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REMOVING THE CONSTRAINTS THAT LIMIT ADOPTION OF THE RICE SORGHUM PATTERN IN TANAUAN, BATANGAS

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INTRODUCTION

Demand for feedgrains in the Philippines far exceeds domestic production. The country is importing 40,000 tons of sorghum per year and 100-150,000 tons of corn (Foreign Agriculture, 1976). In the face of a rapidly rising demand for sorghum, the area actually planted to this crop is quite small. As of November 1974, the total reported area was about 6,000 hectares (The Philippines Recommends for Sorghum, 1975).

Sorghum is advantageously suited to many environments in the Philippines but production has never been significant because adequate market channels between the feed millers and potential growers have not been successfully established. On the grower's side there is often great difficulty and high cost in locating a local market for sorghum (Masaganang Maisan Progress Report No. 7, 1974). On the part of the buyer there is little enthusiasm to purchase small volumes of produce. It is costly to collect and certain minimum quantities are required to adjust feed mixes to accomodate sorghum.

In Cotabato where most Philippine sorghum is produced, the assembler-wholesalers are the most frequent type of market outlet. Approximately 78% of the sorghum produced goes to them (Guzman et al, 1973). In Northern Luzon, sorghum farmers dispose of only 57% of their produce to the intermediaries and end users. The rest is consumed by their own livestock and used for seed (Gonzales et al,1974).

Many years of experiments in the Philippines have produced several good commercial sorghum varieties (The Philippines Recommends for Sorghum, 1975). The crop has excellent productivity under high management conditions, but with drought resistance superior to corn and most other field crops, it is especially outstanding in drought- prone rainfed

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environments. Proving a new crop's suitability as a profitable alternative in the farmer's cropping system is not enough, however. The challenge of evolving a permanent marketing organization must somehow also be tackled.

RATIONALE

Cropping pattern trials were conducted by the IRRI Cropping Systems Program in several barrios of Tanauan and Malvar, Batangas, during the 1974-75 crop season. This is a rolling upland area where the major cropping pattern among small-scale farmers has been upland rice in the early wet season followed by a yellow variety of field corn in the late wet season. Its location is shown by the map in Figure 1. The objectives of the trials were to evaluate a number of alternative field crops, including sorghum, as potentially more productive than corn in this system (Garrity et al, 1975; Herrera and Harwood, 1975).

On seven farms sorghum was planted next to the farmers' own local corn variety in identically sized fields and each were given the same management inputs. Sorghum outyielded the corn on every field averaging 2.9 t/ha vs. 1.7 t/ha for the corn, a difference of 70%. The net income over all 11 sorghum fields in the trial was ₱1,503/ha above cash costs and ₱1,024/ha above all variable costs.

The 5 farmers who planted early in October obtained additional profit from a ratoon crop of over one ton per hectare, long after all their fields are normally fallowed in the dry season.

At the conclusion of the trial farmers in the area expressed interest in commercially producing sorghum. From one year's data it appeared that sorghum had superior yield and income potential to corn since the trials had been carried out in a particularly wet season when sorghum's comparative advantage over corn was expected to be weakest. Therefore, sorghum was recommended as an alternative to corn.

Although farmers were interested, it was obvious that three constraints would make sorghum production in these barrios unlikely the following year:

1. Buyers would purchase sorghum only if a large quantity were produced. This would require numerous farmers to produce and sell their grain simultaneously.

2. There was very little seed with which to start production.

3. There was no sorghum thresher available.

A research project was envisioned which would investigate strategies, including analytical requirements for overcoming these three constraints to the adoption of the rice-sorghum cropping pattern in eastern Batangas. The project would serve as a basis for developing an approach to identifying and solving problems related to the introduction of cropping patterns which include new crops.

OBJECTIVES

The general objective of the study was to determine what additional on-farm and institutional constrains are confronted in the introduction of a new crop, once it has been shown to be biologically feasible and profitable. Specifically, the study was conducted:

1) To conduct a small pilot project on the development of sorghum production and marketing among interested small-scale upland rice farmers of Tanauan, Batangas;

2) To test whether the rice-sorghum pattern could be adopted on a wide scale, entailing the establishment of a permanent sorghum industry;

3) To monitor the yields, costs and income of sorghum production experienced by the participating farmers;

4) To establish a functional link between our research institute and Philippine government whose responsibility is to promote crop industries particularly feed grain production, and;

5) To evaluate the project with a view toward formulating a specific methodology for the successful management of such a project.

METHODOLOGY

The activities of the project were conducted in the following general order:

1. Contacts and collaboration worked out between the 3 agencies

2. Investigation of potential markets

3. Arrangements made for a thresher

4. Barrio meetings held with the formation of associations headed by farmer-leaders

5. Decision reached on marketing arrangements and price agreement

6. Seed distribution

7. Crop management activities and field data collection

8. Field visit by the buyer

9. Harvesting and threshing

10. Grain marketing

11. Crop management activities and data collection on the ratoon crops

12. Harvesting and threshing the ratoon crops

13. Marketing the ratoon crops

14. Barrio meetings concerning purchase of a thresher and the future of sorghum production

15. Farmer visits to thresher manufacturer

16. Data summarization and project evaluation

These activities will be discussed in detail in the following sections.

The Cooperating Agencies

Individuals of three separate agencies carried out the project. These were the Bureau of Plant Industry, the Multiple Cropping Extension Pilot Project of the University of the Philippines at Los Baños, and the Cropping Systems Program of the International Rice Research Institute. The project organization is shown in Figure 2.

The Bureau of Plant Industry

The BPI implements the Masaganang Maisan Program and has a direct commitment to the establishment of a strong feedgrains industry. This involves corn, soybean and sorghum production. Mrs. Gavina Huelgas, the BPI technician covering 20 barrios of Tanauan, worked part-time on all

phases of the project in those project barrios within her area of responsibility. These included Janopol, Natatas, and most importantly Balèle, her home barrio.

The Multiple Cropping Extension Pilot Project, University of the Philippines, College of Agriculture

For the past three years the Multiple Cropping Extension Pilot Project has been conducting research and extension in Barrio Bilog-Bilog, Tanauan. The UPLB technician working there, Mr. Arnold Garcia, conducted all the sorghum project activites in that barrio. Sorghum was familiar to farmers there through previous field trials by Mr. Garcia.

The Cropping Systems Program, IRRI

Four personnel of the Cropping Systems Program worked on the Project. Jose Nicolas guided the project activities as research assistant. A full-time field assistant, Domingo Galang, had responsibility for coordinating all field activities among the farmers, farmer leaders, personnel of the other agencies and the sorghum buyer. He had a vehicle available to him. Ildefonso Cosico tabulated and summarized the data brought in from the field. M.S. student Dennis Garrity, who conducted the 1974-75 trials upon which the project was based, assisted in project formulation, crop management, and other phases.

Locating a Market for Sorghum

Before extensive farmer contacts were made, it was essential to determine the local sorghum market situation. Since there would be considerable risk involved in depending on an individual buyer when no established market existed, it was felt necessary to make some form of price guarantee to protect the participating farmers. Discussions with potential buyers mainly centered on this requirement. Three potential buyers were contacted:

Batangas Feed Mills (Tanauan, Batangas)

This is an assembler-wholesaler firm which procures grains and manufacturers livestock feeds. The firm favored contract buying provided IRRI would act as the 2nd party representing the farmers, and provided further that a 5-year supply of grain sorghum will be

assured to their firm, two conditions which could not be met. The company felt that contracting with individual farmers is tedious and requires a lot of time and effort in terms of paper work. The firm would not provide a transport service for hauling the produce in the barrio.

Lipa City Multi-Purpose Cooperative Marketing Association (Sabang, Lipa City)

This firm is engaged in buying grain and selling manufactured feeds for poultry and livestock. Lt. Col. Juan Viado, the General Manager, favored contract buying and setting the price of sorghum at 90% of the selling price of corn. The firm does not provide transport services.

Malahi Breeding Project (Los Baños, Laguna)

The company is engaged in poultry and hog raising. It procures feed grains and processes its own feeds. Mr. Buell, the General Manager of the firm, did not favor contract buying but his firm was willing to guarantee a sure market for sorghum at prevailing prices, with the stipulation that should prices drop below ₱0.90/kg they would still guarantee ₱0.90 per kg.

Arrangements for a Thresher

Since no threshers were available in the project barrios an arrangement had to be made to obtain a thresher from outside. The Agricultural Engineering Department at IRRI agreed to loan two types of thesher for testing on the project. One was a large axial flow rice thresher valued at about ₱13,000. The other was a small Landmaster thresher valued at about ₱2,000. Their performance and the farmers' reactions to them will be discussed in the results.

Barrio Meetings

The project was conducted in the barrios of Tanauan, Batangas where the cropping pattern trials had been conducted the previous year along with some adjacent barrios. The project area is mapped in Figure 1.

On September 27, 1975, separate meetings were held in the barrios of Janopol, Natatas, and Cale. A total of 28 farmers attended the meetings.

The following agenda were taken up:

1. Seeds - to be initially provided by IRRI but farmers would have to repay them out of their produce after harvesting.

2. Thesher - to be provided by IRRI but farmers would have to pay a service fee for the cost of fuel.

3. Market outlet - three possible buyers had been contacted as possible outlet for sorghum and were interested in purchasing it.

4. Technical assistance - to be furnished by the cooperating agencies, BPI, UPLB, Multiple Cropping Extension Pilot Project, and IRRI.

After the presentation of the agenda, the table was open for discussion including farmers' reactions to participating in such a project. The results of the interaction with the farmers is summarized below:

Farmer's questions/suggestions

- "Will the fertilizer be given free just like last year?" (The farmer cited previous small scale experiments by IRRI wherein all technical inputs were given free).

- "Can't you make an arrangement with the buyers to lend us a few bags of fertilizer; then deduct the cost from our produce after harvesting?"

- "Could we be given loans?"

Farmers' problems

- "I cannot plant sorghum because the cost of fertilizer is high."

- "One problem here in Natatas is that most farms are tenanted and the farmers have to secure permission from their landlord before they can plant any new crop like sorghum."

- "The large landowners in Natatas are getting a much higher return from sugarcane and there is a slim chance that they will accept the idea of changing their crop."

Farmers' comments about sorghum

- "Sorghum is a good crop. Unlike corn, very few know of its uses, which makes it less attractive to crop stealers."

- One farmer complained about the excessive nutrient depletion in his field caused by the ratooning of sorghum.

- According to Isidoro Landicho, a former cooperator from Janopol, "My 1000 sq.m. sorghum field yielded 5 cavans using only compost pit fertilizer."

The results of the meeting revealed some salient points for consideration:

1. Farmers in the area are fertilizer conscious, and relate good crops to their fertilizer requirements.
2. Those farmers who are tenants have little power when it comes to decision making. Each new innovation in crop production has to pass through the deliberation of their landlord.

On the question of fertilizer input, it was pointed out that the project was a production oriented one and unlike the previous field experiments, all inputs were to be shouldered by the farmers themselves. However, we explained that an attempt was being made to set up a loaning scheme under the Masaganang Maisan Program with the Rural Bank of Tanauan.

Loan Financing

Sorghum is one of the feed grains included in the Masaganang Maisan Program with funds reserved for financing. The loans are processed by representatives from the BPI and a rural bank credit officer.

Upon inquiry, we found that sorghum had been withdrawn from the group of feedgrains eligible for Masaganang Maisan loans in Batangas province. The BPI explained that this had been done because too little sorghum was grown in the province. Since the project was organized just shortly before the planting season, there was inadequate time to seek approval from the National Food and Agriculture Council for sorghum loans under the project. We, therefore, worked only with those farmers who had their own financing available. Since the average area planted to sorghum per farmer was only 0.24 ha (Table 3), the lack of bank financing did not prove to be a constraint to participation.

The Farmer Cooperator

Sixty-eight interested farmers signed up as participants. The farmers were required to submit their estimated field size to be planted with sorghum. The volume of seeds each farmer received was based on that estimated field area. Two kilos were distributed for every 1000 sq.m. All of the 68 cooperators received seeds. Of these total, 7 withdrew from the project after planting (Table 1). Thus, only 61 farmers appeared in the final analysis. Four of the 61 farmers had previously planted sorghum in the October 1974 - February 1975 crop season. The balance of 57 were new sorghum adopters. The distribution of farmers by barrio is as follows: Balele (4), Bilog-Bilog (4), Cale (9), Janopol (14), and Natatas (20).

There were 33 owner cultivators, 27 share tenants and one owner cultivator-cum-share tenant included in the study. All cooperators from Balele, Bilog-Bilog and Janopol were owner-cultivators, whereas planters from Cale and Natatas are a mixture of owners and share tenants (Table 2).

Seed Distribution

The first batch to receive seeds were farmers from Balele, Janopol and Natatas. The rest of the seeds were distributed through the sorghum leaders designated in each barrio and through the BPI and the UPCA Multiple Cropping technician assigned in the barrios of Janopol, Natatas, Balele and Bilog-Bilog, respectively. Farmers who had earlier received seeds also served as channels in spreading the news about the sorghum project. In Cale, a house to house campaign was made to explain the project to farmers.

To facilitate easy communication, a sorghum leader was designated in each barrio. The following were chosen as leaders by the farmer-members:

Rosendo Luna	-	Cale
Venancio Planton	-	Natatas and Balele
Isidoro Landicho	-	Janopol
Paulino Ramos	-	Bilog-Bilog

The leaders served as coordinators and were usually contacted first by the technicians and field aide when they visited the barrio to investigate the needs and problems of the participating farmers. Likewise, the leader was expected to inform the group about proper cultural management of the crop in consultation with the technicians.

A total of 535 kilos of grain sorghum was loaned out, the distribution of which is as follows: Janopol (169 kg), Natatas (164 kg), Cale (137 kg), Bilog-Bilog (35 kg), and Balele (30 kg). The largest volume of seeds was distributed in Janopol where 9 out of 14 farmers replanted their fields (Table 3).

