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SAN BARTOLOME: BEYOND THE GREEN REVOLUTION

R.E. Huke, V. Cordova, and S. Sardido

The International Rice Research Institute
P.O. Box 933, Manila, Philippines

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ABSTRACT

Farmers in the developing world have not been thought of as holding progressive attitudes toward innovation, and agricultural settlements have not often been regarded as the last sector of the economy to accept modernization -- and the blame frequently has been placed on the farmer. He has been accused of being reactionary and of living so close to the margin that he is forced to stick to traditional patterns of production because he dares not risk the chance of failure, which is always inherent in change.

Such generalizations are not always true. San Bartolome, Mayantoc, Tarlac province, is a case in point. In this barangay (village) adoption of modern farming techniques has been rapid, evidence of economic change is abundant, and attitudes of local farmers are surprisingly progressive. Population continues to increase, no new land area becomes available for farming, water resources are already moderately exploited, and further production increases will be more difficult to achieve than in the past.

[1]By *R. E. Huke*, visiting scientist, *V. Cordova*, senior research assistant, and *S. Sardido*, statistical clerk, Department of Agricultural Economics, International Rice Research Institute, Los Baños, Laguna Philippines. Submitted to the IRRI Research Paper Series Committee January 1982.

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SAN BARTOLOME: BEYOND THE GREEN REVOLUTION

In Tarlac, agriculture is the way of life for most of the population but farming is not easy. The work is difficult, the returns not great. Much of the land in the province was, until recently, held by absentee landlords, whose 50% share of the produce of a small, overworked farm left the tenant with barely enough to feed his family.

Throughout Tarlac palay (rice) is the premier crop -- it is being planted on roughly 80% of the farmed land. It is the farmer's staff of life and the area's chief item of trade. In days gone by, a traveler passing through the province just before harvest would have seen fields of 2-m-tall, light-green rice plants, each field at almost the same stage of development as its neighbors. Today most of the rice is dwarf (only 1 m tall), but what the crop lacks in height it seems to have more than made up for in vigor.

Perhaps the most striking contrast with the 1960s in an agronomic sense and in its implication to economic and social conditions is the fact that in those areas with national, communal, or private irrigation facilities the rice crop is no longer uniform in its stage of growth. In San Bartolome, as in many barangays, staggered planting (and harvesting) is clearly evident.

By 1980 the farmers in San Bartolome have had considerable experience with modern rice varieties. Much information on agricultural practices and farm economics is available. Baseline data were collected in 1965 and 1967 through field surveys by the Systematic Program for Rural Economic Assistance and Development (NEC-USAID 1968). Intensive field work, including interviews, was done during February-May 1970 and February-May 1980. Data from the 4 surveys, together with aerial maps (scale 1:2500) and field measurements, were used to evaluate changes in land use, agricultural practices, and farm economy. From the first the barangay raised rice to the exclusion of all other crops except a few vegetables and some fruit for local consumption. Barangay fortunes followed closely the fluctuations of rice yields and prices.

THE SETTING

San Bartolome, a young barangay by Central Luzon standards, was first settled about 1860 by Ilocano-speaking migrants from Camiling, the municipality immediately north of Mayantoc (Fig. 1). When word of the fertile and unsettled valley reached Ilocos Norte, several families from there joined the original inhabitants.

Population

Although data from the early years are sketchy it appears that the population of San Bartolome grew slowly but at a gradually increasing rate until 1939. Since then, growth rate has accelerated as shown in Table 1 and Figure 2. The mean number of persons per home increased from less than 5 in 1939 to about 5.5 in 1970 and 1980.

Table 1. Population data, San Bartolome, Tarlac province, Philippines, 1918-80.

Year	Population[a]
1918	457
1939	517
1948	630
1960	774
1970	886
1975	1113
1980	1164

[a] Source: National Census and Statistics Office. Census of the Philippines (years as indicated).

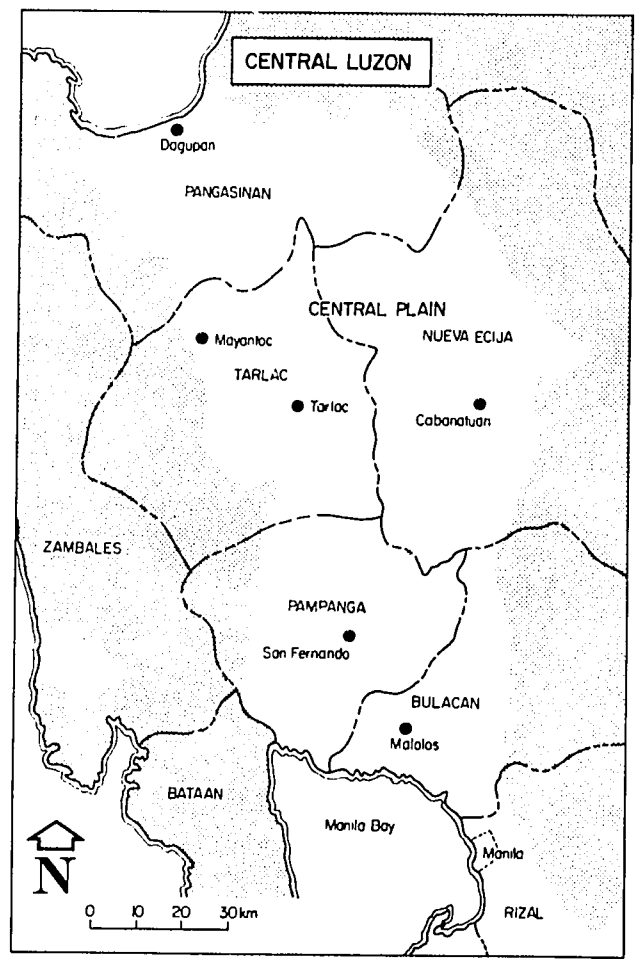

Fig. 1. Mayantoc is on the west side of the Central Plain of Luzon in the province of Luzon.

