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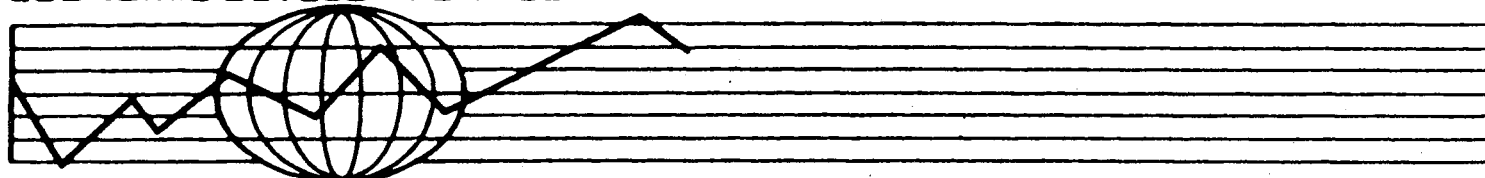
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ECONOMIC DEVELOPMENT CENTER



**THE AGRICULTURAL RESEARCH SYSTEM OF
THE PHILIPPINES: A RECONNAISSANCE REPORT**

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INTRODUCTION

The Philippines, like many other Asian countries have been facing a severe disparity in realized as well as prospective growth in the demand and supply of agricultural products. With population growth of approximately 2 1/2 percent per year and with very modest growth in per capita incomes, the demand for basic foodstuffs has been growing at roughly 4 percent per year. Over long historical periods no countries in Asia, or elsewhere, have been able to achieve a growth in the supply of agricultural products to match this. The U.S. and Japan, for example, have both averaged less than 2 percent per year in the growth of agricultural supply over the past century. A number of countries in recent periods have managed four to five percent growth rates, but not without major investment in irrigation and other forms of land improvement, in public infrastructure and in the development of new technology.

Economists now have completed a considerable body of economic studies which show very clearly that if low cost agricultural supply growth is to be achieved in Asia, investment in the production of new technology must be a central, indeed the central focus of a growth strategy. Something on the order of two hundred studies of the contribution of agricultural research to growth have now been undertaken. Research programs in many commodities and in many countries have been studied. With few exceptions these studies have shown that these research programs have produced agricultural supply growth. Furthermore, they have shown that the costs to an economy of producing such growth through research investment are a small fraction of the costs of achieving growth through alternative means. Put differently, the returns realized on investment in agricultural research have been estimated to be extraordinarily high (Everson, Waggoner and Ruttan, 1979).

Our objective in this paper is to provide a quantitative and qualitative assessment of past investment in agricultural research in the Philippines. Our focus is not simply on the quantity of resources being devoted to this activity but on the progress toward building on institutional capacity to conduct research and to direct research resources toward national objectives.

In the first section of this report we review the history of the agricultural research institutions in the Philippines because their current condition cannot be understood without attention to their history, including the role of the Philippine Council for Agricultural and Resources Research (PCARR) in aiding their development. Although our primary concern is with the Philippine national research institutions, we also consider the contribution and influence of the International Rice Research Institute (IRRI) to national program development. We then provide a quantitative and qualitative assessment of the current system. A further section briefly reviews the major commodity research programs. Although we are sketchy in these reviews, we believe some judgments regarding the quality and quantity of research by commodity is useful. In the final section we assess the state of development and discuss several policy questions for the future.

*This paper is based on a field review trip in August, 1980. This review was undertaken as part of the U.M. Asia Bureau Agricultural Research Review.

II. History

For perspective, we concentrate on three periods; 1949-1962, 1962-1972 and 1972-1980, which correspond roughly with international emphasis on building institutions, international research centers and national programs.

A. 1948-1962: Institution Building

Our major point concerning this period is the extent of the resources required to build the modest but significant research capacity in the country by 1962. The College of Agriculture at Loa Banos (UPCA) attained its capacity with considerable assistance from international agencies. Many graduate fellowships drawn from a national pool and several visiting scholars, notably from Cornell University, were instrumental in this development. Furthermore, most of these resources were concentrated on one institution, (UPCA).

In 1962 the second institution with significant research capacity was the Bureau of Plant Industry (BPI). This capacity was partially built before World War II as was the case with UPCA. In the post-1948 period, however, staffing and training was primarily from UPCA. In building this research system, relatively large investments in land and field plots were made by the BPI. In addition to the BPI, other agencies also developed limited research capabilities. These included The Bureaus of Animal Industry, Soils, Agricultural Economics and The National Irrigation Authority. If present conditions are a reliable guide, however, the research capacity of these units was modest at that time.

Before World War II, research on sugarcane was moderately well advanced in the Philippines particularly at Victorias Milling, a private firm. Efforts to develop a research capacity in the Philippine Sugar Institute were less successful.

By 1962 the Ministry of Agriculture had established many experiment stations throughout the Philippines. Most were staffed with personnel with limited research skills. Similarly, by 1962 the Philippines had built many vocational agricultural schools (later to become colleges) and agricultural colleges. Again, with few exceptions, staff members in these institutions were not research-oriented and were inadequately trained to undertake research.

This pattern of development is not unique to the Philippines. We believe it especially important to note the heavy reliance on institutions outside of the Philippines for graduate training and the fact that almost total support for this training was funded by aid agencies. At this point, Philippine political bodies were generally not willing to sustain the strong research centers that had been developed. They were, however, willing to support the smaller agricultural schools and regional stations which relied on genuinely low cost research personnel.

B. 1962-1972: International Centers Influence.

This decade is characterized by the following developments:

- 1) The first decade of IRRI's operations.
- 2) The further development of the University of the Philippines College of Agriculture at Los Banos.
- 3) The upgrading of numerous vocational schools to agricultural colleges.
- 4) The demise of formal institution-building programs by aid agencies and foundations.

The establishment of IRRI and its extraordinarily rapid success has profoundly effected the agricultural research system in the Philippines. This was the period of "green revolution" euphoria, and IRRI's public relations efforts partly created

the euphoria. Readers of the press can be excused for failing to note that rice research at the UPCA had, in fact, contributed greatly to improved rice production. The fact that the productive rice variety, C4-64, for example, was developed at UPCA at the same time as IR-8 at IRRI, and ultimately was probably a more important variety is not widely known.

During this decade the international agricultural development community turned to building International Research Centers. The institution building of the foundations and USAID, which had been important in the development of UPCA, were largely phased-out during this period. Loans replaced grants and research entrepreneurship became important. Only a few research institutions in the Philippines were organized to take advantage of them.

In some ways the end of this decade was the high point of development for the UPCA. Most of the original Ph.D. fellowships had borne fruit, and the college was developing many strong research and graduate programs. Most faculty were available full time and were dedicated to the teaching and research programs of the college. The UPCA had made great strides and deserved its reputation as a research center.

During this decade other agricultural colleges multiplied. By 1972 some 140 or more colleges, mostly former vocational high schools, were offering Bachelor's Degrees in agriculture. Although most of these programs did not prepare students for a career in research they responded to a demand for schooling in technical agriculture, which was in part created by research at UPCA and, to some degree, at IRRI.

This decade also showed a reduction in the sustained efforts by aid agencies to create centers of excellence in national programs. Many programs designed to strengthen national programs had run their course. The principal

attentions of the foundation and other international agricultural leaders were directed to the international system of research centers. The number of international scientists serving in national programs was sharply reduced. Perhaps as many as half of the staff members of the international centers in the early 1970's were formerly associated with national program development. A significant number of international center staff were Asians who might otherwise have been active in national program development.

It was also clear, by the end of this decade, that the international centers had effects on some local research programs which went beyond the diversion of funds and staff. UPCA's excellent rice research program was clearly affected by IRRI's presence. Indeed by the mid 1970's it had practically ceased to exist.

At the same time it was clear that national interests and concerns had grown during the decade. National entrepreneurship had grown as well. The growth in the agricultural colleges is one indication of this. Similar growth in extension services indicated that regional groups were interested in supporting extension and some very applied research.

C. 1972-1980: National Programs

This period is of most concern in this report. We see the major developments as:

- 1) The establishment of PCAR and later PCARR.
- 2) The effort to build regional agricultural research.
- 3) The reorganization of sugar and coconut research.
- 4) The growth of the agri-business sector.
- 5) The maturation of IRRI as an institution and its further effect on rice research in the Philippines.

- 6) The reorganization of UPCA as the University of the Philippines at Los Banos (UPLB).
- 7) The increased demand by regional institutions and international institutions for researchers at UPLB.
- 8) The increased demand for skilled researchers by non-research institutions.

We have a particular interest in PCARR's efforts over this period.

With limited authority, PCARR has attempted to achieve two major objectives. In collaboration with researchers it has attempted to select research priorities and then assemble more coherent and coordinated projects to achieve these priorities. Second, it has attempted to build stronger research institutions in the major regions of the Philippines. In building these institutions, it is employing a different strategy than was employed in the building of the UPLB units.