The bulk of seeds totalling to 415 kg was intially provided from IRRI stockes while the balance (121 kg) was secured from Mr. Isidoro Landicho, a former sorghum cooperator from Janopol (Table 4). The project personnel could have covered 125-150 farmers but seed supplies limited the size of the project. Many interested farmers could not be accommodated because of insufficient seed.

Farm Record Keeping

The farmer cooperators were given a record sheet on which all their sorghum crop activities were to be recorded. The record sheet was collected every week from the farmers by the IRRI field aide. Incomplete records were sent back to the field for further verification. The weekly record sheets contain such information as the dates of the farmer's daily farming activities on the sorghum field, the hours spent on each particular operation, the sources and number of laborers, and the type and costs of inputs purchased.

Field Inspection

A field aide was frequently in the barrio to conduct field inspections and report his findings to the extension agent who likewise made trips to inspect the farmers' crops. To facilitate easy communication, the field aide coordinated with the sorghum leaders in each barrio. During field inspection, the measurement of the field area and a determination of the plant population were undertaken.

The recommended management practices

In certain operations the management of sorghum is quite similar to that of corn and can be easily understood by farmers who are new at raising the crop. These include fertilization and weed control. But in planting there are two important differences which can cause real difficulties if ignored: depth of seeding and seeding rate.

A critical recommendation was to plant the sorghum seed very shallow (less than 3/4 inch) and to avoid making deep furrows with the plow as is normal for planting corn. These shallow furrows could be made either with the lithao or with the plowpoint after having removed the moldboard. The desired plant population was about 35 plants per m^2, which meant drilling about 20 seeds per meter of row in 60 cm rows to allow for germination losses.

The recommended fertilizer rate was the same as that used for corn in the area, 80 kg N/ha, with one-third applied 10 days after emergence and two-thirds at 35 DAE.

Weeds could be controlled by offbarring at about 15 DAE and hilling up at 35 DAE. Insect control measures were recommended only when an infestation occurred since previous experiments had shown no justification for preventive insecticide application (Garrity et al, 1975). Azodrin was the suggested chemical for these problems.

The variety used was COSOR 3, developed by the University of the Philippines College of Agriculture, a brown-seeded variety with a good capacity to ratoon.

RESULTS AND DISCUSSION

Production

Weather Conditions

The most important feature of the late wet season in the project area was a five week long drought which extended from the second week of November tothe third week of December. Rainfall guages were monitored in three of the barrios and the data is shown in Figure 3. The drought was considerably worse in the southernmost barrios (Janopol, Natatas, and Balelc) than in Cale, a short distance to the north (Figure 3). Nearly all of the sorghum was planted before the second week of November when the drought began, and bore the severe water stress at the seedling stage up to flowering.

A second important weather factor was the span of three weeks of heavy rainfall from late October to the first week of November, during which most of the crop was planted (Figure 3). The frequent heavy rains were often the cause of poor stand establishment for those farmers who did not adopt the revised planting methods.

Crop Management

Planting dates ranged from October 11 to December 10, 1975. The schedule of planting was decided by the farmers and was mainly guided by such factors as the soil condition and the harvest date of the previous rice crop. Poor stand establishment was the predominant management problem and necessitated replanting thirteen of the 66 fields. Poor stands mainly resulted from planting the seed in deep plow furrows, which was the practice followed by these farmers in planting corn. A heavy rain within a few days after planting can silt up the furrow and bury the weak seedlings several inches deep. Table 42 shows that intense rains closely followed the planting of every crop that was eventually replanted, indicating the importance of this problem.

Of those farmers who planted very shallow by using the lithao for furrowing, none were forced to replant (Table 43). Yet four of these nine farmers had intense rains after planting. Many of the fields that were improperly planted with the plow developed poor, spotty stands but were not replanted. This severely affected grain yields on many fields.

Most farmers planted sorghum as a monocrop in the open field, but about one-third of the group grew it as an intercrop under coconut (Table 6). Table 10 compared the sorghum area planted as a monocrop and that planted as a coconut intercrop for each barrio.

Table 7 shows a distribution of participating farmers by the size of the sorghum area per farm. The area planted to sorghum per farm ranged from as low as 0.04 hectare to 1.15 hectares, with an average of 0.24 hectare (Table 8). Table 9 shows the area planted by tenure.

The plant population of each field was randomly sampled after germination. Table 11 is a distribution of plant population showing a wide variation in stand density among fields. Table 12 shows that the overall average plant population at germination was about 37 plants/m^2.

Every cooperator applied nitrogen fertilizer. The average application was 75 kg N/ha, very close to the recommended rate; but the range of application was tremendous, from 14 kg/ha up to 226 kg/ha (Table 13, 14, 15). Farmers who obtained poor stands tended to apply very little nitrogen. Several who obtained excellent stands, however, went on to apply rates which were exceedingly high.

Twenty five of the 61 farmers used insecticides. Table 16 shows the amounts of chemical applied. This was mainly used to control the corn seedling maggot (Antherigoria oryzae Malloch) which was a minor problem on a number of fields and a severe problem on two fields.

Damage to the ripening heads by either the sorghum webworm or the corn earworm was significant on several fields, with a severe infestation on three fields. Folidol was the most commonly applied insecticide. This chemical is not recommended for sorghum because it may be phytotoxic under some conditions. However, since it was the insecticide distributed through Masagana loans, farmers had supplies of it on hand and utilized it rather than purchasing the recommended insecticides. Surprisingly, no damage was observed due to its use. It proved effective, but its use should have been avoided.

The range of harvesting dates is shown in Table 25. The harvest period extended from January 15 to March 27. The crops matured at an overall average of 105 days (Table 26a). This varied from as little as 79 days to up to 128 days. Sorghum intercropped under coconut matured slightly later than in the open, 108 days versus 103 days (Table 26b).

Yield

The mean yield among the 39 monoculture sorghum fields was 1.86 tons/ha. For those fields under coconut the mean yield was 1.01 tons/ha. The combined overall mean yield was 1.53 tons/ha. Yields were determined by weighing the grain produced on each entire field just after threshing.

Figure 4 is a frequency distribution of yields for the monoculture sorghum fields. Yields ranged from as low as 0.19 tons/ha to as high as 4.21 tons/ha. Table 27 shows a frequency distribution of yields for all fields combined. The differences in mean yield among the 5 barrios are given in Table 28.

In order to attempt to explain what environmental and management variables had important influences on yield a simple correlation and regression analysis was conducted. The following variables were tested:

1. Nitrogen application (kg N/ha)
2. Nitrogen application squared
3. Total rainfall during crop growth
4. Rainfall before 55 days after seeding
5. Rainfall later than 55 days after seeding
6. Total labor/ha
7. Land preparation labor/ha
8. Weed control labor/ha
9. Plant population per ha (measured just after germination)

For sorghum both monoculture and intercropped, nitrogen application was the variable most closely correlated with yield. The correlation coefficient was 0.66 for the monoculture, 0.41 for intercropped. The test of a parabolic nitrogen response function (variable 2) gave lower correlation coefficients, 0.61 and 0.32 respectively showing that a linear function fit the response slightly better than a parabolic function.

All of the labor variables showed very little relationship with yield. Rainfall also showed very low correlation, although from field observation it appeared that drought tended to depress yields. The statistical significance of rainfall as a yield determinant can perhaps be increased if measures of the evenness of rainfall distribution are used rather than simply measures of total rainfall.

The correlation between yield and plant population after germination was 0.36 and 0.38 for the monoculture and intercropped sorghum, respectively.

When regression analysis was run, nitrogen was the only significant variable identified. The yield response in kg/ha for the monoculture sorghum is represented by $Y = 11 N^{**} + 919$.

This response function indicates a ₱2.00 average return per peso invested in nitrogen fertilizer, considering that nitrogen costs about ₱5.00/kg and sorghum is valued at about ₱1.00/kg. The farmers' field trials the previous year had an even steeper response to nitrogen (see graph in Figure 5).

The problem encountered in relating yield to variable factors among this sample of farms is that numerous factor interactions are operating. Subgroups of fields will need to be examined which are more homogenous in terms of pest damage and other factors so that the variable in question can be studied while the other variables are held more or less constant. The present analysis does not satisfactorily reveal what conditions other than N fertilization affected yield.

Tables 30 to 37 depict average sorghum yields as separate functions of nitrogen, plant population, labor input, and field size. Although the previous analysis shows that the yield response appears to be more complex than simple single variable relationships can explain, at least some tentative observations can be made.

Table 30 shows that plant population at germination in the range of 38 - 52 plants/m^2 tended to produce the highest average yields over all farms. Populations higher than that level tended to reduce yield. These relationships hold similar for the group including only monoculture sorghum fields (Table 31b). For sorghum under coconut, however, plant populations

above 52 plants/m^2 tended to give the highest yields (Table 31a). Optimum plant populations appear to be higher for sorghum under coconut than in the open, which is the opposite of expectation.

Table 32 demonstrate a tendency for yield to respond to labor input. With labor above 550 manhours/ha. yields were about triple the average for those fields with less than 275 manhours/ha. Tables 33a and 33b show this response for intercropped and monoculture fields separately.

The relationship between field size and yield is shown in Tables 34, 35a, and 35b. Smaller fields (less than 0.15 ha) and larger fields (over 0.30 ha) tended to yield higher than the intermediate sized fields (0.15 to 0.30 ha).

The yield response to different levels of nitrogen fertilizer is evaluated by Tables 36, 37a and 37b. Yields showed a positive relation to nitrogen rising from 0.79 t/ha at applications less than 25 kg N/ha to 2.36 t/ha with applications greater than 100 kg N/ha.

Management Problems

Figure 3 is a frequency distribution of grain yields for all the monoculture sorghum fields. It shows a cluster of yields at very low yield levels. Seventeen of the 39 fields had yields less than 1.5 t/ha, and 9 had yields under 1.0 t/ha. What caused such poor results while some farmers were obtaining over 3.0 t/ha? Table 44 lists the production problems on these low yielding fields. It shows that a poor stand was the dominant yield-limiting factor on most fields. This is especially true for those farms with yields under 1.0 t/ha. Shallow planting must be stressed in future recommendations to prevent such an outcome.

Insect and bird problems were evident on a few of the low yielding fields. Late fertilization was a common problem. Late applications of N were largely wasted when not soon followed by rain. The poor nitrogen response of most sorghum fields, as discussed earlier, reveals a considerable wastage of the N applied. The drought was also partly responsible for this, in addition to fertilizer mismanagement.

Labor utilization

Table 18 indicates that about half of the cooperators spent from 275 to 550 manhours for farm work. The lowest labor input utilization (below 275 manhours) was performed by 26 percent of the cooperators whereas the highest (550 or more manhours) was applied by 23 percent

of the farmers. Fifty-five and 36 percent of the labor inputs were supplied by operator and his family, respectively. The balance of 9% was provided by hired and exchange laborers.

The peak of farm operations was during the harvest period. A total of 118 manhours or 27 percent of the total labor inputs was devoted to harvest operations. Most of the harvesting work was done by the operator and his family.

Other farm operations which required high labor inputs were: plowing (68 manhours), planting (47 manhours), fertilizer application (37 manhours) and threshing (36 manhours). The average combined labor inputs of operator, family, exchange, and hired laborer amounted to 436 manhours per ha (Table 19).

Of the 5 barrios, Balele exhibited the highest labor input utilization with 680 manhours. Cale and Janopol were in the second and third position with 580 manhours and 364 manhours, respectively. The lowest labor utilization spent for farm work was registered in Bilog-Bilog (235 manhours) and Natatas (340 manhours), respectively.

For the barrios of Balele, Bilog-Bilog and Cale, the largest bulk of farm work was spent for plowing and harvesting, whereas in Janopol and Natatas, planting, harvesting and threshing were the most time-consuming farm chores (Table 20).

The breakdown of labor input between the farmer, his family, and outside sources is shown in Tables 21a-e. In Balele, about 75 percent of the farm work was performed by the operator, 23 percent was contributed by the family and only 2 percent was supplied by outside sources. For Bilog-Bilog, the combined labor input of the operator and his family amounted to 82 percent. The balance (18 percent) was secured from outside sources. Cale, Natatas, and Janopol had an identical amount of labor input supplied by the operator and his family with 90, 91, and 92 percent respectively.

Total labor utilization does not differ significantly among the tenure groups with 434, 437 and 410 manhours respectively (Table 22). Amount of labor input expended on sorghum raised in the open field was higher by 116 manhours than crops grown under coconuts (Tables 23 and 24).

Cost and Return Analyses

The average gross returns over all farms was ₱1,620/ha., while returns over cash costs averaged ₱1,071/ha. Net returns over variable costs averaged ₱374/ha. Of the five barrios, Natatas yielded the highest net return of ₱702. Janopol was in second position with a net return of ₱406.00. Cale and Bilog-Bilog were in the third and fourth slots with ₱243 and ₱196, respectively. Balele registered a negative return (-₱560).

Although a meager net return over all variable costs was obtained in some of the barrios, but since the bulk of farm labor (90%) was supplied by the operator and his family, net returns over cash costs may be a more realistic assessment of income. The value of the imputed cost for operator, family and exchanged labor was placed at ₱15.00 per day for operations requiring the use of work animal and ₱7.00 per day for labor without use of animal.

Table 39 indicates that share-tenants received a net profit of ₱609 which was ₱423 higher than the net return accrued by owner cultivator of only ₱186.00. The share tenants incurred the biggest cash costs (₱744). Fertilizer and payment for the use of land were the biggest items of investment for this group of farmers. Among owner cultivators, fertilizer was the largest item of cash expense. The highest non cash costs (₱309) was accrued by owner-cultivators.

Sorghum grown as monocrop in the open field gave a net return six times greater than crops raised under coconuts. Open field crops yielded a net return of ₱566 per ha whereas the latter one gave only ₱92 or a net income differential of ₱474. Expenses (cash and non-cash) such as fertilizer and operator and family labor expended on sorghum raised in the open field were higher than those grown under coconut (Tables 40a, 40b).

