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ON

KEY PROBLEM AREAS -- AGRICULTURE

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NOVEMBER 1970

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KEY PROBLEM AREAS - AGRICULTURE

I. PREAMBLE

Issues

Agriculture directly controls the economic and social life of about 70% of the world's people. The present state of this agriculture, although improving slowly, still inhibits economic progress, frustrates the improvement of rural life and encourages urban migration. Accelerated levels of economic development, political stability and human well-being will depend strongly upon the rate at which the LDCs adopt measures for solving four primary agricultural issues, namely:

A. Materially enhance political response to the rural sector.

B. Substantially increase the wise utilization of agricultural resources.

C. Significantly increase the production, distribution and utilization of food and fiber.

D. Greatly improve effective rural income levels.

Performance to Date

Sporadic, yet inadequate positive progress has been attained in each of the above basic issues facing the LDCs. Rural per capita incomes have remained below 1/3 of urban incomes and generally have failed to increase proportionately with rises in the GNP. Farm production in absolute terms has grown rapidly, but gains in per capita food production have remained disappointingly low on a world basis.*

* Average Annual Charge in per capita food production has varied by region from -1.10% to +2.50% for the past 10 years. The world average (1960-70) of all regions is +0.75%.

Government response to the needs of the rural sector, in terms of price incentives, infrastructure, agricultural research, credit availability, marketing functions, and Ministry of Agriculture budgets has been inadequate and large areas of potentially productive economically useful lands still remain idle.

These constraints, among others, have resulted in per capita production levels that have about maintained the status quo. These levels are too low to satisfy the nutritional needs of growing populations, too low to allow the agricultural sector to contribute substantially to overall economic growth, and too low to offer hope for an improved future to the millions of subsistence farmers saddled with present inequities.

Progress towards the attainment of acceptable rural living levels for the mass of the world's farm population is grossly unsatisfactory. Failure to substantially improve these levels of living tends to increase migration to the cities, creating new influxes of the discontented upon already smoldering urban frustration and preventing the settlement of new lands and the acceptance of modern techniques of agriculture production on the farm.

Early U.S. efforts in attempting to improve agriculture in the LDCs were directed primarily towards the transfer of the techniques of production. These techniques resulted in increased yields but

markets were unreliable, inputs often expensive, credit limited and farm prices low, thus expected profits did not generally accrue. Recent improved analyses of the total economic and social environment offer much broader understanding, more viable approaches and new mechanisms by which an economic environment can be established in which agricultural progress is possible and the technology truly useful.

Constraints and Opportunities

The physical character of the agriculture of any country is largely shaped by the character of the land forms, soils and climate of the region, but what happens within the contraints imposed by physical characteristics is closely related to economic, social and political as well as agronomic forces and the relative balance between these forces. It is the first premise of technical assistance that these forces as well as some of the physical features are alterable, that by deliberate but careful adjustment, both the direction and pace of agricultural development can be altered, and that the economic, social and political costs of such alterations need not be excessive.

Changeable though these factors are, there remain the constraints imposed by the very nature of the typical agricultural system--which is large, ponderous, geared to biological and seasonal climatic forces, made up of thousands of widely dispersed units and controlled by the most conservative and least literate segment

of the population. Because of the nature of these systems, little that is positive from a production standpoint can be accomplished by force, quotas, penalties or other such uses of government authority. Even under the most carefully controlled conditions of a police state, these measures have resulted in disappointing output, and sometimes in agricultural chaos and governmental frustration. The second premise of technical assistance in agriculture then, is that the system must be led or pulled, not forced nor driven. There exists a diversity of tools that can be used for leading or pulling the agricultural sector towards desirable change, some of which can be used or influenced by technical assistance.

Each donor agency should promote the use of these tools with a mixture of caution, courage and wisdom and at the same time encourage the other donors to use them in a coordinated way to assist LDCs in reaching mutually agreed upon goals. There are limits to what each agency can contribute and limits on the LDCs' ability to make wise use of donor assistance. A fairly high level of coordination is required of the host country if differing contributions from multiple donors are to be truly complementary. The third premise then, is that no one agency or organization possesses the diversity of competence nor the magnitude of resources necessary to induce the needed pace of agricultural development. The Technical Assistance Bureau is attempting in this study to identify knowledge gaps or action gaps in this mix of inputs where in-depth attention to a few selected key problem areas can be of maximum benefit to the Regional Bureaus and field missions of A.I.D. and the overall LDC-multiple donor effort.

A Special Note on Farmers' Decisions

The farmers' choices, among alternative production activities, are influenced not only by customs and habits carried over from the past, but by incentives and opportunities (often brought about by new technologies or by new marketing arrangements) and by the risks associated with these opportunities, as he sees them. As stated in the first premise above, many of these factors are alterable. Thus, technical assistance in seeking to foster constructive change, should give substantial attention to the environment of incentives and opportunities for productive activity and the concomitant risks that face the individual farmer. Improvements in incentives and reductions in risks exert the pull on which the second premise is based. Such a complex system of incentives, risks, policies, prices, infrastructure, technology, marketing and the many other interlocking factors cannot be closely engineered, fine tuned or tightly controlled, but there are important gross factors that can usually be altered to which the overall production system is quite sensitive. In this way, the economic balance can be tipped in favor of the producer (if that is the direction desired), frequently without elevating consumer prices, and this advantage usually elicits a supply response. More subtle alterations can come later, if needed at all, when the system is operating and the kinds and amounts of pressure required to cautiously move it are better understood.

The adjustable components of this environment are primarily the set of government policies affecting agriculture and the set of institutions providing services to agriculture, including research. For example, a price policy change can provide the farmer with an incentive to produce, but he may not be able to respond to this incentive without access to adequate credit, technical, marketing, risk bearing or other services that he needs.

LDCs and their technical assistance advisors need to determine the most important and feasible alterations in the farmer's environment of incentive and opportunities to increase his own welfare and at the same time contribute to national development goals.

In any case, what happens in agriculture in nearly any country, is the sum or total of the effects of hundreds of thousands of individual farmer's decisions. The farmer hopes that the decisions he makes will be to his greatest economic and/or social advantage. His government and A.I.D. hope that the decisions he makes will also be to the advantage of the country's economic and social development. Part of our role is to foster (e.g., through technical assistance on policies, planning, research or institutional development) the development of choices in such a way that when the farmer makes the decision that seems best for him, it is also good for the development of the country in which he lives. This is the essence of helping the agriculture sector to adequately feed a growing population, contribute significantly to overall economic development and hopefully result in a better life for the people of the LDCs.

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II. KEY PROBLEM AREA ANALYSIS

II. KEY PROBLEM AREA ANALYSIS

The first task of the key problem area analysis was to characterize traditional agriculture as to the major factors that influence farming systems and practices and the interactions between these factors. Particular attention was given to those factors which impinge upon the farmers' incentives and decisions and upon effective demand for food. A chart showing these relationships is included as ANNEX B.

Armed with the analysis of influencing factors and their interrelationships, and using this as an initial guide, a list of agricultural problems was compiled. A wide variety of other sources was then explored, including the chiefs of agriculture and other LDC experts of the Regional Bureaus, officials of other agencies and the Foundations, and the problem list greatly expanded. These problems were then categorized into problem areas that were more workable, understandable, and conceptually easier to deal with.

In attempting to pinpoint key problem areas that are appropriate for TAB concentration, a study was carried out that consisted mainly of screening the list of problem areas through a number of tests. The lengthy list was first reduced by eliminating the problem areas that were not considered to be keys to agricultural development but simply specific pieces of larger problem areas. Second, the list was again screened to eliminate those problem areas that applied to single countries or small groups of countries, keeping those that applied worldwide, or at least to more than one region. Third, the list was reduced again by eliminating those activities already being given major attention by other agencies,

private or public. The fourth reduction was to eliminate those things the Regional Bureaus or the A.I.D. field missions were in a better position to do than the Central Bureau. The residual list contained only those problem areas considered to be keys to development and appropriate for TAB attention in conjunction with the Regional Bureaus and field missions. This list was divided into a list of activities to which TAB would give secondary attention (some of which were and are presently under way) and a short list of six items to which TAB would give major in-depth attention. A table or chart showing the flow of this screening process with a short paragraph on each step is included as ANNEX C.

The six problem areas to which the Technical Assistance Bureau will consider giving in-depth emphasis are the following:

A. Sector Analysis and Agricultural Economics Capability

B. Rural-Urban Transfer Systems

C. Worldwide Agricultural Research Network

D. Water and Tropical Soil Management

E. Higher-Protein Crop Production

F. Livestock Production (Tropical)

At first reading, the list appears somewhat incongruous as several important components of agricultural systems seem to be missing. It must be remembered, however, that the list is not intended to be comprehensive in the systems sense, but rather to point up knowledge or action gaps in overall systems programs made up of the efforts of the rest of A.I.D. and the other important assistance

agencies, public and private; limited further to those gaps which seemed within the potential capacity of the Technical Assistance Bureau. With this in mind a closer inspection reveals that even though the six problem areas selected do not form a system per se, they are much more closely knit and interrelated than they appear to be. Sector analysis is the basis for strategy and planning in all areas, water and tropical soils management plus livestock production are closely interrelated and both deal with great unused, underused or badly used natural resources. Higher protein crops and livestock production relate to food quantity and especially quality; rural-urban transfer systems override all the production items as they rapidly become the key to production as early demands are met. Agricultural economics capability is a requisite for the whole list but particularly for sector analysis and transfer systems. The research network applies to all of the other five.