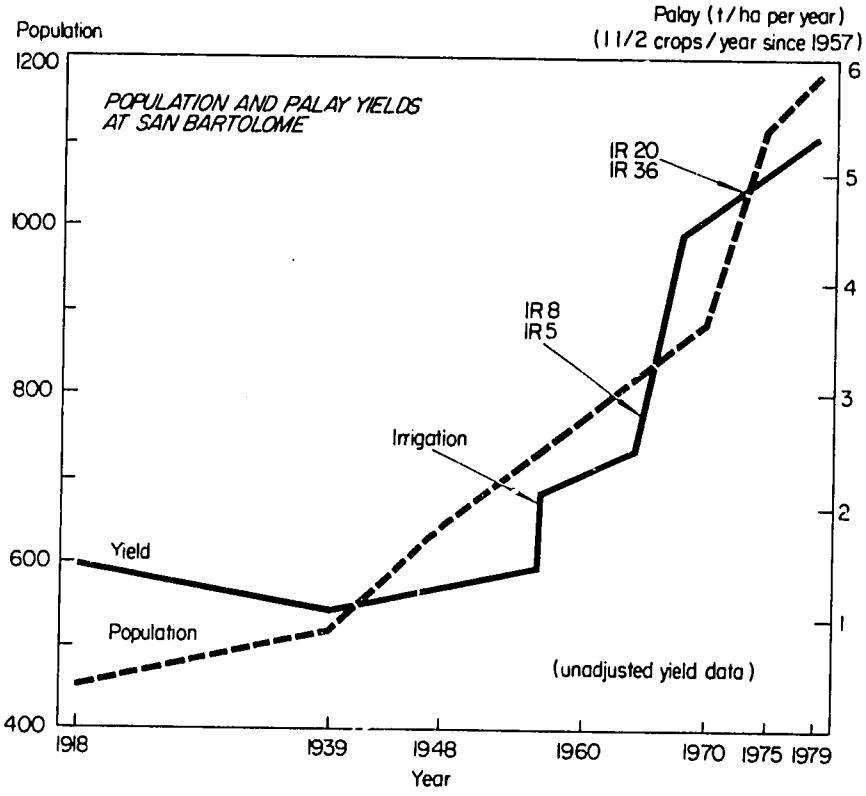

Fig. 2. Trend lines showing the comparative changes in population growth and palay yields in San Bartolome.

The impression one gains from observing the large number of young children in San Bartolome is that the birth rate is high and infant mortality modest. In interviews of 50% of the barangay households the only outsiders identified were the husbands, or in a few cases, the wives, of recently married residents. Presumably this number was balanced by an equal number who left the settlement for marriage.

Between 1970 and 1980 members of two households moved to Mindoro where they had acquired new land, one family moved to the United States, and four families returned to settle in San Bartolome after retirement from government service. The net result of this limited mobility was an increase of one 2-person household over the 10-year period. The census figures in Table 1 indicate a 31% growth over the same period. Clearly this is attributable mainly to natural increase. In 1970 family planning was a foreign idea to most folks in San Bartolome. By 1980 San Bartolome had a prominent Family Planning Center adjacent to the plaza at the heart of the settlement, yet the Center nurse claimed only 7 family planning acceptors among the 205 households.

One indicator that the rate of population growth might continue to rise is that a survey of San Bartolome housewives identified the ideal number of children as four per family while the actual number is three. Families in San Bartolome have fewer children than they consider to be ideal; this despite the fact that several wives reported life as more difficult in 1980 than in 1970 because "growing children eat more and need money for school."

Climate and irrigation

The rainfall pattern of San Bartolome, as in much of Central Luzon, follows a typical northern hemisphere monsoon rhythm with rainfall concentrated in a period from late May through October. In 1 of 3 years a typhoon will bring heavy rains and high wind during November, before the harvest of the first crop. Occasionally a similar storm in late April or early May will provide 100 mm or more of rainfall.

Because the barangay lies against the lee side of the Zambales Mountains it is subject to a modest rain shadow effect. Annual precipitation totals appear to be lower than at sites farther from the mountains and to average slightly more than 1,800 mm.

Although rainfall records are not of sufficient length to provide significant statistical evidence, it seems reasonable to postulate that such a site is subject to greater variability in rainfall from year to year than would be a site farther from the mountains. To help overcome the vagaries of the climate the farmers of San Bartolome and two nearby settlements developed a communal irrigation system, which was inaugurated in 1907. This system provides reliable irrigation to 70 ha of rice land at the northern side of San Bartolome during the wet and dry seasons.

In 1957 the National Irrigation Administration (NIA) constructed Magsaysay Dam, a small concrete diversion dam on the Camiling River, about 10 km upstream from San Bartolome. The dam and associated canal system provides irrigation to a wide area, including 215 ha of rice land in San Bartolome. Because the dam provides almost no storage capacity and the river flow fluctuates from season to season, the irrigation system can provide adequate dry season water to only 50% of the total area served during the rainy season. Accordingly, San Bartolome has dry season water during even-numbered years and the supply is directed to the opposite side of the Camiling River during odd-numbered years.

Thus, farmers served by the NIA system in San Bartolome have traditionally been able to produce 3 rice crops every 2 calendar years. Adequate irrigation water was available in the 1970 dry season and 1980 dry season.

The main irrigation canals are well maintained by the NIA, but with the marked increase in both lumbering and kaingin (slash and burn shifting) farming in the Zambales Mountains, surface runoff has increased markedly as has the volume of silt and debris. This poses a serious threat to the continued success of the irrigation facility.