Specifically, it is relying almost totally on UPLB rather than foreign institutions for scientist training. It is attempting a low-cost expansion of the research system in a setting where most previous development has been a high-cost matter. The costs associated with a successful Ph.D. program in a U.S. university have been rising rapidly and are now on the order of \$75,000 presuming normal brain-drain type losses. Recent indications are that the relatively good experience with Philippine students returning to the home institutions may be deteriorating. (At least this appears to be the case in the social sciences.)

PCARR's strategy to attempt to rely on UPLB makes good sense provided that the graduate training capacity of UPLB can be strengthened. Direct costs are perhaps one-third as high as they are for internationally trained students and there is little loss of students to international agencies or U.S.

institutions. In fact, from PCARR's perspective, it could afford to spend as much or more to strengthen the capacity of UPLB as a graduate training center as it does on direct training support. This has not happened. Indications are that many UPLB graduate programs are not stronger than they were in 1972. A number of factors have been responsible for this.

The most fundamental change is the general increase in the demand for scientists for both scientific and non-scientific tasks. This increase in demand was partly created by the "success" of scientists as administrators and planners. It was partially due to the hiring practices of international agencies and the disruption of salaries that they created. It was also influenced by a shift toward "quick-fix" applied projects by international and national funding agencies.

The response of research systems to these forces, in many countries of Asia, has generally been inadequate to maintain and develop quality research institutions. When the salary structure is inflexible and out of line with markets, most research institutions turn to "multiple-job-holding" which destroys research and teaching institutions. The Philippines has used research honoraria to try to hold researchers' allegiance by making salaries more competitive. This tends, however, to encourage easily managed research projects and does not generally provide incentives for the concentration required for quality research.

Excess demand for Ph.D. level scientists, including social scientists, is pervasive throughout Asia. It appears to have become much more serious in the Philippines in recent years, and a number of important members of the academic community at UPLB are now on leave with international and regional organizations, adversely affecting the research and graduate teaching at UPLB.

As institutions such as UPLB have sought to expand programs, they have created new structures. The College of Development Economics and Management illustrate this. Once a Department of Agricultural Economics in the College of Agriculture, this unit is now a college with two institutes (ACCI and ARI), 3 centers and 4 departments. It offers 3 undergraduate and 7 graduate programs. This institutional organization would suit an institution with perhaps 5 or 10 times the faculty presently at UPLB. In fact, actual faculty strength is approximately the same as it was ten years ago because faculty are on leave and abroad for training. The College now has 125 graduate students, many from other Asian countries, and expects 200 in two years, all with the same faculty strength that taught 50 well 5 years ago.

We see the merit in effective organization, and much of the institutional development at UPLB has merit. It appears to us, however, that complex structures can be a burden when staff is scarce. In our judgment some UPLB units have suffered fragmentation of effort and increased administrative costs by complicating the structure.

In our perusal of research projects at UPLB and elsewhere, we note two trends that may have serious implications for the UPLB units. The first is a shift from traditional scientific disciplines toward a range of applied and broad research programs. The second is a tendency to invest scarce resources in some minor commodities, while neglecting some major commodities.

The shift from the traditional crop and animal improvement programs toward the cropping-system and various "integrated", "intensive" and "basic needs" programs has been heavily influenced by funding agencies. Despite the evidence that the traditional programs have been productive and that many rural development projects have not, funding agencies are attracted by newer programs. Indeed, much of the research that is ostensibly done in these

programs is not research in the conventional sense at all. It might better be called development or refinement and packaging of technology.

The traditional system of research and extension does not appear to work well when extension workers are poorly trained and have little experience on farms. It also does not work well without clients with political clout. The Philippines has both of these problems. In this situation, researchers and research institutions are motivated to move toward extension activities because they see clear opportunities to accomplish things.

Our concern that research is being damaged by this shift is not based on a judgment that the traditional research-extension system is optimal. It probably is not. Our concern is that scarce research skills are not being used to their best comparative advantage. In many fields the Philippines has a limited supply of scientists at the "research frontier". The demand for their skills as teachers and administrators is high.

PCARR has accomplished a great deal in the past several years and it has done this with very limited authority and in the face of a number of serious constraints. We are somewhat critical of certain of the forms which program development has taken, but not of the overall thrust of the development. With PCARR's assistance, some regional strengthening has taken place. It is probably true that the erosion of scientific staff associated with the salary structure has been alleviated somewhat by the form of research support and its use to bring net salaries more in line with market forces. PCARR has certainly increased the demand for graduate training at UPLB and at the Philippine centers and has probably assisted somewhat in increasing the supply as well.

We would note that while PCARR has regularized research funding and research planning, it has also created a lengthy process for project approval

and generally appears to have an administrative system which might be too large. This may be the result of the fact that PCARR has only indirect control over research funds for projects in a number of Ministries.

III. The Current Program: A Quantitative Assessment

We now turn to available data on research spending to draw some comparative insights regarding the system and its development. We are interested in the general growth of the system as well as in its regional and commodity emphasis.

Table 1 provides a summary of the overall growth in the Public Agricultural Research and Agricultural Extension programs in the Philippines measured in constant 1978 pesos. In the past 6 years of most direct PCARR involvement, crops research increased by roughly 60 percent, soils and related research increased by 70 percent while livestock research increased very little. Forestry research (not included in Table 1) increased by roughly 70 percent over this period and fisheries research (also not included) showed an increase of 250 percent.

Table 1 shows that the Philippines has emphasized extension programs to a much greater extent than research programs in its national efforts to improve farm productivity. This has been changed somewhat with the increased emphasis on research in the recent period. It appears that the Philippines is now spending less than half of one percent of the value of its agricultural product on research. This is low by international standards. Boyce and Evenson (1975) estimate that the Philippines was spending much less by this measure than the average for Southeast Asia in 1974. Expenditures on extension are also low by international standards. Other countries in the region appear to have been more extension-oriented than the Philippines.

Table 2 provides a reading on the regional distribution of research funds. It is pretty clear that the bulk of the research funding is spent at the national center programs primarily at UPLB. Some government research undertaken in Manila is included in the national figure. The Southern Tagalog region which includes Los Banos receives the most research attention further exacerbating the regional disparities. Almost 70 percent of the research budget of the Philippines is expended in the Southern Luzon region which includes Manila and Los Banos. These data suggest that from 1961 to 1971 some regions, notably the Visayas, were able to improve their relative positions. We do not have data for 1980 and thus we cannot make a definite statement regarding the effect that PCARR has had on the regional distribution. Our expectation is that the 1980 data will show a more equitable distribution.

The situation with respect to extension is quite different. Only 25 percent of the extension budget is expended at the national level. The discrepancy between the research and extension emphasis is particularly large in the northernmost regions, Ilocos and Cagayan Valley and in the southwest regions of Mindanao.

Table 3 provides calculations based on PCARR data showing expenditures by commodity. The column showing research spending as a percent of the gross value of the commodity in 1980 indicates a high degree of variation in research intensities. Commodities such as pineapples, bananas, citrus fruits and coffee appear to have very little research attention. On the other hand, commodities such as cotton, legumes, tobacco, rootcrops, vegetables and poultry receive relatively high research attention.

Calculations based on the data on commodity shares in research and in value of all commodities show that the congruence or matching up of research with commodity importance has worsened between 1973 and 1980. The correlations

between research budget shares and commodity value shares decreased from .91 in 1973-74 to .73 in 1980. Another statistic, the sum of the deviations between research and commodity shares also increased from .38 in 1973-74 to .49 in 1980.

These data tend to confirm our qualitative impressions. PCARR has generally encouraged a moderately rapid increase in real research investment. It has not, in general, achieved a closer matching of research spending with commodity importance. Some of the expansion has occurred in commodities of minor economic importance. In addition, the substantial reduction in rice research by the UPLB program has resulted in a decline in congruence between research intensity and economic importance.

IV. The Current Program: A Qualitative Assessment

After visiting experiments from Central Luzon to Southern Mindanao and from Panay to Bicol, and after evaporating away interesting but small matters, visitors from another continent retain nine observations.

The yeast is UPLB. Strategically located at the junction of the national metropolis and considerable farming, and given a half-century connection with a major university in the Western World, the agricultural school at Los Banos grew into a university, UPLB, capable of profound research. Presidents of provincial universities employ their honor graduates and then send them to Los Banos where they will acquire "research orientation", a procedure expedited by the scholarship of PCARR. In the provinces a visitor encounters the graduates of UPLB as he would encounter the graduates of St. Cyr if he were to visit the outposts of the French army. Clearly the dispersion or dilution of UPLB would be damaging.