The Ratooned Crops

Success in getting a ratoon crop is dependent on early planting of the first crop, usually before the 10th of October. Since the project began quite late in September most fields were not planted until late October, and for that reason not many ratoon crops could be expected. Thirteen farmers, however, were able to produce a ratoon crop (Table 41a).

A total of 3.75 hectares was ratooned or an average of 0.29 hectare per ratooned farm. Eleven farmers from Natatas ratooned a total area of 3.42 hectares, whereas, one farmer each from Balele and Cale together ratooned an area of 0.33 hectare.

Most of the ratooners were share tenants with a total area of 3.37 hectares. Owner cultivators ratooned only 0.38 hectare. Roughly 2.65 hectares of open field area was ratooned while the ratooned area under coconuts amounted to 1.10 hectares (Table 41b, 41c and 41d).

Only 2 of the 13 farmers used fertilizer and three sprayed insecticide. The ratooned crop had an average maturity of 78 days. The earliest first cutting was recorded on January 17, 1976 whereas the latest was March 10, 1976. Harvesting dates ranged from April 19 to May 18, 1976.

Harvesting and cutting were the major farm operations for the ratooned crop. Seventy five percent or 183 manhours of the total farm work was expended for these two operations. Sixty-five percent of the farm work was supplied bythe operator and his family whereas 35 percent was secured from outside sources (hired and exchanged labor).

A relatively higher labor input was spent by farmers on the open field ratooned crop. Farm labor input in the open field (275 manhours) was almost double the labor input of farmers under coconuts (144 manhours)(Table 41e, 41f, 41g, 41h).

Total production of the ratooned crop amounted to 2.13 tons thus resulting in an average yield of 0.57 ton/ha. The yield of the ratooned crop in the open field was slightly higher than crops grown under coconuts (Table 41i, 41j, 41k).

For all farms, average net return over cash costs, non cash costs and total costs amounted to ₱531, ₱514 and ₱299 respectively. Hired labor and fertilizer were the largest items of cash investments while operator and family labor comprised the biggest item of non cash costs.

The gross returns for open fields and those under coconut do not differ significantly (₱750, ₱734). However, a much bigger cash and non cash costs amounting to ₱513 was expended on open field farms compared to ₱228 invested by farmers on crops under coconuts.

Between tenure groups, owner cultivators received a gross return of ₱855 while the share tenants obtained ₱714. Share tenants spent more operating capital on hired labor and fertilizer as against nothing by owner cultivators. However, a larger non cash costs was charged against the share tenants (41l, 41m, 41n).

Infestation by birds (locally known as Maya) resulted in lower output per unit area. This is a more severe problem with the ratoon crops because during ripening all surrounding corn fields are fallow. All of the 13 farmer cooperators were affected by bird damage. The amoung of grain eaten by birds averaged 123 kg/hectare (Table 41o) from the estimate given by seven ratoon farmers.

Threshing

Two threshers were borrowed by the project to test their suitability for farmer purchase. While the grain was being threshed the project farmers were able to operate them and observe their performance. Reaction were markedly different between the two machine types. The threshing performance of each is shown by Table 46.

The small Landmaster thresher is relatively inexpensive but very time-consuming to operate. The plant stalks are hand-held in bunches with the heads inserted into the thresher. A simple rasp bar strips off the grain. The model has no blower or grain cleaner.

The field tests showed that about 20.5 thresher-hours were required per ton of threshed grain, and this does not include further time spent in cleaning the grain (Table 46). Since three men normally operate the machine the labor requirement for the threshing operation was about 61.5 man-hours per ton.

The large axial flow thresher is an expensive investment but a much more efficient thresher. It is built for rice but handles sorghum with little difficulty. If the sorghum heads are not thoroughly dry, however, they may have to be run through two or more times to be fully threshed. An average of 2.6 thresher-hours were needed per ton threshed (Table 46). It is a very convenient model for custom operation.

Since farmers showed strong interest in this thresher, estimates were worked out concerning the economics of owning and operating one. These are found in Appendix I. They show that when used on rice and sorghum it can be capitalized in 1 1/2 to 2 1/2 years. The major constraint associated with it is its high cost: ₱13,000 - ₱15,000.

At the termination of the project meetings were held among the farmers-participants in barrios Natatas and Janopol to discuss the purchase of threshers to permanently serve the area. The formation of thresher co-ops was discussed but the idea was discarded due to previous problems they had experienced in developing co-ops in those locations. One farmer in each barrio, however, has attempted to finance his own thresher. The one in Janopol worked out a partnership with a wealthier man in the barrio, while the one in Natatas sought financing from his businessman nephew in Manila. They visited a thresher manufacturer in Calamba, Laguna, and agreed on a price. At this date neither has yet made the purchase, due to a lack of capital.

The great difficulty of the small-scale farmers of the project area in investing ₱13,000 in a thresher emphasizes one of the technical failings of the project. The thresher technology tested was of two extremes -- a very expensive model, and a very cheap but inefficient model. There was

no model tested which fit the intermediate price range in between these two extremes. Efficient but simple threshers in the ₱4,000 to ₱6,000 range would probably fit both the financial capabilities and performance standards of this class of farmers much more satisfactorily.

A sorghum industry is not possible unless threshers are permanently available in the barrios, but this goal has not yet been accomplished. In the expanded sorghum project during the next year, more attention must be directed to testing other medium priced threshers and in working out their financing with the banks.

Marketing

The Malahi Breeding Project was chosen among the 3 buyers since it had the best offer as far as marketing arrangements were concerned. The general manager visited the project barrios and fields during the growing season, establishing contacts with the farmer-leaders. As the harvests were completed the firm provided a delivery truck (with a loading capacity of 3 tons) for picking up the produce in the barrios.

The threshed grains were picked up at the nearest convenient point along the road, usually in the front yard of the sorghum leader in each barrio. Sacks were furnished by the buyer. The grain was weighed out before loading it in the truck. Both the buyer and the producer were present during the weighing session.

The farmer was paid cash on the spot after weighing. The agreed price was ₱1.05 per kilo. Under the marketing arrangement Malahi had specified it would pay at least ₱0.90 per kg., and should the market price exceed ₱0.90 per kg it agreed to pay the market price minus hauling costs. Since the local wholesale price for sorghum was ₱1.10 during the February-March period, Malahi paid ₱1.05 per kg with ₱0.05/kg handling expenses.

The marketing proceeded very smoothly and was one of the most successful aspects of the project. Malahi would like to see a permanent sorghum industry develop in Batangas and would like to continue the same purchasing arrangements with farmer groups. The only problem is one of maintaining continued communication with the farmers, since Malahi is a 45-minute drive from the project site.

By the end of the project year it was evident that a number of grain buyers in the Tanauan area were now, upon observing considerable sorghum being produced, determined to buy sorghum in the future. The Batangas Feed Mill in Tanauan is one interested buyer with a very large potential capacity. These conditions indicate that marketing will no longer be a constraint to sorghum production.

Farmers' Reactions to the Project

How did farmers respond to the project and to the performance of sorghum on their farms? The enthusiasm of the participating farmers was the most satisfying result of the project. After having the opportunity to experiment on a commercial basis with this crop, their reaction left little doubt that there would be widespread production if custom threshing becomes available and prices remain as they were in 1975-76. Almost every farmer wants to plant next year and many new farmers came forward to ask about planting.

These attitudes mainly stemmed from the fact that even on the poorer performing fields the farmers always claimed that sorghum had outyielded their current corn crop, or would have if they had planted corn.

CONCLUSIONS AND IMPLICATIONS

We attempted to investigate and solve the major constraints which prevented the adoption of the rice-sorghum pattern in eastern Batangas. On the one hand, it was demonstrated that stable market arrangements can be developed in the area and that a number of buyers are seriously intent on purchasing sorghum. The project showed that even at the modest yield levels obtained in the first year farmers grew the crop, there is sufficient demand for the marketing and threshing services to make the sale of these services a profitable enterprise for middlemen. But there is a remaining difficulty.

It does not appear that the project has catalyzed the sorghum industry to the point of establishing a private threshing capacity, perhaps because the two models that were tested in the barrios were either too small or too expensive (see Appendix I). Outside institutional support is still necessary to sponsor more field testing and demonstration of modestly priced threshers. Only when farmers own threshers, or threshing services can be supplied on a custom basis, can large scale production be sustained.

The Cropping Systems Program is continuing this project for another year in an expanded form, covering four other municipalities in eastern Batangas. There remain two major challenges in organizing a permanent sorghum industry leading to viability of the rice-sorghum pattern: to create a situation where threshers are permanently available in the barrios, and to help farmers improve their sorghum planting techniques and other management practices so that they can much more efficiently maximize productivity.

The pattern trials that were conducted in 1974-75, and the limited introduction of the rice-sorghum pattern in 1975-76, indicate that there are soil and climatic conditions in some areas that favor the rice-sorghum pattern, compared to the rice-corn pattern. However, neither pattern is uniformly superior throughout eastern Batangas. Addition of the rice-sorghum pattern to the farmers' set of choices of crop activities give them more flexibility for adjusting to their production and marketing conditions. Both farmers and the country can benefit from this increased flexibility.

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Table 1. Distribution of sorghum cooperators 5 barrios, Tanauan, Batangas, CY 1975-76.

Item	Barrio					Total
	Balele	Bilogbilog	Cale	Janopol	Natatas	
Number of prospective cooperators	6	4	20	16	22	68
Number of cooperators who backed out	2	-	1	2	2	7
No. of remaining cooperators	4	4	19	14	20	61

Table 2. Terminal status of 61 farmer-cooperators, 5 barrios, Tanauan, Batangas, CY 1975-76.

Barrio	Tenure Status						All Tenures	
	Owner cultivator		Share tenant		Owner cultivator cum. share tenant			
	No.	% rowwise	No.	% rowwise	No.	% rowwise	No.	% rowwise
Balele	4	12.1	-	-	-	-	4	6.6
Bilogbilog	4	12.1	-	-	-	-	4	6.6
Cale	3	9.1	16	59.3	-	-	19	31.1
Janopol	14	42.4	-	-	-	-	14	22.9
Natatas	8	24.2	11	40.7	1	100.0	20	32.7
Total	33	100.0	27	100.0	1	100.0	61	100.0
% columnwise		54.1		44.3		1.6		100.0

Table 3. Volume of seeds distributed, 5 barrios, Tanauan, Batangas, 1975-76.

Item	Barrio					Total
	Balele	Bilogbilog	Cale	Janopol	Natatas	
	in kilograms					
Total volume of seeds distributed	30.00	35.00	137.00	169.05	164.20	535.25
- volume of seeds received by farmers who backed out	9.00	-	5.00	8.00	6.50	28.50
- volume of seeds received by farmers who remained in the project	21.00	35.00	132.00	161.05	157.7	506.75

Table 4. Source and amount of seeds received by farmers, 5 barrios, Tanauan, Batangas, 1975 and 1976.

Barrio	Source of Seeds		Total
	IRRI	Mr. Landicho*	
	in kilogram		
Balele	30.00	-	30.00
Bilogbilog	35.00	-	35.00
Cale	137.00	-	137.00
Janopol	69.00	100.05	169.05
Natatas	143.50	20.70	164.20
All barrios	414.50	120.75	535.25

* Cooperator from Janopol.

Table 5. Planting date for sorghum, 5 barrios, Tanauan, Batangas, 1975-76.

Barrio	Planting Date	
	Earliest	Latest
Balele	Oct. 27, 1975	Nov. 3, 1975
Bilogbilog	Nov. 1 "	Dec. 10 "
Cale	Oct. 16 "	Nov. 20 "
Janopol	Oct. 25 "	Dec. 1 "
Natatas	Oct. 11 "	Nov. 13 "
All Barrios	Oct. 11, 1975	Dec. 10, 1975

Table 6. Distribution of farmers by type of planting field, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-76.

Barrio	Type of Planting Field			Total
	Open	Under Coconut	Both	
	No. of farmers			
Balele	3	1	-	4
Bilogbilog	2	2	-	4
Cale	9	10	-	19
Janopol	12	1	1	14
Natatas	10	8	2	20
All Barrios	36	22	3	61

Table 7. Distribution of 61 farmers by size of plot, 5 barrios, Tanauan, Batangas, 1975-76.

Barrios	Plot size (in has.)						All Barrios	
	∠ 0.15		0.15 - ∠ 0.30		0.30 & above			
	No.	% Row-wise	No.	% Row-wise	No.	% Row-wise	No.	% Row-wise
Balele	2	11.1	1	3.3	1	7.7	4	6.6
Bilogbilog	-	-	3	10.0	1	7.7	4	6.6
Cale	9	50.0	9	30.0	1	7.7	19	31.1
Janopol	4	22.2	7	23.3	3	23.1	14	23.0
Natatas	3	16.7	10	33.3	7	53.8	20	32.7
TOTAL	18	100.0	30	100.0	13	100.0	61	100.0
% column wise	29.5		49.2		21.3		100.0	

Table 8. Area planted to sorghum, 61 farmers, 5 barrios, Tanauan, Batangas 1975-76.

Barrio	Area (in has.)		
	Total	Average	Range
Balele	0.65	0.16	0.04 - 0.31
Bilogbilog	1.10	0.27	0.15 - 0.52
Cale	3.30	0.17	0.07 - 0.34
Janopol	3.50	0.25	0.05 - 0.68
Natatas	6.40	0.32	0.04 - 1.15
All Barrios	14.95	0.24	0.04 - 1.15

Table 9. Average area planted by tenure, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-76.

Tenure	Barrio					All Barrios
	Balele	Bilog[2]	Cale	Janopol	Natatas	
	Average area (in has.)					
Owner cultivator	0.16	0.27	0.13	0.25	0.18	0.22
Share-tenant	-	-	0.18	-	0.38	0.26
Owner cum share tenant	-	-	-	-	0.76*	0.76*
Average	0.16	0.27	0.17	0.25	0.32	0.24

* Only one farmer reporting.

Table 10. Total and average area planted to sorghum by type of planting field, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-76.