Interrelated though these problem areas are, they are each briefly discussed separately below.

III. KEY PROBLEM AREAS

A. SECTOR ANALYSIS AND AGRICULTURAL ECONOMICS CAPABILITY

III. KEY PROBLEM AREAS

A. SECTOR ANALYSIS AND AGRICULTURAL ECONOMICS CAPABILITY

An agriculture sector analysis is essentially a detailed study of agricultural production, distribution and utilization systems, the major components of such systems and the many factors influencing these systems. A thorough understanding of the components of an agricultural sector is necessary for the setting of realistic goals, the formulation of acceptable strategy, the development of workable plans and the structuring of implementing activities. A sector analysis, systematically applied to reasonably accurate data, should describe the main components of the agricultural sector, the relative health of the components, how these pieces fit together, how they interface with and influence each other and the sensitivity of agricultural systems to intentional or naturally occurring changes in components or factors. Also, the analysis should indicate the degree, timing and location of changes required to achieve selected goals.

Strategy formulation and planning, if they are to be truly meaningful, ought to be based on rather comprehensive in depth analysis of the sector one hopes to influence. Detailed analysis of the agricultural sector and the relationship of this sector with all other sectors in the economy are universal needs in developing countries. Interaction among and interfaces between the various components of the agricultural sector need to be evaluated by interdisciplinary groups that can bring to bear broader understanding than that provided

by specialists in the many components involved in the flow of events from original inputs, through production to eventual marketing and utilization. Although such sector analyses must be closely oriented to the specific country involved, there is a universal need for this type of approach in all developing countries. Historically, where assistance groups have failed to effectively promote continuous improvement in agriculture over time, there has often been a failure to do enough analytical work to be able to predict the probable rate of development or response and to plan and decide what to do when certain progress levels have been achieved. That is, the sporadic successes that are regularly achieved and then followed by a decline and demise are usually based on incomplete systems.

Institution or subsector analyses do not appear to be adequate bases for selection among various program alternatives within or among sectors. Criteria and measures which are broadly meaningful and which allow comparison of relative projects and programs must be developed. Intersectoral and sectoral analyses and planning should provide a fairly complete staging of inputs and outputs which permit tracing of actions and responsibilities through the system for rapid isolation of lagging elements and provision for timely remedial action. The full application of evaluation as a management tool is only possible within such a complete system. Effective management also requires that at each management level, the manager be able to view his own stage in

relation to the stages that feed him inputs and those which are consumers of his outputs and to understand the overall relationships and implications of his actions. Flexibility must be built into the system to permit the manager to detect probable lags and shift resources intelligently to obtain essential outputs within the time limitations and to request and obtain additional resources or to alert managers at the appropriate levels of an anticipated lag so they can modify their targets or take other appropriate action.

This whole process then depends heavily upon a thorough understanding of the way the agricultural sector works, the internal and external mechanisms involved, the state of development and general health of the many interrelated components and the effects of policies and practices exercised by the government. A thorough sector analysis should provide this fundamental understanding upon which strategy and planning depend. Of all the functions carried out by A.I.D. in the developing countries this one has received least attention, yet no better method has been found for placing in perspective the entire complex of agricultural systems, to identify problems and plan corrective action at important points in the economy.

The general principles of how to conduct such analyses so as to achieve an unbiased and factual evaluation of the agricultural sector, are now generally know to A.I.D. But the techniques, methods and procedures for carrying out a sector analysis have not been well defined nor refined. A great deal of effort on A.I.D.'s part is required before

acceptable scopes of work can be prepared for even highly competent contractors to follow. A.I.D.'s in-house competence must be strengthened and skilled analysts from other agencies and institutions mobilized in such a way that well coordinated teams can be sent to requesting countries to work with Missions staffs and host country nationals on complete system analyses. Methods and procedures must be improved, updated and coordinated with world banking systems and the more important international agencies and sponsoring countries that assist LDCs. It is envisioned that host country nationals can be readied to do most of the data gathering and analytical work, assisted by outside experts, and then maintained as permanent analysis and planning groups, within National Planning Commissions, to continuously collect data, update analyses and improve plans as conditions change and progress is made.

The level of sophistication of a sector analysis can vary from quickie type studies of a few weeks duration through more comprehensive analyses lasting a few months - at least through one cropping and marketing season - to one or two year very thorough and detailed studies made by a multidisciplinary team of experts assisting host country analysis teams. The ultimate is a never ceasing study that continuously upgrades and improves the analytical work, based on a constant stream of new data. The type analysis decided upon for any one study depends largely upon 1) the kinds of information needed for the level of strategy and planning contemplated, 2) the nature of commitments to be

made based on the study, 3) the time available for the study - or the degree of urgency, 4) the number and competence of analysts that can be supplied by the host country, 5) the organizational structures from which these analysts are drawn, and 6) the funds available for the study.

Agricultural programs in the LDCs suffer from a lack of agricultural economics capability. This lack may exist in A.I.D./W, the Missions or in host country institutions (or any combination of these) and may be expressed in terms of quantity, quality and type. Quantity, as in sheer numbers of economists, and quality in terms of training, field and problem solving experience, are fairly well known or understood. Differences in type of agricultural economists is not so well recognized, and this distinction may be much more important for the LDCs than for agriculturally developed nations. The two major types of agricultural economists are the development economist and the farm management or production economist.

Development economists are concerned with sector analyses, strategy, planning, marketing systems and government policy. These factors are more and more being recognized as highly important and the relatively new field of development economics is intended to deal with these kinds of problems. Sophisticated techniques are rapidly coming out of this field. This type of agricultural economist usually works between the farmer and the government on the problems mentioned above.

Farm management economists are rapidly going out of fashion in developed countries and are getting rare. These economists work on the economics of farming systems and the cost benefits of new systems, alternative crops, new inputs and innovations in farming patterns. They work between the production technician and the farmer. This means that the farm management economist attempts to alter farming systems in order to achieve a better fit between natural resources, the farmers' capability and the existing environment of government policies and service institutions, while the development economist tries to improve the policy-institution environment. The lack of an agricultural economics capability mentioned above is concerned with both of these types. Since the farm management type is becoming hard to find it may be that agronomists with added economics training could serve this function.

The developing countries do not have adequate numbers of trained agricultural economists to carry out sector analyses, identify the most useful development strategies, provide adequate planning, encourage helpful policy formulation, structure improved marketing systems and economic research and to work with production specialists in improving efficiencies and profitability in farming systems. Neither the A.I.D. Missions nor TAB has adequate numbers of agricultural economists to fill the host country deficiency in this regard while local competence is being improved.

This problem of a low agricultural economics capability often prevents adequate analysis of LDC problems, allows poor choices among alternatives to go unnoticed, creates distortions in programs where

interactions are critical and may make the selection of conditions precedent to sector loans difficult or awkward. This last point becomes serious when host governments are required, under the conditions of a loan, to make policy changes which are politically very difficult and to which the production system we are trying to influence may not be very sensitive.

The area of agricultural economics capability was singled out as a key problem area because the deficiency is so widespread and because it impinges directly on all of the other key problem areas described in this paper.

B. RURAL-URBAN TRANSFER SYSTEMS

B. RURAL-URBAN TRANSFER SYSTEMS

Perhaps the most frequently out of balance parts of agricultural sectors in developing countries are the interchange mechanisms by which urban areas supply farm areas with production inputs, consumer goods, credit and other services and by which farmers supply urban areas with food and fiber products. The main difficulty is in providing equitable prices and benefits to each group -- maintaining reasonable balances between incomes and prices and fair but not excessive returns for those who manage the transfer systems. For purposes of this paper these two-eay interchange mechanisms will be called Rural-Urban Transfer Systems. The concept encompasses marketing but is not confined to traditional marketing activities.

The concept of Rural-Urban Transfer Systems is best understood when farmers are considered as both producers and consumers. and urban dwellers are also considered as both producers and consumers. Goods, services and capital flow between these groups with varying degrees of efficiency depending upon the nature, availability and cost of the items transferred, the manner in which the transfers are organized and managed and the political, economic and social factors that influence the transfer systems.

These Rural-Urban Transfer Systems that enhance or retard the flows of goods, services and capital, may work to the advantage of farmers at one time or to the advantage of urbanized groups at another, or they may be detrimental to both rural and urban peoples and benefit only the operating groups that manage the systems. The government

itself may be, and has been in notable cases, the principal favored recipient of transfer system benefits.