Pay is complicated. In a technological age technocrats demand high salaries, and constrained by government standards the universities and the

Ministry of Agriculture have supplemented salaries with honoraria and allowed consulting fees to be sought. Honoraria are paid to teachers for performing approved experiments, and in the Bureau of Plant Industry two projects are expected for the normal salary and then honoraria given for additional ones. "No report, no honorarium" focuses the mind. As an economist would predict, staffs have turned eagerly to research and to such a source of honoraria as PCARR, easing its task of leading agricultural research. Consulting fees have made academics available for economic development by private firms.

Scientists employed by private firms or autonomous authorities are evidently paid higher salaries rather than paid low salaries plus honoraria, and their fields and laboratories were no less active for lack of the incentive of honoraria.

The observer instinctively feels that honoraria are a poor policy, but admiring the efficiency of incentives, he is uneasy about his instinct. Is his instinct wanting to be a gentleman above grubbing for money? Or, is it the union member's opposition to bonuses controlled by the employer? These are poor arguments against honoraria.

More respectable arguments can be made. Surely the school will find it hard to teach when the staff is away in pursuit of honoraria and fees. Surely the agency will find it hard to fulfill its mission when the incentives are in the hands of someone else. And surely the scientist will suffer pangs as he waters down his fixed stock of time to get more honoraria to buy a larger house. Nevertheless, the system was working in 1980. It allows flexibility in a rigid salary structure which would not otherwise hold scientists in the system.

The Bureau of Plant Industry BPI is competent. Employing competent people to work on governmental experimental farms in the hinterlands is

difficult. A corporate salary, an academic gown or the lights of the city cannot be offered. Further, the BPI has been wrenched by reorganizations. Nevertheless, the BPI produces new varieties of rice that compete with the best. One finds plots at a BPI station well designed and maintained. Some experiments are regional replications of a national plan. In other cases, the design is local; for example, in the Bicol, farmers were recruited at P500, assigned at random, and caused to produce rice by weekly, monthly and seasonal planting and harvest.

Evidently a natural role and sturdy people propel the BPI, and the Philippines are well served.

Confidence gets people to the field. In "To Feed This World" (John Hopkins, 1978) S. Wortman and R.W. Cummings wrote that basic farming skills generated the confidence to go to the field and work with farmers. Philippine scientists have abundant confidence in going outdoors and a persistent tendency to work with farmers or to bring farmers to training centers at the stations. Admirable conferences and manuals tell how to run field experiments.

Confidence in one's competence is necessary in the laboratory, too, and here lies a problem. The observer found laboratories unused and equipment unpacked because it might not work, and the observer guessed that if the scientists were as confident in the laboratory as in the field, a way would be found to push ahead. Conferences and manuals on laboratory experimentation might break the ice.

Erecting a building is easier than using it. This hypothesis would undoubtedly be supported by the presidents of an American university, doggedly trying to man and fill buildings built in palmy days. The hypothesis must be supported, too, by Philippine experience because there were little used laboratories in 1980 with equipment labeled for display rather than

worn by use. In 1971 investigators wrote "Problem 2. Major portions of research funds are spent for capital outlay", and 9 years later one sensed this was still true (The Philippine agricultural research system, 1971).

The leaders are thus wise in the planning and pride they invest in the PCARR scholars whom they hope to develop and keep, making their laboratories hum some day. Then they will only have the problem of getting essential but unglamorous supplies. Steady persistence rather than heady reorganization is required to enjoy this return on the investment in infrastructure.

PCARR is for policy. In 1971 the investigators of the Philippine agricultural research system who recommend the formation of PCARR found a conflict of interest in the National Science Development Board's both performing research and granting aid. Thus PCARR has been careful to keep to its coordinating and policy setting role and eschew research. This takes superhuman self-discipline.

Two pressures push PCARR from policy toward the bench or plot. The first presses on the curiosity of the individual scientist at a desk in a bureau. PCARR expects to relieve this by seconding staff to places where research is done. The second presses on the institution when a priority has been set, and no champion rides forward.

A gravity pulls policy makers downward toward detailed management, delaying and then stultifying scientists afield. The lengthy schedule of submission, review and decision published by PCARR is ominous.

The base of the triangle on the PCARR seal says "cooperation". In the field, workers generally praised PCARR's rationalization of the system. Nevertheless, two groups were found consciously and enthusiastically competing to produce the best variety of an important crop. It seems a credit to the sense of PCARR that their coordination has not eliminated the spur of

competition.

Researchers who are leaders are precious. Regional centers and national ones, too, are being formed from collections of neighboring institutions. The policy is to place a university person, an academic, at the head of each. This is rational in a nation with only 8% of its agricultural researchers holding Ph.D.'s (Manpower resources in Philippine agriculture, forestry and mines research, 1978, PCARR, Los Banos) and with manpower development paramount. Universities are first for teaching, however, and by placing an academic at the head, the Filipinos have produced a challenge for the leader of research, who must shine brightly enough from a subordinate position to assure research orientation. Fortunately, one finds Filipinas as well Filipinos with adequate candle power.

Scholarship is the foundation. "Relevance" is written on the seal of PCARR, and the visitor is struck by the education in management and the attention to planning achievements relevant to the public good. "Excellence", too, is written on the seal because, without excellence in science, the barges of management will sail -- but the contents will be wormy.

Scholarship assures excellence and begins with reading. The deficiencies in libraries were mentioned in 1971. Limited library facilities in many research institutions were still visible in 1980. Scholarship continues with the discipline of writing, criticism and then standard publication of findings in 1980 as they were in 1971.

Scholarship is easily equated with the overnice and impractical. PCARR was created to avoid these faults and assure an impact of research upon farming. Nevertheless, the books of the scholar and his publications are needed for Filipino science to feed upon international science and assure that its results are sound enough to be relevant.

The international agencies giveth and the international agencies taketh away. When one inquires as to the whereabouts of many key scientists and faculty members, one finds that they are often on leave or have recently resigned to take a position with FAO, the Asian Development Bank or another international agency. The very agencies which invested in the building of scientific enterprises now appear to be instrumental in their destruction. Filipinos are valued employees in these agencies without doubt. Given the critical importance of national institutions, one would think that a more coherent policy toward short and long term employment of key individuals would be consistent with that development.

V. Commodity and Program Observations

In this section we offer observations that are necessarily incomplete in nature. They do, however, provide more detailed information and comment than previous sections.

RICE

Rice is of great economic importance in the Philippines and much of the rest of Asia. By the early 1960's an effective Philippine national rice research program had been developed. Breeding programs at UPLB and in the Bureau of Plant Industry notably at Malagaya, were well developed. The fact that a number of important varieties, notably C4-64, were produced by this system in the 1950's and 1960's is masked by the success of the International Rice Research Institute and the publicity that attended it. The national program had, of course, by no means exhausted the large potential for variety discovery that existed in the early 1960's. Nonetheless, it was a strong program with attention to upland rice and intermediate depth rice.

The success of IRRI and the international attention paid to IRRI demoralized the UPLB rice research program. Some of this may have been unavoidable, but some was the product of the attention that naturally attended the early success stories of IRRI. IRRI has made large contributions to Philippines production and in many ways to agricultural research in the Philippines. It has trained many researchers and brought them close to researchers in other countries. Unfortunately the Philippine National programs have responded to IRRI's programs by withdrawing to a secondary role. At UPLB this has taken the form of shifting attention to "cropping system". Research in upland rice has been demoted to a minor role even though upland rice remains important. The BPI appears to have maintained a strong program in the Malagaya station.

Given the importance of rice and the differences in the missions of IRRI and the national program, it would appear the Philippine response to IRRI's presence has gone too far. A strong national program is important to IRRI as well as the nation.

CORN

Corn is the second most important grain in the Philippines. It is important both as a food grain consumed directly and as a feed for the expanding livestock industry.

Most publicly-supported research is at the UPLB College of Agriculture and the Institute of Plant Breeding (IPB). The Bureau of Plant Industry, BPI, does some corn research as do the Philippine Atomic Energy Commission and SMARC. Most of the effort is aimed at breeding high yielding varieties that are disease and pest resistant. There are breeding projects in white corn (for human consumption) and yellow corn (for feed grain). The breeding

projects are important because the low corn production in the Philippines is largely due to a lack of high yielding and disease resistant varieties.

Adverse soil conditions also have been an impediment to increased production in some areas. Recent research in micronutrients indicates that some of these problems can be overcome.

In addition to the usual problems of water and fertility that plague corn, the Philippines have a downy mildew, Sclerospora philippinensis, that destroys seedlings. They also have the distinction of discovering a race T of Helminthosporium maydis, which later caused the epidemic of Southern corn leaf blight in America. Control of these diseases allows the corn to survive to be attacked by corn borers.

In 1976 the Philippines produced about 2,800,000 metric tons of corn for food and feed. This was 43% of the rice production of the nation.

Thus yields of corn in the Philippines were only .87 T/ha in 1977 or less than half the world and a sixth of the American average yield.

