

POLICIES FOR PROMOTING AGRICULTURAL DEVELOPMENT

Report of a Conference on  
Productivity and Innovation in Agriculture  
in the Underdeveloped Countries

David Hapgood, Editor

Max F. Millikan, Conference Chairman



CENTER FOR INTERNATIONAL STUDIES  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
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Part I

THE PROBLEM OF AGRICULTURAL PRODUCTIVITY





## Chapter One

### THE CONFERENCE AND HOW IT OPERATED

The worsening food crisis of the underdeveloped nations is becoming ever more apparent. Much of our world is having difficulty feeding itself. Although the productivity of agriculture has advanced in many of the underdeveloped nations, and there are a few instances of notable success like Mexico, Taiwan, and the Sudan, in the regions where most of humanity lives the ancient art of agriculture has been unable to keep pace with the swelling demands resulting from the twin pressures of the population explosion and rising industrial incomes. Agriculture has lagged behind industry, and in country after country it is now acting as a brake on economic growth. The gap in living standards between the underdeveloped and the developed nations is widening dangerously.

A decade ago it seemed to many that the agricultural technology of the developed nations could be quickly transplanted to the underdeveloped world, where it would produce rapid increases in food production. But most such transplants have failed to take root, and the gap in per acre and per capita yields between developed and underdeveloped nations is not narrowing but widening. Ten years ago it was widely believed that one or another single technique (community development is an example) could solve the organizational problem of bringing new technology to millions of individual farmers. Many promising techniques have been tried in many places, but the record of recent years is one of general failure and only rare successes. Industrialization, it was commonly said ten years ago, is the key to development. Industry has advanced in parts of the underdeveloped world, but agriculture in

many nations is not providing the higher levels of nutrition that are the first-priority use of higher incomes.

Against this background the plan for the summer study conference for the purpose of studying the agricultural problem in the underdeveloped world was born in the Center for International Studies of the Massachusetts Institute of Technology and in the United States Agency for International Development (A.I.D.). The conference was conducted by the Center with financial support from A.I.D.

It was not conceived as a purely intellectual exercise but as a study that might be of help to policymakers in the field of agriculture. The goal was to frame useful policy recommendations concerning both research and operations in agriculture. We were aware that within the general field of development far less is known about agriculture than about industry. We had no intention of taking up the controversy as to whether industry or agriculture should receive first priority in development planning. Our assumption was simply that an increase in agricultural productivity is needed to feed growing populations and to prevent the rural sector from limiting over-all economic growth.

As readers of the following chapters will see, agriculture is a peculiarly difficult subject to grapple with. It presents two basic difficulties. First, it is a "systems problem": it involves the interaction of multiple factors as different, and as hard to compare, as crop responses to fertilizers and the cultural values of farmers. Second, the almost infinite variety of local conditions, compounded by the interaction of these varying factors, makes any generalization hazardous.

We hoped at the conference to avoid two extreme positions. One is the single-factor solution. Analysis of agricultural failures has tended, we observed, to follow the discipline of the diagnostician. Each specialist would find that the factor familiar to him was crucial in the given situation, though he might also pay lip service to factors in fields other than his own. His

prescription would then be likely to read: "Do something about my factor first--and the others will follow." Plant scientists, economists, political scientists tend to prescribe remedies within their specialties. Such single-factor solutions we believed to be in contradiction to the essential nature of the agricultural problem. The other extreme position is one that might be called intellectual anarchy. It holds that the complexity of local conditions makes each situation unique; that therefore no general statement is possible, no experience gained in one place is transferable to another. If this were true our study would be of little use. We wanted to discover whether, between these two extremes, any useful generalizations could be made.

Our aim was to try to break out of the dilemma familiar to agricultural policymakers. The dilemma is this: Change in any single factor affecting agriculture produces little or no progress because its effect is limited by other factors; change in several factors is therefore necessary; but the resources are not available to act on several fronts at once; therefore nothing can be done. Our study would be worth while, we felt, if we could find ways out of this dilemma, some "handles" by which the problem could be grasped.

A barrier to discussing agriculture usefully is that, as the subject involves a wide range of professionals whose backgrounds and jargons are different, communication among them is difficult. We decided to bring a group of such men together long enough to get acquainted, to learn something of each other's specialities, and to find a common language.

We met for six weeks at M.I.T.'s Endicott House. We were 44 in all, of whom 33 were present for virtually the full six weeks and 11 for shorter stays of a week or more. (The list of the participants is given on page iii.) In addition about ten appeared for one or two sessions. Represented among us were the several disciplines concerned with agriculture: natural scientists, economists, behavioral scientists. Among us also were men with years of experi-

ence in the actual operation of agricultural programs in each major area of the underdeveloped world: Asia, Latin America, Africa. The atmosphere of the conference was informal. At times we met as a single group; at other times we divided ourselves into small groups, then redivided into different groups. Much of our learning came in conversations outside the formal meetings, at meals and in the evenings. By rubbing our minds against each other's in this manner we succeeded in breaking through the lines of professional disciplines and reaching a common understanding, if not unanimous agreement.

In tackling our subject we found it necessary at the beginning to set some limits on the problems we would discuss. Our horizon in time was, very roughly, the next ten years, though often we looked beyond that horizon. We intended to concentrate on small-scale peasant farming as opposed to plantation agriculture, though as we looked at the best techniques for settling sparsely settled land we found we had to consider the efficient scale of the individual unit. We planned to limit ourselves also to annual food crops. Tree crops and animal husbandry were to be set aside as dominant forms of agriculture; we would take them up only when they were found to be related to food crops. As it turned out, in considering two types of ecologies--rain forests and high-altitude regions--we could not avoid paying more attention to tree crops and animal husbandry than we had intended. Our subject remained vast enough, for, despite these limits, we were still dealing with the primary occupation of most of mankind.

We followed no rigid agenda. Indeed, finding a scheme to encompass our subject proved to be almost as difficult as the subject itself, and for much the same reasons. Whenever we tried to break the agricultural problem into parts we found we were doing violence to its essential nature. It made sense to try to sort out the factors involved and to take a closer look at each of them, but in practice we found that any such sorting cut across relationships that were often more vital to the problem than the pieces

viewed separately. This intellectual difficulty, which persisted throughout our discussions, is a useful clue to the practical difficulties of agricultural development.

It may be helpful to describe briefly how we spent our time. The first two weeks were taken up with mutual briefings, each participant describing what light he felt his particular discipline or project experience could throw on the problems of agricultural productivity. During the second two weeks we broke into four working groups, each concerned with a different type of agricultural ecology and each including a mix of disciplines. For the last two weeks we reorganized into four different subgroups, this time dividing the subject by functional rather than geographic distinctions.

Our report follows the main lines of our discussions. Most of it was drafted by the subgroups into which we divided. Some parts were written by individuals, but the opinions they express fall within the broad consensus of the group. These drafts were then revised and edited by the conference chairman, Max F. Millikan, and the editor, David Hapgood; the text was then submitted to the participants and revised again in the light of their comments. Although the editors have tried to produce a text that reflects the sense of the conference, the report is not the product of unanimity on every point, and the attentive reader will find inconsistencies and varying emphasis from chapter to chapter; we have, for example, grouped the factors we discuss differently in different places. In fairness to our complex subject, these discrepancies have not been edited out, for the report in this form is closer to the realities we discussed than would be a neat pigeonholing of consistent and unanimous views.

Chapter Two, drafted by the conference chairman, explores "the nature of the problem." It sets forth the special characteristics of agriculture, the preconditions for its development (including preconditions in areas that appear distant from agriculture), and the general implications for public policy to be derived from those characteristics and preconditions.