Equitable and workable Rural-Urban Transfer Systems are essential for economic development because:

1. They strongly influence the cost of farm inputs and the cost of food production.
2. They promote or inhibit the acceptance and use of production technology.
3. They elevate or lower farm prices, farm profits and the incentive to produce.
4. They increase or decrease the spread between farm prices and consumer prices, thereby tending to hold down or elevate both production incentives and consumer demand.
5. They encourage or inhibit food processing, storage and preservation, thus affecting spoilage losses and other forms of waste.
6. They speed up or slow down food transport and handling.
7. They affect the incomes and purchasing power of rural and urban people.
8. They reduce or increase the percent of income spent for food, directly affecting savings.
9. They allow or prevent rural people from becoming consumers of urban-made products, greatly increasing or decreasing the size of the market for such products.

10. They influence government policy and in turn are influenced by government policy.
11. They strongly affect the investment climate in the agricultural sector.
12. They promote or discourage investments in agri-industry and employment opportunities in both rural and urban areas.
13. They increase or decrease the displacement of rural people.
14. They tend to enhance or degrade agriculture as a respectable profession and way of life.
15. They set the stage for capital transfers from the agricultural sector to other sectors.

The Rural-Urban Transfer Systems have profound effects upon farmers' decisions and upon the buying habits and buying capability of urban consumers, particularly among small farmers and low income people. These groups, however, that make up most of the populations of the LDCs, have little or no direct effect upon the systems themselves. It is imperative then, that there be wise and rational political and institutional response to this most sensitive development requirement, otherwise small use may be made of highly successful technical advances made in the various agricultural sciences. Transfer systems may be altered in ways that tip the economic scales towards the farmer or towards the consumer depending upon whether production incentive or effective demand is lagging. If both are low, then substantial efficiencies in the system are essential, so that savings

made can be divided in meaningful amounts to both producers and consumers resulting in improved incentives and increased effective demand simultaneously.

Transfer systems, in some form, exist in all of the LDCs, although a system as such is often not apparent. On closer study it usually becomes evident that the transfers are better organized and the operators more knowledgeable than any other part of the agricultural environment. The people who manage transport of farm commodities, processing, storage, wholesale and retail outlets, are aware of farmer and consumer prices, markups, storage and processing costs, transport facilities and charges as well as hidden taxes on sales transactions. The farmers and consumers are not well informed, if informed at all, on these figures. Inefficiencies abound in such tightly controlled systems, some intentional, some simply traditional, and since competition does not exist or is weak, there is very little incentive to make improvements. These inefficiencies tend to increase the spread between farm prices and consumer prices which results in low prices for farmers and high prices for consumers. Therefore, the two primary requisites for production, farmer incentive and effective demand, are both kept low, thus almost assuring agricultural stagnation. Since farmers are highly responsive to assured prices or substantial price increases and since price elasticity for food in hungry nations is high, then even small improvements in transfer systems become powerful tools in increasing food production, distribution and consumption.

Efficient marketing systems are essential as LDCs attempt to modernize their agriculture. Generally, farmers do not have easily

available all the inputs, markets, credit and information required, nor efficient transportation. Private service institutions and private sector businesses are not yet contributing strongly towards improving marketing systems and often are actually perpetuating unproductive systems and are thus keeping their own growth rates low. LDCs have not yet acquired the operational capacity to initiate and direct programs of procurement, pricing, supports, subsidies, warehousing, processing and distribution of agricultural commodities.

Marketing facilities in the LDCs are inadequate to transfer the product from producer to consumer, grain storage is lacking, grading and packing facilities meager, grades and quality standards non-existent and transportation often not available. Marketing of agricultural products for in-country consumption generally is very poorly developed in the LDCs. Spoilage and other forms of waste often exceed the countries' internal food deficits.

Regions like Latin America import only 3% of their consumption of agricultural products yet lose 20% of their total production through spoilage and waste. Much of this loss is due to inadequate storage of the proper type, inefficient and costly processing, high priced and infrequent transportation, poor warehouse and retail market facilities and the like. All of these constitute parts of the rural-urban transfer problem and a great question is: "Which would be cheaper for an LDC; improve the systems and save the extra food needed by reducing the 20% loss to 15%, or increase overall production by about 6%?"

Efficiencies made in these systems can, if properly utilized and administered, reduce food costs to consumers without reducing farm incomes, or increase farm incomes without increasing consumer prices, or some of both. This is vital if effective demand and production incentives need to be improved at the same time.

A very special problem is that small farmers typically pay more for inputs and receive less for their production than large farmers, thus effectively separating them from the commercial mainstream of agriculture and from the money economy. One of the most important aspects of the rural-urban transfer system is its applicability to the plight of small farmers and the highly critical area of rural employment. It is within these transfer systems that powerful tools exist for attacking these basic socio-economic maladies.

The most often heard complaint about the green revolution, new production technology or farm modernization is that large farmers with capital and risk taking capability can utilize new technology sooner than anyone else and by doing so, effectively broaden the gulf between large farmers and small farmers. This makes for rural discontent and more rapid urban migration. If within the transfer system, methods and policies can be developed whereby small farmers can get their production inputs as cheaply and their credit at comparable rates and ease of accessability of large farmers and if they can get as good a price for their production as large farmers then they can be highly competitive with large landholders. The small farmer can do this because with the assistance of his family he can devote more manhours

per acre to his operation than can large farmers. If prices can be brought to near parity then this advantage of a high ratio of labor to land can put small operators in competitive positions. Under such a price regime prosperity can be established among small producers and a supply response similar to that in Taiwan, Japan and Korea should be a possibility. This could be the most important function of a well organized and managed rural-urban transfer system.

Importantly, it is within rural-urban transfer systems that the stage is set for the transfer of savings from one sector of the economy to another sector needing investment for development,i.e., transfers from agriculture to industry. Done carefully such transfers are ultimately helpful to the agriculture sector, but done imprudently, too early in the agriculture sector development period or too massively at one time and the donor sector can be depressed to a stagnant level.

An outline of the function of rural-urban transfer systems is included in this paper as Annex A.

C. WORLDWIDE AGRICULTURAL RESEARCH NETWORK

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Agricultural research as a factor in overall economic growth means different things to different people, depending primarily upon educational background, work experience, political sensitivities, analytical competence, institutional exposure and other factors. Generally, however, most people see agricultural research as mainly concerned with the selection and/or breeding of new crop varieties, the development of packages of cultural practices to go with the new varieties and the evolution of institutions that can carry out these tasks. This is a very narrow view of agricultural research, that is easily over-emphasized,* but it is an important one. The "high payoff technologies" are important because with the best seed, on the right soil, with the proper fertilizer and the appropriate insecticide, one can readily demonstrate double yields in nearly any agricultural zone provided these yields have not recently been so doubled. When farmers in the LDCs see such demonstrations, they often do not accept nor attempt to utilize the new production package. The reasons used to explain the farmer's reluctance are usually that the farmer is ignorant, unwilling to innovate, difficult to convince, stubborn, or a victim of tradition, custom or taboos. While some of these reasons are frequent, it is more often true that the selected technology is too costly to be truly profitable, the needed inputs not available, the investment and marketing risks too

* See "The Dangers of Faddism in Agriculture" by S. C. Hsieh and V. M. Ruttan
Development Digest - Vol. VI - No. 3 - July 1968.

high, real demand for the product is uncertain or for combinations of these reasons with others. The production researcher perhaps has no background that would allow him to recognize all these lateral factors that directly affect the success or failure of the production package he has so carefully put together, but the farmer does.

In addition to the above, there is another fundamental concept that impinges upon the usefulness of production research and profoundly influences farmer acceptance of new technology and farmers' management decisions in developing nations. Throughout the third world markets are full of food. Everywhere one travels, even in the "hungry nations," markets in villages, towns and cities are filled each morning with food items of nearly all types - grains, pulses, vegetables, fruits, root crops, meat, fish, eggs, poultry, etc. Most of these items are locally produced and they are almost never all sold. Clearly farmers are producing up to effective demand, and when one considers the high rate of spoilage, waste and transportation and storage losses; farmers are actually producing significantly above effective demand. This is strong evidence, except in the very special cases of widespread famine due to weather, plague or war conditions, that food supply generally is quantitatively adequate to match people's income levels and that new production technology that tends to increase total food supply is of little value unless effective demand can be substantially increased also. If this reasoning is correct, and there is ample evidence to

indicate that it is, then what are the legitimate reasons for financing agricultural research activities aimed at increasing yields per acre or increasing total production? Such research might be of enormous value to development if it is oriented.in such a way that it tends to:

1. Reduce production costs, possibly resulting in cheaper food prices for poor people, or at least keeping food price rises small, thus increasing demand. (Reducing production costs also increases farm income and directly stimulates production incentives).

2. Free some crop land for export crops or legume or livestock production that would improve protein supplies or protein quality or both.

3. Provide disaster insurance by developing methods of combatting plagues of insects and diseases, seriously adverse weather conditions or drastic market fluctuations.

4. Provide production potential that could meet rapidly rising food demand should high rates of population growth and rising incomes coincide.

5. Publicize production potential and stimulate political response in the form of new or improved government policies on agriculture.

