain Institute (FFGI) at Kan State University will supply 10 professional person-months of consulting and/or technical assistance to this project. Salaries and fringe benefits incurred during this activity will be charged to cooperative agreement AID/DSA-CA-0256. The details of this assistance will be estated in a letter of understanding between FFGI and UCR specialize in post-harvest grain handling

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APPENDIX I

TITLE

ANALYSIS OF GRAIN POSTHARVEST HANDLING SYSTEMS AND MARKET PERFORMANCE IN COSTA RICA.

PURPOSE

To analyze the physical and economic aspects of the postharvest grain handling and marketing systems for grains and pulses, and to identify areas where recommendations may improve the systems and lead to self-help measure.

OBJECTIVES

The following major objectives are included within the scope of this project:

1. To prepare a description of the existing postharvest systems including all aspects involved in the movement of grains and pulses from the producer to consumer.
2. To evaluate the marketing performance of the postharvest systems in terms of efficient use of resources and its effectiveness in meeting goals.
3. To develop recommendations to improve postharvest handling systems and market performance.
4. To increase the technical, professional and informational capabilities of CICRAS and others involved in the postharvest area.

JUSTIFICATION

In the past 30 years Costa Rica has been unable to satisfy its need for grain and pulses despite the increases in yield per unit area that have been shown to take place for most crops. Very often, on-farm storage structures are inadequate and offer little protection against insects, rodents and molds. In most cases, the stored grain cannot be fumigated or treated with approved chemicals to minimize grain

damage. This situation forces the farmers to apply chemicals which may create health hazards to the consumer. A study of the current procedures can lead to more appropiate training and extension efforts as well as to the reduction of postharvest losses.

Air-drying of grains and pulses in most production areas in the country cannot always be achived due to adverse climatic conditions. This situation leads to the storage of grains with high moisture content, a condition which increases the possibility that molds capable of producing aflatoxin will become established in it. Grain containing aflatoxin is a health hazard for humans and animals that may consume it. Costa Rica has very high rates of gastric and liver cancer to which toxins such as aflatoxin could be an important contributing factor.

Prevailing marketing schemes quite often force farmers to hold their grain at the farm under conditions which permit deterioration of the grain. Marketing channels need to be studied and recommendations made to improve and expedite the movement of grains from the field to the consumer. Inadequate transportation also contributes to the inefficient distribution of grains and pulses from the production areas to urban centers. More timely collection and distribution of grains and pulses could significantly increase the amount of marketed grain produced by small farmers.

The handling of grains and pulses in Costa Rica is generally done in bags. There is no provision in the country for handling bulk grain through the marketing channels. The practice of storing grain and pulses in bags becomes increasingly expensive and at the same time increases the probability of grain loss. The use of bags to handle grain makes it difficult to control storage conditions and to take corrective measures if the grain becomes intested with insects and molds.

Rodent damage to grain is often mentioned as a cause of grain loss, especially on the farm. However, rodent damage is also common in

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warehouses and in fields. Even though control methods exist, trained personnel to either assess or control rodent destruction of basic grain and pulses is unavailable

"Guesstimates" of grain and pulses losses in Costa Rica vary from 20 to 45%, but it is impossible to design efficient loss intervention strategies until the location of the losses within the postharvest system is known. Without precise information of this type, loss reduction interventions could miss important targets. Accurate assessment of postharvest losses is imperative in order that scarce financial and human resources be directed and focused at those points in the system where loss reduction efforts are most economical.

This project is fundamental to the understanding of the present grain handling and marketing system in Costa Rica, and to the search for effective loss reduction interventions.

APPENDIX II

PLAN OF WORK

To accomplish the objectives of the project, the plan of work is divided into three parts: (1) description of the postharvest systems, both on-farm and off-farm; (2) evaluation of the efficiency and effectivenes of the grain handling and marketing systems; and (3) development of recommendations to improve the postharvest systems.

I. Description of the grain postharvest handling systems.

The postharvest systems will be analyzed descriptively from the time the grains and pulses are physiologically mature or imported until they are consumed or arrive at a processing facility (corn mil, feed mill, etc.). Information gained from this analysis is essential to identify points within the systems where loss, inefficiency and ineffectiveness are most likely to occur. This information will provide the basis for establishing priorities for further action.

A. Description of the on-farm grain handling systems.

This phase is dependent upon the inclusion of an on-farm grain handling and storage section to the agricultural census which will be carried out by the Dirección de Estadística y Censo of the Ministerio de Economía with funds provided by PL 480.

The activities are as follows:

1. Collect, review and analyze existing information relative to the on-farm handling and storage of grain in Costa Rica.
2. Coordinate the collection of data with Estadística y Censo.
3. Tabulate and interpret the data.
4. Prepare a report and recommendations relative to on-farm grain handling and storage.

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B. Description of the off-farm grain handling systems.

This part will describe grain handling systems from the farm gate to the final retailer or to the processing plant (corn mill, feed mill, etc.). Imported grain and milled rice will also be included.

The activities are as follows:

1. Collect, review and analyze existing information relative to the off-farm handling and storage of grain in Costa Rica.
2. Verify existing information and conduct studies to generate information where necessary.
3. Tabulate and interpret the data.
4. Prepare a report and recommendations relative to off-farm grain handling and storage.