Part II contains four chapters that deal with four major sets of factors involved in agriculture: physical inputs, economic factors, the state of knowledge, the human environment. The chapters are the product of the four subgroups formed during the final period of the conference. The chairmen of these subgroups were Eilif V. Miller (physical inputs), Raj Krishna (economic factors), M. B. Russell (research), and Karl D. Olsen (the human environment).

Part III is also divided into four chapters, by ecological regions. The areas covered are the regions of wet rice cultivation, the rainy tropics where rice is not the dominant crop, the monsoon and subtropical regions, and the high-altitude zones. These chapters are the product of the working groups formed during the middle two weeks of the exercise. (The four regions are mapped and described in the introduction to Part III.) The chairmen of these subgroups were Kenneth L. Bachman (wet rice), Will M. Myers (rainy tropics), Arthur T. Mosher (monsoon and subtropical) and Allan R. Holmberg (high altitudes).

The appendixes consist of papers prepared for the conference by one or more members. They deal with four successful development projects, insurance for innovators, the "will to develop," the role of the bureaucracy, behavioral science research, and land reform.

The division of our report into chapters, like the division of our discussions, is bound to be arbitrary and to some degree misleading, for the burden of our message is precisely that the agricultural problem is not divisible. The reader must keep this in mind. Nothing can prevent the specialist from flipping the pages until he finds what we say about his specialty, nor the operational man from just seeking out those of our findings that concern his part of the world. We can only repeat that to read the report in this way is to miss our basic point. The report is a whole, not the sum of its parts.

We offer no panaceas here. Those looking for a blueprint to follow will be disappointed. We did not find a magic key to unlock

the problems of agriculture, nor do we present a program likely, in ten years or a century, to assure the world's supply of food. We say this with both regret and pride. Regret, for the urgency of the world's food needs demands quick solutions; we did not gather simply to solve an abstract puzzle. (The Indian food crisis appeared in newspaper headlines while we were meeting.) Pride, on the other hand, for we are confident that we are on the right track. If, after our six weeks' deliberations, we laid claim to solving problems that have baffled so many for so long, we could rightly be suspected of having failed to come to grips with those problems in their full complexity. That there are no panaceas is an integral part of what we have to say. We believe that statements on the order of, for example, "cooperatives are the best way to provide farmers with credit" are neither true nor false but are in fact meaningless. No policy can be evaluated except in the context of local conditions, and it is the study of those local conditions as they relate to alternative policies that will prove rewarding.

Yet we believe we have something worth while to say, and that it is the more useful for avoiding facile solutions. If we have uncovered no panaceas, we have not bogged down in what we earlier called intellectual anarchy and decided that we could say nothing at all. We set out to explore our subject, not to resolve it. If we have not mapped the trail, we have at least reconnoitered the ground.

What we present here is essentially a tool of analysis, a method of approaching agricultural policy. It is a handle by which one can grasp the "all-or-nothing" dilemma that confronts decision makers in the field of agriculture. We do not say: "This is what you should do in this situation. . . ." But we do say: "In this kind of situation these are the factors you must consider in planning your program; depending on your local conditions, these are some alternatives you may wish to experiment with; if you do thus and so, then you will soon have to resolve these other problems. . . ."



We also recommend research projects that can be undertaken now and that would bring fruitful short-term results. We could have listed these proposals separately, but we have instead left them in the text, as they were drafted, for we do not believe they should be read outside the context in which they were conceived.

One more word of warning. We have said we do not believe that the technology of agriculture, whether it be a plant variety or a type of extension service, can be successfully transplanted without careful experimentation and adaptation to local conditions. The same principle applies to the ideas set forth in this report. We believe we have provided a useful guide to thinking about agricultural policy in the underdeveloped world; but nothing said here is a substitute for painstaking and comprehensive analysis of local conditions that others know far better than we.

Finally, ours is not a cheerful report. Optimism was not the prevailing mood at Endicott House, and if anything there was less optimism in the air at the end than at the beginning of our conference. Compared to the urgency of the need, what we offer here may seem meagre indeed. Where giant strides are necessary, we have taken but a few tentative steps. The agricultural problem will not be solved in a laboratory or at a conference. To get the people of our world a decent supply of food--that most basic of man's requirements--will require a gigantic effort. It will cost a lot of money, but money is probably the easiest need to fill. The goal will not be met unless many millions of people--technicians, officials, and, above all, farmers--are willing to initiate a radical and often painful process of social change.

## Chapter Two

### THE NATURE OF THE PROBLEM

Anyone wishing to devise a program for increasing agricultural productivity in the underdeveloped countries must bear in mind some general characteristics of agricultural enterprise wherever it is conducted, some preconditions to be met by the society at large if any such program is to succeed, and some policy implications of these characteristics and preconditions. Most of us came to the conference with a number of such characteristics, preconditions, and policy issues in mind. Some of these we did not discuss very much because they were taken for granted by all of us as underlying everything we said. They should be restated so that readers of this report will find them explicit. Others we discussed at great length, moving from a principle to its practical application in particular circumstances and back again toward generalization. In this process some of our preconceptions were altered and others were powerfully reinforced or transformed into new convictions.

It is our purpose in this chapter to review briefly these characteristics, preconditions, and policy issues of agricultural programs in order to highlight the context in which we carried on the more specific functional and geographic discussions reported in Parts II and III. Little here will be new or unfamiliar to students of agriculture. But truths regarded as too simple or obvious to need restatement are often among the most neglected propositions in the development of policy proposals.

## CHARACTERISTICS OF AGRICULTURE

In spite of its diversity, small-scale annual crop agriculture has several common features throughout the underdeveloped world. Our first goal was to find a satisfactory classification or checklist of the principal factors affecting agricultural productivity that we could use to ensure that in both diagnosis and prescription for any particular situation attention would be paid to all its relevant aspects. Since there is an extraordinary degree of interdependence and interaction among all the factors affecting agriculture, any classification is bound to cut across some important relationships. Moreover, any classification of continuous and interdependent phenomena must to some degree be arbitrary. However, the conference finally agreed upon one to use for its own discussions to facilitate communication and ensure some comparability of the analyses we undertook. This classification is outlined in Table 1.

It divides the factors affecting agricultural development into five major categories--physical input factors, economic factors, organizational factors, socio-psycho-cultural factors, and knowledge factors--each of which is divided into a series of subcategories. We hold no special brief for the virtues of this as opposed to any alternative classification, but we are reasonably satisfied that it is comprehensive in the sense that everything that has a significant impact on agricultural productivity finds a place somewhere in the system.

Within each major category of factors affecting agriculture some limited generalization is possible. It is the function of the succeeding chapters to elaborate these middle-level generalizations more fully, but a few examples will illustrate the point. For instance, the major physical inputs are similar for all types of agriculture, unlike industry. Agriculture everywhere needs water, and in many parts of the world an improvement in water control over what nature offers--including added amounts, better timing, better distribution, and the removal of excess through proper drainage--offers major opportunities for productivity increases. Similarly