6. Bring unused or under used land resources into production if needed to meet new internal or external demand.

Production research then can stimulate progress in the four primary agricultural issues listed on page 1 but it is evident that these benefits do not ordinarily flow from production research efforts alone. New technologies for improving production may not increase farm income nor reduce consumer prices unless rural-urban transfer systems are working smoothly so that production inputs and food products are reasonably priced. They will not stimulate production unless they are truly profitable. They will not increase employment opportunities nor influence government attitudes and policies unless farming becomes more prosperous and governments more aware of the true effects of policy decisions on agricultural development. There is then, a rather complex production environment, made of many interrelated facets, that must function reasonably well for new production technology to be useful and for the rational and logical justification of production research financing.

Agricultural research or agriculture-oriented research then should be involved with and thought of in terms of the total production environment:

1. Research administration and management
2. Sector anlaysis and complete systems
3. Improved varieties adapted to ecological conditions
4. Cultural practices that satisfy the new varieties requirements, tied to better management systems
5. Rural-urban transfer systems and marketing risks
6. Input availability and cost

7. Institutions that serve agriculture
8. Government attitudes and policies on agriculture
9. Factors that influence political response to the rural sector
10. Private sector involvement - Agribusiness
11. Population growth
12. Production needs of the country
13. Income and income distribution
14. Effective demand (internal and external) for more production
15. The quality of rural life and job opportunities
16. Environmental degradation due to advances in production technology
17. Utilization of the countries' total agricultural resources.

In effect then, the whole environment within which agricultural production takes place lacks research to properly identify and hopefully correct bottlenecks in the system. As Dr. Lee Howard has pointed out in his paper on health; world population was increasing very rapidly before the doctors and their medical technology had much effect upon it, largely because the environment for survival and production was getting better. Conceivably if the environment should seriously deteriorate, then world population would decline, again in spite of medical technology. The same is true with agriculture. World food production has more than doubled the last two times world population doubled, before technology as we know it had must effect upon it,

mainly because the environment was, if not good, favorable enough.* This world food production could readily decline on a per capita basis if the production environment seriously deteriorates, even in the face of new and vastly superior agronomic technology.

A major problem is how all of the components of the entire production environment can be examined and studied in a unified way, in the light of complete systems, not simply agronomic systems. Clearly single institutions are not geared to such a broad approach and the most successful research organizations that have achieved major breakthroughs have been narrowly focused, not just on a single area like agronomy but on one or two crops like rice or wheat. It would be totally impractical to set up research organizations on each crop and on each component of the entire production environment and impossible to attempt this in each country but it is certainly true that the chances of success are associated with concentrated effort on very narrow goals. This kind of specialization works well on special problems provided that the narrowly focussed goals are not pursued so exclusively that major objectives are lost sight of. This kind of research makes good use of a few highly trained scientists but it is less helpful in building LDC research competence.

Needed then is a relatively large group of agricultural research organizations, some narrowly specialized on specific key problems, some broader in scope designed to work on problems containing several interrelated facets requiring simultaneous study and some very broadly

* See "The Struggle Against World Hunger" by D. Gale Johnson (University of Chicago) Headline Series No. 184.

oriented towards area or regional agricultural systems and containing departments devoted to agricultural related fields like political science, anthropology, sociology, ecology, resource evaluation, statistics, etc. This complex of research institutions needs to be interconnected and integrated into a research network feeding information to each other through a center having automatic storage and retrieval capability and broad experience in handling biological data, titles and classifications. Such a facility already exists in the Smithsonian Institution's Science Information Exchange. This organization has been in existence for 20 years, is skilled in the type methodology required, is presently putting together a central network on the U.S. environment that would be similar to the one envisioned here, is moving up to larger computer systems with greater capacity and could handle worldwide research network data coordination for U.S. and the LDC institutions.

Many of the elements of a worldwide agricultural research network already exist. Outstanding examples of the narrowly specialized type research organizations are the International Rice Research Institute (IRRI)* in the Philippines and the International Center for Wheat and Corn Improvement (CIMMYT)* in Mexico. They have been responsible for scientific breakthroughs that have created the "Green Revolution." Similar but newer, less specialized and less renowned institutes are the International Center for Tropical Agriculture and Livestock (CIAT)*

* IRRI, CIMMYT, CIAT and IITA are all financed and administered by private foundations (Rockefeller, Ford, Kellogg) with important cooperation from host countries and, more recently, substantial financial assistance by A.I.D.

in Colombia and the International Institute for Tropical Agriculture (IITA)* in Nigeria. These are broader in scope than IRRI and CIMMYT, being geared to problems of a climatic environment rather than to specific crops. Much of the research work done by FAO/UN falls into this less specialized category. The U. S. Department of Agriculture and Ministries of Agriculture abroad as well as universities and colleges of agriculture in developed and developing countries run the gamut from very narrowly specific research to investigations of a regional nature.

In the developed countries, networks made up of these kinds of research organizations already exist and have existed for many years. The idea is a deceptively simple one in that most modern networks were formed in an informal way and they have been successul mainly because so many channels of communication have long been open between agricultural scientists of all types. Well managed professional organizations with their individual subject matter journals, international meetings, major conferences, seminars, visiting lecturers, ease and frequency of travel, among other factors, all have contributed to the formation of links between research groups. Modern textbooks with individual chapters written by different experts from various institutions have also contributed to network interchange.

Networks of these types organized on a world basis and involving developed as well as developing nation institutions and their hybrids is a much larger and more difficult problem. The need, however, is very

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great because both financial and human resources are too limited to allow country by country research on agricultural problems, particularly when the whole production environment needs research attention. Some kind of an international network of well-organized agricultural research competence probably offers the best chance to make maximum use of the limited financial and scientific resources. The research task is monumental and the cost of not getting it done is staggering.

A great need in this key problem area is strong influence from TA/AGF in the expansion of research, better organization and management of existing and new research institutes, expansion of research mandates to include complete systems or at least the most critical parts of whole systems, the important linkages between research institutions and stronger linkages between research and the real problems. With these kinds of influences and continued financial support from A.I.D. and other agencies, a worldwide network of research institutions can maximize the use of scarce resources, help reduce expensive overlapping of effort, improve organization and efficiency, avoid repetitive mistakes and tap resources of well developed institutions whose professional personnel cannot be recruited directly.

Two products should flow from such a network - new research findings for problem solving and an improved research competence in the LDCs. The network itself is not the goal but a means to achievement.

D. WATER AND TROPICAL SOILS MANAGEMENT

D. WATER AND TROPICAL SOILS MANAGEMENT

Large increases in world food production must come about by intensification of farming on land already in use or bringing new lands into production or a mixture of the two. For thousands of years world production progress was based on expanded acreage and even in the U.S. this was true until about 30 years ago. This is still true in much of the developing world.

Intensification of land use can result in quantum jumps in crop yields if the new technology required is not too overly complicated and if input costs are not excessive. Improved use of natural rainfall or the introduction of irrigation systems may be parts of the new technology and maximum utilization of these techniques should be made, even where new lands are available, if the practices are not too costly. In other areas it may prove more economical to open new lands to farming and ranching particularly if the intensification alternative calls for high priced imported inputs, extensive mechanization or costly land preparation procedures. If we look for large areas that can still be opened we find two vast ones; the semiarid grazing lands, part of which may be irrigable, and the tropics and subtropics where appropriate knowledge is scarce. Water and tropical soils management then, loom very large both in the areas of increased intensification and in utilizing new lands.

Wherever sufficient areas of suitable land exist in regions where water resources can be developed at reasonable costs, controlled irrigation has great potential for crop production. In the tropics,

irrigation often makes it possible to produce two, three, or even four crops per year under the most efficient systems of management.

There is a serious shortage of basic research on effective use of irrigation water, in conjunction with cropping systems and soil management, to provide sound guidelines on economic development of irrigation agricultural systems for tropical regions. Directly comparable productivity indices for different systems are also lacking. Selection of systems for comparison in differing ecological zones will depend on availability of water as well as crop types and costs of delivering water to crops. Evaluations are needed of crop species that maximize production per unit of water in regions of limited water supply, or that maximize total productivity per hectare of land in regions of abundant water supply. The associated management requirements in physical inputs and labor should be determined in conjunction with total crop production. Similar studies are needed in at least two continents to permit estimates of location effects.

In Africa alone, there are some 36 million acres of land in dry regions that appear to be irrigable, and could be highly productive if properly developed. At present less than one-third of suitable land is now irrigated, and much of this is not being managed to fully develop its normal potential, and to protect against ultimate loss by salt accumulation due to poor internal drainage or unwise use of water. In South America, only a small portion of the potentially irrigable land has been developed. In India, Pakistan, Iran and Afghanistan it is estimated that irrigated farm land may be tripled eventually if

water resources can be developed. The magnitude of these figures on specific countries may be misleading in terms of world potential. At the present time only about 5% of the world's crop land is irrigated, and if all known land that would respond to irrigation and where adequate water resources are known to exist were developed then perhaps 10% of the world's crop land could be so managed. Although in percentage terms of irrigable land the acreage is not highly impressive, the production potential is high and results often dramatic.