Philippine corn yields versus rice and American yields were as follows:

	Corn	Rice
Philippine		
1977, T/ha	.87	1.96
Increase 1957-77, T/ha/yr	.015	.036
American		
1977, T/ha	5.71	4.94
Increase 1957-77, T/ha/yr	.130	.083

The potential for more corn in the Philippines seems great, whether judged by the rate of increase, by the 1977 yield or by comparison with

other nations.

In 1979 an inventory of public research in the Philippines showed P 4.5 million spent on research in corn. This was P 1.60 per ton of corn produced in 1976 and was about 5 times as much as the expenditure on research per ton of rice. At least three commercial concerns in the nation were developing improved hybrid and synthetic varieties.

Opinion is divided as to whether double-cross hybrids can be practical for wide use in the Philippines. The Downy Mildew Resistant DMR1 (yellow) and DMR2 (white) are composites. Tiniguib white flint developed at Southern Mindanao University is said to be resistant also.

In 1979 86% of the money for research in corn was spent at Los Banos in a rice region. This was caused by a concentration of scientists. There is a keen awareness of the disadvantages of developing varieties so far from the environment and pests of the major corn region in Mindanao. A classic problem in research, the attempt to create a center for corn research in Mindanao has been beset by the problem of recruiting staff for a frontier region far from the intellectual center of the metropolis. It is interesting that a substantial commercial effort by the San Miguel Corporation at producing improved corn has followed the same course: research is concentrated near Los Banos and field trials are performed in Mindanao.

The San Miguel corn research problem has a highly motivated and competent research staff. It is too early to predict whether they will be successful in bringing a private firm's incentives into the development of new technology. If the history of other countries is a guide, private breeding programs will probably play a major role in future achievements.

SUGAR

Sugarcane research in the Philippines has a relatively long history. The Victorias Milling sugar mill has had a research program for several decades. Until recently the Canlubang mill near Calamba had a program. Research in the public sector is concentrated in several stations operated by Philsucom.

Our general impression is that the private firms have succeeded in adapting varieties to local conditions but have not been major contributors to the international stock of high-yielding varieties. The public or semi-public research stations (Philsugin and now Philsucom) have apparently been unable to maintain the steady programs required to be major contributors to new technology.

Our impression of the current research programs at LaGranja and Victorias Milling were generally favorable. Effective research programs, perhaps more effective than at any time in the past, appear to be underway. Support for research appears to be available. If these programs can be maintained and strengthened, Philippine sugar production could be increased. The scope for gains in the Philippines appears substantial. It is our impression that the Filipino sugar industry, while managing some important gains, has lagged behind other countries in yield increases.

COCONUTS

With more than half of the world market and a natural comparative advantage in coconut production, the Philippines enjoy some monopoly power for coconut products. Until recently it has been complacent about exploiting monopoly power and increasing production efficiency. Few varietal advances

appear to have been made over the past 50 years or so. Although some improvement in disease control and in management and organization on plantation land have been made, the coconut industry has not, on the whole, been a dynamic sector of the economy.

Two recent developments appear to be changing this. The first is the introduction of dwarf varieties from the Ivory Coast and crosses between Philippine (Laguna tall) varieties and both imported and native dwarfs. It is early to judge the ultimate impact on Philippine coconuts, but it appears likely to be large. During our visit to the PCA station near Davao, we felt that new technology was being developed and modified and were impressed with new research that appeared well designed and responsive to the new genetic resources.

We have mixed opinions about the second development. This is the development of the Philippine Coconut Authority (PCA), which amounts to a "Marketing Board" in the African sense. On the one hand, PCA is supporting aggressive research. On the other, it is pursuing the course of other marketing boards, paying relatively low prices. Prices paid to producers were far below the world market at the time of our visit. This is justified by the PCA, which is presumably accumulating capital to finance replanting to improved varieties. Unhappily, such marketing boards do not appreciate the deleterious effects of low prices. Also they tend to devote their research to buildings, public relations and funds, while replanting and related practices tend to be undertaken inefficiently.

ROOT CROPS

Root crops research include both tropical root crops and white potatoes. There is little overlap in research in these two crop categories.

Most research on white potatoes is at the Institute of Plant Breeding (IPB) on the UPLB campus and the BPI station at Bagiuo, and other is in the College of Agriculture at UPLB and at Mountain State College of Agriculture. The BPI investigates production and utilization of potatoes for the highlands of Northern Luzon. Nine BPI researchers, none with training beyond B.S., are assigned to white potatoes.

The IPB effort is directed toward the introduction of new varieties, breeding, crop protection and development of heat tolerant varieties for the lowlands. Most of this research is directed by a Ph.D., who was trained as a potato breeder and has had some training at the International Potato Center in Peru. Although most IPB work seems well conceived, adaptation of potatoes to lowland conditions may be questionable, given the availability of tropical root crops.

Most research in tropical root crops is done by IPB and the Philippine Root Crop Research and Training Center (PRCRTC). In 1977 the PRCRTC was established at Visayan State College of Agriculture (ViSCA) near Baybay, Leyte to be a national center for research on tropical root crops. It is funded by PCARR and IDRC, with some contribution from such other agencies as the National Science Development Board (NSDB). The PRCRTC is undertaking germplasm collection, breeding, variety trials, protection and utilization. The staff includes 15 researchers and 30 other staff of ViSCA assigned to work on root crops. Most researchers hold M.S. and B.S. degrees. The current program has 53 titles, and despite its short history, it seem effective. Already, new varieties of cassava and yams are undergoing advanced field trials.

The present research is largely in the field. Although the laboratories have been built, the equipment and sometimes the personnel are lacking for

lab work. The field experiments appear well designed and tended. While most of the research is applied, some is concerned with fundamental problems. For example, there is a study of effect of the structure of the canopy on the yield of cassava.

The PRCRTC cooperates with six other institutions: Cagayan State University, Mountain State Agricultural College, UPLB College of Agriculture, Camarinos Sur Agricultural College, University of Southern Mindanao and Palawan National Agricultural College. Most cooperation is part of the program of varietal evaluation. UPLB will do some more basic work in genetics, physiology and biochemistry.

Using root crops for energy is receiving attention. It is hoped that root crops, which can be produced on poor soils, can be used for alcohol. In addition to the difficulties of producing alcohol from root starch, the Philippines has a land shortage not encountered in Brazil.

The results of PRCRTC research are published in *Radix*, a semipopular research news publication and the Annals of Tropical Research, the technical journal published by ViSCA. Some results are published in the Philippine Crop Science Journal and in proceedings of international symposia.

At PRCRTC the research is integrated into the international research programs on tropical root crops. In 1979, the PRCRTC was cohost for the 5th International Root Crop Symposium and it hosted the First International Symposium on cocoyam. The director of the PRCRTC is the secretary of the International Society for Root Crops.

In recent years tropical root crop research has expanded. As the PRCRTC program acquires laboratory equipment and staff training, the quality of research should improve. In time, the PRCRTC may contribute research on root crops that will have international importance.

VEGETABLES

Although vegetable research was not reviewed in detail, it is of economic and nutritional importance. In some parts of the Philippines, like the Central Visays, the lack of sufficient vegetables causes vitamin deficiencies.

Vegetable research is concentrated at IPB and some is done by BPI and the UPLB College of Agriculture. At IPB research is mainly in plant introduction and breeding. Cucurbits get the largest share of attention, crucifers get next, and attention is paid to other vegetables. BPI has a smaller, but more varied, research program that deals mostly with problems of production.

AQUACULTURE

Aquaculture is becoming an important source of food in the Philippines. Fish pens are already commercially important, and fish ponds are beginning to produce.

Aquaculture research, which includes both fish and crustaceans, is dominated by three units; the UP Brackishwater Aquaculture Center near Iloilo, the CLSU Freshwater Aquaculture Center, and the UP College of Fisheries. The Southeast Asia Fisheries Development Center, (SEAFDEC) an ASEAN funded institution located near Iloilo, also contributes to aquaculture research in the Philippines.

The Brackishwater Aquaculture Center and the UP College of Fisheries were not visited. In 1977 the Brackishwater Center had 6 scientists, four with M.S. training and two with B.S. training. At that time, the UP College of Fisheries had 8 researchers, all with B.S. degrees.

The CLSU Freshwater Aquaculture Center is growing. The Center has a well-equipped laboratory. The staff is well trained, two or more with Ph.D.'s and two more on leave for Ph.D. training. The research on high production in fish ponds appears effective.

SEAFDA is an international institution with an international staff from the Philippines, Japan and other ASEAN countries. It is not a large institution. In 1977, there were only 15 researchers at SEAFDC. The Center has reportedly had some administrative problems and has not lived up to its initial promise.

MINOR COMMODITIES

As noted earlier, we observed research expenditures on some commodities that currently have minor or negligible economic significance. Wheat, soybeans and cotton are examples. White potatoes also has large research program relative to its value.

One motive behind supporting research in these commodities is that research can make this commodity commercially important. The other is that researchers see the opportunity to develop a commodity that others are not working on.