During the 1978-79 dry season the NIA undertook major renovation at the headworks of the Camiling River system to provide two-season irrigation for a larger portion of the service area. No sooner had the work been completed than a major typhoon caused erosion and sedimentation that negated the improved service. Alternate-year, dry season water remains the rule.

Soils

The soils of San Bartolome owe much of their character to the fact that the nearby Zambales Mountains are largely ultramafic rocks. From these rocks the San Bartolome River derived material for a deposit of piedmont alluvium from which today's soils developed. The soils are stony or gravelly, heavy, and contain a modest proportion of swelling sandy clay. A soil profile was examined in a major rice field 300 m south of the barangay. The report, in part, was:

> "The dark A horizon in the profile observed extends to about 0.5 m depth, over a grey sandy-clay B horizon with many soft black (iron-manganese) nodules. The rooting depth of the rice is probably about 0.5 m. Therefore, higher yields should be expected than would be calculated on the basis of nutrient and organic matter contents in a plough layer of standard depth." (R. E. Brinkman, IRRI, pers. comm.).

Soil samples were taken from five farmer fields, representing the three major clusters of fields operated by San Bartolome residents. Analyses of these soils at the International Rice Research Institute (IRRI) revealed that all five were deficient in nitrogen and zinc, three were deficient in potassium, and three were marginally deficient in phosphorus. For all 5 soils the organic carbon was close to 1%, total nitrogen was 0.1%, and pH was slightly above 6.

SURVEY FINDINGS

The first impression of San Bartolome is that its farmers are well off. Many of the homes are substantial, the main streets are paved, electricity is in evidence everywhere, television antennas are numerous, and young women sell halo-halo (iced fruit) at the tiny plaza. Some of the facts revealed by changes in the basic farm data support this impression but other facts seem to wave a warning flag and suggest that danger lies ahead (Table 2).

Table 2. Wet season farm data, San Bartolome, Tarlac province, Philippines.

	1965	1967	1969	1979
Farm rice area (ha)	2.2	2.4	2.4	1.7
Mean yield (all palay, t/ha)	1.7	2.3	3.0	3.6
Mean yield (modern varieties, t/ha)		2.8	3.4	3.6
Mean yield (traditional varieties, t/ha)	1.7	2.2	2.7	3.0
Area planted to modern varieties (%)		14	44	94
Farmers planting modern varieties (%)		40	78	98
Mean use of nitrogen (kg/ha)	10	22	34	45

Mean yield of all palay has shown a dramatic rise from 1.7 t/ha in 1965 to 3.6 t/ha in 1980. Yields are characterized by sharp rises resulting from the introduction of IR8 and IR5. Following this initial burst, and especially after 1970 by which time most farmers had already planted their best land to IR5 or IR20, the curve continued to move upward but at a much reduced rate (Fig. 2). After 1970 the modern varieties were planted in an ever increasing percentage of the farmed area (Table 2) and the farmers were using increased levels of inputs as typified by the increase from 34 to 54 kg/ha as the mean application of nitrogen.

The trend was better farmers with better seeds and increased inputs. What could be better?

Land resources

Unfortunately land resources are relatively fixed and if the population continues to increase then

the land resource per capita must decrease. Not only must the same farm area be distributed among a larger number of farmers but also those few new farmers must have a place to live. Soon the expanding population will occupy what at one time was farmland and the area available for crops must decrease. The latter has not yet happened at San Bartolome but the 53 homes added to the settlement between 1970 and 1980 suggest that the time may be near (Fig. 3).

In 1969 the mean farm size in San Bartolome was 2.4 ha but during the following 10 years the same land base was divided among a considerably larger number of farmers. The barangay population grew from 886 to 1,164 and mean farm size shrank from 2.4 to 1.7 ha.

Crop yields

How do reported yields compare to actual yields? To answer this question, crop-cuts were made during the 1980 dry season on the fields of 11 farmers representing the 3 major farm clusters from which soil samples had been taken. The results, shown in Table 3, indicate a mean yield of 5.4 t/ha for these 11 farmers. The figure was well above the barangay mean for the wet season (Table 2) and higher than had been reported for previous dry seasons.

An interview after the harvest determined the actual yield obtained by the 11 farmers. Their reported yields were 13% less than those estimated by the crop-cuts as shown by Table 3.

Yield data are developed by allocating production across area. If crop-cut data are reliable then an overstatement of area could account for the lower reported yield. To check this possibility, aerial photography was ordered at a scale sufficient to allow measurement of individual land parcel size to the closest 0.01 ha. In addition records for 208 measured plots in San Bartolome were obtained from the NIA.

Twenty of the farmers interviewed were found to operate only fields included in the list of chain-measured paddies provided by the NIA and an additional 17 farmers operated only fields that could be accurately identified and measured on the enlarged airphoto. Of the 37 farmers, 27 reported holdings larger than indicated by measurements, 9 reported smaller than actual farm size, and 1 report was accurate. The larger the actual farm the greater the percentage of overestimation of size as shown in Figure 4.

Regression analysis of this distribution produced the formula:

$$Y + .185 + .63x$$

and the t-test indicated that both the intercept and the slope differ at the 1% level of significance from the expected. Clearly the underreporting of size for larger farms is real.