Irrigation reduces farming risks as far as drouth is concerned but adds risks of a long range nature like salt accumulation, waterlogging, destruction of soil structure and erosion. Literally millions of acres are now useless due to malpractices of this nature, and added costs are incurred in teaching farmers new techniques to prevent these problems. Irrigation developments require heavy capital investments, and these are not warranted unless detailed studies clearly show their economic soundness. There are also disease problems associated with irrigation development, examples of which are schistosomiasis, malaria and liver flukes. These diseases, that affect man as well as livestock, can be controlled but advanced planning and added costs are involved. Extra harvesting and grain drying costs may be incurred with new irrigation development. The irrigation system may allow two crops of rice per year, for example, instead of one, or three crops instead of two. When this occurs then at least one of these crops will have to be harvested during the rainy season and artificial drying will have to replace traditional sun drying techniques. If fuel is expensive, this additional cost may seriously reduce the profitability of the extra crop.

In spite of all these problems, irrigation practices are often highly profitable as they almost always allow the use of previously unusable land, permit more crops per year or sharply increase yields from the traditional number of crops. Many of the criteria for evaluating irrigation projects are knownbut factors associated with the tropics must be derived by basic research as here proposed for TAB support.

More than 90% of total arable lands in the LDCs of the tropics and subtropics are farmed with natural rainfall, and management of this water is highly significant in terms of the great area involved. The most efficient management of soils and water supplies is essential to agricultural programs, and these two factors are so closely related that they must be considered together. The technology on soil and water management developed for temperate zone soils is not directly applicable to tropical conditions, but some basic principles are considered to be widely applicable. TAB should foster adaptive research to gain a better understanding of the properties of different kinds of tropical soils, and of the methods of managing such soils so as to create permanently productive systems of farming. The prevalent slash-burn, crop-fallow systems of farming are not adequate for supporting growing populations, but they are quite possibly the best use of such lands in the light of present knowledge.

Water management on arable soils has fundamental significance in the tropics. In high rainfall regions, the disposal of excess water without waterlogging the soil, and without serious soil erosion losses,

requires new research to establish effective guidelines. In regions of limited rainfall, and in wet-dry regions, research is needed to develop effective systems of storing rainfall in the soil profile, to support year-round production in tropical regions.

Information is needed on recognition of specific capability classes of soils, and of related cropping systems and erosion control practices that will contribute to permanently productive agricultural systems. Research is lacking on systems that would provide effective methods of land preparation, use of soil testing to estimate fertility status and provide guides to the use of fertilizers and soil amendments, planting practices consonant with seasonal weather patterns, as well as tillage and crop protection measures to produce optimum crop growth, for each major class of soil.

There is a wide gap in our knowledge of the cumulative effect of management practices on soil productivity and the related effects on soil conservation and water erosion on effective use of rain-fall. These should be evaluated for each system. Such studies are seriously needed on one or more soils representing the most extensive area of arable lands, in major ecological zones, on at least three continents. Significant is the fact that there are about two billion acres of tropical soils with adequate rainfall for cropping that are not now used or only lightly used under shifting agriculture. These lands can, with adequate knowledge, form the basis for expanded agriculture when needed.

E. HIGHER-PROTEIN CROP PRODUCTION

E. HIGHER-PROTEIN CROP PRODUCTION

Protein malnutrition is second only to total food supply in worldwide problems of LDCs. Protein deficiencies in human diets result in ill health and lowered productivity in adults but strikes hardest at infants and young children, with heavy losses in mortality, chronic disease and the hazard of permanent impairment of the central nervous system frequently ending in irreversible mental retardation.* Protein shortages, and deficiencies in protein quality, are perhaps two of the most insidious factors in the low rates of economic development of the LDCs. Such malnutrition can be corrected by several methods:

1. More meat, fish or other products of animal origin, such as milk, cheese, eggs in the diet: This is perhaps the most desirable way to correct both protein quality and quantity problems, and should be vigorously pursued (given major emphasis elsewhere in this report). Difficulties with this system are that animal production is not yet well established nor well understood in tropical or subtropical areas, where most of the protein problems exist, and achieving adequate supplies of livestock products to meet these nutritional problems, on a broad scale, seems questionable on a desirable time frame.

* A recent massive and well designed experiment in Holland that has eliminated family and other sociological variables from the experiments, has failed to show mental retardation. The statistical treatment of these data are not complete, however, and further conclusions will be published by the end of 1970.

2. Protein and/or amino acid fortification of presently used foods: To a limited degree this process is already workable and is relatively cheap but it fails to reach the bulk of the rural population, which is most of the total population in the LDCs, because farm people consume mostly their own production and purchase very little processed foodstuffs, thereby being effectively cut off from fortified products. Also, even though fortification is relatively cheap, there is a cost and this is usually passed on to the consumer. In urban slums, where most of the remainder of the protein problems exist, people tend to purchase the cheapest grade of nearly all products and they do not generally understand nor give any great credence to one quality being superior to another in a nutritional sense. Therefore, unless fortification can be subsidized in some other way and/or be required by law, these urban poor are also cut off from fortification. Some progress has been made in solving these difficulties but fortification remains a problem, particularly for the poor.
3. Utilization of the meal of oilseed crops as protein supplements: The meal, or processing by-products of soybeans, peanuts, sesame, sunflower and cottonseed constitute an additional source of dietary proteins. Once the edible oil has been extracted these meals can be utilized as additives in a wide range of food products. These meals are not well balanced in essential

amino acids, being generally deficient in methionine, but their overall protein content is relatively high once the oil has been extracted. A serious drawback for this method is getting people to make changes in their diets and utilize these products in their food preparation. There are perhaps no people on earth who have ever materially changed their eating habits for nutritional reasons -- except perhaps in some of the most advanced nations. Another problem is getting these by-products consumed by low income groups.

4. Higher-protein crop production: Well known and traditionally utilized grain crops have recently been produced that have higher protein levels and improved amino acid balances. Considerable progress has been made with corn and current research findings with wheat, millets and sorghums are promising. This work can probably be extended to rice.

Food grain legumes (pulses) offer a major hope for achieving protein sufficiency in the LDCs. These crops, including the beans, lentils, peas and related species, are high in total protein but breeding will be necessary to provide strains that are nutritionally well balanced. There is also a lack of improved strains in the sense of disease resistance, insect resistance, responsiveness to fertilizer and irrigation and other yield increasing factors.

Of these sources of food protein, the food-grain legumes (pulses) offer the greatest and earliest opportunity for balancing human diets in LDCs. They are naturally high in total protein (about 25%), and they are normal items in the diets of populations around the world. They are very widely grown by the rural populations and subsistence farmers, and consumed directly. The grains are rather easily stored under a wide range of conditions. No change in eating habits is required to insure wide usage, and thus there is no question of acceptance of an unknown food. These pulse crops, while widely grown for home consumption, are not so widely produced for the commercial market because yields are not high and therefore the farmer can usually earn more by growing cereal grains with high yielding capabilities - like corn or wheat. It is, however, probably easier, and the techniques better known, to increase the yielding ability of pulses than to breed for higher protein levels in wheat. Research to develop high yielding varieties of each of the pulse species, and to improve the quality of the protein will constitute a tremendous contribution to meeting the world problem of protein malnutrition. It is for these reasons that higher protein crop production (both in cereals and pulses) is considered to be a key problem area suitable for TAB concentration. Filling knowledge gaps in this area would be of enormous assistance to the Regional Bureaus and field Missions, in their efforts to combat malnutrition.

F. LIVESTOCK PRODUCTION (TROPICAL)

F. LIVESTOCK PRODUCTION (TROPICAL)

Livestock production, particularly in the tropics, has great significance in the agricultural production systems of the LDCs because:

1. Utilization of Natural Resources

Vast unused or underused areas exist that are semi-arid to arid, too steep to plow, too wet to farm, or too rocky for improved cropping systems. These lands can usually be utilized only by grazing animals. In addition, land in the unsettled interior of continents that can eventually be used for intensive farming, can be utilized immediately by grazing until the infrastructure for intensive farming is in place.

2. Increasing Protein Availability

Animal products in the form of meat, milk, cheese, eggs and poultry together with fish provide natural protein food, that meet the nutritional requirements of man. These nutritional needs can be met with plants alone, but nevertheless there are many large areas where grazing is entirely possible and farming is not. Grazing can be practiced with less infrastructure cost than any other kind of agriculture and interior lands will very likely be first settled by this means.

3. Improving Tropical Soil Management

Animal agriculture is very likely to become an indispensable factor in the development of permanently productive farming systems for the humid tropics. Medium term pastures, of deep rooted grasses

and legumes in long term cropping rotations may prove to be necessary in order to prevent loss of soil fertility by leaching and loss of soil structure and erosion due to tillage in the humid tropics. Such pastures would not be profitable even though they save the soil unless utilized by grazing animals. This may prove to be the most important role of cattle in tropical regions.

Beef cattle have not been given much attention in hungry nations, mainly because of the low conversion factor of feed to meat by beef animals as compared to swine or poultry. Since it requires 8 to 10 pounds of feed to produce one pound of beef these animals are considered to be highly inefficient when compared to poultry where it is possible to achieve one pound of meat with two pounds of feed. The figures are correct but the thesis is not when viewed in the light of the kinds of feeds consumed by beef animals, and whether or not these animals compete with man for food. Beef animals can utilize rough forage (which man cannot) up to 80% or even 85% of their total intake and forage can be grown on land unsuited to general farming. Milling, brewing and sugar by-products and feed grade urea can be added to supply more calories and most of the protein requirement. A small amount of grain would be needed but in terms of food that is competitive with man, more protein and better quality protein, is returned in the form of beef than is consumed by the cattle. Such a system can be developed for almost any generalized farming area. In semi-arid zones,

where extensive grazing is practiced, good range management will usually allow the production of beef animals with no grain feeding if part of the natural forage can be saved for consumption during dry seasons.