TABLE 1. CLASSIFICATION OF FACTORS AFFECTING AGRICULTURAL DEVELOPMENT

<u>Physical Input Factors</u>			<u>Socio-Psycho-Cultural Factors</u>
1. Nonhuman physical inputs			1. Integration of agricultural institutions, practices, and values within the technosocial matrix of the nation
a. Land	e. Fertilizer	i. Other animals	
b. Climate	f. Pesticides	j. Tools and machinery	2. Public administration factors, structure, values, mode of operation of the innovating bureaucracy
c. Seeds	g. Structures	k. Fuel and power other than animal power	
d. Water	h. Work animals		3. Social structure, cultural values, and dynamics of peasant communities
2. Labor			4. Processes of sociocultural change, barriers, and motivations in the innovative sequence, functional harmony or disharmony in society as its constituent parts change
<u>Economic Factors</u>			
1. Transport, storage, processing, and marketing facilities for products			<u>Knowledge Factors</u>
2. Facilities for the supply and distribution of inputs, including credit			1. Organization of basic and applied research
3. Input prices, including interest rates			2. Diffusion of knowledge relating to:
4. Product prices, including prices of consumer goods			a. Technical knowledge, e.g., agronomy, plant genetics, soil science, water management, agricultural engineering, pest control, home technology
5. Taxes, subsidies, quotas			b. Economic knowledge, e.g., land economics, general economics, farm management
<u>Organizational Factors</u>			
1. Tenure, land			c. Policy, e.g., politics, public administration, planning
2. Farm size and legal form			d. General education, e.g., literacy, adult education, mass communication
3. General government services and policies			
4. Voluntary and statutory farmers' organizations for:			
a. Coordinating physical input use, e.g., irrigation associations, tractor stations			
b. Economic services, e.g., purchase, sale, credit associations and cooperatives			
c. Social services, e.g., health centers, schools, family planning centers			
d. Local government			
e. Diffusion of knowledge, e.g., adult education classes, youth clubs			

the big problems in increasing the supply of plant nutrients come down primarily to three major factors--nitrogen, potash, and phosphorous--whatever the crop and its location. With respect to the economic environment, all commercial farming, whatever is grown and wherever it takes place, must be profitable; there must be markets for both inputs and outputs reachable by the farmer; all farming is time-consuming and requires some credit; and, in most types of farming, innovation is inhibited by the high risks associated with the adoption of new practices, some of which can be reduced by appropriate governmental policies. All modern farming requires higher levels of knowledge, education, and training than those required by traditional agriculture. Elements among the organizational and psychocultural factors cut across the endless variety of particular agricultural situations.

Nonetheless, right down the list of factors, agriculture is characterized by an extraordinary degree of variation in its specific requirements for efficient production from crop to crop, from country to country, and from locality to locality within larger regions. Variations in agriculture are much greater than the place-to-place variations in the processes for steel making, textile manufacture, machine tools, and the like. Before the conference began, some of us with less background in agriculture than others were hoping that we might arrive at some fairly powerful general rules about priorities, sequences, policy emphases, and organizational structures that could be applied without much modification to any agricultural region. We were thoroughly convinced by the end of the conference that this was a vain hope. Agriculture is practiced in the underdeveloped world under an enormous range of climatic conditions from the rainy tropics of Africa to the arid lands of the Middle East. Associated with these variations in climate are variations in soils that enormously influence optimal water management, nutrient requirements, needed crop varieties, and a host of other factors. In some places a modification of land tenure arrangements seems a first prerequisite to any advance along other fronts, while in other

areas land is reasonably widely and securely held by owner-cultivators in plots of a size that can be efficient. Although the organizational management of agriculture is a critical limitation in a great many places, there are areas, like Malaysia, where the organizational problem is less urgent than many other factors. In large parts of the underdeveloped world the problem can be described as one of improved management of existing farms, while in considerable sections of Africa, for instance, units that can be described as farms rarely exist. More basic knowledge of plant science is needed everywhere, but in some areas existing knowledge is so far ahead of average practice that further research is a long-term goal, and in other areas we scarcely have the biological knowledge to know what to do to get any agricultural program started.

Taking all five of our major categories of factors into account, the range of diversity is so great that even though some general principles apply very widely, their application in particular situations cannot be by blanket rule but must be based upon the tailoring of a program to meet the detailed diagnosis of each particular locality. A program even for a single crop like rice requires fundamental adaptation to the circumstances of the place where it is to be applied.

We cannot appraise the consequences of a number of factors in our classification by looking at each one separately and then summing the results. The interdependencies among the factors are so strong that the effects of a package of factors are likely to be very different from the sum of the effects of each one applied by itself. This is true within a broad category like physical inputs. Additional fertilizer without water control may have little result, and the consequences of more water may be very modest if additional nutrients are not supplied. If both are supplied together, existing crop varieties that do as well as any others in the absence of water and fertilizer may not benefit as much from these new inputs as new varieties specifically tailored to water and nutrient availability; yield on existing varieties may even be reduced by added water or

fertilizer. Insects and diseases that are unimportant under existing practices may multiply dangerously under irrigated and fertilized conditions and require new measures of disease and insect control.

Even a single physical input involves many nonphysical factors. The effective use of fertilizer, for example, requires economic incentives, better distribution, and extension services to instruct the farmers in its use. Similarly, optimum organization of marketing may depend on what kinds of farmers' organizations are set up for water control; or effective credit institutions may be most usefully linked to arrangements for the supply of fertilizer and seed. Not only the kind but the depth of education and training of farmers, extension workers, experiment station personnel, and the like will depend upon the complexity of the farming operations implied by cropping patterns, input utilization, and varietal improvement. As we shall see later in this report, the interdependence of the factors affecting the farm enterprise has profound and general implications for the organization of programs for the promotion of agricultural productivity.

Another characteristic of agriculture that conditions what we can do to improve it is the extraordinary number and dispersion of decision-making units whose behavior must be changed if this sector is to be modernized. Unless agriculture is industrialized on a massive scale--and with isolated exceptions this seems to us neither feasible nor desirable--any program of change must affect the knowledge, motivations, and voluntary behavior of many millions of independent entrepreneurs. Farm decision makers are widely scattered geographically, they vary enormously in economic status and potential, they cover a wide political spectrum, they are subject even within one country to a considerable variety of institutional connections, and they exhibit a widely varying pattern of attitudes and motivations. By contrast, managerial control in industry and social overhead facilities is highly concentrated, and the development of a reasonably effective industrial labor force is infinitely simpler and more manageable than the building of a modern community of farmers. The characteristic agricultural need for unusually complex and extensive organizational

and administrative arrangements poses an acute dilemma for societies whose scarcest resource is often organizational and administrative talent.

This last characteristic of widely dispersed decision making, taken together with the enormous variability of local conditions, implies another requirement for the organization of governmental services to agriculture that is very seldom adequately met in practice. This requirement is effective two-way communication in the administrative process, with information passing efficiently from the farmer up through the bureaucratic hierarchy as well as down to him from ministries, research stations, and the like. It is now standard doctrine that such two-way communication is necessary for the effective operation of any administrative system, but it is both much more important and much more difficult to achieve in agriculture than in industry because of the decentralization and variability of local circumstances of farming.

Another complication arises from the fact that the modernization of agriculture in many countries requires shifting each small farm unit from a relatively simple pattern of producing a few traditional crops with few if any purchased inputs to a multiprocess enterprise with many interrelated products and inputs. At a later stage, commercialization may lead the individual farmer to specialize on one product, but initially multicropping, rotation, and the introduction of fertilizer, water, new seed, and pest control enormously increase the complexity of farm management and multiply many times the problems of education, training, extension, and organization.

The traditional method on which many societies have relied to achieve some consistency and complementarity in the decisions of large numbers of independent units such as characterize agriculture has been through the operation of a price and market mechanism. In most of the underdeveloped world the traditional farmer, even when he has some commercial operations, engages in a minimum of socially organized collaborative activities. But some aspects of modernized agriculture, such as water management and control, effective insect



and disease control, the use of equipment too large for ownership by a small farmer, and some aspects of marketing require the coordination of farm decisions through more explicitly social mechanisms supplementing the atomistic processes of the market.

Several of these characteristics have a further implication: Sustained growth in agricultural output requires technical, economic, attitudinal, and political transformations of the whole structure of rural society that cannot be brought about quickly. A single decision can, with appropriate outside help, lead quite rapidly to the building of a dam, railway, factory, or sewer plant. But the transformation of traditional agriculture requires a series of interlocking changes in so many different aspects of rural life that a perspective of decades is required. This does not mean that some things cannot be done quickly. We cite in the balance of this report numerous instances of measures with potentially rapid immediate payoff. But the introduction into the rural economy of innovations that will ensure sustained growth requires patience and very steady purpose.