Barrio	Type of planting field			
	Open field		Under coconut	
	Total area	Ave. area	Total area	Ave. area
	in hectares			
Balele	0.61	0.20	0.04	0.04
Bilogbilog	0.78	0.39	0.31	0.16
Cale	1.43	0.16	1.36	0.19
Janopol	2.54	0.20	0.96	0.48
Natatas	3.02	0.25	3.38	0.34
All Barrios	8.38	0.22	6.55	0.26

Table 11. Distribution of 61 farmers by number of plant population, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Plant Population (in 000 plants/hectare)								All Barrios	
	L 240		240 - L 380		380 - L 520		520 & above			
	No.	% row wise	No.	% row wise	No.	% row	No.	% row	No.	% row wise
Balele	1	5.2	-	-	2	15.4	1	10.0	4	6.6
Bilog[2]	3	15.8	-	-	1	7.7	-	-	4	6.6
Cale	3	15.8	4	21.0	5	38.5	7	70.0	19	31.1
Janopol	6	31.6	3	15.8	3	23.0	2	20.0	14	23.0
Natatas	6	31.6	12	63.2	2	15.4	-	-	20	32.7
TOTAL	19	100.0	19	100.0	13	100.0	10	100.0	61	100.0
% column wise		31.1		31.1		21.3		16.4		100.0

Table 12. Plant population per hectare by type of planting field, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Type of Planting Field		All Barrios
	Open field	Under coconut	
Balele	379,305	523,333	408,111
Bilog[2]	304,000	203,000	253,500
Cale	392,767	462,400	427,584
Janopol	319,826	637,916	362,238
Natatas	275,747	298,197	299,568
Average	355,779	293,445	370,329

Table 13. Distribution of 61 farmers using various levels of nitrogen fertilizer, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Level of nitrogen (kg/ha)										All Barrios	
	/_ 25		25 - /_ 50		50 - /_ 75		75 - /_ 100		100 & above			
	No.	% row-wise	No.	% row-wise	No.	% row-wise	No.	% row-wise	No.	% row-wise	No.	% row-wise
Balele	-	-	1	7.1	-	-	1	11.1	2	12.5	4	6.6
Bilog[2]	2	18.2		-	1	9.1	-	-	1	6.2	4	6.6
Cale	2	18.2	3	21.4	4	36.3	3	33.3	7	43.8	19	31.1
Janopol	3	27.3	4	28.6	1	9.1	2	22.2	4	25.0	14	23.0
Natatas	4	36.3	6	42.9	5	45.5	3	33.3	2	12.5	20	32.7
Total	11	100.0	14	100.0	11	100.0	9	100.0	16	100.0	61	100.0
% column-wise	18.0		23.0		18.0		14.8		26.2		100.0	

Table 14. Amount of nitrogen fertilizer applied, 61 farmers, 5 barrios, Tanauan Batangas, 1975-1976.

Item	Barrio					All Barrios
	Balele	Bilog[2]	Cale	Janopol	Natatas	
No. of user	4	4	19	14	20	61
Total (kg N)	69	77	318	273	310	1047
Ave. (kg N/ha)	100	52	97	68	58	75
Range (kg N/ha)	44-144	16-177	17-226	18-166	14-193	14-226

Table 15. Amount of Kg N fertilizer applied by tenure, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Tenure	Barrio					All Barrios
	Balele	Bilog[2]	Cale	Janopol	Natatas	
			kg N/ha			
Owner cultivator	100	52	111	68	54	70
Share-tenant	-	-	94	-	64	82
Other own. share-tenant	-	-	-	-	29*	29*
Average	100	52	97	68	58	75

* Only one farmer reporting.

Table 16. Amount of chemical applied, 61 farmers, 5 barrios, Tanauan, Batangas 1975-1976.

Item	Barrio					All Barrios
	Balele	Bilog[2]	Cale	Janopol	Natatas	
No. of user	3	-	11	2	9	25
Total (cc)	271	-	720	120	778	12,117
Ave. (cc/ha)	1,167	-	247	38	111	199
Range (cc/ha)	0-3,447	-	0-1,629	0-304	0-877	0-3,447

Table 17. Amount of chemical applied by tenure, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Tenure	Barrio					All Barrios
	Balele	Bilog[2]	Cale	Janopol	Natatas	
			cc/ha.			
Owner cultivator	1167	-	253	38	85	201
Share tenant	-	-	246	-	111	191
Owner cum. share tenant	-	-	-	-	318*	318*
Average	1167	-	247	38	111	199

* Only one farmer reporting

Table 18. Distribution of 61 farmers utilizing different amounts of labor input, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Labor inputs (manhours/ha)						All Barrios	
	/ 275		275 - /550		550 & above			
	No.	% row-wise	No.	% row-wise	No.	% row-wise	No.	% row-wise
Balele	-	-	1	3.2	3	21.4	4	6.6
Bilog[2]	3	18.8	1	3.2	-	-	4	6.6
Cale	1	6.2	10	32.3	8	57.1	19	31.1
Janopol	5	31.2	7	22.6	2	14.3	14	23.0
Natatas	7	43.8	12	38.7	1	7.1	20	32.7
Total	16	100.0	31	100.0	14	100.0	61	100.0
% column-wise	26.2		50.8		23.0		100.0	

Table 19. Labor utilization by source and type of farm operation, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Farm Operation	Source of labor				All Sources	% Rowwise
	Operator	Family	Exchanged	Hired		
	manhours/ha.					
Clearing the field	1.1	2.4	-	-	3.5	0.8
Plowing	58.9	2.9	4.8	1.7	68.3	15.7
Harrowing	31.7	2.2	-	0.6	34.5	7.9
Furrowing	13.3	4.6	0.4	0.1	18.4	4.2
Planting	15.4	26.3	5.6	-	47.3	10.9
Fertilizing	16.2	18.9	1.5	-	36.6	8.4
Replanting	7.6	5.9	1.0	-	14.5	3.4
Spraying	6.8	0.5	-	-	7.3	1.7
Thinning	0.7	0.9	-	-	1.6	0.3
Off-barring	8.7	1.2	-	-	9.9	2.2
Weeding	5.5	7.1	2.0	2.8	17.4	4.0
Hilling-up	4.8	-	-	-	4.8	1.1
Harvesting	51.6	54.6	0.4	11.0	117.6	27.0
Threshing	7.6	21.9	2.7	3.4	35.6	8.1
Drying	9.5	5.6	-	-	15.1	3.5
Winnowing	0.5	1.7	-	0.4	2.6	0.6
Hauling	0.5	0.2	-	-	0.7	0.2
All Operations	240.4	156.9	18.4	20.0	435.7	100.0
% columnwise	55.2	36.0	4.2	4.6	100.0	

Table 20. Labor utilization by type of operation, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Farm Operation	Barrio					All Barrios
	Balele	Bilog[2]	Cale	Janopol	Natatas	
	manhours/ha.					
Clearing the field	-	-	-	12.2	2.3	3.5
Plowing	119.4	35.8	94.1	59.4	40.3	68.3
Harrowing	67.2	15.6	55.1	27.7	16.9	34.5
Furrowing	57.8	11.7	20.6	14.0	13.0	18.4
Planting	25.6	23.7	48.4	66.5	42.0	47.3
Fertilizing	36.6	29.1	49.0	41.7	22.7	36.6
Replanting	16.9	3.8	18.2	21.5	8.0	14.5
Spraying	51.9	-	6.3	1.5	5.0	7.3
Thinning	-	-	4.9	-	0.1	1.6
Off-barring	18.8	8.7	13.9	2.7	9.7	9.9
Weeding	16.1	-	25.0	10.4	18.8	17.4
Hilling-up	19.3	-	5.1	3.7	3.3	4.8
Harvesting	149.2	32.5	188.7	91.6	79.1	117.6
Threshing	9.0	9.9	48.0	9.7	52.2	35.6
Drying	92.7	31.5	-	-	21.3	15.1
Winnowing	-	2.8	1.1	1.7	5.0	2.6
Hauling	-	-	1.6	-	0.7	0.7
All Operations	679.7	235.1	580.0	364.3	340.4	435.7

Table 21a. Labor input utilization by source and type of farm operation, 4 farmers, Balele, Tanauan, Batangas, 1975-1976.

Farm Operation	Source of labor				All Sources
	Operator	Family	Exchanged	Hired	
	manhours/ha.				
Clearing the field	-	-	-	-	-
Plowing	103.4	-	-	16.0	119.4
Harrowing	67.2	-	-	-	67.2
Furrowing	22.0	35.0	-	-	57.0
Planting	7.9	17.7	-	-	25.6
Fertilizing	18.4	18.2	-	-	36.6
Replanting	5.7	11.2	-	-	16.9
Spraying	51.9	-	-	-	51.9
Thinning	-	-	-	-	-
Off-barring	8.0	10.8	-	-	18.8
Weeding	10.7	5.4	-	-	16.1
Hilling-up	19.3	-	-	-	19.3
Harvesting	95.8	53.4	-	-	149.2
Threshing	4.6	4.1	0.3	-	9.0
Drying	92.7	-	-	-	92.7
Winnowing	-	-	-	-	-
Hauling	-	-	-	-	-
All Operations	507.6	155.8	0.3	16.0	679.7
% Columnwise	74.7	22.9	nil	2.4	100.0

Table 21b. Labor input utilization by source and type of farm operation, 4 farmers, Bilog-Bilog, Tanauan, Batangas, 1975-1976.

Farm Operation	Source of labor				All Sources
	Operator	Family	Exchanged	Hired	
		manhours/ha.			
Clearing the field	-	-	-	-	-
Plowing	44.6	-	21.2	-	65.8
Harrowing	15.6	-	-	-	15.6
Furrowing	11.7	-	-	-	11.7
Planting	3.2	20.5	-	-	23.7
Fertilizing	9.2	19.9	-	-	29.1
Replanting	-	3.8	-	-	3.8
Spraying	-	-	-	-	-
Thinning	-	-	-	-	-
Off-barring	8.7	-	-	-	8.7
Weeding	-	-	-	-	-
Hilling-up	-	-	-	-	-
Harvesting	6.6	6.4	6.5	13.0	32.5
Threshing	2.6	5.4	1.9	-	9.9
Drying	-	31.5	-	-	31.5
Winnowing	-	2.8	-	-	2.8
Hauling	-	-	-	-	-
All Operations	102.2	90.3	29.6	13.0	235.1
% Columnwise	43.5	38.4	12.6	5.5	100.0

Table 21c. Labor input utilization by source and type of farm operation, 19 farmers, Cale, Tanauan, Batangas, 1975-1976.

Farm Operation	Source of labor				All Sources
	Operator	Family	Exchanged	Hired	
	manhours/ha.				
Clearing the field	-	-	-	-	-
Plowing	82.2	5.2	4.7	2.0	94.1
Harrowing	49.5	3.6	-	2.0	55.1
Furrowing	16.0	2.8	1.3	0.5	20.56
Planting	20.0	25.3	3.1	-	48.4
Fertilizing	23.5	24.4	1.1	-	49.0
Replanting	8.2	6.9	3.1	-	18.2
Spraying	5.7	0.6	-	-	6.3
Thinning	2.1	2.8	-	-	4.9
Off-barring	13.9	-	-	-	13.9
Weeding	4.9	4.5	6.5	9.1	25.0
Hilling-up	5.1	-	-	-	5.1
Harvesting	79.0	97.3	-	12.4	188.7
Threshing	12.9	23.5	6.6	5.0	48.0
Drying	-	-	-	-	-
Winnowing	-	1.1	-	-	1.1
Hauling	1.6	-	-	-	1.6
All Operations	324.6	198.0	26.4	31.0	580.0
% columnwise	56.0	34.1	4.6	5.3	100.0

Table 21d. Labor input utilization by source and type of farm operation, 14 farmers, Janopol, Tanauan, Batangas, 1975-1976.

Farm Operation	Source of labor				All Sources
	Operator	Family	Exchanged	Hired	
	manhours/ha.				
Clearing the field	2.4	9.8	-	-	12.2
Plowing	49.5	2.7	7.2	-	59.4
Harrowing	25.0	2.7	-	-	27.7
Furrowing	11.1	2.9	-	-	14.0
Planting	20.8	29.0	16.7	-	66.5
Fertilizing	16.0	24.7	1.0	-	41.7
Replanting	13.7	7.8	-	-	21.5
Spraying	1.5	-	-	-	1.5
Thinning	-	-	-	-	-
Off-barring	2.7	-	-	-	2.7
Weeding	0.9	9.5	-	-	10.4
Hilling-up	3.7	-	-	-	3.7
Harvesting	54.3	32.7	-	4.6	91.6
Threshing	2.2	7.3	0.2	-	9.7
Drying	-	-	-	-	-
Winnowing	0.3	1.4	-	-	1.7
Hauling	-	-	-	-	-
All Operations	204.1	130.5	25.1	4.6	364.3
% Columnwise	56.0	35.8	6.9	1.3	100.0

Table 21e. Labor input utilization by source and type of farm operation, 20 farmers, Natatas, Tanauan, Batangas, 1975-1976.

Farm Operation	Source of labor				All Sources
	Operator	Family	Exchanged	Hired	
	manhours/ha.				
Clearing the field	1.8	0.5	-	-	2.3
Plowing	37.3	2.1	0.9	-	40.3
Harrowing	15.6	1.3	-	-	16.9
Furrowing	10.7	2.3	-	-	13.0
Planting	11.3	28.1	2.6	-	42.0
Fertilizing	10.2	9.6	2.9	-	22.7
Replanting	4.9	3.1	-	-	8.0
Spraying	4.0	1.0	-	-	5.0
Thinning	0.1	-	-	-	0.1
Off-barring	8.1	1.6	-	-	9.7
Weeding	9.2	9.6	-	-	18.8
Hilling-up	3.3	-	-	-	3.3
Harvesting	24.0	39.0	-	16.1	79.1
Threshing	8.0	37.4	1.3	5.5	52.5
Drying	10.4	10.9	-	-	21.3
Winnowing	1.3	2.4	-	1.3	5.0
Hauling	-	0.7	-	-	0.7
All Operations	160.2	149.6	7.7	22.9	340.4
% Columnwise	47.1	43.9	2.3	6.7	100.0

Table 22. Labor utilization by tenure and source of labor, 61 farmers 5 barrios, Tanauan, Batangas, 1975-1976.