Wide knowledge gaps exist in the whole chain of events in tropical livestock production. Little is known about the performance of selected strains of native cattle when crossed on improved beef types. Temperate zone cattle have proved to be very poorly adapted to insects, diseases, internal parasites, heat, humidity and low quality forages. Native cattle have been exposed to the extreme of the tropical environment for several hundred years and this intense selection pressure has resulted in excellent adaptation if low productivity. A serious need is the determination of how to best utilize this highly selected material in a sound breeding program to increase productivity without sacrificing the excellent adaptation qualities.

Knowledge gaps also exist in livestock feeding and management in the tropics. Research is badly needed on economical production of livestock feeds and the whole gamut of factors in livestock management from breeding through improved pastures, mineral supplements and by-products of food processing, range management, insect, parasite and disease control. Livestock production in the LDCs has received considerable attention in the past but it has nearly always been fragmented with attention paid only to one or two limiting factors at a time. The introduction of temperate climate breeds has been a tremendous waste of money and effort, attacks on parasites and diseases were not coupled with improved nutrition, while attempts to improve

nutrition usually resulted in healthy animals that were too costly to meet market requirements. What seems to be required, particularly in the tropics, is a complete systems-vertically integrated approach extending from forage producer to meat consumer, similar to systems used for poultry but based on grazing instead of harvested and processed feeds. Management of herds is a key factor that is often overlooked by the specialists like veterinarian , animal nutritionists and breeders. Critical to such a system is forage production, range management and the evolution of economical methods to bridge nutritional gaps caused by dry seasons of the year.

Fitting a relatively high production animal into the ecclogical complex of tropical zones is a multidisciplinary problem and sound solutions would tend to open vast areas to livestock production. Tropical livestock production is considered a key problem area as it looms large in improved diets, utilization of large natural resource areas and the evolution of permanently productive farming systems for the tropics.

Annexe

IV. ANNEXES

ANNEX A - RURAL-URBAN TRANSFER SYSTEM FUNCTIONS

ANNEX A

TRANSFER SYSTEM FUNCTIONS

A. Disposal of Farm Produce

1. Private sector activities

a. Assembly

b. Processing - cleaning, grading, drying, fumigating, preserving, packaging

c. Storage - bulk storage, warehousing, refrigeration

d. Transport

e. Marketing - exports, wholesaling, retailing, promotion advertising, pricing

2. Government Activities

a. Essential infrastructure - storage, facilities, roads, railroads, utilities

b. Market research

c. Market news

d. Policy - exports, pricing (controls, stabilization, guaranteed minimums, etc.)

- taxes (sales, service, export)

- restrictions (controls, quarantine, etc.)

e. Credit - availability, interest rates, restrictions

B. Procurement of Farm Needs (inputs)

1. Private sector activities

a. Production inputs - fertilizer, seed pesticides, tools, equipment, machinery, fuel, credit

b. Other consumer goods - trucks, wagons, carts, tires, radios, household equipment, clothing, processed food.

2. Government Activities

a. Essential infrastructure (See A,2, a.)

b. Cooperative assistance - legislation, organization, credit

c. Input subsidies - where needed

d. Policies - price controls, procurement assistance

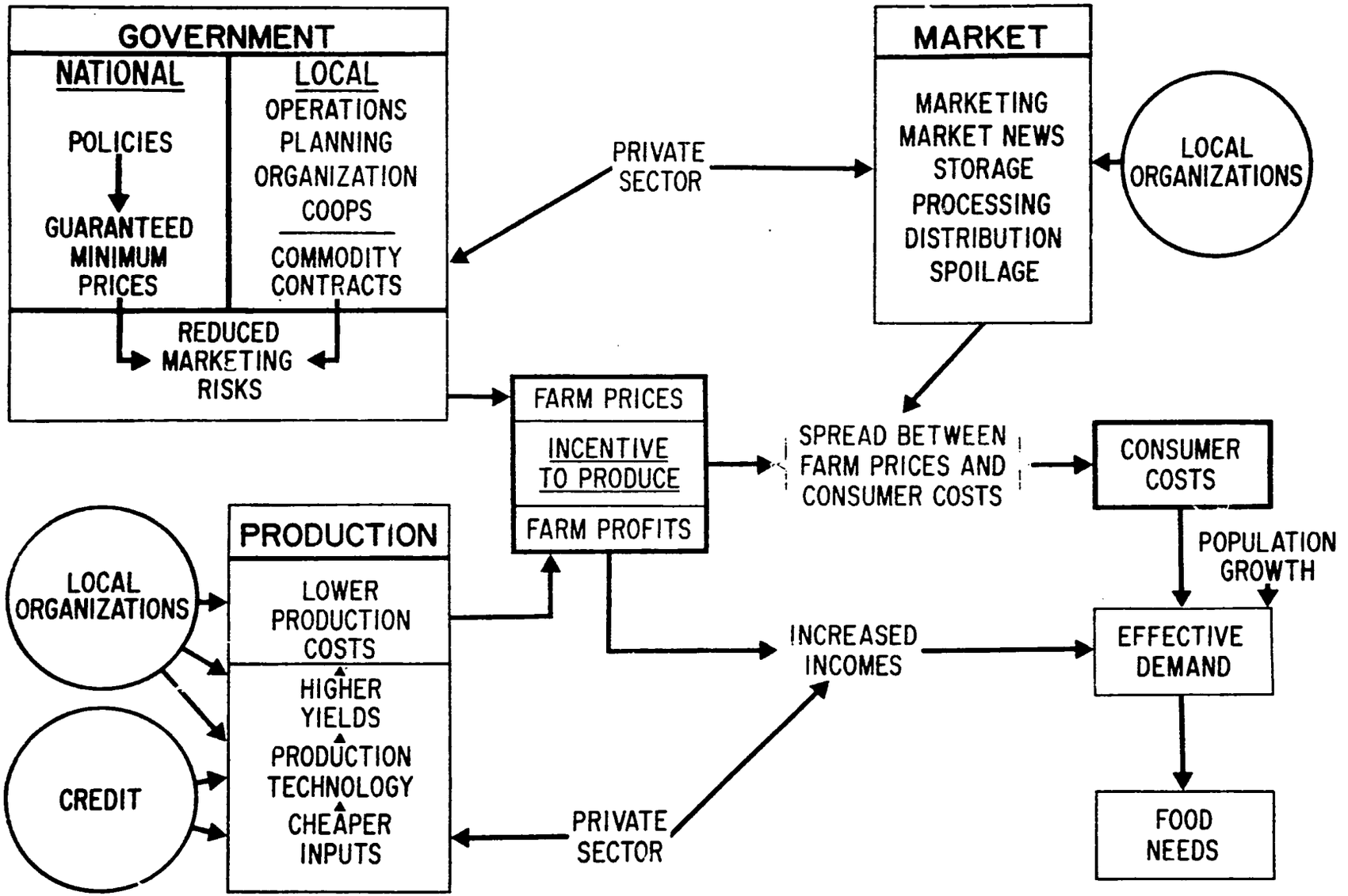
e. Taxes - sales taxes, transport taxes, import taxes, etc.

This outline generally indicates functions "normally" carried out by the private sector and by governments, but it is not intended to be rigid. There are many cases where governments carry out activities that normally would be private sector functions and vice versa. and special conditions often dictate such situations. There are also many possible linkages, interchanges and sharing of functions.

ANNEX B - AGRICULTURAL SYSTEMS CHART

THE AGRICULTURAL SYSTEMS CHART

The development of a strategy for addressing the four issues listed on page one, requires a thorough understanding of how an agricultural system works and how the major influencing factors interact with each other. Failure to understand the agricultural system or the inability to adequately estimate the sensitivity of the system to specific changes in any of its parts, usually results in a hodgepodge of more or less unrelated projects, each in itself a good thing, but not adding up to an integrated program. Other such projects fail to achieve their individual goals because of other more limiting but undetected factors elsewhere in the system that prevented the expression of success in an otherwise good project. What is needed then is some kind of a systems approach that would allow the planners to view the whole system at once so that a large number of variables and their interactions can be considered simultaneously. By such a system bottlenecks can be more readily identified, knowledge and action gaps surfaced, interactions estimated, institutional or organizational deficiencies pinpointed and alternate pathways considered. A very simple and highly generalized flow chart of such a system is included here, as figure 1, that shows the central components of an agricultural system. This chart is a bare skeleton in that each block on the chart could be enlarged into a system of its



Milo L. Cox, AID/W

own and other blocks added as required in specific cases, but a simplified form is adequate for this discussion.