Finally, in most underdeveloped countries an intangible characteristic of agriculture that poses barriers to its modernization is the fact that it is conceived of as a low-status occupation. If agriculture is to be effectively modernized, it must attract the attention of a significant number of the brightest, most imaginative, most innovative, and most ambitious members of the rural community. This is true both in farming and in such farm-related activities as research, extension, cooperatives, and marketing. But these are precisely the individuals in underdeveloped societies who are most likely to identify farming with traditional drudgery and see their only potential for mobility, self-improvement, and exciting challenge in an escape from farming to industry and urban life. Even though in many underdeveloped countries the widely held view that there is a surplus population in the countryside is valid in the aggregate, there is no surplus of the energetic and innovative types who alone can take the lead in the modernization of agriculture. Development programs must deal with this problem of raising the status and challenge of agriculture.

## PRECONDITIONS FOR AGRICULTURAL DEVELOPMENT

A large number of conditions outside the realm of agricultural policy itself, even when that policy is very broadly defined to include research, education, marketing and price policy, rural organizations and administration, and the like, must be at least minimally met if any program to expand agricultural productivity is to have even a marginal chance of success. Perhaps the first and least tangible of these conditions is that a will to develop agriculture must be present in the minds of at least some of the national and local leadership. There must be more than merely a verbal recognition of the importance of this sector. Because of the characteristics outlined in the preceding section, the amount of administrative time and attention that must be given to agriculture is out of all proportion to its relative financial requirements. Yet its low status inhibits the leadership in many countries from devoting to it the energies required. Effective programs of development once begun will reinforce this will, but there is a substantial lower threshold of this motivation of leadership without which no program, however skillfully designed in detail, has much chance of taking hold. Two of our participants have devoted some time to exploring objective measures of the will to develop, and they review their conclusions in Appendix C to this report.

A second requirement is at least some modicum of political stability and continuity in a country undertaking agricultural development programs. This is of course required for the effectiveness of development programs of any sort, but is perhaps peculiarly necessary for agriculture because of two of the characteristics of agriculture outlined in the previous section, namely that it involves the participation of very large numbers of people at decision-making levels and that the modernization of traditional agriculture requires time horizons not of months or years but of decades. One should not exaggerate the minimal degree of political stability and continuity required for at least some progress in the rural sector. A good many underdeveloped countries probably exhibit this minimum, but

there are certainly a number where the absence of this precondition makes the prospects bleak however fully the other requirements are satisfied.

A third requirement is at least a minimal corps of administrative and organizational talent and competence. We say a good deal in Chapter Six about how to expand this resource to meet the very large needs of agricultural programs for these inputs, but in agriculture, unlike some branches of industry and social overhead, an indigenous administrative and organizational base of at least a limited sort is absolutely essential. A steel plant, a railway system, a mining enterprise can be launched in an underdeveloped country largely or entirely with expatriate administration and management, with the breeding of an indigenous corps of managers postponed to a later date. The same can be done in isolated instances with industrialized plantation-type agriculture, but for the bulk of peasant-type agriculture it is impossible.

This implies a fourth requirement: the existence of at least a few nationals trained in agriculture before an effective program can be launched. One of their first tasks will be a training program to expand this corps at an adequate rate, but without the seed corn of at least a small group of indigenous professionals, an action program cannot even be started. Again, most underdeveloped countries probably meet these minimal initial requirements in getting started, but in some countries the numbers are so small as hardly to provide a viable nucleus.

Fifth, there must be expanding markets for the products of agriculture if an agricultural development program is to have any chance of success. In specialized crops these may be export markets, but the basic demand for the foodstuffs emerging from the heightened production of food in the underdeveloped world must come from the economies of the underdeveloped countries themselves. While the bulk of the total consumption of agricultural products will continue to be in rural areas, since this is where the majority of the population of the underdeveloped countries will continue to live for some decades, rising urban incomes play a necessary catalytic role in the commer-

cialization of agriculture. This implies that incomes outside the agricultural sector must be expanding if modernized agriculture is to prosper. Again, in much of the underdeveloped world, progress has recently been more promising in industry and social overhead than in agriculture. Although this condition does not appear impossible for many countries to meet, we state it to raise a warning flag that a diversion of resources into agriculture sufficiently massive to interrupt growth in other sectors of the economy could well be self-defeating. Agriculture, industry, and infrastructure must grow together.

A sixth condition related to the preceding and implying a similar conclusion is that both domestic and foreign resources must be available to supply the necessary capital inputs for agricultural modernization. Some underdeveloped countries like Ghana, Thailand, and Colombia have already developed a specialized foreign-exchange-earning export agriculture and may be able to finance the modernization of their food crop agriculture from the unstable earnings of the present export sector. And of course after modernization is well under way, a prosperous and rapidly growing diversified agriculture can readily supply its own capital requirements and even some excess for investment in other branches of activity. Agricultural development programs should be so designed as to promote self-sustaining growth in agriculture in this sense at the earliest possible date. Nonetheless in many countries, including some big ones like India, it is unlikely that traditional agriculture can transform and modernize itself in the early stages (including the supply of new inputs of fertilizer, water, and the like, the expansion of social overhead facilities for transportation and communication serving agriculture, and the establishment of educational facilities essential for agricultural advance) without an additional injection of resources from outside the agricultural sector.

The same conclusion holds in many cases when we turn our attention from aggregate capital resources to the specific needs that can be met only from abroad. While agriculture seems at first blush to be less dependent for its success on adequate supplies of foreign

exchange, creating an adequate supply of the expanded inputs of water, nutrients, pesticides, knowledge, and training, and the expansion of facilities for transporting, storing, and distributing agricultural products that the modernization of agriculture requires, place very heavy burdens on a country's foreign exchange resources. Again, those countries where traditional agriculture has been export oriented may be able to meet these requirements from the foreign exchange that their own agriculture produces, but many will require either foreign aid or an industrial or extractive base with a high foreign-exchange-earning potential.

#### POLICY IMPLICATIONS

A number of policy implications that follow from the above characteristics of agriculture and preconditions for its development became increasingly evident as the conference proceeded. Although few of these are novel to those who have thought deeply about agricultural problems, they received emphasis, body, and content in our joint deliberations, and it may not be amiss to restate them briefly as a prelude to the more detailed exposition in subsequent chapters.

The first generalization concerns the application of generalizations to specific situations. As we pointed out in Chapter One, the diversity of situations in which agriculture operates in the underdeveloped countries--physical, economic, institutional, and motivational--taken together with the pervasiveness of interdependence in any particular situation means that generalizations cannot be applied without adaptive research and experiment. The biologists have taught us this with respect to crop varieties. The basic principles of breeding improved crop varieties are developed in the biological laboratory and are independent of their place of application. But few plant breeders would feel safe in recommending to a minister of agriculture that he should adopt for use throughout his country, or even in any particular region of it, a variety that has been highly

successful elsewhere without an extensive series of field tests to determine its adaptation to local conditions of climate, soil, water and fertilizer availability, pest and weed prevalence, and so on.

