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9. ABSTRACT

The development and diffusion of new technology are critical ingredients for the expansion of agricultural production in LDCs. Improved technology can originate and spread in several ways--through farmers, industry serving agriculture, and public sponsored research and outreach activities. The effects of these three groups are often intertwined. First comes widespread folk technology, involving the adaptation of seeds, breeds, and practices to new locations. The second stage is an expansion of mechanical technology, developed by both farmers and industrial firms. The third stage involves the development of biochemical technology derived from a growth in scientific understanding. Some combination of the three stages may usually be found in any one LDC. The main institutional components of improved science and technology are research, education, and extension. A.I.D. has been involved in supporting all three institutional forms. Although the three components compete for resources, they can have a highly complementary effect when combined in the right balance. The authors of this report suggest that there is a need for more coordination of A.I.D.-sponsored research activities, both within the agency and with other sponsoring organizations; that the main educational needs in agriculture must be provided by indigenous institutions; and that a greater effort be made to reach disadvantaged students and to provide a practical perspective to their training. They also recommend more specialists for A.I.D. operations, especially in the areas of agricultural education and extension.

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DEVELOPMENT AND DIFFUSION OF NEW AGRICULTURAL TECHNOLOGY

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PREFACE

This paper was prepared as one of five background documents for the "AID Agriculture Development Policy Paper," May 1977 (draft 4).* It relates to functional priority 3, "Development and Diffusion of New Agricultural Technology," pp. 36-43. It was initially drafted before the policy paper was written, principally in December 1976, and has subsequently been revised in May and June 1977. The principal changes are in the first two sections.

The current draft is not an official A.I.D. policy statement. Official policy is stated in the document noted above. Rather, this paper presents the views and interpretations of the author (and other individuals who are cited therein). Hence its role is a background or working paper. While prepared as an adjunct to the policy paper, it is designed so that it may be read independently.

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* The other four papers are:

- Donald McClelland, "Asset Distribution and Agricultural Development."
- Martha de Melo, "Agricultural Planning, Government Budgetary Allocation and Pricing Policies."
- John Westley, "Rural Infrastructure."
- John Westley, "Marketing and Storage, Input Supply, Rural Industry and Credit."

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1. INTRODUCTION

The development and diffusion of new technology are critical ingredients for the expansion of agricultural production in developing nations. Science constitutes the theoretical underpinning for improved technology. Technology is in turn the application of science to real problems. Technology provides a way of doing things better - of producing an expanded quantity or improved quality of product.

Technology which is new to an individual farmer may not, of course, be new in an historical sense. Our concern will be with technology which is both new to him and represents an improvement over his current technologies. Generally this improvement will lead to expanded production at lower cost per unit of product. The result is a social benefit composed of returns to both producers and consumers. The benefits to producers, however, are typically more uneven than the benefits to consumers.

Improved technology can originate and spread in several ways. The farmer himself can be a source of improved technology. So can industry serving agriculture. Public sponsored research and outreach activities are of increasing importance in developing nations.

The effects of these three groups are ofter interwined in what is an emerging historical pattern. First comes widespread artisan or folk technology, involving the adaptation of seeds, breeds, and practices to new locations. The second stage is an expansion of mechanical technology, developed by both farmers and industrial firms. The third stage is the development of biochemical technology which is derived from a growth in

scientific understanding; public agricultural research and outreach activities have been particularly active in this area.[1/] In any one developing country, some combination of the three stages may usually be found.

The main institutional components of improved science and technology are research, education, and extension (or outreach). Each component is composed, to rather differing degrees, of the public and private sector.

- Research is concerned with the development of improved science and technology. It may be informal or formal in nature. Informal research is done by farmers, local blacksmiths, and others. Formal research, involving a more scientific basis, may be carried out by public institutions or private firms.

- Education is concerned with the formal teaching of science and technology, or laying the base for understanding each, generally in a formal public-supported institutional framework. Education may range from general scientific training at higher institutions of learning to relatively narrow training programs at non-degree technical institutes.

- Extension (or outreach) may be viewed as a non-formal form of education which usually takes place at the field or farm level. It may include demonstration activities on farms, experiement stations, or in training centers. Extension is concerned with the communication and application of improved technology at the farm level and the reverse process of communication between farmer and researcher. In some cases

much of this interchange is done by a public extension service; in other cases private firms or other institutional structures may be utilized. In Western societies, extension often includes more than agriculture: in the U. S., youth development (4-H) and home economics are major components.

The Agency for International Development (A.I.D.) has been involved in supporting, in varying degrees, all three institutional forms. Several recent Congressional actions provide a strong influence o A.I.D.'s activities in the field of agricultural technology. The two principal forces are (1) a Congressional mandate to focus on problems of the poor majority, and (2) the establishment of a Board for International Food and Agricultural Development (BIFAD) under Title XII of the Foreign Assistance Act.

- The Congressional mandate, development of which began in 1973, is a broad charge to A.I.D. to emphasize the poor majority in conducting its programs. A.I.D. is also to do more to enhance the role of women in the development process. In terms of technology, particularly research, this orientation is stated as follows in Section 103A of the Foreign Assistance Act:

> Agricultural research carried out under this Act shall (1) take account of the special needs of small farmers in the determination of research priorities, (2) include research on the interrelationships among technology, institutions, and economic, social, and cultural factors affecting small-farm agriculture, and (3) make extensive use of field testing to adapt basic research to local conditions. Special emphasis shall be placed on disseminating research results to the farms on which they can be put to use, and especially on institutional and other arrangements needed to assure that small farmers have effective access to both new and existing improved technology.

Further discussion of implications and various interpretations of the mandate will be provided in the next section.

Essentially all of A.I.D.'s work on agricultural science and technology was consolidated under Title XII ("Famine Prevention and Freedom from Hunger") of the International Development and Food Assistance Act of 1975. This act provided for the establishment of a seven-member advisory board to be selected from outside the federal establishment, particularly from American colleges and universities. The Board in turn was named in August 1976 and formally established in October 1976. The Board established two joint committees (with university, A.I.D., and USDA membership) in the spring of 1977: research, and agricultural development. The latter committee will give particular emphasis to within-country programs, and will have special responsibility for education and extension. Although the Board and the joint committees will have a pronounced influence on A.I.D.'s activities in agricultural technology in the future, they are still in the formative stage and will not be discussed in detail in this paper, except to note a few areas which may be of special interest to them. Details on the Title XII structure are provided in a recent report to Congress.[2/]

This report will focus on the three institutional components of new technology noted earlier (research, education, and extension) within the A.I.D. context. Three general considerations, however, need to be reviewed before going to a more detailed examination of each.

2. GENERAL CONSIDERATIONS

Evaluation of new technology involves three general considerations: an understanding of the distribution of benefits of new technology, review of their relation to current A.I.D. policies, and assessment of needs and balance.

A. Benefits of New Technology

The main effect of new technology is to bring about increased food supplies at lower costs per unit of product. Two groups benefit in the process: producers and consumers.[3/]

Those producers who first successfully adopt the new technology generally receive increased incomes (they do, however, take some technological risk). These benefits are lessened as more growers adopt the new practice and supplies expand, bringing prices down. The last farmers to adopt new technology, often the poorest (but not necessarily the smallest) farmers, generally receive the least benefit and may actually be disadvantaged. Thus the benefits of new technology to producers, contrary to popular belief, normally are ambiguous. Some farmers will be advantaged, others will be little affected, and some may be disadvantaged.

To the extent that the new technology brings about increased production and lower prices, all consumers of that good will be advantaged. Thus, in contrast to the production effect, the consumption effect is relatively unambiguous. The effect on consumers, however, will vary according to their income and consumption pattern. Lower income families spend a larger portion of their income on food. The following data from

a recent survey of 230 families in Cali, Colombia, are illustrative:[4/]

Average Family Income - U.S. $/Month -	Proportion of Family Income Spent on Food - percent -
29.55	86.6
56.39	65.5
89.49	63.7
161.41	49.9
382.33	34.7

A reduction in food prices, therefore, will have a significant effect on the poorer families. Obviously, the effect of lower prices on the poorer families will be greatest if it is concentrated in the commodities that they purchase in greatest quantity. In the case of Cali, these basic commodities included cassava, maize, plantains, potatoes, and rice.[5/]

In many evaluations of agricultural technology, and indeed in many A.I.D. discussions, emphasis has been placed on the evaluation of technology largely in terms of the effect on producers. The consumer effect, peculiarly, has received little consideration. Yet in many cases, the consumer effect is more significant. A recent study of semi-subsistence rice producers in the Philippines suggested that 80% of the total social benefits from technological change went to consumers and 20% went to producers.[6/] The division of benefits in other cases would vary according to (1) the degree the product is consumed by producers, (2) the extent to which the product is exported, and (3) the elasticities of supply and demand.[7/] Clearly, however, any socially responsible evaluation of research must consider the effect on consumers as well as producers.

A particularly sharp example of the trap that one can fall into

with partial analysis is again provided by Colombia. The development of high-yielding varieties of rice has led to a substantial increase in production on irrigated land, which is in the hands of larger and wealthier farmers. Meanwhile, rice production on upland farms, operated by smaller and poorer farmers, has declined abruptly - presumably because of the lack of comparable advances in technology. Thus the program would appear questionable from one social point of view. But a recent study has calculated that since 1968, the net savings to consumers in Colombia, due to lower prices, has been at $120 million (against a total research investment of about $4 million). Rice prices have been cut by about 40% in non-inflated prices. The benefits of the lower prices went largely to the lowest income, who eat the most rice. The poorest 25% of Colombian households, receiving only 4% of the nation's income, obtained 28% of the price-reduction benefits. The final and unanswered question is the degree to which the benefits to consumers were offset by presumed losses to the upland farmers. Unfortunately a parallel study was not made of the precise effests on the latter group.[8/]

A somewhat similar study of rice production in the Philippines has shown similar consumer benefits. But the fact that Philippine semi-subsistence rice producers consume a significant portion of their output has meant that the benefits have been much more equally distributed among producers. In fact, during the period from 1967 to 1970, when supply expanded faster than demand and prices fell by about 20%, the income position of small farmers improved relative to that of large farmers. Since 1970, however, demand has exceeded supply, and prices

have risen, providing a "large windfall gains to large producers who sell a major portion of their output, while providing little benefit to small semi-subsistence farmers." The results of this analysis lead the authors to conclude that:

> a critical factor for attaining a more equal income distribution in the developing economies is the intensification of efforts for developing improved technology for the subsistence crop sector to enable the supply function of major food staples to shift more rapidly than demand.