Although the first is a reasonable motivation, history has produced few commodities brought to economic significant by research. Every country in Asia has hoped it could become another Brazil in soybeans, and none has succeeded. Surely, one would not expect the Philippines to produce wheat on a significant scale.

Stretching limited resources thinly over many commodities doesn't make sense.

SOIL

Soil scientists engage in research on crop production and in soil survey, conservation and testing activities. Although soil scientists are found in many agencies, the Bureau of Soils and the Department of Soil Science at UPLB are by far the leading units in soil science.

The Bureau of Soils performs research at labs in Manila and six field stations. The field stations have one to seven researchers, while the central laboratory has 37. In 1977 only 2 Bureau of Soils researchers had training beyond a B.S. Because pay is low, it is hard for the Bureau to get and retain good people. The field stations are far from the field stations of other agencies. This discourages communication about the problems of the regions, makes cooperative research difficult, and reduces the impact of the limited research of the Bureau.

With the demise of the Philippine Journal of Soil Science the opportunity to publish in a national professional journal no longer exists. The Bureau publishes Soils Technical Bulletin, but there appears to be little or no review of papers in this journal.

The Bureau continually updates soil surveys. The published soil surveys are only reconnaissance surveys that contain little or no laboratory data. Although they supply some information to researchers locating experimental sites and generalizing experimental data, their utility is limited. Also, most (if not all) of the old surveys are out of print and difficult to obtain. Although much of the Philippines has been surveyed at the semidetached (scale of 1/50,000) and this effort is continuing, surveys have not been published. To obtain information about the soils in a region, a researcher must go to the Bureau office.

The basic survey unit in the Philippines, as in the U.S., is the soil series. Soil series are useful in agricultural planning, research and recommending agricultural technologies. Potentially more powerful generalizations can be made using a soil classification scheme that groups soils together according to their chemical, physical and mineralogical properties. In the Bureau of Soils there is interest in adopting the USDA Soil Taxonomy in the Philippines, and a proposal has been submitted through PCARR. It was reported that an American reviewer questioned the availability of sufficient leadership to carry out the project. The adoption of the Soil Taxonomy has been hampered by the lack of mineralogical information; recent purchase by FAO of an X-ray diffractometer for the Bureau of Soils and the UPLB Department of Soil Science makes it possible to obtain the required information.

The interest in adoption of the Soil Taxonomy has been influenced by the Philippine participation in the Benchmark Soils Project. The Benchmark Soils Project is a University of Hawaii AID project to evaluate the usefulness of the Soil Taxonomy in agro-technology transfer.

Much of the funding comes through Hawaii, but the Philippines supplies local leadership and technicians. Until about a year ago the project leader was a UPLB teacher. Currently, the Bureau has the leadership role. Because only two Philippine soils are involved there is little direct gain to the Philippines. There are some indirect benefits, especially in training in use of the Taxonomy.

Bureau of Soil labs test soil for farmers and researchers. There are 29 labs with a goal of 80,000 samples per year. This is only 2,700 samples per year for each lab, a low level of utilization of the facilities.

The Department of Soil Science at UPLB is the only strong soils research unit in the Philippines. The department has about 10 Ph.D. scientists

and is reasonably well-equipped. Its work is widespread, some experiments being as far away as Palawan. The department, however, cannot possibly serve the needs of all of the Philippines.

Mountain State College of Agriculture, the only other teaching institution on soil science, is developing a research program. A recent Ph.D. from UPLB leads four scientists. This department should prove a valuable asset in the highlands of Northern Luzon.

The PHILSUCOM unit at La Granja has more than three soil scientists including one Ph.D. and two M.S. degree holders to work on soil problems associated with sugar cane. They have their own soil testing lab that competes to some extent with Bureau of Soils lab. La Granja is also developing its own soil survey because of the inadequacy of information from the Bureau of Soils.

AGRONOMY

Agronomy is loosely defined and it usually encompasses the studies of the production of grains and forages. This usually includes plant breeding but does not always include soil science.

Agronomic research is the responsibility of BPI, IPB, the Departments of Agronomy and Soil Science at UPLB, as well as many other research units throughout the country. BPI is the largest research organization in the Ministry of Agriculture. There are 20 BPI experiment stations and farms. The Central Experiment Station in Metro Manila has the largest staff, about 50. A few of the Central staff have M.S. degrees, but most BPI researchers have B.S. degrees.

The Maligaya Rice Research and Training Center is a large station with a staff of about 30 and is an important station in the National Rice Program.

Some rice varieties that were very popular in the past, and are still used, came from this station. The Maligaya station is also in charge of rice seed increase. Despite the modest resources, this rice program is functioning well.

The Department of Agronomy at UPLB has a highly trained staff, most with Ph.D.'s. The department has four divisions; Plant Breeding, Crop Production and Management, Weed Science and Seed Science and Technology. These divisions recently replaced the commodity alignments, and the new organization gives the department and the individual investigators more flexibility.

Several national journals exist for the publication of agronomic research: the Philippine Agriculturalist, Philippine Journal of Crop Science and the Philippine Weed Research Journal. Although the Philippine Agriculturalist is a well-edited journal, up to 2 years may pass before a paper is published.

FARMING SYSTEMS

The interest in farming systems is growing. In 1978 and 1979 more projects in farming systems were funded than before. This seems to be, in part, an outgrowth of the interest at IRRI in cropping systems as well as worldwide interest in research adapted to small farmers. The general approach is to take available technology (varieties, fertilizer practices, pesticides, etc.) and develop new cropping schemes that will improve the productivity of the small farmer.

The two largest cropping systems programs in the Philippines are the program of UPLB in the Department of Agronomy and the KABSAKA program in Iloilo, which is an IRRI-PCARR cooperation.

The KABSAKA program is a combination of adaptive research (trials) and extension. Recently the greatest effort has been in extension with the Bureau of Extension (BAEx) supplying the technicians. The goal has been to get farmers to change from the traditional single crop of rainfed rice, possibly followed by one upland crop to a two rice crop. This is possible because of new short-season varieties and the long rainy season in that area.

Dynamic leadership of extension no doubt contributes to the success of the project. The technicians and participating farmers seem highly motivated. Farmers report dramatic increases in income and many are satisfied that the extra effort in management of the new system yields worthwhile returns.

The KABSAKA system is limited to areas with long, rainy seasons and to lower land where water is available longer. There are also some soil limitations. Even with these limitations the KABSAKA investigators feel that the system can be used over much of Panay, and the project is being extended.

Farming systems programs can improve agricultural production, but they do rely on existing technology and may be useful under limited agro-ecological conditions. There is a danger that cropping systems research could starve the plant breeding, plant pathology and soil science programs.

ANIMAL SCIENCE

Animal Science was not reviewed in detail. The only research units visited were the carabeef research farm at Central Luzon State University (CLSU) and the Bureau of Animal Industry unit at La Granja.

The BAI has four stock farms, new units at La Granja, and a slaughter house laboratory. In 1977, the stock farms had from one to four B.S. researchers. The major emphasis of the farms appears to be genetic improvement

of the cattle in their regions. There is some work in artificial insemination.

The carabeef research farm at CLSU is just starting and building its facilities. The work appears well-conceived. The researchers hope that one result will be better use of the grassy hills of Central Luzon, and have promising results with legumes.

The UPLB beef and carabeef research includes the Department of Animal Science, the Dairy Training and Research Center (DIRI) and the ANSA Cattle and Crop Farms in South Cotabato. The work includes breeding, feeding studies and animal health studies.

The total research in beef and carabeef is small compared to the demand and small compared to the potential for the utilization of land that is unsuitable for intensive cropping.

ECONOMIC RESEARCH

Research in agricultural economics is moderately well-developed in the Philippines. The UPLB faculty includes several competent economists. The M.S. programs offered at UPLB are well-designed and produce skills on a par with comparable U.S. programs. The past research of the faculty has been useful.

The demand for Ph.D. agricultural economists in the Philippines is high. Several faculty members are on leave on short foreign assignments. Others have taken longer term positions with international agencies. The taking of leave on short notice is obviously deleterious to teaching and research. The turnover of faculty members moving to other positions is not necessarily bad, although the move to international agencies probably will not increase productivity.

Few economists and scientists move from Los Banos or Manila to regional institutions because incentives are inadequate. Most economists and scientists in the regional institutions are originally from the regional institutions and have strong ties to them. Development of these institutions, however, requires incentives to attract economists and scientists from the metropolis.

Research in Agricultural Economics has generally been oriented to commodities, especially marketing and price studies. The early studies of major commodities have been followed by studies of minor commodities.

Most research by graduate students is applied and generally valuable. In fact, some of the better research is part of graduate programs. The incentive system for faculty research encourages too many easily managed projects that rely on research assistants. Often reports are bundles of tables produced by assistants and inadequately analyzed by leaders.