Source of labor	Tenurial Status			All tenures
	Owner cultivator	Share tenant	Owner cum * share tenant	
Operator	252.2	229.9	144.3	240.4
Family	152.2	156.9	227.0	156.9
Exchanged	16.8	23.0	-	18.4
Hired	12.6	27.2	38.7	20.0
All sources	433.8	437.0	410.0	435.7

* Only 1 farmer reporting.

Table 23. Labor utilization by type of planting field and source of labor, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-76.

Source of Labor	Type of Planting Field	
	Open Field	Under Coconut
	manhours per hectare	
Operator	248.4	212.7
Family	178.3	120.5
Exchanged	22.3	18.4
Hired	27.0	8.5
All Sources	476.0	360.1

Table 24. Labor utilization by type of planting field and farm operation, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-76.

Farm Operations	Type of Planting Field	
	Open Field	Under Coconut
	manhour/hectare	
Clearing the field	4.2	2.2
Plowing	71.0	61.8
Harrowing	36.2	29.1
Furrowing	17.1	18.6
Planting	49.4	43.1
Fertilizing	44.3	26.1
Replanting	19.5	7.0
Spraying	6.2	10.4
Thinning	2.7	-
Off-barring	9.1	10.5
Weeding	24.8	7.8
Hilling-up	5.3	6.4
Harvesting	131.0	86.6
Threshing	36.9	31.2
Drying	11.8	15.8
Hauling	3.4	1.7
Winnowing	3.0	1.8
All Operations	476.0	360.1

Table 25. Harvesting date for sorghum, 5 barrios, Tanauan, Batangas, 1975-76.

Barrio	Harvesting Date	
	Earliest	Latest
Balele	Jan. 24, 1976	Feb. 28, 1976
Bilog-Bilog	Feb. 22, 1976	March 27, 1976
Cale	Jan. 30, 1976	March 6, 1976
Janopol	Feb. 7, 1976	March 10, 1976
Natatas	Jan. 15, 1976	March 10, 1976
All Barrios	Jan. 15, 1976	March 27, 1976

Table 26a. Maturity periods of sorghum, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Maturity Period	
	Average	Range
	No. of days	
Balele	106	90-111
Bilog-Bilog	115	109-128
Cale	108	96-116
Janopol	102	86-112
Natatas	102	79-124
All Barrios	105	79-128

Table 26b. Maturity period of sorghum by type of planting field, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Type of Field	
	Open	Under Coconut
	No. of days	
Balele	108	90
Bilog-Bilog	112	118
Cale	106	110
Janopol	102	102
Natatas	100	106
All Barrios	1103	108

Table 27. Distribution of 61 farmers by size of yield, 5 barrios, Tanauan, Batangas, 1975-1976.

Yield Range (tons/ha)	Barrio										All Barrios	
	Balele		Bilog[2]		Cale		Janopol		Natatas			
	No.	%row-wise	No.	%row-wise	No.	%row-wise	No.	%row-wise	No.	%row-wise	No.	%row-wise
/ 0.5	2	50.0	2	50.0	2	10.5	3	21.4	1	5.0	8	13.1
0.5 - / 1.0	1	25.0	1	25.0	2	10.5	3	21.4	7	35.0	15	24.6
1.0 - / 1.5	1	25.0	-	-	5	26.3	1	7.1	5	25.0	12	19.7
1.5 - / 2.0	-	-	-	-	4	21.0	2	14.4	2	10.0	9	14.8
2.0 - / 2.5	-	-	-	-	3	15.8	3	21.4	1	5.0	7	11.4
2.5 - / 3.0	-	-	1	25.0	1	5.3	1	7.1	1	5.0	4	6.6
3.0 - / 3.5	-	-	-	-	1	5.3	1	7.1	2	10.0	4	6.6
3.5 - / 4.0	-	-	-	-	1	5.3	-	-	-	-	1	1.6
4.0 and above	-	-	-	-	-	-	-	-	1	5.0	1	1.6
Total	4	100.0	4	100.0	19	100.0	14	100.0	20	100.0	61	100.0

Table 28. Total production and mean yield per hectare, 61 farmers, 5 barrios Tanauan, Batangas, 1975-1976.

Barrio	Total Production (in tons)	Mean Yield (tons/ha)	Range (tons/ha)
Balele	0.73	1.09	0.86 - 1.52
Bilog[2]	1.68	0.96	0.26 - 2.81
Cale	5.57	1.73	0.44 - 3.55
Janopol	5.51	1.46	0.19 - 3.15
Natatas	8.92	1.58	0.41 - 4.21
All Barrios	22.41	1.53	0.19 - 4.21

Table 29. Mean yield per hectare by tenure, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Tenure	Barrio					All Barrios
	Balele	Bilog[2]	Cale	Janopol	Natatas	
	Yield (in tons/ha)					
Owner cultivator	1.10	0.96	1.79	1.46	1.24	1.33
Share-tenant	-	-	1.72	-	1.88	1.79
Owner cum share tenant	-	-	-	-	1.04*	1.04*
Average	1.10	0.96	1.73	1.46	1.58	1.53

* Only one farmer reporting.

Table 30. Relationship between sorghum yield and plant population, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Plant population				All Barrios
	/240,000	240,000 - /380,000	380,000 - /520,000	520,000 & above	
Balele	0.86	-	1.33	0.86	1.09
Bilog[2]	0.35	-	2.81	-	0.96
Cale	1.42	1.47	1.79	1.98	1.73
Janopol	1.36	0.89	2.55	0.94	1.46
Natatas	1.35	1.42	3.25	-	1.58
Average	1.18	1.35	2.20	1.66	1.53

Table 31a. Relationship between plant population and yield of sorghum planted under coconut, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Plant population				All Barrios
	/240,000	240,000 - /380,000	380,000 - /520,000	520,000 & above	
	Yield (in tons/ha)				
Balele	-	-	-	0.86 (1)	0.86 (1)
Bilog[2]	0.27 (2)	-	-	-	0.27 (2)
Cale	0.49 (1)	1.14 (3)	0.99 (2)	1.72 (4)	1.28 (10)
Janopol	-	-	1.96 (1)	0.57 (1)	1.27 (2)
Natatas	0.55 (2)	0.93 (7)	0.89 (1)	-	0.85 (10)
Average	0.42 (5)	0.99 (10)	1.21 (4)	1.39 (6)	1.01 (25)

( ) No. of farmers reporting.

Table 31b. Relationship between plant population and yield of sorghum planted in open field, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Plant population				All Barrios
	/ 240,000	240,000 - / 380,000	380,000 - / 520,000	520,000 & above	
	Yield (in tons/ha)				
Balele	0.86 (1)	-	1.33 (2)	-	1.17 (3)
Bilog2	0.51 (1)	-	2.81 (1)	-	1.66 (2)
Cale	1.89 (2)	2.45 (1)	2.32 (3)	2.32 (3)	2.24 (9)
Janopol	1.36 (6)	0.89 (3)	2.64 (3)	1.30 (1)	1.55 (13)
Natatas	1.69 (5)	2.12 (5)	3.25 (2)	-	2.13 (12)
Average	1.45 (15)	1.75 (9)	2.44 (11)	2.07 (4)	1.86 (39)

( ) No. of farmers reporting.

Table 32. Relationship between sorghum yield and labor input, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Labor inputs (in manhours per hectare)			All Barrios
	/ 275	275 - / 550	550 & above	
	Yield (in tons/ha)			
Balele	-	1.52	0.95	1.09
Bilog2	0.35	2.81	-	0.96
Cale	1.41	1.32	2.29	1.73
Janopol	1.03	1.69	1.67	1.46
Natatas	1.09	1.77	2.74	1.58
Average	0.95	1.63	2.72	1.53

Table 33a. Relationship between labor input and yield of sorghum planted under coconut, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Labor input (manhours per hectare)			All Barrios
	/275	275 - / 550	550 & above	
	Yield (in tons/ha)			
Balele	-	-	0.86 (1)	0.86 (1)
Bilog[2]	0.27 (2)	-	-	0.27 (2)
Cale	1.41 (1)	1.26 (9)	-	1.28 (10)
Janopol	-	1.96 (1)	0.56 (1)	1.27 (2)
Natatas	0.93 (5)	0.77 (5)	-	0.85 (10)
Average	0.82 (8)	1.15 (15)	0.71 (2)	1.01 (25)

( ) No. of farmers reporting.

Table 33b. Relationship between labor inputs and yield of sorghum planted in open field, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	labor input (manhours per hectare)			All Barrios
	/ 275	275 - / 550	550 & above	
	Yield (in tons/ha)			
Balele	-	1.19 (2)	1.13 (1)	1.17 (3)
Bilog[2]	0.51 (1)	2.81 (1)	-	1.66 (2)
Cale	-	1.83 (1)	2.29 (8)	2.24 (9)
Janopol	1.03 (5)	1.93 (5)	1.65 (2)	1.55 (13)
Natatas	1.36 (3)	2.34 (8)	2.74 (1)	2.13 (12)
Average	1.08 (9)	2.08 (18)	2.13 (12)	1.86 (39)

( ) No. of farmers reporting.

Table 34. Relationship between sorghum yield and plot size, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Plot size (in ha.)			All Barrios
	/ 0.15	0.15 - / 0.30	0.30 & above	
	Yield (in tons/ha)			
Balele	0.99	1.53	0.86	1.09
Bilog[2]	-	0.34	2.81	0.96
Cale	1.79	1.66	1.83	1.73
Janopol	2.14	0.85	1.96	1.46
Natatas	1.61	1.71	1.38	1.58
Average	1.75	1.35	1.62	1.53

Table 35a. Relationship between plot size and yield of sorghum planted under coconut, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Plot size (in ha.)			All Barrios
	/ 0.15	0.15 - / 0.30	0.30 & above	
Balele	0.86 (1)	-	-	0.86 (1)
Bilog[2]	-	0.27 (2)	-	0.27 (2)
Cale	1.46 (3)	1.20 (7)	-	1.28 (10)
Janopol	-	-	1.27 (2)	1.27 (2)
Natatas	0.69 (1)	0.76 (4)	0.96 (5)	0.85 (10)
Average	1.19 (5)	0.92 (13)	1.05 (7)	1.01 (25)

Table 35b. Relationship between plot size and yield of sorghum planted in open field, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Plot size (in ha)			All Barrios
	/ 0.15	0.15 - / 0.30	0.30 and above	
	Yield (in tons/ha)			
Balele	1.13 (1)	1.53 (1)	0.86 (1)	1.17 (3)
Bilog[2]	-	0.51 (1)	2.86 (1)	1.66 (2)
Cale	1.97 (6)	3.26 (2)	1.83 (1)	2.24 (9)
Janopol	2.14 (4)	1.05 (8)	3.15 (1)	1.55 (13)
Natatas	2.07 (2)	2.23 (7)	1.94 (3)	2.13 (12)
Average	1.97 (13)	1.54 (19)	2.07 (7)	1.86 (39)

( ) No. of farmers reporting

Table 36. Relationship between sorghum yield and nitrogen fertilizer applied, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Level of Nitrogen (in kg/ha)					All Barrios
	/-25	25 - / 50	50 - / 75	75 - / 100	100 & above	
	Yield (in tons/ha)					
Balele	-	1.52	-	0.86	0.99	1.09
Bilog[2]	0.39	-	0.26	-	2.81	0.96
Cale	0.95	1.02	1.83	1.68	2.24	1.73
Janopol	0.54	0.80	1.67	2.03	2.45	1.45
Natatas	1.09	1.52	1.44	1.20	3.71	1.58
Average	0.79	1.20	1.49	1.51	2.36	1.53

Table 37a. Relationship between kg N fertilizer applied and yield of sorghum planted under coconut, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Level of Nitrogen (in kg/ha)					All Barrios
	/ 25	25 - / 50	50 - / 75	75 - / 100	100 & above	
	Yield (in tons/ha)					
Balele	-	-	-	-	-	0.86 (1)
Bilog[2]	0.27 (1)	-	0.26 (1)	-	-	0.27 (2)
Cale	0.95 (2)	0.79 (1)	1.82 (3)	1.11 (1)	1.17 (3)	1.28 (10)
Janopol	0.57 (1)	-	-	-	1.96 (1)	1.27 (2)
Natatas	0.71 (4)	0.78 (2)	0.75 (2)	1.3 (2)	-	0.85 (10)
Average	0.69 (8)	0.78 (3)	1.21 (6)	1.14 (4)	1.37 (4)	1.01 (25)

( ) No. of farmers reporting.

Table 37b. Relationship between Kg N fertilizer applied and sorghum yield planted in open field, 5 barrios, Tanauan, Batangas, 1975-1976.

Barrio	Level of Nitrogen (in kg/ha)					All Barrios
	/ 25	25 - / 50	50 - / 75	75 - / 100	100 and above	
	Yield (in tons/ha)					
Balele	-	1.53 (1)	-	-	0.99 (2)	1.17 (3)
Bilog[2]	0.51 (1)	-	-	-	2.81 (1)	1.66 (2)
Cale	-	1.13 (2)	1.83 (1)	1.96 (2)	3.03 (4)	2.24 (9)
Janopol	0.53 (2)	0.80 (4)	1.67 (1)	2.03 (2)	2.53 (4)	1.55 (13)
Natatas	1.63 (2)	2.24 (3)	1.77 (4)	1.00 (1)	3.71 (2)	2.13 (12)
Average	0.97 (5)	1.37 (10)	1.76 (6)	1.79 (5)	2.65 (13)	1.86 (39)

( ) No.of farmers reporting

Table 38. Cost and Return of Producing Sorghum, 61 farmers, 5 barrios, Tanauan, Batangas, 1975 - 1976.