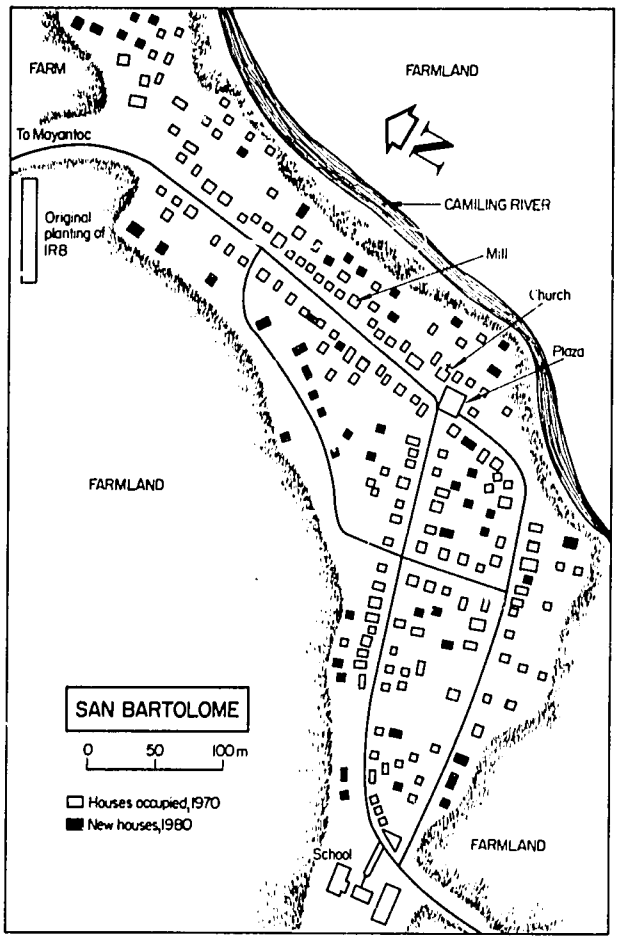

Fig. 3. In 1970 San Bartolome had 157 homes; by 1980 many had been rebuilt and 53 additional dwellings had been added. Little vacant space remained.

Table 3. Crop-cut yield versus yield reported by 11 farmers, San Bartolome, Tarlac province, Philippines, 1980 dry season.

Farmer number	Farmers' input levels: N (kg/ha)	Weedings (no.)	Sprays (no.)	Rat control	Yield[a] Crop-cut	Yield[a] Reported
1	75	1	4	2	6.5	6.6
2	76	1	4	1	4.8	4.7
3	67	1	3	2	5.9	4.0
4	77	1	3	1	7.3	4.6
5	101	1	4	1	4.5	5.0
6	101	1	5	1	5.9	5.7
7	85	1	5	0	5.6	4.8
8	-	-	-	-	4.1	2.5
9	106	1	3	2	5.0	6.0
10	101	1	3	4	4.4	
11	61	1	3	0	5.0	4.3
Mean[b]					5.4	4.8

[a]Dash indicates no report. [b]Mean excludes farmer 8.

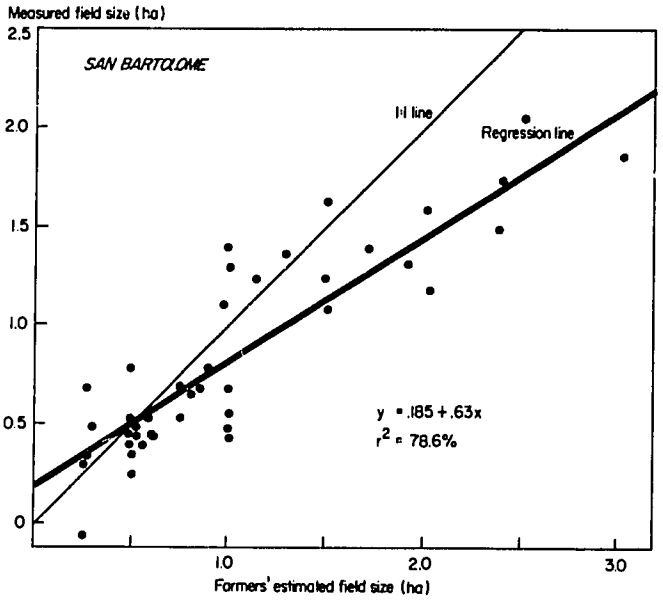

Fig. 4. The majority of the farmers in San Bartolome reported their holdings to be larger than they actually are.

Data from interviews with 56 farmers indicated a mean yield of 3.9 t/ha for the crop harvested in April 1980. As indicated above, this figure did not agree with the crop cuttings taken randomly from among 56 farms or with the general estimate of yields from the entire area. The figure appeared too low.

The 56 farmers had harvested from a total area reported as 62 ha. The area of each of these farms was corrected according to the above regression formula with the result that the actual area harvested by the 56 farmers appears to have been 44.8 ha. Assuming that the data on production from the just completed harvest were accurate, the individual yield was not 3.9 t/ha as reported by the interviews but 5.4 t/ha. This is the same yield measured by the 22 crop-cut samples taken from among these fields and documented in Table 3. Similar discrepancies between reported and measured farm size have been reported earlier (Labadan 1977).

Fertilizer levels

Barangay averages for wet season crops showed a marked increase in the use of nitrogen from 1965 to 1979 (Table 2). The fertilizer recommendation by the Bureau of Agricultural Extension for IR36 for the wet season was 60-30-30 kg NPK/ha (See: Ministry of Agriculture, Bureau of Agricultural Extension, 1980).

Most farmers used complete fertilizer (14-14-14) and only 8 of the 9[illegible] interviewed stated they had applied extra nitrogen. As a result of this mix of fertilizer type the phosphorus and potassium levels exceeded the Bureau's recommendation.

IRRI soils tests (described earlier) resulted in a recommendation of 99 kg nitrogen/ha and the use of zinc, either as seedling root dip or harrowed into the soil before transplanting, to obtain a 5 t/ha yield. The San Bartolome mean application of nitrogen was slightly less than 50% of that recommended for the 5 t/ha yield. It appears that San Bartolome farmers have some scope for increased yields through heavier nitrogen applications.

In the dry season the nitrogen application may more closely approach the recommended levels. Table 3 indicates that in 10 of the crop-cut farms, nitrogen was applied in the range of 61 to 106 kg with a mean of 83 kg/ha. At adjusted farm sizes this mean application was in the order of 96 kg/ha and the measured yield was 5.4 t/ha.