The caution, however, that if inequities are to be avoided for producers, it is vital that small farmers not be neglected in the process of technological development. Thus "efforts should be strengthened to facilitate the adoption of technological innovations by small farmers."[9/]

On balance it seems clear that most new technologies designed to increase food production will have a positive benefit for consumers and at least some producers. The distribution of benefits among producers will be more mixed, depending on the nature of the technology and economic and social conditions. But the effect on small producers need not -- contrary to some views -- necessarily be bad, especially under semi-subsistence conditions.

B. Relation to Current A.I.D. Policies

A.I.D. is operating under a Congressional mandate to aid the poor majority in developing nations to raise their living standard above subsistence levels. The poor majority is indeed a majority of the population in most developing nations. An A.I.D. statement on the

mandate states that:

> The poor majority is massive by any measure; it totals over 800 million people by our definition, or about three quarters of the total population of A.I.D.-assisted countries. More than 90% of some countries' population is in this group, while in other better off countries the proportion is far lower.

Several benchmarks are provided: the two of most relevance to this paper are per capita income below $150 per year (1969 prices) and a daily diet of less than 2,160 to 2,670 calories. The A.I.D. guidance states, moreover, that targets for A.I.D.-assisted programs and projects "to the greatest degree possible...should be the case in terms of their contribution to the long term--5 to 10-year--goals of improving the status of the poor."[10/]

All of this would seem to suggest a key role for improved agricultural technology. Improved technology can, as we have seen, benefit a broad range of consumers and producers. Improved technology is not, however, always a blessing or sufficient by itself. Its limitations and problems are well known and extensively discussed. Clearly technologies must be carefully selected and accompanied by other activities if they are to be of greatest benefit to the poor.

But even if these steps are taken, new technologies may not--as discussed in the previous section--be of equal benefit to all farmers or of great assistance to the poorest farmers in their role as producers. In some cases, the problem may simply be that some groups benefit relatively more than others.[11/] In other cases, however, some of the poorest farmers may actually be absolutely disadvantaged, either through a low price for their product or because of other actions induced by technological change elsewhere in rural society (such as, for example, changes in land

holding patterns or in loss of employment on other farms because of increased mechanization). The effect of landless laborers is difficult to predict.[12/] The answer to improving the lot of the poorest rural residents, therefore, is seldom to be found in simple technological fixes.[13/] A broader spectrum of economic and social forces and policies play a role in creating extreme poverty and therefore must play a role in solving them.

Just what proportion of assistance resources should be devoted to the poorest of the poor in comparison to the poor majority, or society as a whole is a difficult question to answer. But since appropriate agricultural technology offers promise of benefiting all consumers (particularly the poor), and most producers (except, perhaps, the very poorest), it should be considered of considerable social benefit. Exclusive preoccupation with the poorest of the poor, to the neglect of improved technology,[14/] could actually lead to a worsening of the lot of the poor majority.

Hence, it would seem appropriate for A.I.D. to emphasize agricultural technologies which would be of benefit to the poor majority as producers as well as consumers. This, in turn, might involve steps to (1) improve the crops and types of livestock which the poor majority raise and consume in the greatest abundance (such as sorghum or millets, with a caveat to be noted in fn. 19), (2) try to find ways of reducing risk of adopting new technologies, (3) try to develop increased tolerance to biological stress on the part of these plants and animals, to further expand work on biological nitrogen fixation, and (4) try to improve

technology information and delivery systems to poor farmers. Improvements in public services such as credit, irrigation, and marketing can facilitate these efforts.

Attempts should be taken to avoid developing and pushing technologies which will be almost exclusively used by large farmers or which will cause considerable unemployment (such as the development of large scale farm equipment such as self-propelled combines). Relatively simple forms of improved technology (commonly known as intermediate technology), both mechanical and biochemical, might receive increased attention. Socio-economic analysis of current farming practices and needs and of the probable effect of new technologies, could be of considerable value in guiding this process. These points have been generally recognized in recent A.I.D. agricultural science and technology programs.

C. Needs and Balance

While the overall need for improved agricultural science and technology in and for the developing nations is great, the specific needs do vary considerably by country. Some countries have a relatively good research/education/extension framework, and principally need additional funding for specific facilities and programs. Others have only the most rudimentary agricultural science and technology programs: they need help in building the basic elements as well as everything else. In other cases, a country may be relatively strong in one or two of the institutional components but weak in the third. And it must be noted that, in a broader context, agricultural science and technology is only one of many factors influencing agricultural production within a

country (many of the others being discussed in the "AID Agriculture Development Policy Paper" and the other four background papers).

Thus, some sort of balance will be needed (1) between agricultural technology and other development programs, (2) within the individual institutional components of agricultural science and technology, and (3) between science and technology (as defined on p. 1) within the agricultural sphere. No one can state with any degree of precision what the most appropriate balance should be for the LDC's as a whole or within specific LDC's. Only a few general observations can be made.

The first is that agricultural science and technology programs (particularly research) have been found to have relatively high rates of return, even if current figures are discounted to some degree.[15/] This suggests, as Evenson has noted, that there has been substantial public underinvestment in these areas.

Evenson has also found that the lower a country's income per capita the higher the proportion of the limited agricultural science and technology budget spent on extension and the lower the proportion spent on research. The reverse is found in higher income nations: the higher the income, the more spent on research as opposed to extension. These relationships are illustrated in Table 1. On this basis, one might suspect that the less developed nations may be relatively underinvesting in research (though one has to be careful in pursuing the matter too far because, in part, more of the extension function may be in private industry in the developed nations). Education also needs to be considered but we have no comparable data.

Table 1

EXPENDITURES ON RESEARCH AND EXTENSION AS A PROPORTION OF THE VALUE OF AGRICULTURE PRODUCTION BY PER CAPITA INCOME GROUP

	National Income Group -dollars-	Research -percent-	Extension
I	(> 1,750)	2.55	0.60
II	(1,001-1,750)	2.34	0.31
III	(401-1,000)	1.16	0.40
IV	(150-400	1.01	1.59
V	(< 150)	0.67	1.82

Source: James K. Boyce and Robert E. Evenson, National and International Agricultural Research and Extension Programs, Agricultural Development Council, 1975, p. 11 (Table 1.7).

The question of balance between science and technology is difficult to quantify. Technology in other than its most simple forms is dependent upon science. But science, especially the more basic forms, is less location specific than technology and hence may be borrowed to some extent from higher income nations. LDC's will, however, need some scientific capacity to be able to utilize research done elsewhere. And they will clearly need an ability to adapt and develop technology to local conditions. As Evenson and Kislev have stated, little outside knowledge of either form can be borrowed unless indigenous research is underway.[16/]

Time is also a factor. Improved agricultural science and technology takes time--generally years and sometimes decades--to develop. A.I.D./Washington and A.I.D./mission administrators, not to mention LDC officials, are usually in office for only a few years and place a heavy premium on showing results while they are still around. If agricultural science and technology has not, because of the existence of this attitude in the past, been well developed, then it is most difficult for it to be wound up to give quick products.

Of the three institutional components of technology, some would suspect that extension can perhaps be geared up the quickest. For many years there was a notion that there is plenty of improved technology around, in large part in DC's, and that all that is needed is an extension service to get the word out. This simply isn't so in most cases (one possible exception is the case of very simple technologies). As noted earlier, a local research base is usually needed in order to tailor the

technologies to local conditions. The staffing of this research activity requires educated scientists, some of whom can be expatriates. But the extension function, while perhaps not requiring such a high degree of scientific training, does require trained nationals. Hence both research and training must normally be in place before effective extension can be done. There are few quick solutions.

All told, then, questions of variable needs appropriate balance and timing present difficult challenges to any discussion of agricultural science and technology. While the more extreme imbalances may be readily noted, resolution and fine tuning present an extremely difficult policy challenge.

3. AGRICULTURAL RESEARCH

Agricultural research as discussed here primarily refers to formal public-sponsored agricultural research. Formal research may also be provided by the private sector, and informal research may be conducted by a wide variety of farmers and other groups.

A. Elements [17/]

The A.I.D.-sponsored program of agricultural research has three main institutional components: (1) contracts with American institutions, (2) multilateral grants to international agricultural research, and (3) bilateral grants and loans to individual developing nations. In each case, the primary focus is on devising techniques to increase the production (and in some cases the nutrient level) of food crops and livestock for consumption within developing nations. To the extent possible, it

encourages the production of basic food crops (wage goods) consumed by the bulk of the population. It is not oriented to the production of traditional export products or of non-food crops.

The research emphasis on food for domestic use is, suprisingly, somewhat new to many LDC's. For decades, relatively little agricultural research has been conducted in most developing nations, and much of what was done was devoted to export commodities.[18/] Food crops and livestock were largely neglected. This pattern did not begin to be materially changed until after World War II, and in some cases not until the 1960's. Led by the development of high-yelding varieties of wheat and rice at two international agricultural research institutes (CIMMYT and IRRI, respectively), there was a rebirth of interest in developing national agricultural research systems to focus on food commodities for domestic consumption.

There is at present an emerging global agricultural research system composed of both LDC and international research programs, as well as research organizations in developed nations. There are also some regional or multi-country research activities. The various components are loosely linked together in various research networks. Except for some of the research effort in DC's which is science-oriented, most of the focus is on developing improved technology for increasing food production. As the global system develops and matures, it may be necessary to give more attention to expanding more basic or scientific forms of research (IRRI and CIMMYT are currently finding this to be the case).

A.I.D. contributions to this process were rather limited until about 1969. Shortly after the formation of A.I.D. in 1961, the need for a centralized research program was realized. A program was established in 1962 but initially had some severe management problems. Moreover, it was discouraged from doing research on crops in world surplus, a category which was defined as including wheat and rice. There was also an overall limit on the amount spent on research. Nevertheless, about $22 million was spent on agricultural and nutrition research, principally (if not entirely) with U. S. institutions, over the seven years from 1962 to 1968, an average of about $3 million per year. Expenditures jumped somewhat in 1970 to about $5 million, then held relatively steady until 1974 and 1976 when they jumped again to $8 million and $10 million, respectively (Table 2). Bilateral grants and loans by regional bureaus (including country missions) during the 1960's are not known but were probably modest.