On the whole though, economic research is viable in the Philippines. If the most recent batch of faculty training abroad returns, some strength lost through leaves will be restored. If this restoration does not occur there will be serious repercussions on the training of economists for the regional centers. (At present it appears that three or four key faculty members may be lost to UPLB. If this happens the program will be seriously weakened.)

VI. The Future

The broad picture that emerges from our survey of Philippine agriculture is:

1. A central research unit (UPLB) has developed research and training of international standing.

2. Outside UPLB the Ministry of Agriculture stations (notably BPI) are generally the most stable, and strongest research institutions. Although they are weak on laboratory work, they are strong on research in the field.
3. Outside UPLB, the academic institutions face challenges as they attempt to become first-rate research institutions. They are burdened by low salaries and by a tradition of being high schools and undergraduate colleges.
4. Presently both the UPLB and the regional institutions have been weakened by their inability to hold the devotion and energy of their staff and to concentrate on research. This is because their salary structures are increasingly incongruent with the market, exposing them to increased national and international raiding.
5. The policy milieu pulls skilled researchers toward the applied, even extension, end of the research spectrum. There is also a tendency to undertake work on unimportant commodities.
6. At present maintaining the scientific foundation of research and keeping up with scientific frontiers is not given high priority.

These characteristics of the Philippine system are not surprising. The development of effective research systems is hard. Other countries - including the U.S. - have gone through similar phases. On the whole, the Philippine system is in good condition and is one of the strongest in Asia.

As we see it, however, the picture obtained from studies of returns to agricultural research, and our assessment of the Philippine system is one calling for continued aggressive quantitative and qualitative improvements. The Philippines will rely, as other countries have, on two institutional

structures or mechanisms in achieving future quantitative and qualitative improvements. The first is formal planning and administrative institutions, i.e., PCARR. The second is the local political mechanism. International agencies will have some influence, but will not be dominant.

During the past several years PCARR has certainly been the dominant institutional force shaping the system. It has utilized international assistance and has responded to local political factors.

The organized national interest groups do influence the research programs; sugar and coconut research are obvious examples. As yet, however, strong regional groups pressuring for strong regional research institutions do not appear to have emerged. The "articulation" of clientele interests to research is thus weak. (See Evenson, Waggoner, Ruttan, Science 205:1101, 1979.)

In the long run this articulation of clientele interests guides research and the development of research institutions in appropriate directions, and it is hoped that it will grow stronger in the Philippines. For the foreseeable future, however, PCARR and the research institutions themselves will do most of the guiding. This situation has all the dangers of top-down administration and the tendency for public institutions to serve their own interests rather than those of their public clientele.

In noting this we are not suggesting that PCARR has fallen victim to these dangers. In fact, PCARR has been careful to consider a range of interests and to proceed in the larger public interest. For example, development of regional research has been aided greatly by PCARR, while it has regularized the research programs.

PCARR will oversee the next decade of development and further challenges to regional centers. Because of the basic stability of the Ministry of

Agriculture institutions, they will probably continue to be the major institution outside the UPLB. Some of the regional academic and research centers will realize gains according to their leadership, their ability to move people from metropolitan to the regions, and their development of research orientation.

In the next decade UPLB will have an even more vital role as the graduate training center. It will also have to lead in shoring up the scientific base, building new potential for applied research and maintaining a role in the international scientific community. This will require support for journals and libraries.

In our judgment, the next decade will require substantial support from international sources for the investments called for by the economic potential. Although PCARR can, and probably will, provide leadership and direction, it is unclear that the Philippine government will provide the full support required.

Generally international agencies have provided funds to establish programs and then transfer them to local governments to prove themselves. At a certain point they often wean a country from international support. This point often comes at the stage of the current Philippine research program, and many policy makers feel that the Philippine system should be weaned soon. We see further international support as vital for without it the system may stagnate for a decade as key scientists leave for more lucrative jobs in other national and international agencies. Judiciously placed funding for supplies and libraries will be critical to the development of regional centers, especially because they are not likely to be priority items to the national government.

In summary, the Philippine system has progressed, has leadership, has experience and has an institutional set-up conducive to further development. National and international funds will be well invested in achieving further development.

APPENDIX 1

SOURCES AND PROCEDURES OF CONSTRUCTING THE
RESEARCH AND EXTENSION EXPENDITURES SERIES

Principal Sources of Data:

The principal sources of data are public agencies and institutions doing either or both research and extension in agriculture, and those providing research grants in agriculture. The Budget Commission serves as source of reference for estimating data for some period in the series not available from the operating agencies.

The principal and direct sources of data by agency are as follows:

Bureaus of the Department of Agriculture

1. Bureau of Plant Industry, Dept. of Agriculture, Manila
2. Bureau of Animal Industry, Dept. of Agriculture, Manila
3. Bureau of Soils, Dept. of Agriculture, Manila
4. Bureau of Agricultural Economics, Dept. of Agriculture, Quezon City
5. Bureau of Agriculture Extension, Dept. of Agriculture, Quezon City

Commodity Institutes:

1. Philippine Tobacco Administration, Quezon City
2. Philippine Virginia Tobacco Administration, Quezon City
3. Philippine Sugar Institute, Quezon City

Commodity Institutes (Continued):

4. Philippine Coconut Authority (formerly Philcoa and Philcosin), Quezon City

State Colleges and Universities:

1. UP College of Agriculture, College, Laguna
2. University of Eastern Philippines, Samar
3. Central Luzon State University, Nueva Ecija
4. Central Mindanao University, Bukidnon
5. Mindanao Institute of Technology, Cotabato

Research Granting Institutions and Offices:

1. National Science Development Board, Biuutan, Taguig, Rizal
2. National Research Council of the Philippines, Bicutan, Taguig, Rizal
3. National Food and Agriculture Council, Quezon City

Budget Commission, Manila

Procedures of Series Construction:

The series was developed mainly by compiling basic data from the various sources, summarizing them by agency, then by regions. Where necessary, reference data from the Budget Commission were compiled and used as reference in interpolating or extrapolating for some periods with no available actual data from the agency concerned.

Within the agency sources, the data were obtained either from the auditing, or budget offices or both, depending on the agency concerned.

Other common sources include the annual reports, stations and regional reports, etc.

Department of Agriculture

The bureaus of DA that carry on both research and extension activities in Agriculture are the Bureau of Plant Industry (BPI), Bureau of Animal Industry (BAI), Bureau of Soils (BS), and Bureau of Agricultural Economics (BAEcon). The Bureau of Agricultural extension is mainly an extension agency, and does no research.

Accounting and budget records were the common sources of data compiled from the bureaus of DA. One of these and the most common principal source is the "Report of Operations" or Budget Form 133. This contains actual expenditures by quarter for the whole fiscal year by programs and projects. Research directors and other technical personnel provided helpful advice.

Bureau of Plant Industry (BPI). In addition to general "Reports of Operations", BPI Annual Report also indicates expenditures by program and project. From these sources and references we obtained the research and extension expenditures which are described as "Crop Research" for research and "Crop protection services" for extension.

BPI maintains regional experiment stations which carry on research and some form of extension. The biggest and most important of these are Maligaya Rice Research and Training Center (MRRTC), Bicol Rice and Corn Experiment Station (BRCES) and Visayan Rice and Corn Experiment Station (VRCES).

Reports of regional experiment stations and regional offices of BPI were the basis of the regional distribution of research and extension expenditures. The MRRTC, BRCES and VRCES data were obtained directly from the respective

accountants and directors in the region.

The scope of BPI research covers all crops but main emphasis since the 50's has been on rice and corn. Other crops specified in the budget allocation are tobacco and abaca.

Bureau of Animal Industry (BAI). Main source of data compiled in Accounting Division was the "Report of Operations" files. From these we obtained the research expenditures which were specified as a project. Extensions were estimated at 75% of "Livestock and poultry development services", and 50% of "Animal diseases and control services".

BAI maintains stock farms, breeding stations and breeding centers throughout the country. Thus in the absence of actual expenditure data reports by region, we calculated the regional breakdown of BAI research and extension expenditures based on the proportion of stock farm, breeding station and breeding centers for each region. There is one stock farm per region, several breeding centers in a region, and a breeding station in almost every province. The stock farm, breeding station and breeding center were each given the same weight in obtaining the proportion for each region. In turn, the regional proportion with respect to stock farm and breeding stations and centers was applied to the total expenditures to get the regional distribution.

Bureau of Soils (BS). Expenditures data were compiled from the Budget Division. The budget officers provided the necessary files of "Reports of Operations" and other financial records. Historical accounts of the research activities of the Bureau were provided by the Research Division Chief which together with a list of projects by year and by location serve as a guide in

our regional distribution of the research and extension expenditures.

As in the case of BPI and BAI, research expenditures are reported under one project/program of the "Report of Operations". But the extension expenditures were obtained from two categories which we calculated as 90% of "laboratory services" in addition to field fertilizer experiments which we treated as extension.