This same principle of the need for adaptive research and experimentation under local conditions is fully as valid for manipulations of the economic environment, for organizational and institutional patterns, for the types and complexities of knowledge that can be absorbed by the local population, for education and training, and indeed for the whole package of interrelated activities that must constitute an agricultural program. This need for adaptive research and experimentation outside the biological field is not yet well understood by those responsible for agricultural programs in the underdeveloped countries. They seek outside advice on what kinds of programs they should adopt, whereas the best advice that can be given is that they should conduct pilot schemes and test the adaptability of ideas developed elsewhere for their own complex of local conditions. In what follows we cite a number of dilemmas without any clear indication of how to solve them. Viable solutions for a particular region can be found only by adaptive experiments in that region with careful evaluation to test the results. A checklist of such dilemmas will produce no solutions but may direct attention to a series of hypotheses to be tested against local conditions.

An important dilemma is that while on the one hand a great many things need to be done to make modern agriculture work, running through the whole list of factors affecting productivity, and while many of these things require for their successful performance administrative and organizational attention from all levels of government, the human resources available to perform all these functions are exceedingly limited, and if too much is attempted at once, nothing will be done well. It is clear that the effective manipulation of all the variables that affect agricultural productivity in such a way as to eliminate simultaneously over the whole country all the potential bottlenecks is beyond the capacity of most underdeveloped governments. Faced with this dilemma, what do they do?

One possible answer is to be found in a sequence of trial-and-error attempts. In a small region in which almost everything is missing, a quick diagnosis will suggest one or two critical bottlenecks or urgently felt needs, like the control of pest losses or the timing of water supplies. Administrative energies can initially be concentrated on breaking this bottleneck. As progress is made, complementary bottlenecks will appear, such for example as institutions to supply credit for the purchase of insecticides, or more extension agents to explain its proper use to the farmer. If the initial program is concentrated in a small district, and if at the start there exist administrative skills and resources to broaden the program as the need becomes apparent, diagnosis and remedy can proceed sequentially, adjusting the program in stages to the revealed priority issues. The alternative procedure, more logical but perhaps less feasible, is to conduct a local survey attempting to diagnose in advance all the elements required, their interconnections, and their relative priorities and then to design a complete package program to deal with them. Choice between these techniques will have to be made locally, and experiments with both are to be encouraged. The one thing of which we are fairly confident is that organizational experiment of this sort should initially be on a small scale and not national in scope. It is clear from the interdependence of all the factors affecting agriculture that the nationwide manipulation of one variable, like price policy or ample fertilizer supplies or adequate water or a good credit system, is likely by itself in most cases to produce only limited results. Where the prospects for a high immediate payoff are very promising from such single-factor programs, they may be tried on a national scale, but in such cases, administrative resources should be kept available to follow up quickly with programs of complementary factors as they turn out to be needed. For the longer run the conference broadly accepted the principle of attempting to install fairly complete packages in limited areas, either sequentially or all at once, rather than dealing nationwide with a few problems one at a time.

This leaves open a great many questions. How large should these packages be? Which elements in them deserve the most emphasis? How should they be designed and administered? How many should there be, and how rapidly can the number be expanded? Answers to all these questions will differ not only from country to country but also from region to region within countries. They can be found only by pilot study and experimentation. The early experiments will almost certainly involve much heavier inputs of manpower than could be quickly extended to whole regions, but if serious attention is paid to ways of reducing the manpower inputs in the future, such pilot programs can yield insights for national policy. Meanwhile more modest effects may be achievable by more widely diffused policies outside the package areas.

A further important question is how much diversification of crops and practices is desirable and feasible both nationally and in the individual farm unit. In many circumstances a higher degree of diversification, certainly nationally and frequently on the individual farm, will reduce risks and significantly increase the efficiency of farm operations. But done properly such diversification makes much heavier demands on the knowledge and education of the farmer and on the training and competence of the extension service that backs him up than simpler types of agriculture. Again there is no general answer, and the solution for a particular region with particular physical and human characteristics can be found only through adaptive research and experimentation.

Another problem that characterizes many areas of development policy is rendered particularly acute in agriculture by some of the conclusions we have already reached. It is the problem of balancing considerations of productivity and of equity. How far are the limited resources--economic, physical, and human--available to the government of an underdeveloped country to be used to promote the maximum possible increases in the output of its economy, and how far are they to be used to ensure an equitable distribution of the yields of that economy among its members and particularly among its underprivileged



members? From what we have already said about the principle of concentration, it is clear that productivity will as a rule increase more rapidly if resources are concentrated on limited regions and within those regions possibly on limited numbers of people. Although this will not always be true, frequently those most likely successfully to adopt a package of inputs and practices yielding much higher returns will be those who have had some experience of success in the past and more than average resources to risk on innovations in the future. Concentrating resources on the more promising regions and individuals may therefore result in increasing rather than reducing the disparities between the more and the less fortunate.

There was a general feeling among us that practical politicians faced with this dilemma might well be pushed too far in the direction of sacrificing productivity for equity even though in the absence of significant increases in productivity more resources may never become available to improve the lot of the less fortunate. On the other hand, concentration on productivity at the expense of equity may violate deeply held social values and may also generate such tensions within the society as to make the continuation of productivity programs difficult or impossible. Again, few general principles can be suggested to guide the administrator in making the compromises necessary in each particular situation.

Fortunately the alternatives are not usually limited to an inequitable concentration on success by too few or an unproductive spreading of resources over too many. Concentration can be accompanied by other measures to relieve inequities that may contribute to productivity rather than limit it. A notable example is the development of a rural public works program using primarily the abundant resource of unskilled rural labor for such projects as feeder roads or water distributaries that would contribute to productivity and provide employment for the least favored of the rural population--the landless laborers and those displaced from farming. This important problem is discussed further in the last part of Chapter Four.

These alternatives are merely illustrative of a broader range of problems having to do with conflicts between economic goals and sociopolitical goals that may be in competition with them. Since the conference was devoting its primary attention to agricultural productivity we did not go at length into cataloging these conflicts or suggesting principles for their resolution, but we were continuously aware that such conflicts exist and must be taken into account. Again how far they exist in fact and how far they are only fears in the minds of politicians can frequently be tested effectively only by pilot experiments on a small scale, where the potential threat to deeply held sociopolitical goals is much more limited than when the experiment is tried on a national scale.

Another dilemma that confronts any government attempting to organize an agricultural program to affect large numbers of cultivators is: how far to attempt by a variety of devices to generate voluntary and active participation by cultivators in the program and how far to rely on paternalistic and coercive devices to ensure performance. The former choice is much more desirable in human and political terms but may be much slower, much more costly in both economic and human resources, and at least in the short term somewhat less effective. Indeed in certain situations like complex water management or pest and disease control, coercion may be necessary, for a minority of noncooperators may threaten the success of a whole program. Again how far it is practicable to pursue the desirable aim of securing maximum participation and voluntary cooperation will have to be determined in particular cases and can frequently be settled only by a highly experimental approach with a variety of pilot schemes.

A dilemma that ran through almost everything we did at the conference and underlies many of the points made earlier is the one posed by the desperate urgency in many countries for raising production as quickly as possible and the need in most areas for much further study and experiment (physical, economic, organiza-

tional, psychocultural, and intellectual) before launching major and time-consuming reorganizations of agriculture. In most situations, whatever we do in the short run, it is likely that the thorough transformation of agriculture required to produce radically improved performance will take decades to effect. On the other hand, with population pressing and with industrialization being limited in its growth by the agricultural bottleneck in many places, politicians who want to survive cannot wait decades. A statesmanlike posture is of course to pay attention to both short-term and long-term measures. We were convinced that in many places significant if limited improvements in agricultural performance can be brought about with measures that can be taken fairly promptly. However, unless longer-term measures are initiated at once to expand our basic knowledge of the factors contributing to agricultural improvement and to experiment with more radical alterations in the whole structure and pattern of traditional agriculture, the short-term measures will very soon, in a matter of a few years, bump against ceilings of performance that cannot then be broken through without a protracted delay in the pace and momentum of advance. We have tried in the balance of our report to divide our recommendations into the short-term and longer-term ones, but the balance between these must be determined in each particular case by weighing the immediate urgencies against longer-term needs.