Beginning in 1969 the constraint on support of research on wheat and rice was removed, and A.I.D. began to make substantial contributions to the international agricultural research centers. In 1969, it gave $425,000 to CIMMYT; in 1970, it provided a total of $1.68 million to 4 international centers; and by 1971, this contribution increased to $2.98 million. In 1971, the Consultative Group on International Agricultural Research was formed. Subsequent A.I.D. contributions to the centers under the aegis of this group are presented in Table 3.

While the international center contributions may have taken the spotlight during the 1970's, A.I.D. also has mounted a very significant

Table 2

FUNDING FOR AGRICULTURAL AND NUTRITIONAL RESEARCH CONTRACTS ADMINISTERED BY THE TECHNICAL ASSISTANCE BUREAU, A.I.D. 1/

FISCAL YEAR	Agriculture	Nutrition	Total
		- millions of dollars -	
1962-1968	19.630	2.330	21.96
1969	3.500	0.220	3.72
1970	4.574	0.603	5.177
1971	4.528	0.738	5.266
1972	4.927	0.703	5.630
1973	5.624	0.785	5.409
1974	7.632	0.901	8.553
1975	8.060	0.317	8.377
1976 (obl.)	8.068	2.049	10.117
1977 (auth.)	7.110	0.995	8.105 2/

1/ Excludes contributions to international centers (Table 3).
2/ Plus $2.5 million for Title XII, for a total of $10.605 million.

Source: 1962-1975. From table provided by John Ryan of TA/PPU, October 21, 1976.
1976, 1977. Compiled from data provided in "Project Breakdown by Cluster," TA/PPU, September 30, 1976, Table F.

Table 3

AID GRANTS TO INTERNATIONAL AGRICULTURAL RESEARCH CENTERS AND PROGRAMS*

	Fiscal Year					
	1972	1973	1974	1975	1976	1977
	- thousands of dollars -					
Sponsored by CGIAR**						
Centers						
IRRI 1/	750	725	1,100	1,925	2,150	3,000
CIMMYT 2/	1,090	1,500	1,350	1,765	2,550	2,900
IITA 3/	746	1,200	1,500	2,080	2,500	2,850
CIAT 4/	721	875	950	1,230	1,700	2,340
CIP 5/	100	340	550	575	1,000	1,450
ICRISAT 6/	100	745	1,000	2,060	1,900	950
ILRAD 7/	-	-	342	540	1,500	1,200
ILCA 8/	-	-	100	140	1,200	2,100
ICARDA 9/	-	-	-	50	200	1,000
Programs						
WARDA 10/	-	-	108	120	90	250
IBPGR 11/	-	-	-	80	200	200
CARIS 12/	-	-	-	90	-	110
Subtotal	3,507	5,385	7,000	10,655	14,990	18,350
Outside CGIAR						
AVRDC 13/	600	600	600	600	600	600
IFDC 14/	-	-	-	4,100	5,100	5,700
Subtotal	600	600	600	4,700	5,700	6,300
Total	4,107	5,985	7,600	15,355	20,690	24,650

* Contributions to capital construction/equipment and core operations through Technical Assistance Bureau. Excludes special projects and other activities.

** Consultative Group on International Agricultural Research.

1/ International Rice Research Institute, Philippines.

2/ International Maize and Wheat Improvement Center, Mexico

3/ International Insititue of Tropical Agriculture, Nigeria.

4/ International Center for Tropical Agriculture, Colombia

5/ International Potato Center, Peru.

6/ International Crops Research Institute for the Semi-Arid Tropics, India.

7/ International Laboratory for Research on Animal Diseases, Kenya.

8/ International Livestock Center for Africa, Ethiopia.

9/ International Center for Agricultural Research in Dry Areas, Lebanon, Iran, Syria.

10/ West Africa Rice Development Association, Liberia.

11/ International Board for Plant Genetic Resources (Genes Board), FAO.

12/ Current Agricultural Research Information System, FAO (temporary sponsorship).

13/ Asian Vegetable Research and Development Center, Taiwan.

14/ International Fertilizer Development Center, United States.
Plus $1.8 million in interim quarter (between FY 1976 and FY 1977).
Includes $8.8 million for capital construction and equipment (completed in FY 1977).

bilateral program of loans and grants for agricultural research and for the support of agricultural research systems in the developing nations. The major loans and grants made in prospect for the 1970's are summarized in Table 4. The value figures generally include research and research-related activities (as indicated in the footnotes).

Altogether A.I.D. currently has a very extensive program of contract, multilateral, and bilateral support to agricultural research in and for the developing nations. In virtually every case, the activities are oriented to the basic food needs of the bulk of the population. Where feasible, a low-income orientation is now stressed. This involves selection of commodities grown by poor farmers.[19/] and, where possible, attempts to reduce reliance on purchased inputs (through, for example, breeding in tolerance to water and temperature variations, resistance to insects and diseases, and attempts to seek biological forms of nitrogen generation), or production systems that can be used on smaller farms (such as multiple cropping). It is not possible, however, to divorce farmers completely from the needs for purchased inputs, nor will it be possible to easily or routinely develop technologies for the sole benefit of the poorest farmers.

B. Issues

While it might be argued that the current A.I.D. agricultural research package is realistic, productive, and socially responsible, this does not all mean that no significant policy problems exist. Current issues might be grouped under two headings: balance and linkages, and coordination.

Table 4

MAJOR AID GRANTS AND LOANS TO DEVELOPING NATIONS FOR AGRICULTURAL RESEARCH AND RELATED ACTIVITIES[1]/

(Proposed Projects, as of November 1976, in Parentheses)

Region and Country	Grant		Loan		Total
	Amount thousands of dollars	Period Fiscal years	Amount thousands of dollars	Date Agreement Signed	Amount thousands of dollars
ASIA					
Bangladesh	2,561	1976-78	4,000	3/29/76	6,561
Indonesia	1,540	1971-78	-	-	1,540
Indonesia 2/	(1,800)	(1978-82)	(7,000)	(proposed)	(8,800)
Korea	-	-	5,000	1/28/74	5,000
Nepal	5,000	1975-81	-	-	5,000
Pakistan 3/	2,696	1969-79	7,600	4/30/74	10,296
Philippines	806	1975-78	5,000	12/23/75	5,806
Philippines	-	-	(10,000)	(proposed)	(10,000)
Sri Lanka 4/	-	-	(4,200)	(imminent)	(4,200)
Subtotal*	12,603		21,600		34,203
NEAR EAST					
Afghanistan 5/	(15,000)	(1977-82)	-	-	(15,000)
Egypt 6/	8,000	1976-81	-	-	8,000
Egypt 7/	(1,600)	(1977-82)	-	-	(1,600)
Morocco 8/	(2,550)	(1977-82)	-	-	(2,550)
Yemen 9/	1,730	1976-81	-	-	1,730
Yemen 10/	2,792	1976-81	-	-	2,792
Subtotal*	12,522		-		12,522
AFRICA					
Lesotho 11/	(6,373)	(1978-82)	-	-	(6,373)
Liberia	(3,424)	(1978-82)	-	-	(3,424)
Sierra Leone	(4,000)	(1977-81)	-	-	(4,000)
Tanzania	3,860	1971-82	-	-	3,860
Regional:					
-East Africa 12/	4,788	1972-81	-	-	4,788
-West Africa 13/	3,636	1970-76	-	-	3,636
-West Africa 14/	4,542	1975-79	-	-	4,542
-West Africa 15/	(6,500)	(1977-81)	-	-	(6,500)
Subtotal*	16,826		-		16,826
LATIN AMERICA					
Brazil 16/	-	-	11,930	3/9/71	11,930
El Salvador 17/	-	-	4,000	11/30/72	4,000
Honduras 18/	(1,200)	(1978-80)	-	-	(1,200)
Paraguay 19/	(1,100)	(1978)	(5,500)	(proposed)	(6,600)
Uruguay 20/	-	-	4,850	12/5/75	4,850
Regional: 21/					
-Central America	1,580	1975-78	-	-	1,580
Subtotal*	1,580		20,780		22,360
TOTAL*	43,531		42,380		85,911
Total Proposed	(43,547)		(26,700)		(70,247)

*Excludes proposed projects.

1/ National and regional projects funded by regional bureaus. Virtually all projects include an outreach component; some include other activities. Where the research component is thought to be less than 85% of the total, an estimate of the research portion is indicated in the footnotes. The research portion of some proposed projects is not clear yet.

2/ Sumatra (outer islands) agricultural research project (principally rice).

3/ About 56% of grant ($1.5 million) for research. In addition, a grant of $7.4 million in local currencies was made in 1974.

4/ Rice research. Awaiting signature in Colombo.

5/ Agricultural research and development. About 50% research.

6/ On farm water use and management. About 60% research.

7/ Rice research and training. About 80% research.

8/ Applied rainfed agricultural research. About 70% research.

9/ Tropical and subtropical horticulture. About 50% research.

10/ Sorghum and millet. About 50% research.

11/ Farming systems research.

12/ Food Crops.

13/ Major cereals.

14/ With the West African Rice Development Association (WARDA). (Exclusive of grant made through the CGIAR).

15/ Semi-arid food grains. About 75% research.

16/ About 80% research.

17/ Research, education, extension. About 40% research.

18/ About 50% research.

19/ Research and technical assistance. About 66% research.

20/ About 60% research.

21/ Development of small farmer cropping systems at CATIE. In addition, a grant of $1.66 million has been made to CATIE to develop a Central American system for agricultural research and information management.

Source: Data provided by regional bureaus.

(1) Balance and Linkages

We have seen that the A.I.D.-sponsored agricultural research program has three main components: (1) contracts with American institutions, (2) multilateral grants to international agricultural research centers, and (3) bilateral grants and loans to individual developing nations. With the establishment of BIFAD and a Joint Research Committee, the first category is expected to be modified or enlarged into a program of joint collaborative research projects, generally with developing nations but also possibly including the international centers (thus the above distinctions will become blurred).