Table 4. Tenure status of 99 farmers, San Bartolome, Tarlac province, Philippines, 1979.

Status	Farmers (no.)
Owned all land farmed	54
Held mortgage for all land farmed	3
Rented all land farmed	4
Sharecropped all land farmed	8
Owned land plus mortgaged	3
Owned land plus rented	7
Owned land plus sharecropped	15
Owned, rented, and shared	1
Owned, mortgaged, and shared	1
Mortgage and rented	1
Tenure not clear	2

Tenure

One factor that may help account for the relatively high productivity and the appearance of well being at San Bartolome is the high proportion of owner operators and the small number of landless workers. In 1970 only 4 of 158 families were identified as being without land to farm and in 1980 only 5 of 205 families were landless. In this respect San Bartolome is an exceptional barangay. Of the 99 families interviewed in 1980 more than 50% owned all the land they farmed and 31 families owned at least a portion of their farms as may be seen in Table 4. Two had shifted from share tenancy to leasehold (rental) following the declaration of martial law in 1972. With this exception there was no major change in tenure pattern over the decade. The declaration of the entire country as a land reform area in 1972 had little impact on San Bartolome.

One small but unexpected impact that land reform may have had concerns yield level. The laws allow

a farmer to hold up to 7 ha of rice land provided he works them all himself. Of the 99 farmers interviewed in 1980, 3 owned land scattered between 3 different barangays. Before the 1972 legislation, at least one of these plots would have been operated by a share-tenant. This is no longer the practice. All three farmers themselves operate land in three separate barangays and, as one farmer confided, "yields are poor because I just cannot do all the work."

Diffusion of modern varieties

During May and June 1966, government agencies, a private fertilizer manufacturer, and the IRRI made IR8 seed available to selected farmers in the municipality of Mayantoc. The recipient farmers, chosen by the local farm management technicians, were those considered important community leaders, among the most successful farmers, and those with the interest and the resources necessary to multiply the seed effectively. Most of the seed was planted in 2 barangays north of San Bartolome and in a third barangay 2 km south and across the Camiling River. One farmer in San Bartolome received 12 kg seed sufficient to plant about 0.25 ha.

An irrigated field immediately adjacent to the road leading to the poblacion, one of the most visible fields in San Bartolome (see Fig. 3), was chosen as the demonstration plot in the barangay. The planting was supervised by the resident agricultural extension worker, checked on three times during the growing season by IRRI personnel, and the plot well cared for by the farmer. The weather was normal and insect damage was modest. The 0.25-ha plot yielded 5.5 t/ha, an impressive yield (average yield for the barangay at that time was 2.2 t/ha).

Because of the alternate-year irrigation system, the next available planting time was the 1967 main wet season. During that growing season, and in the months that followed, the resident agricultural extension worker discussed with the barangay farmers advantages and potentials of IR8 and of the even newer IR5. By planting time in 1967 a large number of farmers were convinced to try some of the new rices. Local farmers did not, however, like the shortness of the new varieties, thinking harvesting would be difficult. They were also concerned by the fact that the demonstration plot had required far greater care than other fields of equal size. The fact that most of this increase in labor was related to improved farming technology rather than being unique to the variety was not immediately obvious. In particular, the straight-row, equally spaced transplanting technique, which had been used in place of the usual waray-waray (random) method, caused much concern.

On the other hand, the farmers were impressed by the high final yield, the nonlodging of the crops, and the fact that IR8 had shown little loss from either insect or disease damage. The advantages clearly outweighed the perceived disadvantages and most farmers were anxious to plant part of their holdings to the semidwarf rice. Few, however, risked their entire crop area.

Before the main planting in 1967, seed of the new varieties was still scarce, its cost was higher than that of local varieties, and the farmers still had questions about the reliability of this short, high-tillering plant type. But the high potential yield was attractive enough to convince 40% of the barangay farmers to plant at least part of their holdings to IR8 or IR5. As a group this 40% risked only 1/3 of their plantings to the new seed and in aggregate this area equalled 14% of the rice area of the barangay (Table 2). Fine harvests followed and 2 years later, 78% of the farmers planted 44% of their total rice area to modern varieties.

From 1969 to the 1979 wet season the number of adoptors and the proportion of land planted to the modern varieties continued to expand. The adoption process apparently followed a typical S curve and appears to have completed the cycle. By the 1979 wet season 94% of San Bartolome's rice land was planted to modern varieties (Table 2). In the same season only 2 of 99 farmers interviewed did not plant modern varieties (Table 5). In the years ahead San Bartolome can no longer look to the diffusion process for production increases. The process of adoption of the modern varieties had been completed.

Table 5. Use of modern rice varieties by 99 farmers, San Bartolome, Tarlac province, Philippines.

	1969-70		1979-80	
	Wet season (no.)	Dry season (no.)	Wet season (no.)	Dry season[a] (no.)
Modern varieties only	19	24	87	93
Modern and traditional	59	49	10	5
No modern varieties	21	26	2	0

[a]One farmer did not plant rice.

Insect control

The first insecticide used by any farmer in San Bartolome was applied by a farmer employed as an agricultural extension worker in a neighboring barangay. No one followed his example until 3 years later when 2 fellow farmers joined him. The new innovators were apparently influenced by the extension effort that accompanied the government's campaign to spread the Japanese system of rice cultivation. Interestingly enough, none of the three farmers adopted the straight-row transplanting system advocated for an intensive cultivation technique based on then current Japanese methods and advocated by the Bureau of Agricultural Extension in the mid-1950s.

In 1957, the gravity irrigation system was completed and with concentrated extension efforts 24 more farmers were persuaded to adopt the use of insecticides. During the next 8 years there was only modest extension of the innovation. However, during 1966-67 the rapid spread of the use of IR8 and of the yet unnamed IR5 was paralleled by an almost equally rapid diffusion in the use of sprayed insecticides, as shown in Table 6. During the first 13 years of the history of insecticide use in San Bartolome, about 45% of the farmers adopted its use. The ratio of adoptors doubled in the 4 years following the introduction of modern varieties.