II. Evaluation of grain market performance.

The performance of the market will be evaluated in terms of its efficiency and effectiveness.

1. Planning.
   a. Collect and review existing information.
   b. Design a format for collecting primary data.
2. Examination of market performance.
   a. Measure each market and service.
   b. Obtain the services and costs associated with each function and operation.
   c. Review governmental policies as well as support and regulatory functions.
   d. Describe the physical and institutional infrastructure in the marketing systems.
3. Tabulate and interpret the data.
4. Prepare a report and recommendations relative to the efficiency and effectiveness of market performance.

III. Preparation and publication of the final report and recommendations.

This report will describe the postharvest grain systems on and off the farm, and will evaluate the efficiency and effectiveness of the grain market system. It will also contain such recommendations for improving grain handling and marketing as can be justified with the information gathered in this project.

SCHEDULE FOR PLAN OF WORK

COMPONENT	ACTIVITY	1983								1984			
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
		1		2						3			4			5	
Description of Postharvest Systems	IA On-farm	Pre-survey planning		Coordination with Census Team						Data Tabulation and Analysis			Report and Recommendations				
	IB Off-farm	Pre-survey planning		Data Collection						Data Tabulation and Analysis			Report and Recommendations				
Evaluation of Market Performance	II	Pre-survey planning		Examination of Market Performance						Data Tabulation and Analysis			Report and Recommendations				
Preparation and Publication of Final Report	III															Final Report and Recommendations	

SUMMARY OF ESTIMATED BUDGETS

(¢ C.R.)

Period (Months)	Direct[1] Cost	Management[2] Cost	In-country*[3] (KSU)		Total
15	2,148,900	2,184,000	741,000		5,073,900
			a. Indirect cost[4]		1,092,000
			b. Sub-total		6,165,900
			c. Overhead cost 10% of (b)		616,590
			Grand total		6,782,490

* Excludes KSU-AID/W Cooperative agreement contribution ($40,000.00 = ¢1,560,000)

[1]Direct Cost	- Salaries and fringe benefits (at 40% of salary) for team members - Travel expenses and per diem - Computer time for data tabulation - Paper and copying for publication of reports - Training field personnel
[2]Management Cost	- Salaries and fringe benefits (at 40% of salary) for directors - Salaries and fringe benefits (at 40% of salary) for secretarial and clerical personnel - Office equipment and supplies - Communications - Utilities - Vehicle rental & maintence - Books and reference materials - Miscellaneous
[3]In-country KSU Cost	- Travel and per diem for FFGI consultants
[4]Indirect Cost (relates to support for team members)	- Salaries and fringe benefits (at 40% of salary) for secretarial and clerical personnel - Office equipment and supplies - Communications - Utilities - Miscellaneous

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ESTIMATED BUDGET

Activity	Team Member	Person-Months	COST (¢ C.R.) Direct	Indirect	Others
IA 1.a.	Ag. Economist	2	39,000	39,000	19,500
b.	Agronomist	2	39,000	39,000	19,500
a,b	FFGI		--	--	( )*
IA 2.	Ag. Economist	1	19,500	19,500	29,250
	Agronomist	1	19,500	19,500	29,250
IA 3.a.			--	--	97,500
b.	Ag. Economist	2	39,000	39,000	
	Agronomist	2	39,000	39,000	
	FFGI		--	--	( )*
IA 4.a.	Ag. Economist	2	39,000	39,000	
	Agronomist	2	39,000	39,000	
b.	FFGI		--	--	( )*
			SUB-TOTAL	741,000	
IB 1.a.	Ag. Economist	2	39,000	39,000	19,500
b.	Agronomist	2	39,000	39,000	39,000
c.			--	--	42,900
a,b	FFGI		--	--	( )*
IB 2.	Ag. Economist	4	78,000	78,000	78,000
	Enumerators (2)	20	273,000		117,100
IB 3.a.	Ag. Economist	2	39,000	39,000	
	Assistant	2	39,000	39,000	
b.	Ag. Economist	2	39,000	39,000	
	Assistant	2	39,000	39,000	
	FFGI		--	--	( )*
IB 4.a.	Ag. Economist	2	39,000	39,000	
b.	FFGI		--	--	
			SUB-TOTAL	1,271,400	

* See summary of estimated budgets

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ESTIMATED BUDGET

Activity	Team Member	Person-Months	Direct	Indirect	Others
II 1.a.	Ag. Economist	2	39,000	39,000	19,500
	FFGI		--	--	( )*
II 2.a.					
b.	Ag. Economist 1	4	78,000	78,000	78,000
c.	Ag. Economist 2	2	58,500	58,500	39,000
d.	FFGI		--	--	( )*
II 3.	Ag. Economist 1	4	78,000	78,000	19,500
	Ag. Economist 2	2	58,500	58,500	19,500
	FFGI		--	--	( )*
II 4.	Ag. Economist 1	2	39,000	39,000	
	Ag. Economist 2	2	58,500	58,500	
	FFGI		--	--	( )*
			Sub-total	994,500	
III	Directors	4	( )*	( )*	175,500
			Sub-total	175,500	

* See summary of estimated budget