The three activities in turn raise a number of questions of balance and linkages. One of the most obvious might be: there is an appropriate balance of financial resources between the three? To even begin to respond, one should have an idea of how much is being spent on each per year. This is easy to document for the first two categories (Tables 2 and 3), but more difficult to do on an individual year basis for category 3. A preliminary tabulation, including a crude estimate for category 3, suggests the following breakdown: 20/

Item	Category	FY 1976	FY 1977
		- millions of dollars -	
1	Contracts with U. S. Institutions (Table 2)	10.1	8.1
2	International Centers (Table 3)	20.7	24.7
3	Bilateral Grants and Loans to LDC's (*)	20.0	17.0
4	Research Program Grants (Title XII) (Table 2)	-	2.5
	Total	50.8	52.3

*From Helen Wilson, TA/PPU, November 15, 1976. 1977 figure is upper variant of estimate range.

With the exception noted above, items 1 and 4 might be considered similar. Item 3 was lower in FY 1977 than in previous years for no particular reason.

In the future, item 2 (international centers) would be expected to grow moderately, while larger relative rates of increase would be expected in the other three items. If the past policy is followed with respect to the international centers, the U. S. contribution of up to 25% would be conditioned by the rate of increase of other donors. The other three categories do not involve a similar matching and hence could be more variable; they could conceivably absorb enormous funds, especially at the level of LDC research systems. It is not clear at this point what the precise balance between the four should be, but certainly the overall research input should continue to be substantial and of high priority.

More subtle questions concern other aspects of balance. How should the A.I.D. research effort be apportioned between problem areas or disciplines? How much, for example, should be spent on biological science as compared with social sciences? How much biological research should be devoted to plants as compared with livestock? And how should the funds be allocated among individual commodities (see fn. 19)? An emerging question might be: how much of the efforts should go into interdisciplinary team efforts as compared to traditional disciplinary approaches? Or how much attention should be given to an interdisciplinary effort in crop X as compared to work on cropping systems (e.g. multiple cropping) or on farming systems (both crops and livestock)? These questions may appear simple but, beyond obvious distortions, much more complicated when examined closely. This is an area which is just beginning to attract research attention.[21/] Answers will in part depend on

A.I.D.'s global strategy and the strategy adopted at the country level.

Two other questions of balance might be considered. First, the value of bilateral grants and loans is about equal at present, but the grant proportion of proposed projects is much higher (Table 4). Does this suggest any policy issues or is it merely a reflection of a higher proportion of low income nations? A second and more difficult question is whether grant or loan funds should continue to be tied to foreign exchange costs or whether a larger portion should be made available for local costs - or even for recurring operational costs?

All of these points have concerned the balance within the area of research. Even more difficult questions come into play when we consider the balance of research with education and extension, and in turn with other agricultural development activities.

(2) Coordination

Some coordination of AID-sponsored research activities, both within the agency and with other sponsoring organizations, is clearly desirable. But just how far the coordination process need go is open to discussion.

Just as A.I.D.'s agricultural research program has several components, it also has several different sponsors within A.I.D./Washington. Three of the four categories are presently handled through the Technical Assistance Bureau, while the bilateral programs are handled by the regional bureaus. Although there is some interaction between the groups in the way of exchanging information on proposed projects and funding, they generally have operated quite independently. The TA Bureau has been taking steps to have the regional bureaus more closely involved in

the international center activities. And the regional bureaus have been represented in the Title XII meetings.

One of the main limitations on doing more is simply a lack of manpower. Neither TA nor the regional bureaus has enough agriculturists with a research bent to get very involved in the activities of the other groups. The numbers of direct-hire research personnel in the regional bureaus and country missions is extremely limited. And TA, though it is becoming better staffed in research, would be hard pressed to fully cooperate in evaluating all the national proposals. Until there is more manpower available for research activities, particularly in the regional bureaus and missions, coordination in the Agency may remain relatively limited.

Coordination with other U. S. government agencies and universities is somewhat variable. A.I.D. has some contacts with the Agricultural Research Service and the Economic Research Service of the U. S. Department of Agriculture. Fairly close ties are maintained between the international research centers and the International Programs Office of ARS, and this contact is expected to become closer. Ties between the other research efforts are more sporadic. This situation may well change with the full implementation of Title XII.

The degree of coordination of research efforts with other national and international groups varies. The contributions to the international centers are fully coordinated through the Consultative Group on International Agricultural Research. Where appropriate and possible, the contracts with American organizations and the bilateral programs are also tied

into an international center. But there is little or no coordination of the A.I.D.-sponsored contracts with those of other developed nations. The same situation is true of the bilateral programs, though there is some coordination at the country level. As other developed nations become more active in the research picture, and they are doing so, increased research coordination will be needed and desirable if scarce resources are to be allocated most efficiently.

4. AGRICULTURAL EDUCATION

Agricultural education is defined here as including formal professional education in agriculture at the university level, both graduate and undergraduate. A broader definition of agricultural education might include post-high school trade schools, or even vocational high schools, but these institutions are only touched on here.[22/] While general primary and secondary education of farm people is of great importance, it is well beyond the scope of this paper. Some of the same issues discussed here, however, would apply.

A. Elements

Collegiate level education in agriculture in the developing nations can, to some extent, be categorized (for lack of better terms) as being of two major types: traditional and modernized. Traditional collegiate education in agriculture has remained essentially unchanged for many decades and has been little influenced by the outside world. Modernized systems have been the subject of broad college development programs with the assistance of A.I.D. and American agricultural colleges, or of some

other developed nations or international organizations. Despite some well-known college development programs in Asia, the bulk of LDC agricultural graduates still attend traditional institutions.[23/] In some countries, essentially no form of college level training exists.

The development of modernized collegiate level education in agriculture has played a prominent role in A.I.D. efforts in the past. The appearance and existence of colleges of agriculture in many nations is due to no small effort to A.I.D. support. A.I.D., in turn, relied heavily on U. S. colleges for the expertise and staffing. From 1951 through 1966, A.I.D. spent nearly $150 million on university contracts for technical assistance in agriculture, principally for the development of agricultural colleges--a process which also included some attention to research and extension.[24/]

These projects in turn generally provided for training of LDC residents in the United States and in third country institutions. From 1952 to 1966, 2,360 participants under 68 A.I.D.-university contracts in 39 countries were trained, generally at the host university in the United States. Of this number, 64% were degree candidates, and 53% were from the Near East and South Asia.[25/] The number of all A.I.D.-sponsored participants grew to 9,759 between 1969 and 1976, and also included a sizeable number trained in third countries (Table 5). The peak year, however, was 1972 and since then the number of participants has dropped by more than half, from 1,540 in 1972 to 715 in 1976.

Table 5

A.I.D.-SPONSORED TRAINEES IN AGRICULTURE
ARRIVALS BY FISCAL YEAR 1/

Fiscal Year	In United States		In Third Countries 3/	Total
	AID Direct 2/	AID Contract 3/		
1969	663	263	604	1,530
1970	671	230	517	1,418
1971	801	162	572	1,535
1972	676	233	631	1,540
1973	660	151	483	1,294
1974	505	92	366	963
1975	412	94	258	764
1976	478 2/	86	151	715
Total	4,866	1,311	3,582	9,759

1/ Includes both academic and non-academic (short term) trainees. Out of the total of 1,579 trainees in 1975 and 1976, 41.4% were in academic programs and 58.6% were in non-academic programs. Most of the current non-academic trainees, however, have college degrees.

2/ Financed by AID/Washington. In 1976 the total cost of the A.I.D. non-contract (direct) training program in agriculture was nearly $5.3 million, of which 3.7 million was for academic training and $1.6 million for non-academic training.

3/ Financed by A.I.D. country missions.

Source: Data provided by Sandra K. Gardner, Office of International Training, Bureau for Program and Management Services, A.I.D., December 10, 1976. Data in footnote 2 provided by William J. Telfair, SER/FM/CSD, December 10, 1976.

Other American groups, foreign governments, and international organizations have also made significant contributions in this area.[26/]

While precise annual data is not available, it appears that A.I.D. programs of agricultural college development in LDC's probably peaked in the 1950's and 1960's and that this effort is now running at a lower level. One rough tabulation, in fact, suggests that education development projects proposed for FY 1977 totaled only $4.5 million, principally in Africa.[27/] A.I.D.-sponsored training in other countries has also clearly dropped off, with the 1975 and 1976 levels about half of these of 1969 and 1970 (Table 5).

Collegiate education in agriculture in LDC's, particularly in traditional institutions, often has several distinct differences from its counterpart in the United States. First, it is usually under the control of the Ministry of Education and is often separated from agricultural research and extension (which are usually under the administrative control of the Ministry of Agriculture). These elements are also often physically separate. In modernized institutions an attempt is usually made to provide a closer linkage. Secondly, neither faculty nor students may have had much practical experience with scientific farming, nor indeed with farming in general. They largely come from urban areas. Modernized colleges attempt to provide at least some practical experience. Thirdly, the rural students also typically have more difficulty than their urban counterparts in meeting admission requirements because of poor quality schooling.[28/]

Given this background and these organizational and social differences, how have the agricultural colleges worked out? Traditional colleges have evidently not done well. Modernized institutions, such as those assisted by A.I.D., have fared somewhat better.[29/] The general nature of the shortcomings is well expressed by Clarence Gray of the Rockefeller Foundation.

> To date, in /developing/ countries, there has been great disparity between the promise and the reality of most educational systems, particularly in agriculture. Increasingly, national leaders in developing countries are questioning and criticizing publicly supported agricultural colleges with regard both to the quality of their graduates and their overall contributions to national development. They complain specifically about large investments in agricultural education with little apparent impact on the pace and magnitude of national agricultural development. Nearly three decades of development experience in the post-World War II period appear to support this growing lack of confidence in the economic, developmental role of agricultural colleges as they are now structured and operated.