Item	Barrio					All Barrios
	Balele	Bilogbilog	Cale	Janopol	Natatas	
No. of farmers reporting	4	4	19	14	20	61
			peso per hectare			
Cash Cost						
Hired labor	46.5	32.7	20.8	4.6	13.4	17.1
Food	-	14.4	21.6	-	-	7.7
Fertilizer	463.6	237.4	469.9	345.2	271.8	360.7
Insecticide	69.7	-	15.2	2.3	5.5	11.6
Fuel/oil	14.0	6.3	14.4	9.2	10.5	11.4
Landlord's share	-	-	280.6	-	161.8	140.4
I. TOTAL CASH COSTS	593.8	290.8	822.5	361.3	463.0	548.9
Non Cash Costs						
Unpaid family labor	182.1	79.0	185.0	118.0	130.0	144.5
Exchanged labor	0.3	47.0	29.2	32.4	7.1	21.9
Unpaid operator labor	664.0	170.0	457.0	270.0	215.1	329.5
Seeds	84.3	65.7	89.6	100.0	56.2	79.1
Charge for the use of land	183.7	161.5	47.4	244.2	86.0	121.7
2. TOTAL NON CASH COSTS	1114.4	523.2	808.2	764.6	494.4	696.7
3. TOTAL COSTS (1+2)	1708.2	814.0	1630.7	1125.9	957.4	1245.6
4. GROSS RETURNS*	1148.2	1009.6	1873.7	1526.5	1659.8	1619.7
5. RETURNS/CASH COSTS (4-1)	554.4	718.8	1051.2	1165.2	1196.8	1070.8
6. RETURNS/NON CASH COSTS (4-2)	33.8	486.4	1065.5	761.9	1165.4	923.0
7. NET GAIN (+ or -) (4-3)	-560.0	195.6	243.0	400.6	702.4	374.1

* at ₱1.05/kilo

Table 39. Cost and Return of Producing Sorghum by Tenure, 61 farmers, 5 barrios, Tanauan, Batangas, 1975-1976.

Item	Tenurial Status			All tenures
	Owner cultivator	Share tenant	Owner Cum. share tenant	
No. of farmers reporting	27	33	1	61
	pesos per hectare			
Cash Costs				
Hired labor	18.0	15.1	45.9	17.1
Food	1.7	15.2	-	7.7
Fertilizer	354.2	377.1	132.4	360.7
Insecticide	11.8	11.7	4.7	11.6
Fuel and oil	12.2	10.5	5.9	11.4
Landlord share	-	314.4	78.7	140.4
1. TOTAL CASH COSTS	397.9	744.0	267.6	548.9
Non Cash Costs				
Unpaid family labor	143.5	142.2	235.3	144.5
Exchanged labor	20.9	24.0	-	21.9
Unpaid operator labor	339.6	321.5	212.0	329.5
Seeds	82.4	74.7	89.5	79.1
Charge for the use of land	223.0	-	62.7	121.7
2. TOTAL NON CASH COSTS	809.4	562.4	599.5	696.7
3. TOTAL COSTS (1+2)	1207.3	1306.4	867.1	1245.6
4. GROSS RETURNS*	1393.6	1915.4	1095.2	1619.7
5. RETURNS/CASH COSTS (4-1)	995.7	1171.4	827.6	1070.8
6. RETURNS/NON CASH COSTS (4-2)	584.2	1353.0	495.7	923.0
7. NET GAIN (4-3)	186.3	609.0	228.1	374.1

* at ₱1.05/kilo

Table 40a. Cost and Return of Producing Sorghum (open field), 5 barrios Tanauan, Batangas, 1975-1976.

Item	Barrio					All Barrios
	Balele	Bilogbilog	Cale	Janopol	Natatas	
No. of farms reporting	2	3	9	13	12	39
			pesos/hectare			
Cash Costs						
Hired labor	62.0	65.5	21.6	3.3	14.7	18.7
Food	-	28.8	19.5	-	-	6.0
Fertilizer	472.7	298.4	597.5	369.5	316.0	409.9
Chemical	23.9	-	18.6	2.5	4.4	8.3
Fuel/oil	10.6	6.2	21.2	9.8	13.6	13.5
Landlord's share	-	-	408.4	-	238.3	167.6
TOTAL CASH COSTS	569.2	398.9	1086.8	385.1	587.0	624.0
Non Cash Costs						
Unpaid family labor	227.5	109.2	250.9	116.7	136.2	161.8
Exchanged labor	0.4	82.7	42.5	25.1	8.1	24.9
Unpaid operator labor	531.9	148.3	592.2	264.5	218.7	340.7
Seeds	63.5	76.0	111.6	103.9	69.5	90.5
Charge for the use of land	197.0	186.0	100.1	259.6	118.2	175.4
TOTAL NON CASH COSTS	1020.3	602.2	1097.2	769.8	550.7	793.3
TOTAL COSTS	1589.5	1001.1	2184.0	1154.9	1137.7	1417.3
GROSS RETURNS	1231.5	1743.3	2470.4	1622.3	2235.5	1982.8
Net Return Over						
CASH COSTS	662.3	1344.4	1383.6	1237.2	1648.5	1358.8
NON CASH COSTS	211.2	1141.1	1373.2	852.5	1684.8	1189.5
TOTAL COSTS	-358.0	742.2	286.4	467.4	1097.8	565.5

Table 40b. Costs and Returns of Producing Sorghum (under coconut trees), 5 barrios, Tanauan, Batangas, 1975-1976.

Item	Barrio					All Barrio
	Balele	Bilogbilog	Cale	Janopol	Natatas	
No. of farmers reporting	2	1	10	2	10	25
		pesos per hectare				
Cash Costs						
Hired labor	-	-	20.2	38.3	10.7	15.4
Food	-	-	23.5	-	-	9.4
Fertilizer	436.4	176.5	355.0	361.6	203.2	283.8
Chemical	206.8	-	12.1	-	7.1	16.0
Fuel and oil	24.5	6.4	8.2	3.5	5.9	7.4
Landlord's share	-	-	165.5	-	68.3	93.5
TOTAL CASH COSTS	667.7	182.4	584.5	403.4	295.2	425.5
Non Cash Costs						
Unpaid family labor	45.9	48.8	125.7	128.1	129.0	117.9
Exchanged labor	-	11.3	17.2	163.5	5.6	23.1
Unpaid operator labor	1060.5	191.6	335.2	194.4	206.2	289.9
Seeds	146.7	55.4	69.7	88.9	45.1	63.3
Charge for the use of land	143.8	44.1	-	212.5	49.2	46.0
TOTAL NON CASH COSTS	1396.9	351.2	547.8	787.4	435.1	540.2
TOTAL COSTS	2064.6	533.6	1132.3	1190.8	730.3	965.7
GROSS RETURNS	898.5	275.9	1336.7	1328.4	895.6	1057.2
NET RETURNS OVER						
Cash Costs	230.8	93.5	752.2	925.0	600.4	631.7
Non Cash Costs	-498.4	-75.3	788.9	541.0	460.5	517.0
Total Costs	-1166.1	-257.7	204.4	137.6	165.3	91.5

Table 41a. Distribution of 13 farmer-ratooners, Tanauan, Batangas, 1975-1976.

Barrio	Tenure Status		All Tenures
	Owner cultivator	Share tenant	
Balele	1	-	1
Cale	-	1	1
Natatas	2	9	11
All Barrios	3	10	13

Table 41b. Area ratooned by barrio, Tanauan, Batangas, 1975-1976.

Barrio	No. of farmers reporting	Area (in ha)	
		Total	Ave.
Balele	1	0.09	0.09
Cale	1	0.24	0.24
Natatas	11	3.42	0.31
All Barrios	13	3.75	0.29

Table 41c. Area ratooned by tenure, Tanauan, Batangas, 1975-1976.

Barrio	No. of farmers reporting	Area (in ha)	
		Total	Ave.
Share tenant	10	3.37	0.34
Owner cultivator	3	0.38	0.13
All tenures	13	3.75	0.29

Table 41d. Area ratooned by type of planting field, Tanauan, Batangas, 1975-1976.

Type of field	No. of farmers reporting	Area (in ha)	
		Total	Ave.
Open field	10	2.65	0.26
Under coconut	3	1.10	0.37
All fields	13	3.75	0.29

Table 41e. Labor utilization by barrio and type of farm operation, Tanauan, Batangas, 1975-1976.

Farm operations	Barrio			All Barrios
	Balele	Cale	Natatas	
		Man hrs./ha.		
Cutting	86.0	49.1	81.9	79.7
Fertilizing	-	-	15.6	13.3
Spraying	10.8	-	1.6	2.2
Off-barring	21.5	-	17.2	16.2
Hilling-up	-	-	9.1	7.7
Weeding	-	-	2.1	1.8
Harvesting	86.0	49.1	09.9	103.4
Thresing	3.2	2.4	10.3	9.2
Drying	-	-	2.6	2.2
Hauling	-	-	1.7	1.3
Winnowing	-	-	9.2	7.7
All Operations	207.5	100.6	261.2	244.7

Table 41f. Labor utilization by source and type of farm operation, Tanauan, Batangas, 1975-1976.

Farm operations	Source of Labor				All Sources	Percent rowwise
	Operator	Family	Exchanged	Hired		
			Man hrs/ha			
Cutting	21.0	19.3	3.0	36.4	79.7	32.6
Fertilizing	2.7	5.3	5.3	-	13.3	5.4
Spraying	1.7	0.5	-	-	2.2	0.9
Off-barring	15.6	-	-	0.6	16.2	6.6
Hilling-up	7.1	-	-	0.6	7.7	3.1
Weeding	1.8	-	-	-	1.8	0.7
Harvesting	25.4	45.2	2.5	30.3	103.4	42.3
Thresing	2.4	1.0	5.7	0.1	9.2	3.8
Drying	1.8	0.4	nil	-	2.2	0.9
Hauling	0.1	0.7	0.3	0.2	1.3	0.5
Winnowing	2.4	4.9	-	0.4	7.7	3.1
All operations	82.0	77.3	16.8	68.6	244.7	100.0
% column wise	33.5	31.6	6.9	28.0	100.0	

Table 41g. Labor utilization by tenure and source of labor, Tanauan, Batangas, 1975-1976.

Source of labor	Tenure Status		All tenures
	Owner cultivator	Share tenant	
		Man hrs/ha	
Operator	166.5	56.6	82.0
Family	165.5	50.8	77.3
Exchanged	19.7	15.9	16.8
Hired	-	89.3	68.6
All Sources	351.7	212.6	244.7

Table 41h. Labor input utilization by type of planting field and source of labor, Tanauan, Batangas, 1975-1976.

Source of labor	Type of planting field		All fields
	Open field	Under coconut	
Operator	85.8	69.1	82.0
Family	85.8	48.8	77.3
Exchanged	21.4	1.4	16.8
Hired	82.0	24.3	68.6
All sources	275.0	143.6	244.7

Table 41i. Total production and average yield per hectare, Tanauan, Batangas 1975-1976.

Barrio	Total production (in kg)	Yields (in tons/ha)
Balele	54.4	0.58
Cale	172.5	0.71
Natatas	1907.2	0.56
All barrios	2134.1	0.57

Table 41j. Yield per hectare by tenure, Tanauan, Batangas, 1975-1976.

Barrio	Tenure		All tenures
	Owner cultivator	Share tenant	
Balele	0.58 (1)	-	0.58 (1)
Cale	-	0.71 (1)	0.71 (1)
Natatas	1.07 (2)	0.51 (9)	0.56 (11)
All barrios	0.95 (3)	0.52 (10)	0.57 (13)

( ) No. of farmers reporting

Table 41k. Yield per hectare by type of planting field, Tanauan, Batangas, 1975-1976.

Barrio	Type of field		All fields
	Open field	Under coconut	
Balele	0.58 (1)	-	0.58 (1)
Cale	0.71 (1)	-	0.71 (1)
Natatas	0.63 (8)	0.41 (3)	0.56 (11)
All barrios	0.64 (10)	0.41 (3)	0.57 (13)

( ) No. of farmers reporting.

Table 411. Cost and return of producing sorghum (ratooned) by barrio, Tanauan, Batangas, 1975-1976.

Items	Barrio			All Barrios
	Balele	Cale	Natatas	
No. of farmers reporting	(1)	(1)	(11)	(13)
Cash Costs				
Hired labor	-	-	113.9	96.4
Fertilizer	-	-	92.0	77.8
Insecticide	12.9	-	1.3	2.1
Fuel/oil	5.4	3.1	2.8	3.0
Landlord's share (in cash)	-	-	42.3	35.8
TOTAL CASH COSTS	18.3	3.1	252.3	215.1
Non-Cash Costs				
Unpaid family labor	77.1	51.5	69.0	68.3
Exchanged labor	126.0	36.5	90.7	89.2
Unpaid operator labor	56.4	-	8.7	11.7
Payment for loaned seeds	-	106.3	10.1	16.7
Landlord's shares (in kind)	98.3	-	28.4	31.6
Charge for the use of land				
TOTAL NON-CASH COSTS	397.4	194.3	224.6	232.5
TOTAL COSTS	415.7	197.4	476.9	447.6
GROSS RETURNS	614.2	564.4	775.1	746.5
NET RETURN OVER				
Cash cost	595.9	561.3	522.8	531.4
Non-cash costs	216.8	370.1	550.4	514.0
Total costs	198.5	367.0	298.2	298.9

Table 41m. Cost and return of producing sorghum (ratooned by type of planting field, Tanauan, Batangas, 1975-1976.