Bureau of Agricultural Economics (BAEcon). BAEcon, which just became a bureau in 1964, was formerly a division of DANR. Since then its activities have been to provide statistical services. Not much research was undertaken until the early 70's.

Bureau of Agricultural Extension (BAEx). The largest extension expenditure is from the BAEx - it being mainly on the extension bureau. Summary of total bureau expenditures from 1958-1973 were obtained from the Accountant through the Director. For the early years from 1952-53 to 1957, and to construct the regional series involved compiling and tabulating by regions from the Accountant's file of records.

Commodity Institutes

In the case of the commodity institutes (Philippine Sugar Institute, Philippine Tobacco Administration, and Philippine Virginia Tobacco Administration) the statement of expenditures provided by accountants includes both research and extension. Separating the two series again involves estimates on the proportion arrived at from the available records and from consultation with knowledgeable personnel. The proportion of research and extension expenditures in these agencies varies from year to year depending on their respective emphasis.

Philippine Tobacco Administration (PTA). The "Audit Report" and the accountant's financial statement were the main sources of data compiled. Research and extension departments in charge indicated that from the 1950's to the early 1970's, the proportion of expenditure allocation was about 50-50.

Research and extension budgets were separated only starting 1973-74. Before 1973 research and extension were combined into one.

Starting in 1960, with the creation of PVTA, PTA was mainly concerned with native tobacco. These native tobaccos are used as fillers in the manufacture of tobacco "sugar".

Philippine Virginia Tobacco Administration (PVTA). This tobacco agency was established only in 1960. It is solely concerned with the Virginia tobacco used in the manufacture of cigarettes. From 1960 to 1965, it was more of an extension agency, with little research.

Emphasis on research started in 1965 with the creation of a "development office" as provided for in R.A. 4155 which was approved in 1964. Extension and training was carried out by the branch offices.

To separate research and extension expenditures, proportions were applied from period to period. From 1960 to 1964 research and extension were 30-70, respectively; 50-50 in 1970-71, and 60-40 in 1972 to 1974.

In 1972 PD 166 provided for the undertaking of research - PVTA just started giving research grants in 1975.

Philippine Sugar Institute (PHILSUCIN)

Philsucin research and extension activities were reported to have commenced in 1955. The period 1955-1961 were the formative years; research and development was about 70% extension and 30% research. From 1962 to 1970

research increased in proportion, to about 70-30.

Data supplied by the accounting office indicated research expenditures by experiment stations, while extension expenditures by mill districts. An example of an extension activity is rain making.

Philippine Coconut Authority (PCA). The present PCA replaces the two predecessor coconut agencies. The first was established in 1953, and called PhilCOA; the second, called PhilCORI, was established in 1964 under NSDB.

Records of both agencies indicate that there was very little research on coconut under Philcoa. Philcorin did considerable research in the late sixties and early seventies, but it was concentrated in the Davao stations.

UnderPCA, starting in 1974, the coconut research was expanded, and the corresponding budget was increased significantly.

State Colleges and Universities

UPCA is the first among the State Colleges and Universities to undertake agricultural research and it was the only one with sustained and significant research programs. Other institutions with some research activities include Central Luzon State University, Central Mindanao University, Mindanao Institute of Technology and the University of Eastern Philippines.

The research and expenditure data of these agencies were obtained from their respective annual reports and from some accounting and budget reports in the case of UPCA.

Granting Agencies

The National Science Development Board, National Research Council of the Philippines and National Food and Agriculture Council are mainly research

granting institutions.

For MSDB and NRCP, research grants for agriculture were isolated by examining available lists of projects supported. NSDB accounting records of "Statements of Expenditures" indicate that agriculture, forestry and fishery research were combined. Thus, to isolate the pure agriculture research expenditures, we applied the known proportion to the total combined research expenditures, which vary from 75 to 95, an average of 90%, for NSDB from 1966 to 1972. For NCRP, only 20%, on average, of its research grant expenditures, was for agriculture. The agency is more concerned with basic research.

The NPAC research grants are mostly made at UPCA. These are all in agriculture, and mostly on rice and corn. Our data on NPAC research grants was obtained from the receiving institutions like UPCA and some bureaus of DA.

Budget Commission

Data obtained from the Budget Commission on the total expenditures (actual and estimates) of some agencies was used for reference purposes only. For some of the agencies with incomplete reports for some years or periods in the series, estimates were made from the known periods of research and extension proportions against the agency total. Based on these proportions of research and extension to total expenditures, we estimated the missing periods in the agency research and expenditure series from total expenditures reported in BC annual budget documents.

APPENDIX 2

NOTES ON INSTITUTIONS

PCARR

The Philippine Council for Agricultural and Resources Research (PCARR) was established in 1972 to coordinate research programs and to make research more cost-effective in producing new agricultural technologies. In this PCARR has been successful and in addition PCARR has succeeded in encouraging the beginnings of a decentralized research system. Agricultural research in the past has been greatly dominated by UPLB. The new research centers at CLSU, USCA, USM and La Granja have the potential to be very important in the agricultural development of their respective regions.

PCARR has succeeded in remaining as a coordinating body despite the suggestions that PCARR get involved directly in research. One exception appears to be the KABSAKA program in which IRRI funded personnel work under the direction of PCARR. There has also been the suggestion that PCARR personnel be given leaves of absence to conduct research or be given permission to conduct research in areas where no proposals are submitted. The strength of the PCARR role as a coordinating body would likely be reduced if PCARR personnel were in any way competing with other agencies for funding. The idea that it would be good for PCARR personnel to be experienced in research is not a bad idea, however, it is probably more important that coordination of research and participation in research remain separate.

Researchers, however, are not entirely satisfied with PCARR as a granting agency. The most apparent problems are the slow review of research proposals and the delays in the release of funding. The pace of the review process is a minor hindrance compared to the delays in funding. The yearly

dispersment of funds to the research units has been reported to be delayed as much as 6 months. This causes severe hardships for on-going research projects, especially those projects in which field work must be done. Some research organizations have large enough alternative sources of funds to support the PCARR projects until the PCARR funds are released. For some units this is difficult and the delays make it very difficult for researchers and their employees.

ViSCA

The Visayas State College of Agriculture (ViSCA) was established in 1973 on the site of a small agricultural college near Baybay, Leyte. It has now grown to 1,300 students and is the leading institution in the Visayas Coordinated Agricultural Research Program, ViCARP. Also located on the campus are the Philippine Root Crop Research and Training Center (PRCRTC) and the Regional Coconut Research Center (RCRC).

Leadership has been aggressive. In the short history of ViSCA an impressive physical plant has been built and is continuing to expand. Funding has been obtained from AID, IDRC and the World Bank as well as from the Philippine government. Although equipment and staff are lagging behind the building, there is vigorous effort in all. The PRCRTC was established in 1977 as a national center for research in tropical root crops. About four years ago the RCRC was established for coconut research for significant copra industry in the Central and Eastern Visayas. In 1978 ViCARP was established as a coordinating agency for agricultural research in the same regions. It is intended to coordinate research by the Regional Research Center at ViSCA, BPI, BAI, FORI and other agricultural colleges in the region.

The Regional Research Center is the research organization of the college and directs the research activities of the teachers. Some of the teachers also work with the Regional Coconut Research Center and PRCRTC. In number of projects, the research is dominated by rural sociology, socio-economics and corn and sorghum. Research is hampered by heavy teaching loads by most of the faculty. Over one-third of the research projects are research for B.S. theses.

The core staff of PRCRTC and the Regional Coconut Research Center have few teaching responsibilities and account for over half of the research

projects at ViSCA. The PRCRTC has a core staff of 15 and 30 other ViSCA staff contribute to the research. The coconut center has 13 staff. In all of the research units most researchers have M.S. or B.S. degrees with about an equal number of M.S. and B.S. degree-holders.

Research at the coconut center has not progressed far. This year the first nuts are being harvested from the first plantings of rapidly growing trees. Initial problems for the newly-imported Ivory Coast hybrids were caused by the coconut spike moth. While waiting for the trees to mature, the Center has been developing methods for selection of seedlings by farmers and developing a new copra drier. In general the coconut program appears to be well-conceived with modest and realistic ambitions.

The manpower development program of ViSCA is ambitious. Initially staff was hired outside ViSCA, but currently the emphasis is on advanced training for present faculty and on selecting graduates of ViSCA who will be sent for advanced training. Currently, 73 faculty are on study leave, 44 at universities in the Philippines, 24 in the U.S. and 5 elsewhere abroad. Even with enough money, development will be limited by the number of quality ViSCA graduates that can be attracted to the ViSCA faculty. For the next few years, ViSCA will graduate less than 150 B.S. per year. Like other colleges and universities, ViSCA has problems among their highly trained faculty. Some leave after fulfilling their contractual obligations, and it is reported that a few pay the required fee to buy out of their contracts. The major reason for leaving is a higher salary.