The reasons for this deficiency, in Gray's views, center about the fact that students have little motivation, meagre background knowledge, and few farming skills. Moreover, the traditional colleges are discipline-oriented rather than service and problem oriented. The disciplinary orientation provides "categorical, lockstep instruction" which "is ill-suited for meeting agricultural manpower requirements."[30/]

John Pino, also with the Rockefeller Foundation, agrees that traditional agricultural education "is not pulling its weight in the national development efforts of low-income countries." He suggests a long catalogue of

reasons, including those cited by Gray, but also mentions:[31/]

- a pervasive authoritarian ethos, limiting scientific innovation;
- a lack of prestige for agricultural disciplines, therefore second-rate career opportunities for agricultural specialists;
- an emphasis on book learning to the neglect of empirical research and discussion;
- a lack of coordination among the functions of teaching, research and communications; and,
- the lack of funds for adequate experimental farms and laboratory facilities.

Some of these voids may be met in a small but vital way by the training programs carried out by the international agricultural research institutes. These programs range from applied production training to post-doctoral research.[32/] The numbers of individuals receiving such training, however, can only remain small compared to LDC needs.

The main training needs must be provided by indigenous institutions. More agricultural colleges and programs must be modernized. And even the modernized institutions must continue to extend their reach to disadvantaged students[33/] and to providing a practical perspective.[34/] An even longer list of challenges was raised at the World Conference on Agricultural Education and Training in 1970.[35/] While these problems are concentrated in traditional programs, some exist in modernized programs.

Pino also notes (and this may not be widely recognized) that at any level education in agriculture requires a greater financial investment than many other fields. In fact, he places it next to dentistry.[36/] Part of the high cost stems from the need for laboratories and experimental farms. There is, perhaps as a result, an inclination to skimp on these facilities. Moreover, the experiment station may be, as noted, run by

another ministry in another location.[37] This can be a major deficiency. Wortman maintains that "the experiment station is as important to the college of agriculture as the teaching hospital is to the medical school..."[38]

College training also needs to be balanced by agricultural education at other levels. As Gordon Havord of UNDP has noted:

> In many countries there is substantial dependence upon people who are trained as middle-level technicians--a kind of training which does not require the commitments of time and money that are necessary at the university level.[39]

The shortage of individuals trained at this level has been noted by others.[40]

Much remains to be done in improving agricultural education at the collegiate level and examining needs at other levels.

B. Issues

Some of the general issues facing agricultural education, have already been introduced. It is difficult to react to these comments on the basis of recent A.I.D. experience within LDC's, partly because there appears to be relatively little recent activity. Moreover, there do not seem to be any A.I.D. employees with specific responsibility for overseeing agricultural education within LDC's.

In contrast to this situation, however, A.I.D. has long had an Office of International Training (and in turn has sponsored a similar office in USDA which is concerned with arranging training outside the home country). The number of individuals trained under A.I.D. sponsorship has, as noted in Table 5 (p. 29), dropped about in half between 1969-70 and 1976-77. The drop was sharpest in the mission-funded portion. There are several reasons for this decline, including overall program phasedowns in

countries which formerly provided numerous trainees (e.g., Vietnam, Thailand), increased development of local institutions, and a shift to more graduating training (which has a higher cost per student). Also, the number of training officers in A.I.D. has dropped sharply over the years and less attention may be provided to training by those who remain in missions. Money does not appear to have been a particular problem.[41/]

With respect to in-country training, one might initially step back and ask what the agricultural education needs of the LDC's are at all levels of education. What is the current and potential demand for graduates of agricultural colleges? Are the real educational needs of many LDC's now greater at the intermediate technician level? We don't know the answer, but of course it might be expected to vary by country. India, for example, would appear to have more agricultural college graduates than it can absorb,[42/] while some countries in Africa are extremely short. This is a matter that bears further study.

At the collegiate level, it appears that an increasing proportion of undergraduate training is being provided within agricultural institutions within the individual or neighboring developing nations, and that relatively fewer undergraduates are being sent to the United States. This would appear to be a wholly expected and desirable trend. There is also probably some growth in LDC training at the Master's level. The situation at the Ph.D. level is unclear, but there will probably be a continuing need for training of this level in developed nations. There has, however, been increased emphasis on the LDC student doing his

thesis work on an LDC problem, preferably with some LDC field work. Some Ph.D. students are also conducting thesis work at the international agricultural research institutes. Aside from degree work, one would expect a continuing need for short-term training on special projects within developed nations.

In any case, it would appear desirable to begin to develop stronger linkages between collegiate education and agricultural research and extension in countries where this is not already the situation. Just how this can best be done, however, is difficult to say where different Ministries and different physical locations may be involved. Certainly the point deserves further attention.

Just as the recent A.I.D. role in within country agricultural education is obscure, so is its potential future role in terms of the Congressional mandate. Agricultural education in itself may not have a quick or direct effect on improving the financial situation of the poor individuals except as it opens up the possibility of additional employment. Agricultural education does, however, provide the human resources necessary to staff the many research, extension, and other programs which are necessary to aid the poor majority and to increase food production. Thus even if education may not often directly aid the poorest members of society, the human products of agricultural education will be able to assist them in numerous other ways.

With these important indirect contributions in mind, then, what should A.I.D. do more or less of in the future? To answer this, we will need to know both more about what A.I.D. has and is doing, and what the

more general needs are. Hopefully, U. S. agricultural colleges, under the Title XII framework, could be of great assistance in these matters. Many of them have, under A.I.D. auspices, helped develop LDC agricultural institutions in the past and have undoubtedly learned much that would be of use in the future. Moreover, as educators they should be in an excellent position to review and study agricultural education needs in developing nations. The Title XII agricultural development committee would be a most appropriate place to bring these matters together. In addition, the college experience might be augmented by that of the international agricultural research institutes in conducting training programs and by other non-technical educational techniques. Some further research on agricultural education may be called for.

With more information in hand, A.I.D. would be in a much better situation to assess whether it is doing too much or too little for agricultural education, and whether it is doing the wrong things or is aiming at the wrong groups in some cases. Ultimately, A.I.D. will also need to consider the balance of emphasis given to education compared to agricultural research and extension.

5. AGRICULTURAL EXTENSION

Agricultural Extension is used here as a synonym for outreach or the series of non-formal educational activities which take place between the research process at one end and farm adoption on the other end. Although some agriculturists tend to think of formal extension services, a myriad of institutional approaches may be utilized.

A. Elements

Extension or outreach is, or at least should be, a two way process--with information flowing from researchers to farmer and with expressions of needs and ideas flowing from the farmer back to the researcher. In developed countries, this exchange is carried out both by public bodies such as the Extension Service and by business firms through their sales efforts. In some cases, farmers will contact researchers directly without benefit of an intermediary.

The situation is somewhat different and considerably more difficult in less developed countries. Relatively little extension work is carried out by private firms. While public-funded extension services are generally present, and are relatively well funded compared to research (Table 1, p.13), they are usually considered inadequate and underfunded for the task that faces them. As Lele notes: "Extension agents are few and far between, ill-paid, ill-trained, ill-equipped with a technical package, and consequently very poor in quality."[43/]

Moreover, the extension task in developing nations is in many ways much more difficult than in developed countries. The average extension worker must service a much larger number of farmers, particularly poor farmers, than his or her DC counterpart. Much of their time may be spent on administrative work for programs which are not production oriented. Rural transportation and communication are difficult. And when the farmers are reached, it is often the male who is contacted. Women, who actually do much of the farming, may be bypassed.[44/] In either case, the farmers are poorly educated (though not unintelligent), skeptical,

and have limited resources with which to take up new practices. Their skepticism may be well founded: they may find their extension advisor of city origin with little knowledge of farm level conditions. Indeed for this reason, as well as others, the extension agency may not make much of an attempt to get into the countryside. Because of this and the relatively poorly organized state of the farmers, there may not be much useful feedback to the researcher.[45/]

All of this presumes that there is some information of value to take to the farmer in the first place. In view of the rather limited state of development of national agricultural research systems in many countries, this cannot be taken for granted. Yet at one time it was. In the heady days following the Marshall Plan, it was widely assumed that the United States had plenty of agricultural technology which would be of value in developing nations. Hence in the 1950's and early 1960's A.I.D. gave considerable support to the development of agricultural extension systems before an indigenous research capacity was developed. Moreover, the university development programs, which involved extension, often comprised a competing and duplicative element. These and other problems had the result that the university efforts to develop extension activities were less successful than their efforts on behalf of teaching and research.[46/]

Those engaged in this exercise evidently had forgotten American history on this point: the establishment of formal extension work followed the start of research by many decades--and even then there was little new knowledge to disseminate that was useful and profitable in

farming.[47/] This led Schultz to ask, in the mid-1960's:

> Why then have we opted first and foremost for extension work in what we have done abroad? We obviously have been blind to the lessons of our own experience; for the plain fact of the matter we have stressed extension and neglected research. USAID programs starting with the early Point Four endeavors have had and continue to have a strong extension bias. They have been built on the convenient assumption that in all of these countries there existed a large body of useful knowledge awaiting to be put to use in farming. Why wait for years for the findings of new research? Time is of the essence and this assumption also conveniently supports crash programs. Colleges of agriculture in general have blithely entered into government contracts to concentrate abroad on agricultural extension work, often as part of the Ministry of Agriculture, an arrangement they would abhor in the United States.[48/]

There may, of course, be some cases where initial focus on extension rather than research may be appropriate, such as where simple technologies are involved.

The initial A.I.D. emphasis on extension was subsequently replaced by an increase in attention to research and to tying extension or outreach efforts to specific commodity projects or regional programs within countries. Following a review of A.I.D. loans and grants in November 1976, Delbert Myren of A.I.D. observed:

> ...there are at present relatively few projects that have Extension as a primary focus. What has transpired over time is that extension activities have been integrated into grants and loans where the main thrust is on farm credit, cooperative development, research, or the more general subject of rural development.[49/]

A brief review of 125 projects with an extension component, in operation in the 1970's or projected, revealed that it ranged from 1% to 100%. Only 16 projects were characterized as being predominantly (more than 50%) extension; of the 16 most were tied in with a commodity or some other program; few if any appeared expressly designed to include the

general extension service as such.[50/]

Even though the extension component was fragmented, the pieces were substantial and numerous enough to add up to a significant total. A rather liberal interpretation, in fact, suggests that the extension component of the 125 projects might be valued as high as $189.2 million, of which grants accounted for 47% and loans for 53%. The projects were most numerous and largest in value in Africa and Latin America, followed at some distance by the Near East and Asia (details are provided in Table 6). Another preliminary tabulation suggests that the total value of extension activities under consideration for FY 1977 was about $15.6 million.[51/] While the total value ascribed to extension in these tabulations may be too high, even a discounted figure would be quite substantial.