By 1980 all the 99 farmers interviewed were using insecticide and most claimed they had been using it "for many years." Table 7 shows that 86 of 99 farmers sprayed insecticides and the normal practice was 4 sprays for the entire farm. In addition to this, several farmers sprayed their seedbeds. Twelve farmers used a single application of granular insecticide in addition to four sprays. One farmer used a single application of granules.

One farmer reported that he sprayed eight times and that the concentration had been exactly as suggested on the insecticide label. This man said he would rather spray than stay at home and argue with his wife. Clearly fund had been wasted and the ecosystem perhaps endangered.

In 1980 we asked, "What is the most serious problem limiting yields on your farm?" The most common answer was "brown planthopper." This is surprising because IR36 was raised to the exclusion of almost all other varieties and was well known for its high resistance to the brown planthopper present in Central Luzon. Clearly IR5 and IR20 losses to tungro and the brown planthopper in the early 1970s are well remembered. Farmers now spray with a vengeance whenever a rise in the insect population is observed. The rate of application is difficult to determine but the farmers questioned insisted they mixed according to the directions on the bottle and sprayed "just as the extension agent told us."

Table 6. Date of first use of insecticide among 101 farmers, San Bartolome, Tarlac province, Philippines, 1969.

Year	First users (no.)	Total[a]
1952	1	1
1955	2	3
1957	24	27[b]
1959	2	29
1960	9	38
1961	0	38
1962	0	38
1963	2	40
1964	0	40
1965	6	46
1966	15	61[c]
1967	16	77
1968	7	84
1969	5	89
Non-users		9
Inadequate data		3

[a]Total includes number of first users during the year and number of users during the previous years. [b]1957 marked the opening of the Camiling River Irrigation system. [c]1966 marked the beginning of the introduction of modern varieties.

Table 7. Pest control during the 1979 wet season by 99 San Bartolome farmers, Tarlac province, Philippines.

Pest	Control method	Cases (no.)	Total frequency	Applications (no.)
Weeds	Pulling	49	67	1+
	Spraying	9	9	1
	Use of granules	4	4	1
	Spraying and pulling	33	92	3 (including 1 spray)
	Use of granules and pulling	2	9	4 (1 application of granules)
	No control	2		
Insects	Spraying	86	317	4
	Use of granules	1	4	4
	Use of granules and spraying	12	62	5 (4 sprays)
Rats	Zinc phosphide	30	32	1
	Ratoxin	10	11	1
	Other methods	52	126	2+
	No control	7		

During the 1980 dry season harvest, fields throughout the cropped area were surveyed for insect damage. Whiteheads appeared with modest frequency but little other direct evidence of insect damage could be seen. The spraying program in San Bartolome may have helped minimize insect damage but at a great cost in terms of labor and insecticide investment and possibly at a risk in terms of ecological balance. Little scope for improved yields is seen on this front.

Weeding

With weeding the picture differs from insecticide use. In San Bartolome, 14% of the farmers expressed a strong dislike of the task (Table 8). Weeding practices vary widely. One man said he truly enjoyed weeding the fields and spent at least 1 day each weekend in his 0.5-ha plot. Asked what method he used, he replied, "2-4 Dot" -- a local pun meaning pulling by hand. This man's yield of 5 t/ha in both the wet and the dry seasons put him clearly in the top quartile in terms of yield.

At the opposite extreme one farmer freely admitted he never weeded his farm because he "just did not like to do it." An inspection of his fields at midseason confirmed his statement. The rice was hardly visible among the weeds. His yield was in the lowest quartile.

Ninety-seven of 99 farmers claimed to have done some weeding. Techniques ranged from two farmers who used herbicide granules plus three hand weedings to two farmers who claimed they never weeded.

Many fields were heavily infested with weeds at harvest. Perhaps there is scope for increased yields in better weed control.

Rat control

Farmers see rats as the second most serious factor limiting rice production. Of 99 farmers 92 claimed to take individual action against the pest (Table 7).

Once a year the municipality of Mayantoc holds Rat Killing Day. Everyone spends the day in the fields and along the canals destroying rat burrows or smoking the rats out of the burrows and killing them. The mayor gives a small cash award for each rat tail turned in. San Bartolome also has a Rat Day similar to the Rat Killing Day in Mayantoc. These efforts are of modest success judged by the stories of barrels of rats killed in a single day. Many families claim to have the best recipe for cooking the rodents and many claim to eat rats that are physically killed. Great care is taken not to eat those that have been poisoned.

Visual evidence at harvest indicated at least modest rat damage in many fields. Here, too, there appears to be scope for more effective action and improved yields.

Land values

Land values at San Bartolome have shown remarkable increases over the years. Prices paid have traditionally been based on the quality of the plot as reflected in the expected yield and on the recent history of palay prices. The cash value of rice land in San Bartolome increased from ₱2,000/ha in 1959 to the seemingly extraordinary price of ₱22,700/ha in 1980 (Table 9). This represents an increase in perceived cash value of more than 11-fold in 30 years, or an average growth of 8.4%/year at compounded interest rates.

How does that compare with expected yields and prices?

Table 8. Attitudes of 99 farmers (93 spouses) toward farm tasks, San Bartolome, Tarlac province, Philippines, 1980.