Starting in the lower right hand corner with the block labeled food needs* we have a block that is easily calculated for any given country. All the data needed is the number of people in the population, the rate of population growth and the amount of food considered to be an adequate diet for the region and food needs can be readily determined. This number, arrived at in this way, is often frighteningly large and this is the number that has people and governments worried because it is larger than food production in many countries. It is often large enough to make most government officials reassess their doubts about Malthus. Now let's look at the next block labeled effective demand. This block represents the amount of food the population can afford to purchase -- or it's a measure of the size of the market. Effective demand, particularly in a hungry country is much smaller than food needs. Therefore if farmers produce up to the need level and throw this production on a market (effective demand) that cannot absorb it then this "over production" works its way back through the system to farm prices. Farm prices fall, the incentive to produce is reduced and the farmer tends to retreat into subsistance agriculture because he has no other alternatives -- and this is precisely what we are

*For this discussion phrases or words underlined refer to items on the chart.

trying to get him out of. If consumer costs are held down by government policy (often done to maintain peace in the urban areas) the same thing happens to the farmer. That is, sooner or later farm prices and farmers' profits decline and his production incentive goes down with it. If attempts are made to get farm prices up in order to increase production then this is eventually reflected in higher consumer prices which is politically explosive but worse then that high consumer prices lower effective demand. This sets a ceiling on production more effectively than a lack of production technology. So we have a seesaw effect: trying to help the farmer and his incentives we hurt the consumer and demand. Trying to hold consumer costs down to get demand up we hurt the farmers' incentive. And we must have both -- i.e. there must be a strong incentive to produce and a demand for the product, else production will not increase above subsistance levels.

One of the most workable ways to break this impasse is through the marketing process. There is usually a large spread between farm prices and consumer prices. If efficiencies can be achieved in the marketing process then large savings can be achieved in the price spread. If policies are such that a part of these savings can be allocated to the farmer and part to the consumer then incentive to produce and effective demand can be increased

simultaneously. In the market block on the chart there is a list (illustrative but not all inclusive) of factors that can usually be improved. If market news can be made available to the farmer so that he knows the value of his commodity before he barters, if storage facilities are available for that production which cannot be sold immediately, if items can be processed for sale later, if distribution is faster and cheaper, if spoilage can be reduced then the spread can be reduced. Middle men, multiple transfers and sales taxes on transactions contribute to large price spreads and much can be gained by efforts to increase efficiency in this area. Paradoxically the middlemen -- shippers, warehousemen, wholesalers, retailers, etc.-- are the only organized group in the marketing process. Farmers rarely know what prices the ultimate consumer pays and the consumer is usually not aware of what the farmer receives. The people who work in the price spread area are wonderfully adept at soaking up efficiencies achieved at either end of the marketing chain, i.e. if production costs are reduced making lower commodity prices possible, this is rarely reflected in decreased consumer costs. Conversely when consumers must pay higher prices, this almost never results in higher prices to farmers. Government intervention that would increase competition in the marketing area usually pays big dividends in farmer incentive and consumer demand, both prime requisites for

increased production.

The Government block has been divided arbitrarily into a national government that sets policies and a local government that is more involved in local planning and organization. On the national government side a single policy, Guaranteed minimum prices, is used as an example only. Any one or group of policies could be included or substituted for this one. Guaranteed prices does not mean a subsidized nor necessarily a very high price. It is intended as a floor or minimum price. This reduces the farmer's marketing risks and gives him confidence to purchase the inputs required to get high yields. The problem with this procedure is that it is difficult to decide on which policies would give the best results and it is often difficult to get traditional policies changed even when they have become disincentives to investment in the agricultural sector. Many times policy changes are politically difficult for governments to make. Lending agencies usually write policy changes into loan requirements but often write in too many conditions or insist on policy changes that really do not have much effect. That is to say that until the lending agency has gained competence in estimating the sensitivity of the production system to various policy changes made to different degrees and at different times, they are not yet prepared to wisely

write the conditions precedent to the loan. A systems approach should minimize this difficulty.

On the local government side, the most important factor assisting farm income is where private sector processors offer farmers contracts for their production, at prices agreed to prior to planting, if the farmers will meet processors' requirement for variety, quality, etc. This is already working well in many countries for certain products. The difficulty here is that the process usually is helpful only to those farmers near the processing plant. But the basic principle is no different than the Government backed guaranteed minimum price program. Both of these should tend to raise farm income and production incentive.

The production block is where most assistance agencies have put major emphasis. Here we expect the private sector to provide cheaper inputs to farmers. This added to the production technology coming from the experiment stations gives higher yields at lower per unit cost of production. This gives increased farm profits without price changes. This process is a powerful tool in getting production incentives up without increasing consumer prices. The whole system then is geared to getting consumer demand up without reducing farmers' prices or getting farm prices up without killing off the demand, or some

desirable mix of the two.

If the private sector earns profits selling inputs to farmers, and they must, then this is reflected in somebody's increased income which is a major factor in demand. Farm profits increase demand also, mainly for commodities other than food, but it is surprising how much processed food is now sold in many rural communities. So we have come full cycle on the chart. Now the problem is how do we get all of these blocks on stream at the same time. This is the basic strategy and when the system is working fairly well we expect:

1. Farm prices to improve
2. The Incentive to produce to grow and production to increase
3. The price spread to decline
4. Consumer costs to decline or remain stable or at least to increase very slowly
5. Effective demand to get closer and closer to food needs, the basic goal

Now we come to a seeming paradox. Almost everywhere in the LDCs we encounter markets full of food. In the face of real hunger much food is for sale and it is mostly food of local production and it is almost never all sold. This means essentially that the farmer has always traditionally produced up to effective demand and he is still doing so today. Actually, because there is a large spoilage component in storage and in the wholesale

and retail markets, the farmer is producing above effective demand, by the amount of this spoilage, minus imports. Anywhere you travel, even in remote villages, if you have some money you can buy food. It is very true, however, that if all of the people had enough money to buy all the food they wanted, the local markets would run out quickly, but there is nearly always enough food to satisfy effective demand. Farmers know that they only drive markets down when they produce more than they can sell, so any program that pushes increased production without getting demand up is likely to fail.

If the farmer has always met effective demand, how was this possible? Generally it has been possible because demand has always gone up slowly. Population growth and increased incomes both tend to make demand go up (and they are both occurring all over the world) but spiraling consumer prices depresses it. The resultant vector is a very slow rise in demand and a primative agriculture can change fast enough to meet this slow demand rise. Farmers have traditionally done this by increasing the land cultivated or, in their own limited way, increased the intensity of their agriculture. They have not generally gone the route of purchased inputs and high level technology where quantum jumps in production are possible basically because it has not been profitable. But they have

about used up these two ways of increasing production. There may be more land but it is remote and not economically available to the farmers and they cannot intensity much more without resorting to high cost inputs of fertilizers, new varieties, pesticides, etc. Therefore if effective demand for food should take off under the impetus of population growth and increased incomes, then a primative agriculture would no longer be adequate and means would have to be found to make new lands available to the farmer or increase his profits to the point where he could afford technical inputs or some mix of the two.

The system then is like a heating system that pumps hot water to all the rooms in a house. It's a continuous system and any restriction anywhere in the house reduces the flow. The problem may be upstairs, downstairs, in front of the pump, behind the pump or in the furnace, but a restriction slows down the whole system. If it were a complete stoppage the limiting factor could readily be located, but it is rarely so in agricultural systems. Different parts of the system may work well or poorly at different times so a mechanism for locating bottlenecks that are not obviously apparent is necessary.

There is nothing really new in this system. All of the items have been discussed for years. This approach is simply an attempt to

organize the major factors in such a way that the effects of each part and the possible interaction between parts become apparent. Analysis of the agricultural sector along these lines should show where major effort is required and should tend to concentrate resources on the most limiting factor. This is particularly important because usually there are not enough funds to work on all the various parts at once. As soon as the most limiting factor has been identified and progress is being made towards a solution to this particular problem, then attention can be directed at deciding which factor will become the most limiting once the first one has been solved. By this process an order of priority can be established.

Of course this chart must be altered to fit conditions in any specific country. In its present form it is so generalized that it may omit factors peculiar to a given country. For simplicity many factors have been omitted but are implied. Research must be applied at several points, particularly to production and marketing, extension activities fit between the production block and the farmer, land tenure problems could be attached as a policy problem, etc. until the chart fits the country of concern to the planner. This approach is simply a plea for orderly thinking about a food problem. It is no panacea nor is it a substitute for careful analysis, thoughtful strategy formulation and detailed planning. Rather it is a tool that should facilitate these activities.