Thus even though A.I.D. is evidently doing relatively little to build general extension structures, it appears to be providing significant support to the extension or outreach function as a part of other projects. Just how well this particular extension component is working out and how effective it is, however, is not really known. No one person or office in A.I.D. appears to have any overall responsibility for, or knowledge of, current extension programs.

B. Issues

Since the nature and extent of A.I.D.'s current involvement in agricultural extension is not well known, it is difficult to outline the leading current issues. Nevertheless some literature is available which makes it possible to suggest some general questions.[52/]

Table 6

A.I.D. GRANTS AND LOANS TO DEVELOPING NATIONS;
ESTIMATED VALUE OF EXTENSION COMPONENT *
(1970 to Present, Including Proposed Projects)

Region	Grants	Loans	Total	(number)
		- thousands of dollars -		
Asia	7,079	12,513	19,592	(23)
Near East	16,502	4,750	21,252	(15)
Africa	58,447	21,150	79,597	(42)
Latin America	6,893	61,868	68,761	(45)
Total	88,921	100,281	189,202	(125)

* A rather rough definition of extension was used in sorting out these data. It included:
- Efforts from the supply side to deliver the results of research;
- Efforts from the demand side with respect to (i) raising the level of capability of farmers to process and use new knowledge, and (ii) organizational activities at the local level to facilitate use of new knowledge.

Source: Delbert Myren, "Agricultural Extension: A.I.D. Experience, Present Involvement and Some Unresolved Issues," AID/TA, November 1976, Appendix A. (Prepared for the Title XII Board meeting, November 22, 1976.)

One of the initial issues might be to ask: how important is a formal extension or outreach function? The high-yielding varieties of wheat and rice, in many cases, spread quickly and widely without a major extension drive. The answer probably is that major and significant technologies which offer a sharp improvement in returns will spread rather quickly among the more progressive and wealthy farmers. The process, however, can probably play a significant role in (1) spreading this technology more rapidly to the smaller farmers; and in (2) spreading improved technology which offers less dramatic return among a wide range of farmers. For purposes of carrying out the Congressional mandate of reaching the poor majority, an extension function, therefore, is probably of major importance, even though it may be difficult to demonstrate a close statistical correlation between extension and productivity in LDC's.[53/] The extension function is also needed to provide feedback to researchers.

The next issue is to determine the most efficient and effective way of carrying the externsion process out, assuming new technology has been generated by research. Some of the real and major problems faced by extension services in many developing countries have been noted. In certain cases, the operations of these groups could be materially improved by relatively simple changes in the existing system--such as providing: more vehicles (or funds to maintain those which are available), adequate expense accounts for field travel, and some form of incentive for getting

out of the office. In other cases the needed changes may be more substantial--requiring, for example, a completely new approach to selecting and employing extension workers or tying their work much more closely into research. In some cases part of the problem may be alleviated by bringing the research workers in closer contact with the extension workers or farmers; in other cases leading farmers might be engaged as extension workers.[54/] Several other variants of the conventional model are discussed by Coombs and Ahmed.[55/]

But more may be required. In fact, relatively new structures of nonformal education may be called for. Coombs and Ahmed group these approaches, in the context of rural development, under three main headings: (1) the training approach, (2) the cooperative self-help approach, and (3) the integrated development approach.[56/] Their vision is much broader than the transfer of technology; indeed they implicitly criticize conventional extension for being so narrow. My own experience with extension in the United States, however, would raise the question of whether sufficient attention is given to technology transfers and feedback to researchers. The problem is probably more severe in the LDC's.

Here we might briefly note four technology-oriented approaches of varying degrees of technical sophistication, starting with the most simple.

- The training and visit system of extension, designed by Daniel Benor of the World Bank, has been tried in several countries. It is designed for areas with large numbers of small farms using traditional

methods and low level technology. It initially focuses on major crops and on a few simple aspects of their production which offer the greatest scope for increasing incomes. It uses village workers with comparatively low educational standards supported by subject matter specialists and provides close supervision through a management system which establishes a clear single line of responsibility.[57/]

- The Pueblo Project was organized by CIMMYT to increase maize production among small farmers. The strategy emphasized research in farmer's fields, groups for instruction and credit, and the use of farmer-monitored demonstration plots. While there was close coordination with credit agencies, there was little connection with federal research and extension agencies. Evaluation of the program has shown mixed results, but provided a number of suggestions for improvement of such efforts.[58/]

- Production centers, in Wortman's use of the term, may be defined as follows:

> ...a farm staffed by a small number of scientists concerned with development of agricultural practices for the surrounding region. It would serve as a headquarters for extension personnel and as an important testing site in the national system. An important activity would be the advanced field training of substantial numbers of young people who would participate in extensive tests on the station and on surrounding farms.[59/]

In short, these units might be similar to some of the smaller field stations operated by some of the State extension services in the United States.

Commodity oriented national programs have been conducted in a number of developing nations in recent years. They seek to link the

final phases of research with on-farm testing and adoption. Some commodity programs are of a temporary production campaign nature with heavy extension involvement; others are of a more permanent research nature. In the former case, the campaigns have emphasized the use of improved seed and fertilizer and the provision of credit. When given sufficient attention and support, these campaigns have often proven effective in meeting short-run production goals. The Masagana 99 program in the Philippines appears to be a recent example. The problem is to keep up the momentum once the initial fervor has passed. More permanent research-oriented commodity programs have been utilized in India and other countries. Some of these could well have more of an extension or outreach nature.[60/]

In addition to these approaches it should be noted that the international agricultural research institutes conduct relatively small but effective training and outreach programs with crop specialists in individual LDC's.[61/]

Other varients could be cited--and are by Coombs and Ahmed in their 1974 book and in a more recent publication.[62/] These books, and other recent materials, need to be studied in detail.[63/] Information is particularly needed on cost-effective approaches for small farmers.[64/] In any case, the decision of what is the best approach for a particular country can only be made on a individual country basis and after further review.

Meanwhile what is A.I.D. to do? How much attention should be given to extension? How much funding should be provided? In view of A.I.D.'s

rather large de facto financial contributions to extension, it would seem that a noticeable increase in attention at the Washington level is called for. Certainly the lack of any A.I.D./Washington staff members assigned to this area might be seen as a most peculiar oversight. The Title XII board appears to have a significant interest in extension and its agricultural development committee may be expected to provide a needed point of focus. Whether more funds are immediately needed for extension programs in light of the relatively large current investment is not at all clear. These and other such concerns are important and deserve future attention within A.I.D. and the BIFAD process.

6. CONCLUDING REMARKS

Improved technology, when applied at the farm level, can play a key role in improving the lot of the poor majority in most of the developing nations. Technology cannot, of course, do the entire job; it may, by itself, have less to contribute to the position of the poorest of the poor than certain social programs. And it certainly cannot do the job by itself; a whole range of other activities, many of which are described elsewhere in "A.I.D. Agriculture Development Policy Paper," must also be undertaken if agriculture is to get moving and the poor majority are to progress. But without improved science and technology, few other programs, including those of a rural development nature, will move very far or have any lasting effect.[65/] Improved technology, therefore, is usually a necessary though not sufficient factor.

The three essential institutional components to improved technology are research, education, and extension. Research is the heart of the

system, but is of little or no value unless it is put into use. The effective application of technology requires both formal education and training programs and less formal extension or outreach functions. Education also provides the trained personnel for both research and extension. Education and extension may, of course, be concerned with matters other than technology and hence in this sense may be somewhat broader. While the three components are competitive for resources, they can have a highly complementary effect when combined in the right balance. The balance will in turn depend on the stage of agricultural development of the country as well as on other matters.

As important as they are, agricultural research, education and extension have gone through some peculiar ups and downs in A.I.D. Even before A.I.D. was founded in 1961, agricultural education and extension were in favor in predecessor organizations, an emphasis which continued into the early A.I.D. years in the 1960's. Research received some increase in attention with the formation of A.I.D. in 1961, but was relatively neglected until the late 1960's when it began to assume some significance, and the 1970's when it attained full stride. But by the time research was moving, both education and extension had become relatively neglected in overt terms, although not overlooked in project funding. In a more rational sequence of activities aimed at new technology, one might have started with research and education, followed by extension. Extension without a technology to extend and without a trained staff is a rather futile activity (except with a simple technology or where extension is primarily aimed at some other purpose). Conversely,

research without a trained staff may be slow in getting underway and without an outreach system may be underutilized. The three form a close and symbiotic relationship when properly phased and meshed.

But if the potentials from this interrelationship are to be more fully realized, and if the three areas are to provide a more substantial contribution to agricultural development, A.I.D. will have to face the question of providing more specialists for its own operations. At present the research function is understaffed, particularly in the regional bureaus in A.I.D./Washington and in the field. But the situation in research is far better than for agricultural education and agricultural extension - for which, incredibly, there appear to be no specialists (or even non-specialists) in A.I.D./Washington to provide expertise or who have overview responsibility. If this observation is correct, A.I.D. clearly needs to review its staffing pattern (which seems to emphasize the generalist, especially in higher positions, rather than agricultural specialists)[66/] if it is to provide a well-balanced program in agricultural science and technology). Presumably the Title XII Board will be interested in this matter and have some thoughts to offer.

The challenges to effective research, education, and extension in the developing nations are many and they are formidable. Indeed the task would seem to be more difficult than in the developed nations for a variety of reasons. Hence assistance organizations like A.I.D., which intend to help carry out effective agricultural and rural development activities, also face severe difficulties in improving these essential institutional components of improved agricultural technology. Assistance agencies often do not know how to best respond to these challenges.

They also often do not know how to structure and balance their programs or those of the developing nations--though essential bits of information may be around in scattered form.

A.I.D., however, tends to loose sight of the fact that it is not alone in this challenge. Other developed nations and international assistance organizations face the same problems in their aid programs. Moreover, any balancing of A.I.D.'s resources in and for agricultural technology, should be influenced by the degree and nature of assistance by other assistance groups in these fields. Although there is some knowledge of such matters at the mission level, there is little such information in A.I.D./Washington (aside from the international centers).