	Attitude[a]	Decide crop varieties	Supervise hired labor	Plow	Plant	Weed	Spray and fertilize	Harvest and thresh	Others
Operators (n = 99)	+	67	73	76	54	65	71	70	28
	o	23	17	6	12	15	16	11	6
	-	2	2	8	11	14	7	5	6
	o	7	7	9	22	5	5	13	59
Spouses (n = 93)	+	19	20	1	37	33	23	40	18
	o	4	9	1	13	7	7	10	4
	-	2	3	4	7	10	5	1	4
	o	68	61	87	36	43	58	42	67

[a] + = strong liking for the task, o = modest liking for the task, - = dislike of the task, 0 = no expression of attitude.

In 1950 yields averaged roughly 1.8 t/ha and the selling price of land was ₱2,000/ha. When asked in 1970 about the value of their rice land the farmers agreed it was about "₱1,000 for every 460 kg of expected yield." This was supported by records of 5 land transfers within the barangay in 1970. In 1970 the mean yield of modern varieties during the main growing season was 3.4 t/ha. The added value associated with alternate-year dry season irrigation had been taken into account in the ₱1,000 price.

Even though no rice land was sold in San Bartolome during the 1979-80 crop year, farmers were in close agreement that the value was roughly ₱3,000/460 kg. Over a 30-year period the value based on expected yield had increased 6-fold. Over this same 30-year period, irrigation, better farming techniques, and improved seed had considerably increased the expected yield. Inflation rates had been high, rice prices had fluctuated considerably, the peso had been devalued, and even the size of the local measure had changed. In such a tangled economic web one wonders how the farmers could possibly assess the value of their land.

Interestingly the value of the peso had shrunk 6.1 times whereas the amount required to purchase land capable of producing 460 kg of palay had grown by almost exactly the same ratio. Farmers apparently have a clear picture of the value of the land they farm.

We noted earlier that Operation Land Transfer, instituted in 1972, did not apply in San Bartolome because there were no absentee landowners with large holdings. Had land been transferred under this operation, the absentee owner would have been paid at the level stated by the legislation. This rate was 2.5 times the gross annual yield or an average of roughly ₱15,000/ha at San Bartolome. At that price land would have been a real bargain.

Table 9. Rice land values in San Bartolome, Tarlac province, Philippines, 1936-80.

Dates	Mean price paid per ha (₱)[a]	Price/460 kg expected yield (₱)[a]
1936-40	600	300
1950-56	2,000	500
1957-59	3,200	800[b]
1967-69	7,500	1,000[c]
1979-80	22,700[d]	3,000

[a]1982 exchange rate US$1 = ₱7.26. [b]Price rise due to completion of Camiling River Irrigation. [c]Modern varieties introduced, yield up. [d]Value as estimated by operators; none sold in 1979-80. Mean value as defined by Operation Land Transfer = 2.5 x gross annual yield = ₱15,000.00.

Farm labor

A system of labor exchange (bayanihan) was a common practice in transplanting and harvesting in 1970 but was all but abandoned in San Bartolome in 1980. As farming practices became more intensive and pressures built to have even more precise timing of field operations, the system of mutual aid was apparently unable to cope. In 1980, professional crews, composed chiefly of local people, were available for transplanting and harvesting. The pay is in cash at ₱10/day and merienda (snack) must be included. Some families with small farm areas arrange to have all the work done by family members but this is the exception rather than the rule.

Threshing, except for malagkit (a glutinous rice) and seed rice, has been done entirely by machine for many years. In 1966 an enterprising resident of Mayantoc purchased a used large thresher (tilyadora) and began selling its services throughout the municipality. Business was so good that a second thresher was obtained the following year, and by the 1969 wet season, San Bartolome was served by six threshers owned by three Mayantoc residents. By 1980 the same 3 owners had a total of 8 machines available to the barangay. The threshers are so large and unwieldy that they cannot be taken into the fields, thus the farmer, with mutual aid from friends, had to haul the harvested rice to the thresher beside the road. Hauling is on sleds pulled by carabao.

Farmers like the tilyadora because they feel it saves time and labor. It also is less expensive than any other method. In 1970 the cost was 4% of the yield, paid in kind. By 1980 the cost had risen to 5%. In 1970 the San Bartolome barangay council collected from the owner of the thresher a tax of 2 centavos/46 kg palay threshed. That tax paid for the paving of the plaza and for other local improvements. After the martial law was declared the barangay council lost this source of funds. The tax now goes to the mayor of Mayantoc.

During 1973 and 1974 many farmers in San Bartolome bought small threshers that could be used in the fields. One of those men confided that after 1 year he sold his thresher because it was too slow and required too much work. Table 10 indicates that of 99 farmers only 1 owned a thresher in 1980 and it was so new that it had not yet been used.

Table 10 shows that most families own a carabao and about 40% of the farmers have their own hand tractor. Land preparation techniques vary from farm to farm and even on a given farm according to the soil condition and the water availability. One characteristic common to all farmers is the use of some combination of carabao and hand tractor in land preparation. Clearly carabao and tractors are shared among relatives, friends, and neighbors.

Nonfarm changes

Labor practices have undergone profound change, cash flows have increased markedly, and material

wealth is clearly evident in San Bartolome 1980. By 1970 this trend had begun but it accelerated during the decade to 1980. In 1970 about 30% of the homes had been rebuilt. Traditional raised bamboo homes of two rooms and a cooking area were being replaced by larger, more substantial buildings. The new homes were of cinder block and sawn lumber, many with jalousied glass windows. These were expensive homes for the time but much of the money remained in San Bartolome because most of the construction was done by local residents.

In 1980 it was clear that the trend toward better housing had continued. Few of the old style bamboo homes remained. Even the homes that were new in 1970 were overshadowed in 1980 by a number of fancy 2-story bungalows. Electricity had been brought to the barangay and was everywhere in evidence, most obviously in the rows of television antennas on either side of the streets.

In 1970 music could be heard in San Bartolome during early evening hours. About two dozen families owned battery-powered transistor radios, which were enjoyed by many. During the past 10 years larger and more powerful radios have been acquired by many families and more than one-thirds of the homes had television.