Building has provided more than adequate laboratory space (at least for PRCRTC and the coconut center). The space is under-utilized because of lack of equipment and manpower. Also, the lack of a 24-hour electrical service eliminates some laboratory investigations.

Library development is also active. The library has over 24,000 volumes plus over 400 titles of technical journals and bulletins. The present journals are adequate for most current research. The important abstracts are available as are the most important foreign journals. There is a program to obtain back issues.

The researchers at ViSCA have the opportunity to publish in the Annals of Tropical Research. ViSCA has published one volume, and it appears carefully reviewed and edited. The journal will publish papers from ViSCA as well as other institutions.

The ViSCA educational program is growing at a controlled rate. The current enrollment is 1,300. The demand for study at ViSCA is high and one student of 4 who took the entrance exam was admitted.

ViSCA boasts of being second only to UPLB in quality of research and teaching in agriculture. This appears to be a valid boast. ViSCA is already an important center for research and will likely continue to grow in importance.

University of Southern Mindanao

The University of Southern Mindanao (USM) located at Kabacan, North Cotabato, is the site of the Southern Mindanao Agricultural Research Center (SMARC). The president of USM is also the research director of SMARC. The research program at SMARC is the least developed of the research centers visited. The animal science unit has new buildings that are unoccupied and there are only the beginnings of a program. The crop research units have begun to occupy the new (A.I.D. built) buildings but the laboratories are not being used. The lab equipment that has been delivered remains in shipping crates. Some of the new (A.I.D. purchased) equipment is, however, inappropriate for the jobs that need to be done. For example, SMARC has two large grain drills that have no function in their program. Some of the field work is variety trials in cooperation with other institutions like the root crop trials done in cooperation with the Philippine Root Crop Research and Training Center. Other research projects like those in coffee, rubber, corn and sorghum are directed by USM staff. The field experiments were well designed but the effort is very small compared to the size of the USM faculty.

There are several problems that make it difficult for researchers at USM. The size of the college population, now 7,700, puts a large teaching burden on the faculty. The current policy is to restrict enrollment. The lack of library resources, also, makes research difficult. The USM library (including the SMARC collection) does not provide even the basic journals to support a research program. The relatively low level of training of the faculty is another problem. USM has a low percentage of faculty with post-graduate training.

The problem of manpower development of USM has been aggravated by the Muslim

insurgency in Southern Mindanao. There have been fewer incidents recently but the threat of insurgent activity is still real. This makes it difficult to attract and hold good faculty members.

Researchers at USM can publish their results in a new technical journal published by USM. This journal publishes papers much more quickly than the national journals.

Central Luzon State University

Central Luzon State University (CLSU) located at Munoz, Nueva Ecija is the site of Central Luzon Agricultural Research Consortium. The center directs the agricultural research of the University and coordinates research with BPI, BAI and other agricultural research units within the Central Luzon Region.

Much of the research of CLSU is oriented toward generating technologies that can be used by small farmers. CLSU has a brickmaking project and a demonstration farm where integrated farming and culture systems are evaluated and demonstrated to farmers. CLSU also has a carabeef farm, that is still under construction, where studies are on-going in breeding and pasture systems for the improved utilization of hilly land. Most of the research is done by researchers with B.S. and M.S. training. This research program will likely make a positive contribution to agricultural development in Central Luzon, but is not capable of generating new knowledge for long term continued development.

The strongest research program at CLSU is in the Freshwater Agriculture Center. This research program has a well-trained staff (2 or 3 Ph.D.'s with 2 more in training) and has good facilities. Progress is being made in the development of fish pond technologies. The potential for further development appears to be great.

LaGranja Agricultural Research Center

The LaGranja Agricultural Research Center (LGARC) was established in 1976 to bring together the research units of the Philippine Sugar Commission (PHILSUCOM), BAI and BPI that were already located at LaGranja. Later the UPLB College of Agriculture unit at LaGranja joined the consortium.

The total research staff at LGARC is 62. There are 2 Ph.D. researchers, 14 with M.S. degrees and 47 with B.S. degrees. The PHILSUCOM unit is the largest and the most highly trained group.

All of the research units have new buildings that are more than adequate for present needs. The BAI buildings have not been completed. The laboratories are quite well-equipped but appear to be under-utilized. For example, the soil testing laboratory will process only 5-600 samples per year in a well-equipped lab.

The PHILSUCOM research unit has a very active program both in breeding and in production technology. PHILSUCOM's breeding program has produced the most popular varieties for use in the Philippines and it is continuing to release new highly promising varieties. The crop production divisions are well-integrated with the extension arm of PHILSUCOM. A current project of the Soils and Plant Nutrition division is to produce a specialized soils map for use by PHILSUCOM extension technicians.

The BPI and UPLB units share the responsibility for research in upland rice, corn, sorghum, wheat tritacale, legumes, vegetables and root crops. The upland rice work is largely evaluation of IRRI varieties. A large fraction of the legume research is in soybeans.

The research of the UPLB unit is mostly varietal evaluation. In addition, the unit is a center for the farm practice training of UPLB College of

Agriculture students. A two-year college training program has been suggested. With the availability of agricultural training at other institutions on Negros it does not seem reasonable that such a program should be pursued.

The BAI unit has only one researcher. Another will be hired soon. This unit will operate largely as a stock farm for improvement of local cattle and swine.

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Table 1
Expenditures on Research and Extension
in the Philippines
Thousands of 1978 pesos

<u>Year</u>	<u>Expenditures</u>		<u>Expenditures as % of Value of Agricultural Production</u>	
	<u>Research</u>	<u>Extension</u>	<u>Research</u>	<u>Extension</u>
1953	4,880	11,500	.13	.30
1961	19,766	50,640	.24	.50
1971	31,720	76,640	.30	.70
1979	52,400	110,000	.45	.91

Table 2

Regional Research and Extension Emphasis

Year	Proportion of Agricultural Research Undertaken by Region									
	UPCA Manila	Ilocos	Cagayan Valley	Central Luzon	Southern Tagalog	Bicol	Eastern Visayas	Western Visayas	N&E Mineanao	S&W Mineanao
1953	58%	1%	2%	5%	22%	2%	1%	3%	3%	3%
1961	60%	2%	3%	6%	10%	3%	3%	6%	4%	3%
1971	49%	2%	2%	11%	15%	1%	7%	10%	2%	2%
1975	53%	3%	2%	12%	15%	2%	5%	5%	2%	2%

Source: See Appendix 1

Year	Proportion of Agricultural Extension Undertaken by Region									
	UPCA Manila	Ilocos	Cagayan Valley	Central Luzon	Southern Tagalog	Bicol	Eastern Visayas	Western Visayas	N&E Mineanao	S&W Mineanao
1953	30%	8%	5%	15%	11%	6%	6%	8%	6%	5%
1961	18%	9%	5%	18%	12%	7%	6%	9%	7%	8%
1971	25%	6%	5%	14%	16%	5%	7%	10%	6%	5%
1975	25%	9%	5%	11%	16%	4%	5%	9%	6%	9%

Source: See Appendix 1

Table 3

Public Sector Research

Commodity	Research Spending as a Percent of Gross Value by Commodity	Commodity Research Share in Total Research Budget		Commodity Share in Gross Value of all Commodities	
	1980	1973-74	1978	1973-74	1980
<u>Crops</u>		.44	.448	.592	.621
Coconut ^a	.125	.072	.058	.084	.087
Corn and Sorghum ^a	.132	.060	.039	.065	.065
Corn	.095				
Fiber crops	.994	.040	.041		
Abaca	.163				.007
Cotton	(High)				
Fruit Crops ^a	.087	.040	.026	.070	.078
Banana	.004				
Pineapple	.003				
Mango	.070				
Citrus	.046				
Other	.250				
Legumes ^a	1.28	.030	.051	.007	.008
Ornamental Horticulture		.002	.014		
Plantation Crops		.006	.011		.042
Rubber	.130				
Cacao	.206				
Coffee	.004				.037
Cereals	.047	.060	.047		
Rice	.034			.187	.169
Wheat	(High)				
Root Crops	.540	.014	.072		.030
Sugarcane ^a	.011	.058	.011	.050	.053
Tobacco	.594	.020	.034		.005
Vegetables	.430	.040	.044		.019
Fisheries ^a	.150	.080	.158	.118	.174
Forestry ^a	.190	.132	.144	.111	.092
Livestock ^a	.080	.170	.067	.177	.112
Beef - Carabeef	.035	.06	.021	.066	
Dairy			.009		
Pork	.070	.04	.007	.052	
Poultry ^a	.400	.04	.005	.047	.041
Pasture		.039	.021		
Socio-Economics		.050	.101		
Soil and Water Res.		.067	.072		

Sources: PCARR and Statistical Abstracts

^aThe correlation between shares in the research budget used in the value of all commodities was 0.91 in 1973-74 and 0.73 in 1980. The nine commodities correlated are identified by "a".

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