A final generalization to which we would all subscribe is that the fundamental problem confronting agriculture is not so much the adoption and spread of any particular set of physical inputs or of economic arrangements or of organizational patterns or of research institutions. Rather it is to build into the whole agricultural process--from the farmer to the university research institute, from the field extension agent to the minister of agriculture--an attitude of experiment, trial and error, continued innovation, and adaptation of new ideas. Once this innovative and experimental spirit permeates the rural community, the farm supply and marketing industries, the bureaucracy, and the intellectual institutions concerned with agri-

culture, the gulf that presently exists in most underdeveloped countries between city and country, between universities and farmers, between ministers and village officials will be bridged, and continued development can be built into the system. Without it improvements in performance, though they may occur, will be halting and transitory and thus provide no lasting contribution to agricultural productivity.



Part II

AGRICULTURAL POLICIES: THE MAJOR FACTORS



## INTRODUCTION

Part II will deal with agriculture in the broadest sense, seeking policy suggestions in the range of factors described in the previous chapter and classified in Table 1 in Chapter Two.

Chapter Three deals with the physical inputs: the factors that can be added to make the land yield larger crops. Here we propose a major effort on fertilizer.

Chapter Four deals with the economic environment: how it can be manipulated to increase the farmer's incentive to produce. Here we propose, among other policies, price supports for food crops and subsidies for fertilizer and other inputs, the use of surplus labor for rural public works, and the testing of a scheme to provide innovation insurance for farmers.

Chapter Five deals with knowledge: the research and educational policies needed to provide a flow of new technology and the men who will put that technology into practice. We were pretty well agreed by the end of the conference that unless a greatly stepped-up program of long-range research is initiated now we could exhaust the potential of presently known technology without providing long-term solutions to the world's food problems.

Chapter Six deals with the organizational environment of agriculture: the principles governing the relations between the farmer and the institutions of his society, and how that relationship is affected by the attitudes and values of both farmer and bureaucrat. Here our key recommendation is for many pilot experiments in each country, with organizational alternatives tailored to local needs and local situations.

Thus the questions we are attacking here are basically two: What techniques exist for increasing agricultural yields? What must be done in other fields to put those techniques into practice or to add to their number?





## Chapter Three

### THE PHYSICAL INPUTS

We concentrate our attention in this chapter on five major physical inputs that may be purchased by farmers either individually or collectively: chemical fertilizers--primarily nitrogen (N), phosphate (P), and potash (K); water; improved plant varieties; tools and machines; and pesticides. Since the proper application of these inputs to what is now regarded as the world's supply of arable land could multiply agricultural yields by several fold, the conference did not take up ways of farming land not now considered arable.

Since the effectiveness of one physical input depends on the presence of others, a combination or package of new inputs usually produces greater yields than the sum of those inputs applied singly. For example, in experiments performed in Indiana a doubling of water availability with no fertilizer raised corn yields by only about 16 per cent. With the addition of 100 pounds of nitrogen per acre the same increase in water increased yields by 38 per cent. The addition of 100 pounds of nitrogen with the existing water level increased yields by 186 per cent, while with the doubled water supply the increase was 239 per cent.

When economic yields are calculated, it may be that no single input will repay its cost, whereas a package of new inputs would be highly profitable. Or, even if profitable, the margin of gain on a single input may be too small, given the risks that characterize farming, to lead the farmer to adopt it. A theoretical (but not untypical) illustration would be: \$1 invested in irrigation without other inputs might return \$2 in added yield; the same return might

be gained on each of the other inputs alone. But \$1 invested in a package of those same inputs might return \$10.

Some physical inputs introduced singly, for instance pest control or the addition of fertilizer, may yield important gains. Yet though these are cases of single inputs, they are not single-factor solutions, for each involves a wide range of nonphysical factors. Pest control may require a high degree of social organization; and getting fertilizer on farmers' fields involves complex problems of administration, distribution, knowledge, and economic policy.

Thus even with a single physical input we are dealing with a package of factors. Since adding other physical inputs simply makes the package more complicated, the policymaker designing the package is confronted with a difficult series of choices between optimum feasibility and optimum return. The simplest program is the easiest to design and administer and stands the best chance of being adopted by farmers. But, as we have seen, it also offers the least return. The addition of new inputs places an increasing strain on both the farmer and the agent of change. Thus, as the package becomes potentially more profitable, its chances of being successfully introduced are likely to diminish. The optimum package of physical inputs (varying of course from place to place) will be the one providing the best compromise between potential yield and likelihood of effective adoption.

#### FERTILIZER

Among the physical inputs, fertilizer, in the opinion of many, offers the best hope of a quick and major increase in agricultural production. How great and how certain that gain may be are still under dispute among professionals. Some of us felt that fertilizer alone could produce great gains over the next decade, before other physical inputs become limiting. Despite the problems involved, this group favored a major effort on fertilizer. A minority felt that the

evidence is still insufficient to justify concentration on fertilizer under present conditions. This minority dissented, at least in part, from the policy proposed in this section.

Fertilizer adds to the natural supply of plant nutrients in the soil. Crops have fairly definite nutrient needs. A 1,000 pound per acre crop of paddy rice, for example, needs 30 pounds of nitrogen, 10 of phosphate, and 25 of potash. To double the yield, the supply of nutrients available to the plant must be doubled. Most of the soils of the tropics and subtropics supply only about 30 pounds of nitrogen a year. This limits the yield of most cereals to 800-1,200 pounds per acre, compared to about 2,500 pounds in many temperate zones. Lack of nutrients, rather than the nature of existing crop varieties, appears to be the limiting factor in areas that have enough water. The experience of a minority of farmers in underdeveloped areas indicates that the existing varieties may yield much more than the present average yields.

Some of us were persuaded, on the basis of the experience of the Food and Agriculture Organization (FAO), that substantial yield increases--of at least 50 per cent--are often possible with the single input of fertilizer. Since 1961 the FAO has run extensive fertilizer trials and demonstrations in fifteen nations in the Middle East, West Africa, and northern Latin America. The trials were conducted mainly on food crops on farmers' fields and without other inputs. The most economic fertilizer treatments sometimes produced increases of 50-80 per cent; rarely was the increase less than 30 per cent or more than 100 per cent. A tentative generalization from this evidence would suggest that the use of fertilizer may be able to increase the production of the major food crops in important areas of the three continents by about 50 per cent where water is not a limiting factor.

But fertilizer is little used in the underdeveloped world. As Table 2 shows, Asia, Africa, and Latin America consume far less fertilizer than do the developed nations. Fertilizer consumption is closely correlated to per acre yields and to the general level of

development. The range among nations is extremely wide. Denmark, for example, consumes 64 pounds of nitrogen per capita per year, India only 1.7 pounds, and China 1.2 pounds. The underdeveloped nations produce even less fertilizer than the little they consume. As Table 3 shows, their production in 1962/63 supplied only about half of their own consumption.

TABLE 2. FERTILIZER CONSUMPTION, 1962/63

	Total Consumption (Metric Tons)	Pounds Per Capita
Asia (except China and Japan)	1,780,000	4.1
Africa	810,000	6.6
Latin America	898,000	8.9
Soviet Union	2,749,000	27.0
Japan	1,640,000	38.0
Europe	14,630,000	74.0
United States and Canada	8,782,000	94.0

The use of fertilizer in the underdeveloped world is inhibited by many factors. The cost/yield ratio is in general less favorable to the farmer than in the developed nations. The farmer in underdeveloped nations typically pays more for fertilizer and gets a lower price for his crop. The result is that the same physical return--four pounds of crop for one pound of fertilizer, let us say--may be economic for one farmer but not for the other. This is especially true of food crops; as a consequence, fertilizer is used more on higher-priced cash crops than on food crops.