Table 10. Farm production equipment owned[a] in San Bartolome, Tarlac province, Philippines, 1900.

Item	No.	Mean value (₱)	Remarks
Carabao	128	2,250	Only 10 families did not own any
Oxen	7	2,000	All for fattening
Hand tractor	37	6,764	Two families owned 2 each
Sprayer	86	267	Three families owned 3 each
Harrow	18	58	
Plow	17	88	
Irrigation pump	2	8,100	
Thresher	1	10,000	Purchased in 1980

[a]Based on data from 99 completed surveys.

In early 1972 San Bartolome residents sold shares within the settlement and raised ₱50,000 which was invested in extending the electric lines 3-1/2 km to the barangay. The fact that these farmers, by 1970, had adopted modern varieties and new farming techniques and had learned that change could be rewarding apparently made them more receptive to other new ideas. In 1972 they were eager to work together to bring electricity to the settlement. Once electricity was available several neighborhood associations were formed to pump, store, and pipe domestic water to various homes.

Even as early as 1970 the increasing prosperity of the San Bartolome residents had not gone unnoticed among the itinerant peddlers who frequented the weekly market in Mayantoc. The new homes, the fine plaza, and the increased level of spending had induced a number of the more venturesome traveling sales groups to visit San Bartolome. The pattern was always the same. A jeepney equipped with a loudspeaker would drive slowly through the barangay with marshall and popular music alternating at top volume. Children and adults would follow it to the plaza where the huckster and his assistants would take over and with a combination of stories and blatant sales pitch spend the next hour entertaining the willing audience and selling a few bottles of their miracle medicine guaranteed to cure all ills. The products available did not represent a great variety nor were they of the best quality, but for the first time, the market had come to the barrio. Almost immediately the jeepney-based market had an impact on two of the three tiny shops (sari-sari) in San Bartolome. To protect their minute volume of sales, and with some hope of expansion, these two shops added soft drinks and a few extra canned goods to their inventories.

By 1980 two of the sari-sari stores had grown to the point where they provided considerable profit for the operators -- profit that previously had been made, if at all, by markets outside of the barangay. In both cases the daily sales were reported as between ₱100 and ₱200. At both shops the variety of goods was vastly increased over that available in 1970 and refrigerators made it possible to sell cold drinks and few perishables. At least four smaller sari-sari shops were in operation as well and at two sites groups of young women kept ice and sold halo-halo.

The appearance of material wealth within the homes was also greater in 1980 than had been obvious in 1970. Refrigerators, gas or electric stoves, and stereo sets were fairly common as may be seen from Table 11. Except for sewing machines and radios these are purchases made since 1970.

Table 11. Household equipment owned[a] in San Bartolome, Tarlac province, Philippines, 1980.

	No.	Age 0-5	5-10	>10
Radio	58	26	13	19
Television	34	23	11	0
Sewing machine	53	11	6	36
Refrigerator	23	18	5	0
Stove (gas or electric)	43	21	21	1
Electric fan	25	20	5	0
Stereo	15	12	3	0

[a]Based on interview with 99 families.

Balikbayan

How can rice farms averaging only 1.7 ha provide the level of living seen in San Bartolome? At the existing level of technology they cannot, at least not without some outside income. Of the 99 farmers interviewed at least 7 held full-time jobs outside the barangay: an engineer, a regional extensive coordinator, two schoolteachers, and an owner of a small transportation company. At least two families had income related to Mindoro migration -- one farmer in San Bartolome sold his Mindoro holdings and brought the money home, a second family received money from a close relative who had become successful in Mindoro.

At least 4 farmers, including a 78-year-old gentleman, had retired to take up farming in their native barangays. Pensions from the Philippine Constabulary and from the United States Navy were of great help in maintaining a life style of ease and comfort in San Bartolome. Many families had made heavy sacrifices to help their children become successful in medicine, nursing, or other professional fields. Of all the investments made by the farmers of San Bartolome this one may have returned the biggest dividends -- at least if money is used as a measure of success.

At least 8 of the 99 families volunteered the information that they had family members abroad. Indeed, during the interview period, two balikbayan (returning home) families arrived for vacation at San Bartolome. Most commonly the contacts are with the United States and are related to nursing or to medicine. One family reported a contact in Spain, another reported contact in Germany. In every such case identified, the overseas family member remitted sufficient cash to considerably help the family's day-to-day living. In one case a sister in the United States paid the complete cost of a water system serving six households. In another case a daughter had paid for a television set and an electric refrigerator.

CONCLUSION

In 1970 the strongly positive impact of modern rice varieties and of the accompanying new technology was already apparent both in the farm fields of San Bartolome and in the settlement itself. The mood was one of optimism and change was already apparent in a more cosmopolitan attitude, a greater concern for the political future of the nation, and a much increased acquisition of material goods. Fortunately the attitude in 1970 was also strongly biased in favor of education for the children (Huke 1974).

By 1980 the process of adoption of both seeds and farming practices was nearly complete. The rapid yield and production increases of the late 1960s and the 1970s have little prospect of continuing although lesser increments will help for many years. Unfortunately the rapid population growth so pronounced in 1970 has shown little indication of slowing by 1980.

In 1970 a farmer named Antonio neatly encapsulated the problem when he said, "It is too bad we did not have modern varieties a few years earlier -- then my wife and I could have had lots more children." That attitude has not changed and may yet bring disaster to San Bartolome and to tens of thousands of barangays in much of South and Southeast Asia.

The environmental resource base of land, water, and solar energy is fixed. The technological resource frontier has already achieved its great leap forward and only smaller steps are on the horizon. The human resource continues its exponential growth. The greatest hope for sustained well-being of tomorrow's citizens of San Bartolome appears to be increased help from outside.

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The International Rice Research Institute
P.O. Box 933, Manila, Philippines

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