ANNEX C - KEY PROBLEM AREA ANALYSIS CHART

ANNEX C

AGRICULTURAL KEY PROBLEM ANALYSIS

I. ISSUE AND OBJECTIVES	II. PRINCIPAL INHIBITORS TO REACHING OBJECTIVES	III. FUNDAMENTAL REQUISITES FOR CORRECTING THE INHIBITORS	IV. IMPORTANT FACTORS NEEDED TO ACHIEVE FUNDAMENTAL REQUISITES	V. KEY PROBLEM AREAS SUITABLE FOR TAB/AGF MAJOR EMPHASIS WITH REGIONAL BUREAUS AND MISSIONS	VI. SECONDARY EMPHASIS FOR TAB/AGF, PRIMARILY ON REQUEST FROM REGIONAL BUREAUS AND MISSIONS
1. MAJOR WORLD ISSUE a. NOT ENOUGH FOOD (Quantity) (Quality) for POPULATION 2. MAJOR AGRICULTURE-CENTERED DEVELOPMENT OBJECTIVES a. HIGHER LEVEL OF LIVING FOR RURAL & URBAN PEOPLE FLOWING FROM: (1) HIGHER NET RURAL INCOME (2) MORE RURAL EMPLOYMENT (3) MORE & BETTER FOOD (RURAL & URBAN) (4) VIABLE RURAL PHYSICAL ENVIRONMENT	1. LACK OF INCENTIVE TO IMPROVE PRODUCTION, STEMMING PRIMARILY FROM INADEQUATE FARM PROFITS 2. LACK OF ECONOMICALLY AVAILABLE PRODUCTION RESOURCES 3. LACK OF ADEQUATE PRODUCTION DISTRIBUTION, UTILIZATION TECHNOLOGY	1. INSTITUTIONS TO GUIDE AND SERVE AGRICULTURE (WORLD NETWORK)	a. Agric. Sector Analyses b. Agric. Research and Extension c. Agric. Econ. Capability d. Organization & Management (District Development)	a. Sector Analysis and Agric. Economics Capability b. Agric. Research Network	a. Agric. Extension Systems b. Agric. Credit Institutio c. Identify Agric. Res. Nee d. Organization & Managemen
		2. EFFECTIVE PRODUCTION SYSTEMS	a. Improve all Major Food crops b. Improve production of higher-protein crops c. Develop Livestock Production d. Improve water & Soil Management	a. Water and Tropical Soils Management b. Higher-Protein Crop Production c. Livestock Production (Tropical)	a. Major Food Crops b. Soil-test, Fertilizers c. Crop Protection d. Environmental Protection e. Seed Technology f. Farm Engineering g. Forestry h. Aqua-culture
		3. EFFICIENT RURAL-URBAN TRANSFER SYSTEMS	a. Provide production inputs b. Market farm products c. Reduce spoilage & Waste d. Stimulate private sector	a. Rural-Urban Transfer Systems	a. Grain Drying & Storage b. Commodity Protection c. Private Sector Participation
		4. HELPFUL GOVERNMENT POLICIES	a. Favorable Exchange Rates b. Equitable Price Policies c. Adjust Import Duties d. Avoid Restrictive Legislation		a. National Econ Planning & Programming, including: - Land Use - Generation Agric. Employme - Agric. Policy Research
		5. ADEQUATE TRAINED MANPOWER (INCLUDING SMALL PRODUCERS)	a. Agric. Teaching b. Govt. Guidance on Agric. c. Staffing Agric. Institutions		a. Assistance in Improving Agric. Training, esp. in - Research Capability - Research Administration - Agric. Econ Capability
		6. APPLICATION OF CAPITAL RESOURCES	a. Govt. Commitment b. Attract Private Capital c. External Official Assistance		a. Technical Assistance re A.I.D. Loans

ANNEX C

THE KEY PROBLEM AREA ANALYSIS CHART

This chart is essentially a work sheet or a chart of a thought process by which the writers attempted to start with some basic assumptions about the food-population equation and rural problems in general and end up by selecting the key problem areas in agriculture to which TAB would give in depth emphasis and a list of problem areas to which TAB would give secondary emphasis. The exercise was oriented towards filling knowledge or action gaps in order to assist A.I.D.'s Regional Bureaus and Field Missions and to promote agricultural development generally in the LDCs.

Column I. Issue and Objectives

Considering that rapid population growth and inadequate food supply were the two most critical problems facing the LDCs, the agricultural sector of each country has as its major issue food production. Closely related to improving food supplies are the associated agricultural objectives of improving farm income, rural employment opportunities and the whole physical and social environment of rural people,moving steadily towards a higher level of living in rural areas and perhaps slowing the pace of urban migration.

Column II. Principal Inhibitors to Reaching Objectives in Column I.

Among many other lesser inhibitors the three major ones were judged to be:

A lack of incentive to improve production stemming primarily from inadequate farm profits;

A lack of economically available production sources;

A lack of adequate production, distribution and utilization technology.

Column III. Fundamental Requisites for Correcting the Inhibitors of Column II.

Nearly all of the major requisites collected by the writers from diverse sources could be categorized under the following headings or requisites:

Institutions to guide and serve agriculture;

Effective Production Systems;

Efficient Marketing Systems;

Helpful Government Policies;

Adequate Trained Manpower;

Capital Resources.

Column IV. Important Factors Needed to Achieve Fundamental Requisites of Column III.

Each fundamental requisite in Column III was subdivided into numbers of factors. This constituted the long list of problems mentioned earlier in this report. The list was reduced by screening through several selection criteria until the list in Column V was achieved.

Column V. Key Problem Areas Appropriate for TAB/AGF Major Emphasis with Regional Bureaus and Missions.

Further screening to eliminate those problem areas getting major attention from other agencies and those which could better be done by the Regional Bureaus and Missions the list in Column IV was reduced

to the basic six problem areas to which TAB could direct special in depth attention. The whole point of the exercise was to arrive at the factors listed in Column V.

Column VI. Secondary Emphasis for TAB/AGF Primarily on Request from Regional Bureaus and Missions.

This column is a composite of:

Projects already under way under TAB/AGF auspices.

Important areas receiving attention from other agencies to which TAB contributes in some way.

Important projects being cooperatively operated by Regional Bureaus and TAB/AGF.

Other problem areas where TAB is likely asked for assistance by the Bureaus or Missions.

ANNEX D - KEY PROBLEM AREAS IN AGRICULTURE AND THEIR RELATIONSHIP TO THE SPRING REVIEW OF NEW CEREAL VARIETIES

ANNEX D

KEY PROBLEM AREAS IN AGRICULTURE AND THEIR RELATIONSHIP TO THE SPRING REVIEW OF NEW CEREAL VARIETIES

Conclusions from the Spring Review of New Cereal Varieties and their implications for A I.D. were studied carefully and incorporated into the selection processes which resulted in Key Problem Areas appropriate for TAB/AGF major emphasis being defined as: Sector analysis and agricultural economics capability, worldwide agricultural research network, water and tropical soils management, higher-protein crop production, livestock production and improvement of marketing systems.

Many important points emerged during the Spring Review, such as 1) the fact that the "green revolution" directly touched only a minority of the farm population, 2) the problem of small disadvantaged farmers and the growing disparity between them and the large farmers, 3) marketing problems that tend to increase that disparity, 4) water and soil management problems that reduce the use of natural resources, 5) the need for continuing research and 6) the general low profitability of farming in the LDCs.

All of the six Key Problem Areas selected by the TAB for in depth emphasis are to some degree applicable to the above Spring Review items but especially relevant are those concerned with marketing, water and soils, high protein crops and sector analysis.

ANNEX D

There has been some concern expressed during the preparation of this paper that advances due to the green revolution in wheat and rice might produce such disparities between disadvantaged farmers and larger farmers that socio-economic problems would arise resulting in discontent and unrest more serious than the condition the green revolution was designed to alleviate. This is a provocative idea but it attributes a larger than reality magnitude to the green revolution. In the green revolution countries, less than 15% of the wheat and rice acreage has been planted in the miracle varieties (by the most generous estimates) and only seven-tenths of 1% of their total crop land has been planted in these varieties. This is in the countries where the green revolution has been most successful. It does not seem that the effects mentioned above could become a key problem due to the new varieties. India has already reported that they cannot further increase their acreage of Mexican wheats because they already have them on nearly all of their appropriate accreage-- i.e., where they have controlled irrigation.

ANNEX E - KEY PROBLEM AREAS IN AGRICULTURE AND THEIR RELATIONSHIP TO THE JOINT REPORT TO THE PRESIDENT

ANNEX E

KEY PROBLEM AREAS IN AGRICULTURE AND THEIR RELATIONSHIP TO THE JOINT REPORT TO THE PRESIDENT

Conclusions from the Joint Report to the President were studied carefully and incorporated into the selection process which resulted in Key Problem Areas appropriate for TAB/AGF, major emphasis being defined as : Sector analysis and agricultural economics capability, worldwide agricultural research network, water and tropical soils management, higher protein crop production, livestock production and improvement of marketing systems. The "Four Ways to Help" part of the Joint Report, quoted below, influenced the choice of key problems.

"1. A substantial increase in A.I.D. support of an international agricultural research network, in both developed and developing countries, directed at the problems of agricultural growth in the latter countries.

"2. Expanded efforts to obtain, impart and apply knowledge of soil and soil and water, in order to increase food production and to protect the environment.

"3 Increased and more relevant agricultural training in both the United States and the developing countries.

"4. Emphasis on the development of competence, and especially in Ministries of Agriculture, to plan and manage agricultural programs, and to provide supporting services to the agricultural sector."

All of the six Key Problem Areas selected by TAB for in depth emphasis impinge to some degree on the four factors mentioned above but especially relevant are those concerned with Sector Analysis, Water and Soils, High Protein Crops, Marketing and Agricultural Research Network.