Items	Type of field		All fields
	Open field	Under coconut	
No. of farmers reporting	(10)	(3)	(13)
Cash costs			
Hired labor	108.9	54.5	96.4
Fertilizer	101.2	-	77.8
Insecticide	2.7	-	2.1
Fuel/oil	3.3	2.0	3.0
Landlord's share (in cash)	29.6	56.5	35.8
TOTAL CASH COSTS	245.7	113.0	215.1
Non-cash cost			
Unpaid family labor	76.4	41.4	68.3
Exchanged labor	18.7	2.5	15.0
Unpaid operator labor	96.8	64.0	89.2
Payment for loaned seeds	13.1	7.2	11.7
Landlord's share (in kind)	21.7	--	16.7
Charge for the use of land	41.0	-	31.6
TOTAL NON-CASH COSTS	267.7	115.1	232.5
TOTAL COSTS	513.4	228.1	447.6
GROSS RETURNS	750.3	733.9	746.5
NET RETURN OVER			
Cash costs	504.6	620.9	531.4
Non-cash costs	482.6	618.8	514.0
Total costs	236.9	505.8	298.9

Table 41n. Cost and return of producing sorghum (ratooned) by tenure, Tanuan, Batangas, 1975-1976.

Items	Tenure		All Tenures
	Owner	Share tenant	
No. of farmers reporting	(3)	(10)	(13)
Cash costs			
Hired labor	-	125.3	96.4
Fertilizer	-	101.2	77.8
Insecticide	4.3	1.4	2.1
Fuel/oil	3.4	2.9	3.0
Landlord's share (in cash)	-	46.6	35.8
TOTAL CASH COSTS	7.7	277.4	215.1
Non-cash costs			
Unpaid family labor	149.0	44.0	68.3
Exchanged labor	17.3	14.3	15.0
Unpaid operator labor	187.0	59.9	89.2
Payment for loaned seeds	34.7	4.8	11.7
Landlord's share (in kind)	-	21.7	16.7
Charge for the use of land	136.8	-	31.6
TOTAL NON-CASH COSTS	524.8	144.7	232.5
TOTAL COSTS	532.5	422.1	447.6
GROSS RETURNS	854.9	714.0	746.5
NET RETURN OVER			
Cash costs	847.2	436.6	531.4
Non-cash costs	330.1	569.3	514.0
Total costs	322.4	291.9	298.9

Table 41 o. Extent of bird damage, Tanauan, Batangas, 1975-1976.

Barrio	Name	Amount of grain damaged (kg/ha)
Natatas	Timoteo Canta	172.4
	Venancio Planton	265.0
	Iluminado Magpantay	34.5
	Servillano Manacop	147.0
	Gregorio Nuñez	66.7
	Cornelio Malabanan	143.6
Cale	Benito de Leon	29.2
Average		122.6

Table 42. Rainfall conditions immediately following first planting of crops that were seeded in plow furrows and subsequently replanted, Tanauan, Batangas, 1975-1976.

Barrio	Farmer	Date of planting	Rainfall within 7 DAS	No. of heavy rains (35+ mm) within 7 DAS
Janopol	J. Quilao	October 25	44	1
	V. Quilao	29	140	2
	C. Lizardo	30	140	2
	F. Macatangay	30	140	2
	P. Vivas	30	140	2
Natatas	R. Platon	October 28	138	2
Cale	B. de Leon	October 17	156	2
	A. Mercado	17	156	2
	L. Manguiat	24	70	1
	B. de Leon	24	70	1
	F. Mercado	25	70	1
Balele	J. Huelgas	October 27	102	1
	A. Ofrin	31	126	2

DAS - days after seeding

Table 43. Rainfall conditions immediately following planting of sorghum crops that were seeded in lithao furrows, Tanauan, Batangas, 1975-76.

Barrio	Farmer	Date of planting	Rainfall within 7 DAS	No. of heavy rains (35+ mm) within 7 DAS
Cale	H. Luna	October 17	156	2
	G. Mosambiqui	October 24	70	1
	F. Luna	November 11	5	0
Natatas	H. Rodrigo	October 26	17	0
	P. Nuñez	November 11	4	0
	D. Castillo	November 8	6	0
	V. Platon	November 13	9	0
Balele	S. Huelgas	October 17	102	1
	A. Ofrin	November 3	42	1

Table 44. Yields and production problems of monoculture sorghum farmers with the lowest yields, Tanauan, Batangas, 1975-1976.

Farmer	Yield	Production problems in estimated order of importance
		Yield Level: 0 to 1.0 t/ha.
J. Quilao	0.19	Extremely poor stand
R. Luna	0.44	Disease: panicles infertile (Helminthesporcum leaf spot suspected)
F. Pamplona	0.45	Poor stand; soil problem; no rain after fertilization
B. de Leon	0.46	Very poor stand; no weed control, no fertilizer
E. Reyes	0.49	Very poor stand; low fertilizer application; no rain after fertilization
V. Matundan	0.51	Poor stand; poor weed control; low nitrogen and applied late
S. Lopez	0.57	Extremely poor stand; low N application and applied late
R. Platon	0.71	Poor stand; very poor weed control; low N application
R. de Chavez	0.72	Poor stand; late fertilization with no subsequent rain; poor weed control
A. Sumagui	0.86	Poor stand; severe shootfly and headworm; poor weed control
		Yield Level: 1.0 to 1.5 t/ha
L. Manacop	1.00	Poor stand; no weed control; no rain after fertilization
J. Huelgas	1.13	Severe headworm and damagedby chickens
R. Platon	1.29	No rain after fertilization
J. Lizardo	1.30	No weed control; late fertilization with no subsequent rain
A. Ofrin	1.31	Poor stand; low fertilizer application with no subsequent rain
P. Nuñez	1.40	Very poor stand; late fertilization with no subsequent rain
I. Magpantay	1.43	No weed control; low fertilizer application with no subsequent rain

Table 45. The performance of two threshers tested for sorghum threshing, Tanauan, Batangas, 1975-1976.

	Model	
	IRRI Axial Plow	Landmaster
1. No. of fields threshed	62	4
2. Average no. of thresher hours per ton	2.6[a/]	20.5[b/]
3. Average fuel consumption per ton (liters)	4.40[a/]	18.20[b/]
4. Fuel cost per ton (₱)	6.20[a/]	25.50[b/]
5. Average no. of laborers	5	3

[a/] The sorghum panicles were re-cycled through the thresher an average of four times.

[b/] Cleaning the grain is not included in these data.

Costs and Returns of Owning and Operating a
Rice Sorghum Thresher in Tanauan, Batangas

These estimates were prepared to evaluate the potential profitability of a privately-owned thresher for rice and sorghum in the Tanauan area.

I. The Thresher

Model: Axial flow thresher with oscillating screen grain cleaner
Manufacturer and dealer: Kaunlaran Machineries Corp. Calamba, Laguna
Purchase price: ₱15,000 cash (Reduction of ₱2,000 obtainable if purchased by a farmer)

II. Estimated costs and returns of owning and operating by crop season

These estimates are based on field production of the crop under farmer management and field tests on the thresher over a two-year period.

The cropping pattern: Rice-sorghum-sorghum
Seasons: Rice - May to August
Sorghum - Sept. to December
Sorghum ratoon - January to March

A. Rice - Threshing season: August - October

1. Gross income

Estimated area for which thresher in demand: 80 ha[1/]
Average yield normally expected: 2.0 t/ha
Quantity threshed: 2.0 t/ha x 80 ha = 160 tons
Thresher's share at 5% of quantity threshed[2/] = 160t x 0.05 = 8.0t.
Value of thresher's share at ₱1.20/kg (NGA support price)
= 8,000 kg x ₱1.20/kg = ₱9,600

2. Costs

a. Labor and management - two men plus manager needed to operate thresher

Amount threshed per day = 6 tons palay
No. of days required = 160 tons/4 tons = 40 days
Labor costs per day = 2 men @₱8/day + manager @₱10/day = ₱26/day
Total labor cost - 40 days x ₱26/day = ₱1040

[1/]This is the rice area in Janopol Oriental and Occidental which Isidoro Landicho estimates would be threshed if a thresher were available (lower limit).

[2/]Standard rate in Central Luzon for rice.

b. Fuel

Fuel consumption of thresher is approximately 1 liter per ton threshed
Fuel consumption - 1 liter/ton x 160 tons = 160 liters
Fuel costs = 160 liters x ₱1.50/liter = 240

c. Hauling thresher from barrio to barrio with a jeep

No. of trips = 20
Cost per trip - 6.00
Hauling cost = ₱120

d. Variable costs = ₱1040 + 240 + 120 = ₱1,400

3. Net returns over variable costs

Gross income = ₱9,600
Variable cost = 1,400
Net income ₱8,200

B. Sorghum - 1st crop Threshing season: December - February

1. Gross income

Estimated area in 1976-77 for which thresher would be in demand = 60 ha[3/]
Average yield = 1.5 t/ha[4/]
Quantity threshed = 40 ha x 1.5 t/ha = 90 tons
Thresher's share @ 6% of threshed grain = 0.06 x 90 tons = 5.4 tons
Value of thresher's share (gross income) = 5400 kg x ₱1/kg = ₱5,400

2. Costs

a. Labor - 3 men plus manager needed to operate the thresher

Amount threshed per day = 3 tons sorghum
No. of days required = 90 t/3 t per day = 30 days
Labor costs per day = 3 men @ ₱8/day + manager @ ₱10/day = ₱34
Total labor cost = 30 days x ₱34/day = ₱1020

[3/] This assumes a quadrupling of the area planted to sorghum from the small pilot project of 1975-1976.

[4/] 1975-76 average for 61 supervised farmers, 14 has, was 1.5 t/ha; 1974-75 average for 11 farmers cooperating in pattern trials, 1.1 ha, was 2.4 t/ha.

b. Fuel

Fuel consumption of thresher = approx. 3.9 liters/ton
Total consumption (fuel) = 3.9 x 90 tons = 351 liters
Fuel costs = 351 liters x ₱1.50/liter = ₱527

c. Hauling thresher from barrio to barrio with a jeep

No. of trips - 25
Cost per trip - ₱6.00
Hauling cost - ₱150.00

d. Variable costs - ₱1020 (labor) + ₱527 (fuel) + ₱150 (hauling) = ₱1697

3. Net return over variable costs

Gross income -	₱5,400
Variable costs	1,697
Net income	₱3,703

C. Sorghum Ratoon Threshing season: March - May

1. Gross income

Estimated area in 1976-77 for which thresher would be in demand = 15 ha[5/]
Average yield -11.0 tons/ha
Quantity threshed - 15 ha x 1.0 t/ha = 15 tons
Thresher's share @ 6% of threshed grain = 0.06 x 15 tons = 0.9 tons
Value of thresher's share (gross income) = 900 kg x ₱1/kg = ₱900

2. Costs

a. Labor[6/]

No. of days required - 15 tons/3 tons/day = 5.0 days
Total labor costs = 5 days x ₱34/day = ₱170

b. Fuel costs

Total fuel consumption - 3.9 liters/ton x 39 tons = 152.10 liters
Fuel costs = 152.0 liters x ₱1.50/liter = 228.15

[5/] This assumes 25% of the first crop area is successfully ratooned.

[6/] Labor needed to operate thresher assumed the same as for the first crop.

c. Hauling thresher

No. of trips - 8
Cost per trip - ₱6.00
Hauling cost - ₱48

d. Variable costs for ratoon sorghum - ₱170 labor + ₱228 fuel + 48 hauling = ₱446

3. Net returns over variable costs

Gross income -	₱900
Variable cost	446
Net income	₱454

D. Net income over all 3 seasons in the first year

Rice	-	₱8,200
Sorghum	-	3,700
Sorghum (ratoon)	-	450
		₱12,350

E. Manager's income over the 3 threshing seasons

Rice harvest	₱400
Sorghum 1st crop	300
Sorghum ratoon	50
	₱750

III. Summary

These estimates indicate that more than one year of operation would be needed to pay of the cost of the thresher. The purchaser should not figure to safely regain his investment on the thresher until after 1½ to 2 crop years. The above estimates may be reduced if 100 - 200 hectares of sorghum would be produced in the pilot project planned for 1976-77. Unforseen mechanical problems may unexpectedly increase expenses, however, and reduce potential income during the harvest season. Overall the investment appears to be sound and profitable but the investor should be able to carry indebtedness according to the possible loan repayment schedules below.

Utilization rate		Net returns & loan balance by months after purchase*				
		3 months	7 months	15 months	19 months	31 months
One-half projected usage	Net return	4,100	5,950	10,275	12,125	18,300
	Balance	-8,900	-7,050	-2,725	-875	5,300
Projected usage	Net return	8,200	11,900	20,550	24,250	36,600
	Balance	-4,800	-1,100	+7,550	+11,250	+23,600

* Assumes thresher purchased one month before rice harvest, and the entire ₱13,000 thresher value is financed.