It is to be hoped that the Title XII Board for International Food and Agricultural Development and its associated joint committees for research and agricultural development will provide the needed focus and resources necessary for a more enlightened and efficient approach to agricultural science and technology and in turn to improving the lot of the poor majority in developing nations.

7. FOOTNOTES

1/ William N. Parker, "On a Certain Parallelism in Form Between Two Historical Processes in Productivity Growth," Agricultural History, January 1976, pp. 106-107, 114-115. Also see Dana G. Dalrymple: Technological Change in Agriculture: Effects and Implications for Developing Nations, U. S. Department of Agriculture, Foreign Agricultural Service, April 1969, pp. 23-24; "New Technology: Rose and Thorn," 1970 Yearbook of Agriculture, U. S. Department of Agriculture, pp. 299, 300.

2/ "Report to the Congress on Title XII Famine Prevention and Freedom from Hunger of the Foreign Assistance Act of 1961 as Amended," A.I.D./ TA, April 1, 1977, 30 pp.

3/ For a more detailed and rigorous discussion of this matter, see Reed Hertford and Andrew Schmitz, "Measuring Economic Returns to Agricultural Research," in T. M. Arndt, D. G. Dalrymple, and V. W. Ruttan, Resource Allocation and Productivity in National and International Agricultural Research, University of Minnesota Press, 1977, pp. 148-167. The matter is also dicussed in other papers in the volume (see the index). In some cases, increased domestic production may partly substitute for imports, so that the net effect on domestic food supplies is less than might be expected from the production increases.

4/ P. Pinstrup-Anderson, "Decision-Making on Food and Agricultural Research Policy: The Distribution of Benefits From New Agricultural Technology Among Consumer Income Strata," Agricultural Administration, January 1977, p. 15. Also see Pinstrup-Anderson, et al., "The Impact of Increasing Food Supply on Human Nutrition: Implications for Commodity Priorities in Agricultural Research and Policy," American Journal of Agricultural Economics, May 1976, pp. 131-142.

5/ But even a reduction in prices of these commodities may not be enough, by itself, to eliminate hunger among the poorest members of society; other measures, involving target-group-oriented programs, may also be needed. See Shlomo Reutlinger and Marcelo Selowsky, Malnutrition and Poverty: Magnitude and Policy Options. John Hopkins University Press(World Bank Occasional Paper 23), 1976, 82 pp.

6/ Yujiro Hayami and Robert W. Herdt, "Market Price Effects of Technological Change on Income Distribution in Semisubsistence Agriculture," American Journal of Agricultural Economics, May 1977, p. 250.

7/ Ibid., pp. 245-256; Dung Nguyen, "Intersector-Distributional Implications of Agricultural Progress in an Open Economy: An Extension," American Journal of Agricultural Economics, May 1977, p. 374. Examples of the distribution of benefits between producers and consumers for six crops under varying elasticities of supply and demand in Brazil are provided by J. P. Ramalho de Castro and G. Edward Schuh in "An Empirical Test of an Economic Model for Establishing Research Priorities: A Brazil Case Study," in Arndt, Dalrymple, and Ruttan, op. cit., p. 508.

8/ Based on "Adoption of Rice to Colombia a Boon," New York Times, November 17, 1976. Details are provided in Grant M. Scobie and Rafael Posada T., The Impact of High-Yielding Rice Varieties in Latin America, With Special Emphasis on Colombia, Centro Internacional de Agricultura Tropical (CIAT), Cali, Series JE-01, April 1977, 165 pp. CIAT is currently considering the establishment of an upland rice breeding program.

9/ Hayami and Herdt, op.cit., pp. 249-256 (quotations from pp. 255, 256).

10/ Department of State, AIDTO CIRCULAR A-263, April 30, 1975, p. i (underlining added). A subsequent report by the World Bank has suggested that about 75% of the population of the LDC's has caloric-deficient diets: 19% are deficient up to 250 calories per day and 56% are deficient by more than 250 calories (The Anatomy of Hunger, A World Bank Publication Summary, 1976, p. 2; an overview of Reutlinger and Selowsky, op.cit.).

11/ With technological change, even poorer farmers may experience some absolute improvement. The problem as often viewed, however, is that the absolute position of the wealthier farmers often improves more and hence the relative disparity widens. (See, for example, Carl H. Gotsch, "The Green Revolution and Future Developments in Pakistan Agriculture," in Rural Development in Bangladesh and Pakistan (ed. by R. D. Stevens, et al.), University Press of Hawaii, Honolulu, 1976, p. 361.)

12/ The net effect is generally considered negative. The laborers should benefit as consumers, but this could more than be offset by loss of jobs. The employment situaton, however, will vary - depending in part on the nature of the technology (whether it is labor-displacing or labor-intensive) and the social structure. Little solid information exists on this group.

13/ Moreover, there are very few - if any - agricultural production technologies which can be designed for the exclusive benefit of the poorest of the poor. Virtually every existing technology could be used by larger or wealthier farmers.

14/ Representatives of one A.I.D. regional bureau noted at an AAC meeting on November 1, 1976, that the interpretation of the mandate utilized in their region had led to a slighting of certain agricultural science and technology activities (see Information Memorandum for the Administrator from Caroline McGraw to Philip Birnbaum, AAC 79-E, December 7, 1976, p. 3; emphasis in the memo is on extension but the discussion was more general). A narrow interpretation is also evident in criticism of the proposed Integrated Wheat Development Project for Afghanistan (see F. H. Denton, "Afghan Wheat, A Modified PID Concept," NE/DP/PL, December 3, 1976, 7 pp.).

15/ Many of these studies with respect to research are summarized in T. M. Arndt and V. W. Ruttan, "Valuing the Productivity of Agricultural Research: Problems and Issues," in Arndt, Dalrymple, and Ruttan, op.cit., p. 4-8.

16/ Robert E. Evenson and Yoav Kislev, Agricultural Research and Productivity, Yale University Press, 1975, pp. 61, 77, 160, and 161.

17/ Further details and documentation on the points discussed in this section is provided in: /Dana G. Dalrymple/"Global Agricultural Research Organization," in World Food and Nutrition Study: The Potential Contributions of Research, Supporting Papers, National Academy of Sciences, July 1977, Vol. V, Study Team 14, Subgroup B, (in press). Also see the main report with the same title, July 1977, pp.128-153 (Chp. 3).

18/ See, for example, Albert H. Moseman, Building Agricultural Research Systems in the Developing Nations, Agricultural Development Council, New York, 1970, pp. 57-65. Further perspective is provided by William Woodruff in Impact of Western Man; A Study of Europe's Role in the World Economy 1750-1960, St. Martin's Press, New York, 1967, pp. 174-175.

19/ The potentials in this area, however, may be more limited than is widely recognized. In the case of some crops raised by low-income farmers - such as cassava, sorghum, and millett - the constraints apply to both supply and demand. In terms of supply, these crops are raised under the poorest growing conditions; thus once certain basic improvements are made, the technical limit to yield increases may be rather low. Similarly, the demand for such crops for food consumption is rather limited; they have both low price and income elasticities of demand. The result is that a given increase in production may result in a greater drop in farm price than would be true of crops with more elastic demand. And the drop in price may not, beyond a certain point, be of great advantage to many consumers because of their lack of interest in the commodity. Thus, once the

19/ (cont) limited market demand for these crops is satisfied and production conditions permit, both producers and consumers may be better served by turning attention to crops with higher price and income elasticities of demand. This argument would be less significant for self-sufficient farmers who do little trading in the market and are both producer and consumer; they, however, would be the most difficult to reach with the new technology. In some cases, improved production techniques, such as the cassava, could lead to increased production by commercial growers for feed, rather than sharply increased production by small farmers for food use. The matter of crop choice is, for these and other reasons, a complicated one that merits further study.

20/ These figures differ somewhat from those given in the "A.I.D. Agricultural Policy Paper" (p. 27). Part of the difference is that these figures include contributions to the International Fertilizer Development Center under Item 2; in the policy paper table they are listed elsewhere. Also, the policy paper figures are those requested by A.I.D., not actual appropriation or expenditure.

21/ See, for example, the following papers in Arndt, Dalrymple, and Ruttan, op.cit.: John Mellor, "Relating Research Resource Allocation to Multiple Goals," pp. 484-493; and de Castro and Schuh, op.cit, pp. 504-522.

22/ For an introductory discussion of intermediate and vocational training, see: World Conference on Agricultural Education and Training, Copenhagen, 1970, FAO/UNESCO/ILO, Vol. I (Proceedings), pp. 103-133; and Philip H. Coombs, with Manzoor Ahmed, Attacking Rural Poverty; How Nonformal Education Can Help, Johns Hopkins University Press (for the World Bank), 1974, pp. 131-133, 135, 241-242.

23/ This paragraph is based on discussions with Richard L. Shortlidge, Jr. (AID/PPC), who has done extensive study of higher agricultural education in India.

24/ The early administrative history of this program is fully discussed by John M. Richardson, Jr., in Partners in Development; An Analysis of AID-University Relations, 1950-1966, Michigan State University Press, 1969, 272 pp. The experience is analyzed in Building Institutions to Serve Agriculture (AID-University Cooperation in Technical Assistance), Committee on Institutional Cooperation Purdue University, 1968, 236 pp. Historical details on several of these projects are provided in Hadley Reed, Partners with India; Building Agricultural Universities, University of Illinois, College of Agriculture, 1974, 159 pp.; K. L. Turk, The Cornell-Los Banos Story, New York State College of Agriculture, Cornell University, 1975, 504 pp. The reference to $150 million was provided in Building Institutions..., p. 222.

25/ Building Institutions..., op.cit., pp. 182, 183.

26/ According to one source, of about 2,250 foreign graduate students studying agriculture in U. S. universities in 1976, only 520 or 24% were currently being directly supported by A.I.D. ("Development of Research Personnel," in World Food and Nutrition Study: The Potential Contributions of Research, Supporting Papers National Academy of Sciences ,1977, Vol. V, Study Team 14, Subgroup C).

27/ Estimate provided by Helen Wilson, TA/PPU, December 16, 1976 (calculation made in summer of 1976).