The cost of producing fertilizer in the underdeveloped world is comparatively high. Capital costs, involving imported machinery, are high, the lowest cost methods of production are not always used, and inefficient management frequently increases operating costs. In India, for example, production costs are 50 per cent higher than in the United States.

TABLE 3. FERTILIZER DATA: ASIA, AFRICA, AND LATIN AMERICA

<u>Production, Consumption, and Imports of Fertilizer, 1962/63</u>			
(in million metric tons of plant nutrients)			
	<u>Production</u>	<u>Net Imports</u>	<u>Consumption</u>
Asia (except China and Japan)	0.67	1.11	1.78
Africa	0.46	0.35	0.81
Latin America	<u>0.60</u>	<u>0.30</u>	<u>0.90</u>
	1.73	1.76	3.49

<u>Fertilizer Needs at 30 Pounds Per Person Per Year</u>		
(in million metric tons of plant nutrients)		
	<u>1970</u>	<u>1980</u>
Asia (except China and Japan)	15.7	19.9
Africa	4.4	5.6
Latin America	<u>3.9</u>	<u>5.2</u>
	24.0	30.7

<u>Additional Grain Production Equivalent to</u>		
<u>30 Pounds of Plant Nutrient Per Person*</u>		
(in million metric tons)		
	<u>1970</u>	<u>1980</u>
Asia (except China and Japan)	109	143
Africa	29	38
Latin America	<u>24</u>	<u>34</u>
	167	220

\*Calculated as 10 tons of grain per ton of plant nutrient.

Distribution is probably the most critical bottleneck. Getting the fertilizer from factory or dock to the farmer requires extensive planning and a complex infrastructure. The fertilizer must be transported to the region where it will be used and stockpiled well in advance, which requires adequate transportation facilities and local storage places. Timing is crucial; the fertilizer is of no use if it arrives after the time when it must be applied. The critical factors here are physical infrastructure and effective management, both of which are frequently lacking.

The farmer suffers from other inhibitions. If he is a tenant rather than an owner, he has, under most tenancy conditions, less to gain from fertilizer. A typical tenancy arrangement forces the farmer to pay for all inputs and deliver half the crop to the landlord; so the tenant who uses fertilizer gets only half as much return on his investment as he would if he owned the land. Even when it is proven to be profitable, the farmer may be as slow to adopt fertilizer as he is to try any innovation requiring a cash outlay; for risks are reluctantly taken by people living close to the level of starvation. (We suggest later some ways of overcoming these obstacles to innovation in the economic environment.)

Knowledge also is lacking. In one sense this means that the farmer does not receive existing information--from salesmen or extension services--about the use of fertilizer. In another sense the information itself is lacking. Indiscriminately applied, fertilizer may reduce yields. The optimum dose and blend of fertilizer vary widely with soils and crops. The blend usually contains at least two of the three major ingredients--N, P, and K--but the proportions will differ according to local needs. Nor is crop response proportionate to the amount of fertilizer applied: that is, doubling the dose does not necessarily double the extra yield. Only a particular dose may be economic; less, or more, may not pay off. Only extensive local trials can determine how much to use of what mixture.

The majority of us felt that, despite the problems involved, the potential was sufficient to justify a major effort toward promoting the use of fertilizer. With present technology, the majority felt that it should be possible with fertilizer alone to raise food production enough to guarantee the food supply of the underdeveloped world for several years. At some point--and we differed as to how soon it would be--another ceiling would be reached; fertilizer would not be able to raise yields any further in the absence of other physical inputs. But precious time would have been bought. We all agreed that this time must be used to set in motion the complementary activities that eventually would make possible, through other inputs, other advances in production. Some considerations involved in generalizing fertilizer use are set forth below.

#### Future Fertilizer Requirements of Developing Countries

At present rates of growth the projected increases (over the 1960 level) in the populations of Asia (excluding China and Japan), Africa, and Latin America will total 400 million in 1970 and 900 million in 1980.

Agricultural production has been approximately static in these areas during the past four years. Clearly a considerable rise in production will be needed to feed the added population even at present low levels of nutrition. To continue to provide one pound of grain per person per day in 1980 will require a grain production of about 150,000,000 tons in 1980, in addition to the 1960/61 production of 231,000,000 tons. This represents an increase of 65 per cent in only twenty years.

A target of 30 pounds of consumption of plant nutrients per capita per year in Asia, Africa, and Latin America is postulated as a necessity for attaining even minimal food production in 1980. It would be highly desirable to attain such a consumption target by 1970, but this seems impossible. Table 3 shows the tonnage of fertilizer in each area in 1970 and 1980 corresponding to 30 pounds



per person per year. This goal would require consumption of 30.5 million tons of plant nutrients, compared with three million tons in 1960/61. In 1962/63 the consumption of fertilizer in terms of plant nutrients was as shown in Table 2.

The following distribution of plant nutrients is suggested within the 30 pounds per capita target: nitrogen (N)--16 pounds, phosphate ( $P_2O_5$ )--8 pounds, potash ( $K_2O$ )--6 pounds. The world average ratio of N- $P_2O_5$ - $K_2O$  was near 1:1:1 for many years, but nitrogen has been steadily pushing ahead relative to phosphate and potash during the past few years. Therefore some analysts have suggested a ratio of 2:1:0.75 as a provisional "norm" for Asia, Africa, and Latin America. However, many regions may deviate substantially from the norm.

Table 3 shows that the projected 30.7 million tons of plant nutrients used in 1980 would correspond at best to 220 million tons of additional grain over and above 1962/63 production. This calculation assumes a return of ten pounds of grain for one pound of plant nutrient, a higher rate of return than is now being achieved in many nations. Thus the grain target would not be met unless other physical inputs, such as seeds and water, were supplied in appropriate quantities, along with the nonphysical inputs of knowledge and organization. Additional grain production of 220 million tons would be somewhat more than enough to maintain grain consumption at one pound per capita per day in 1980, but part of the fertilizer would be needed for other foods and non-food crops. Therefore the goal of 30 pounds per capita per year represents a minimal target to feed Asia, Africa, and Latin America in 1980.

#### The Short Term--1970

For 1970 let us postulate a short-term target of 20 pounds per capita per year. This would break down by continents as shown in Table 4. The total consumption of 16 million tons needed in 1970 compares with a total production of 1.7 million tons in 1962/63.

New projects are under way in many countries, and production on the three continents may reach 4 to 6 million tons by 1970. This is far from the goal. Therefore the consumption target of 16 million tons will presumably have to be met largely by increased imports. The 5 years remaining before 1970 is too short a time to achieve self-sufficiency in Asia, Africa, and Latin America even under a forced-draft crash program.

TABLE 4. FERTILIZER CONSUMPTION TARGET:  
ASIA, AFRICA, AND LATIN AMERICA, 1970  
(Million Tons)

	<u>N</u>	<u>P<sub>2</sub>O<sub>5</sub></u>	<u>K<sub>2</sub>O</u>	<u>Total</u>
Asia (except China and Japan)	5.6	2.8	2.0	10.4
Africa	1.6	0.8	0.5	2.9
Latin America	<u>1.4</u>	<u>0.7</u>	<u>0.6</u>	<u>2.7</u>
	8.6	4.3	3.1	16.0

There was a world-wide shortage of fertilizer in 1964 due to rapidly increasing demand in the United States and Western Europe and the import demand of the Soviet Union, China, India, and other large consumers. However, production capacity is expanding rapidly in the developed nations, and it appears likely there will be enough capacity in operation to meet all needs in 1970.