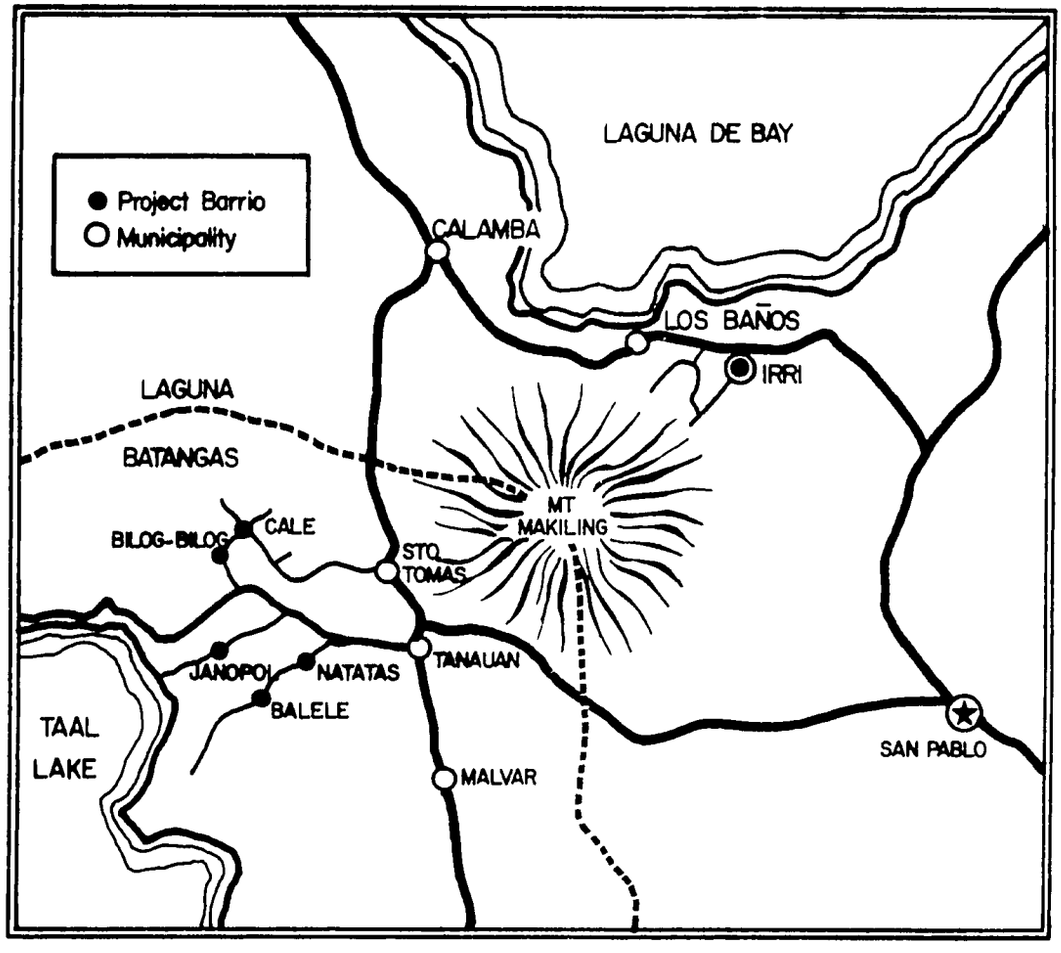

Fig. 1 The Sorghum Project Area

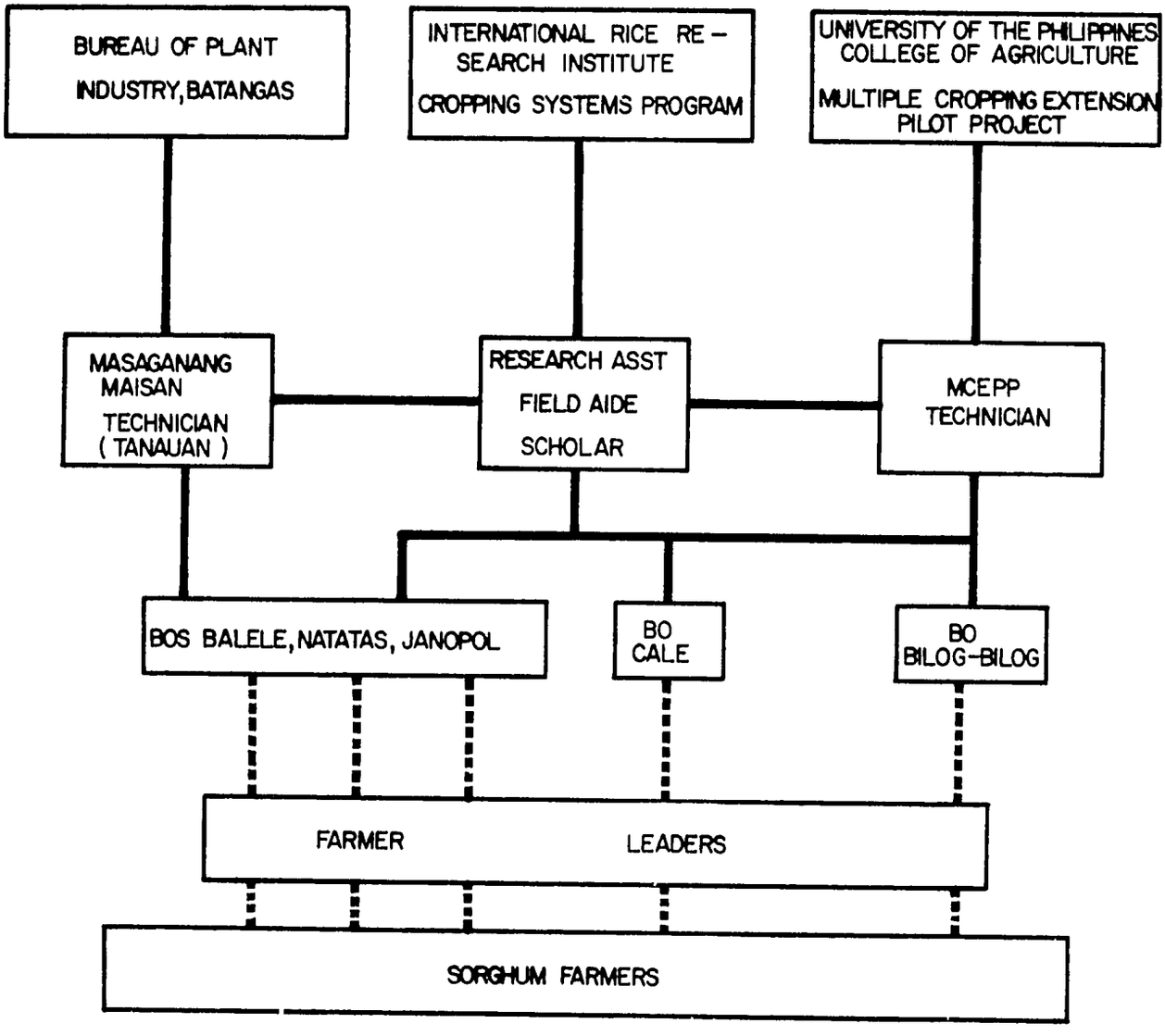

Fig 2 Organizational diagram of the sorghum project

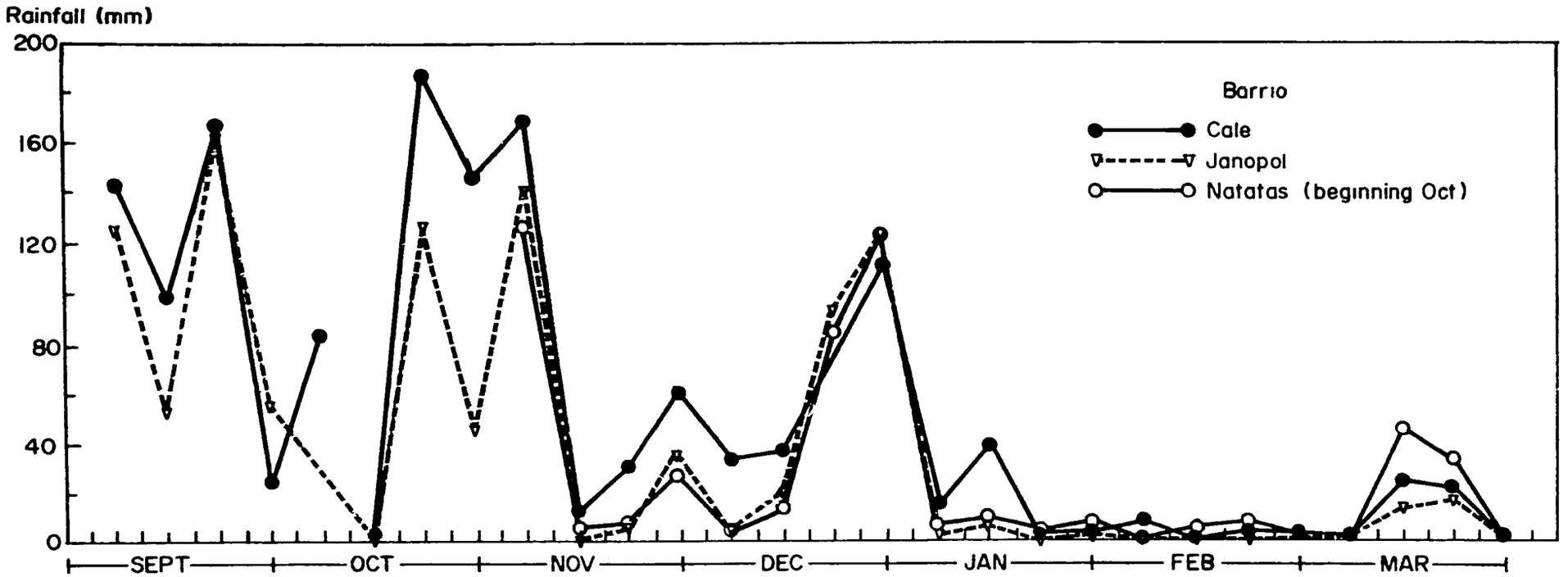

Fig. 3 Weekly rainfall during the late season, 1975-76. Tanauan, Batangas

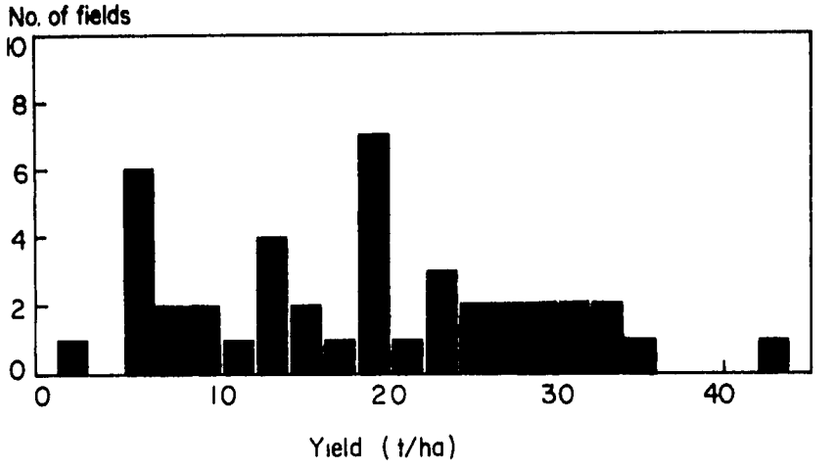

Fig. 4 Frequency distribution of grain yield for all the monoculture sorghum fields.

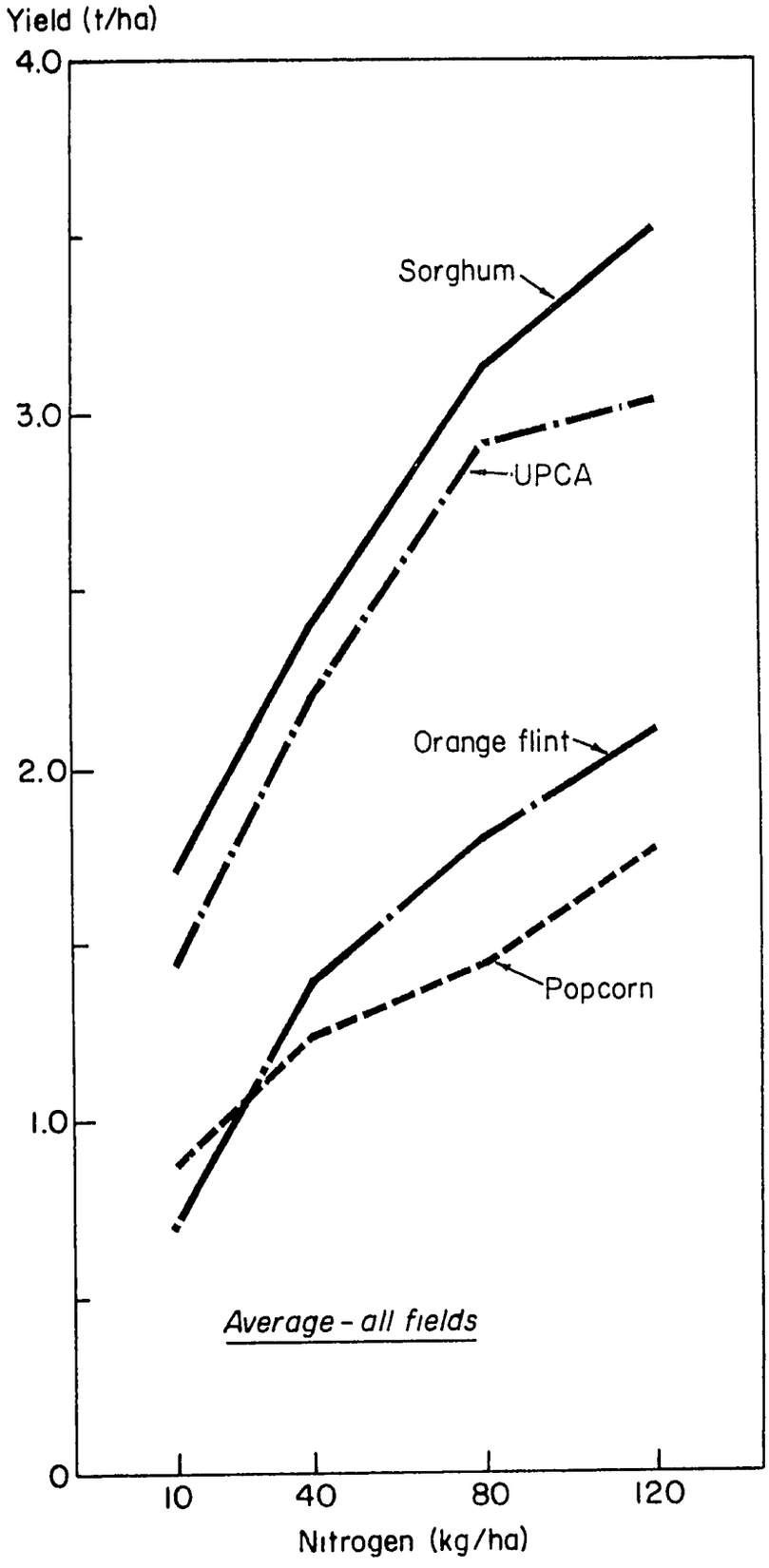

Fig 5 A comparison of the yield response to applied nitrogen by sorghum (Cosor 3) and three varieties of field corn (local orange flint, popcorn, and UPCA variety) grown under farmers' management in four barrios of northeastern Batangas, late wet season.