28/ For further discussion of these matters, see: Sterling Wortman, "National Agricultural Systems," in Strategies for Agricultural Education in Developing Countries, the Rockefeller Foundation, working papers, December 1974, p. 29; World Conference.... op.cit., and Building Institutions, op.cit.

29/ Coombs and Ahmed, op.cit., p. 131. The authors cite the new agricultural colleges in India, Los Banos in the Philippines, Makere University in Uganda, and Chapingo in Mexico.

30/ Clarence G. Gray, III, "Agricultural Curricula and Instruction for National Development," in Strategies..., op.cit., p. 179, 180.

31/ John A. Pino, "Graduate Training for National Development: A look at the Rockfeller Foundation Approach," in Strategies..., op.cit., p. 194.

32/ The training programs conducted by CIMMYT and IRRI are described and analyzed by Burton E. Swanson in "Impact of the International System on National Research Capacity: The CIMMYT and IRRI Training Programs," in Arndt, Dalrymple, and Ruttan, op.cit. pp. 336-363.

33/ For example, the G. B. Pant University of Agriculture and Technology initiated a special bachelor of science program for gramsevaks or village level workers. As a substitute for 5 years experience or more in extension or its equivalent, they were allowed lower admission requirements and a shorter period of formal study. A detailed analysis by Shortlidge indicated generally good academic performance. Thus, a program which allowed participation of a lower socio-economic group was efficient in both equity and economic terms . (Richard L. Shortlidge, Jr., "University Training for Gramsevaks in India: An Example of Recurrent Education in a Low-Income Country," Economic Development and Cultural Change, October 1975, pp. 139-153.)

34/ Some examples of practical education programs are provided in "Managing Planned Agricultural Development," Government Affairs Institute (for A.I.D.), August 1976, chp. XIV, pp. 6-15.

35/ See World Conference..., op.cit. (Vol. I), 201 pp., and (Vol. II), 184 pp. A short list of 8 items is summarized by Coombs and Ahmed, op.cit., pp. 130-132.

36/ Pino, op.cit., p. 195.

37/ There are a few exceptions, particularly where "governments handed over to a new university all or part of one of the old experiment stations of the Department of Agriculture, with its pre-existing facilities for teaching and research." Examples include: the University of Malaya at Serdang, the University of Ceylon at Peradeniya, Ahmandu Bello University at Samaru (Nigeria), and the University of Sierra Leone at Njala and Rokupr. (G. B. Masefield, A History of the Colonial Agricultural Service, Claredon Press, Oxford, 1972, p. 125.)

38/ Wortman, op.cit., p. 30.

39/ Gordon Havord, "Conference Summary," in Strategies..., op.cit., p. 434.

40/ World Conference..., op.cit., p. 92.

41/ Based on comments by Joseph W. Kovach, Office of International Training, Bureau for Program and Management Services, A.I.D., December 10, 1976.

42/ This situation in India varies between the modernized and traditional colleges. Graduates of the modernized colleges are in relatively strong demand; graduates of the traditional colleges have more difficulty in finding employment. (Based on discussion with Richard L. Shortlidge, Jr.)

43/ Uma Lele, The Design of Rural Development, Lessons From Africa, Johns Hopkins University Press (for the World Bank), 1975, p. 62.

44/ The British Colonial Agricultural Service found in the 1940's that the failure of the extension message to reach women was one factor delaying progress, particularly in East Africa where women performed many of the agricultural tasks (Masefield, op.cit., p. 97).

45/ These and related matters are discussed by Coombs and Ahmed, op.cit., pp. 125-128, 239-241.

46/ Building Institutions..., op.cit., pp. 57, 228, 229.

47/ The British Colonial Agricultural Service evidently had rather clear views on this matter as early as the 1920's. A recent history of the Service refers to "The dogma, accepted in principal everywhere, that extension must be preceded by research..." (Masefield, op.cit., p. 96).

48/ Theodore W. Schultz, "Education and Research in Rural Development," in Rural Development in Tropical Latin America (ed. by K. L. Turk and L. V. Crowder), New York State College of Agriculture, Cornell University, 1967, pp. 396, 397.

49/ Delbert Myren, "Agricultural Extension: A.I.D. Experience, Present Involvement, and Some Unresolved Issues," A.I.D./TA, November 1976, p. 1. (Prepared for the Title XII Board Meeting, November 22, 1976.)

50/ Ibid., p. 2. Further details are provided in Appendix A of the Myren paper. One exception, for which a project paper has been prepared, is a proposed extension outreach loan of $3.0 million for Thailand.

51/ Estimate provided by Helen Wilson, TA/PPU, December 16, 1976 (calculation made in summer of 1976).

52/ A comprehensive evaluation of experience in Latin America through the late 1960's is provided by Edward B. Rice in Extension in the Andes: An Evaluation of Official U.S. Assistance to Agricultural Extension Services in Central and South America, A.I.D./PPC, Evaluation Paper 3A, April 1971, 552 pp. (Also published under the same title by the MIT Press in 1974.)

53/ Ibid., pp. 387-400.

54/ "The Tanzanian Government has decided recently that there will be a person in each village, drawn from it and a part of the structure of the village organization, who will be responsible for providing assistance to the village farmers. Apparently, this is to be in substitution for traditional extension agents." Field representatives would, however, be assigned to work with the village representatives under one proposal. ("A Conceptual Framework for USAID Agricultural Assistance in Tanzania," American Technical Assistance Corporation, October 1976, pp. 10, 13.)

55/ The varients include: The Office of Rural Development in Korea, production programs in Africa, and the Société d'Aide Technique et de Cooperation in Senegal. Coombs and Ahmed, op.cit., pp. 30-35.

56/ Coombs and Ahmed, op.cit., pp. 24-26, Training is reviewed in Chapter 4, pp. 36-48; self help in Chapter 6, pp. 66-83; and the integrated approach in Chapter 7, pp. 89-111.

57/ Details of this approach are provided in Daniel Benor and James Q. Harrison, Agricultural Extension: The Training and Visit System, World Bank, May 1977, 55 pp.

58/ A relatively abundant literature exists on Plan Pueblo. One of the most useful summary papers is Don Winkelmann, "Plan Pueblo After Six Years," in Small Farm Agriculture: Studies in Developing Nations (ed. by G. F. Patrick et al.), Purdue University, Experiment Station (Dept. of Agricultural Economics), Station Bulletin 101, September 1975, pp. 130-146. Also see: Delbert Myren (ed.), Strategies for Increasing Agricultural Production on Small Holdings, CIMMYT, August 1970, 86 pp.; and The Pueblo Project: Seven Years of Experience, 1967-1973, CIMMYT, 1974, 118 pp.

59/ Wortman, op.cit., p. 32.

60/ For details on research- oriented campaigns, see A. H. Moseman, "Coordinated National Research Projects for Improving Food Crop Production," in Arndt, Dalrymple and Ruttan, op.cit., pp. 367-380.

61/ The outreach activities of IRRI and CIMMYT are outlined in Arndt, Dalrymple, and Ruttan, op.cit., as follows: Nyle C. Brady, "The International Rice Research Institute (IRRI) Outreach Program," pp. 295-305; Haldore Hanson, "The International Maize and Wheat Center (CIMMYT) Outreach Program," pp. 306-322.

62/ Manzoor Ahmed and Philip H. Coombs, Education for Rural Development; Case Studies for Planners, Praeger, 1975, 661 pp.

63/ See, for example, Dale W. Adams and E. Walter Coward, Jr., Small-Farmer Development Strategies: A Seminar Report, The Agricultural Development Council, 1972, 23 pp.; and Benor and Harrison, op.cit.

64/ Some such information is provided in "Managing Planned Agricultural Development," op.cit., Chp. XIII, pp. 1-74.

65/ For further comment on this point, see Vernon W. Ruttan, Integrated Rural Development Programs: A Skeptical Perspective," International Development Review, No. 4, 1975, pp. 9-16.

66/ One recent tabulation indicates that the number of agricultural specialists in A.I.D. decreased from 379 to 82 between 1968 and 1976; concurrently the number of program specialists increased from 84 to 383 ("AID Due For Hard Appraisal," Front Lines, March 31, 1977, p. 8). The matter was discussed during the confirmation hearings for the new A.I.D. Administrator John J. Gilligan.

8. SELECTED BIBLIOGRAPHY

Mazoor Ahmed and Philip H. Coombs, Education for Rural Development; Case Studies for Planners, Praeger, 1975, 661 pp.

T. M. Arndt, D. G. Dalrymple, and V. W. Ruttan (eds.), Resource Allocation and Productivity in National and International Agricultural Research, University of Minnesota Press, 1977, 617 pp.

Daniel Benor and James W. Harrison, Agricultural Extension: The Training and Visit System, World Bank, May 1977, 55 pp. (To be published in Spanish and French.)

James K. Boyce and Robert E. Evenson, National and International Agricultural Research and Extension Programs, Agricultural Development Council, New York, 1975, 229 pp.

Philip H. Coombs, with Manzoor Ahmed, Attacking Rural Poverty: How Non-Formal Education Can Help, Johns Hopkins University Press (for the World Bank), 1974, 292 pp.

/Dana G. Dalrymple/ "Global Agricultural Research Organization," in World Food and Nutrition Study: The Potential Contributions of Research, National Academy of Sciences, Supporting Papers, 1977, Vol. V, Study Team 14, Subgroup B (in press).

Robert E. Evenson and Yoav Kislev, Agricultural Research and Productivity, Yale University Press, 1975, 204 pp.

Yujiro Hayami and Robert W. Herdt, "Market Price Effects of Technological Change on Income Distribution in Semisubsistence Agriculture," American Journal of Agricultural Economics, May 1977, pp. 245-256.

Albert H. Moseman, Building Agricultural Research Systems in the Developing Nations, Agricultural Development Council, New York, 1970, 137 pp.

Edward B. Rice, "Extension in the Andes: An Evaluation of Official U.S. Assistance to Agricultural Extension Services in Central and South America, Agency for International Development, Evaluation Paper 3A, April 1971, 552 pp. (Also published under the same title by the MIT Press in 1974.)

World Food and Nutrition Study: The Potential Contributions of Research, National Academy of Sciences, June 1977, 192 pp.