#### Long-Range Development of Fertilizer Supplies

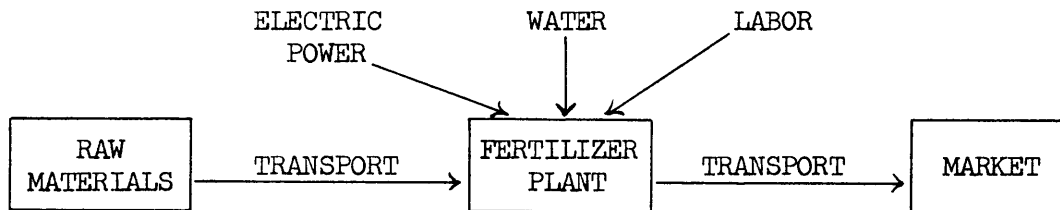
While the 1970 fertilizer requirements of Asia, Africa, and Latin America will have to be met largely by imports, the larger countries should plan to become self-sufficient in fertilizers by 1980. On the basis of 30 pounds of plant nutrients per person per year, a country of 5,000,000 population, the minimum for a basic factory, would need 75,000 tons of plant nutrients per year. The annual production value of such a unit would be about \$10 million.

## The Physical Inputs

Fertilizer plants become progressively cheaper in both capital and operating costs as they become larger, but the additional gain beyond 150,000 to 200,000 tons (nutrient basis) in annual capacity is slight.

Smaller countries could establish a large fertilizer plant cooperatively on a regional basis. West Africa, Central America, and the Middle East seem to be areas where such an approach is clearly desirable.

The economic feasibility of a fertilizer plant is determined largely by (in addition to its size) its location with respect to raw materials, markets, and transportation. Secondary factors include electric power, water, and labor supply. These factors may be illustrated by the following diagram:



A plant may be located at the raw materials, at the market, or anywhere between the raw materials and the market. The delivered cost of the raw materials is the important criterion, and since water transport is relatively cheap, coastal locations are preferable when raw materials are shipped by water. Raw materials need not be available in the nation itself. For example, Japan has the third largest fertilizer industry in the world, next to the United States and the Soviet Union, and yet Japan imports all her raw materials.

The raw materials needed for fertilizer production are four:

Hydrocarbons, preferably gaseous or liquid, to combine with air and water to produce ammonia, the basic source of nitrogen.

Phosphate rock.

Potash salts.

Sulphur.

Table 5 shows the occurrence of these raw materials in the major areas of the world.

Ammonia either can be used directly as a fertilizer or can be converted into solid derivatives such as urea, ammonium nitrate, ammonium sulfate, ammonium phosphate, and others; it can be used in aqueous solutions, called nitrogen solutions, in combination with ammonium nitrate and/or urea.

Phosphate rock is converted into any of several fertilizer materials by treatment with sulfuric acid. This is why sulfur is an essential raw material for fertilizer production. Potash salts usually come to the fertilizer plant as potassium chloride or potassium sulfate ready to be mixed with nitrogen and phosphate materials.

The principal hydrocarbon raw materials used for producing ammonia are natural gas, naphtha (raw gasoline), and crude oil. Natural gas is used in the lowest cost plants. Naphtha is also used, but it is usually more expensive than natural gas. Naphtha is used extensively in India and Western Europe. Japan uses principally crude oil.

Capital costs for fertilizer plants may be summarized as follows in terms of annual capacity:

Per 100,000 tons N	\$15,000,000-\$20,000,000
Per 100,000 tons $P_2O_5$	\$ 5,000,000-\$10,000,000
Per 100,000 tons $K_2O$	No processing required
Per 100,000 tons mixed fertilizer*	\$ 1,000,000-\$ 1,500,000

Therefore construction of factories with a capacity to produce 30,000,000 tons of plant nutrients (16:8:6 ratio) in Asia, Africa,

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\* Cost of blending plant in addition to cost of producing fertilizers.

## The Physical Inputs

TABLE 5. KNOWN RAW MATERIAL RESOURCES FOR FERTILIZER PRODUCTION

	Hydrocarbon <sup>1</sup> (for Nitrogen Production)	Phosphate	Potash	Sulfur <sup>2</sup>
United States and Canada	+++	+++	+++	+++
Mexico and Central America	++	+	0	+++
South America, West Coast	+	+	0	0
South America, East Coast	+++	+	0	0
Western Europe	+	0	+++	+++
Eastern Europe	++	0	+++	+
Soviet Union	+++	+++	+++	++
North Africa	+++	+++	0	0
Sub-Sahara Africa	+	++	+	0
Middle East <sup>3</sup>	+++	++	+	+
India	+	0	0	0
Pakistan	++	0	0	0
China, Mainland	+	+	0	0
Japan	0	0	0	++
Indonesia	+++	0	0	0
Rest of Southeast Asia	+	+	0	0
Oceania	0	+++	0	0

<sup>1</sup>Gaseous and liquid hydrocarbons only; excludes coal.

<sup>2</sup>Includes elemental sulfur and sulfur content of pyrites.

<sup>3</sup>Includes Turkey, Cyprus, Syria, Lebanon, Israel, Jordan, Arabian states, Iraq, Iran, Afghanistan.

+++ Ample resources.

++ Good resources.

+ Scarcity of resources.

0 Not known.

and Latin America would cost about \$4 billion--one tenth the cost of putting a man on the moon.

Cheaper fertilizer may be obtained from recently built nitrogen factories in areas with a plentiful supply of cheap natural gas, such as the Persian Gulf, North Africa, Venezuela, and Trinidad. Plants established there could ship liquid ammonia to the consuming countries for conversion to solid fertilizer, or they could make and ship solid fertilizers directly. Typical of such a large low-cost nitrogen plant is a new factory in Trinidad with a capacity of 150,000 tons that uses the cheap natural gas available there. A similar plant is now under construction in Kuwait in the Persian Gulf. Another approach to cheaper fertilizer is to ship liquefied natural gas from gas surplus areas such as the Persian Gulf to places with a large fertilizer demand, like India.

The new approach of local blending can lessen the difficulty of distribution. Bulk blending at the local warehousing sites can be a cheap means of combining the three varieties of fertilizer in any proportion that local soils or crops require. Such blending plants are small, efficient, and low in capital costs. They function equally well with imported or locally made materials, as long as the particle sizes are roughly equal. The blended product can be sold in bulk or in bags. Bulk blending favors the decentralization of storage and the accumulation of stock in the agricultural regions well ahead of the rush season.

The cost of setting up a bulk-blending plant in a provincial town on a railroad siding, and providing stockpile storage for 3,000 tons of fertilizer mixing ingredients, may run approximately \$100,000.

Such plants ease fertilizer distribution because only three main ingredients need to be handled to provide any possible combination of the three major plant nutrients. They provide a local supply base upon which the farmer can rely and thereby increase the chances that he will get the mix he needs when he needs it.

## IRRIGATION WATER

Irrigation agriculture is the most productive kind of farming devised by man. It is also the most expensive. The capital costs of providing the water for irrigation agriculture are commonly so large that they cannot be fully met by the farmers themselves but must be spread throughout the economy.

Because of its high capital and operating costs, irrigation agriculture must be intensive. The yields per unit of water must be high, which usually requires an intensive use of land. If the water is spread on too much land, a large per cent of the water will be lost through seepage and useless evapotranspiration. To maintain the high yields required by the high cost of irrigation agriculture, all other factors of production--fertilizers, pest control, high-yield seeds, and effective farm practices--must be used to full advantage. Many aspects of water supply through irrigation are illustrated in Chart 1 in this section. In many irrigation projects, attention has been too much concentrated on construction of central facilities (shown between the dotted lines on the chart) with inadequate attention to other aspects of water management.

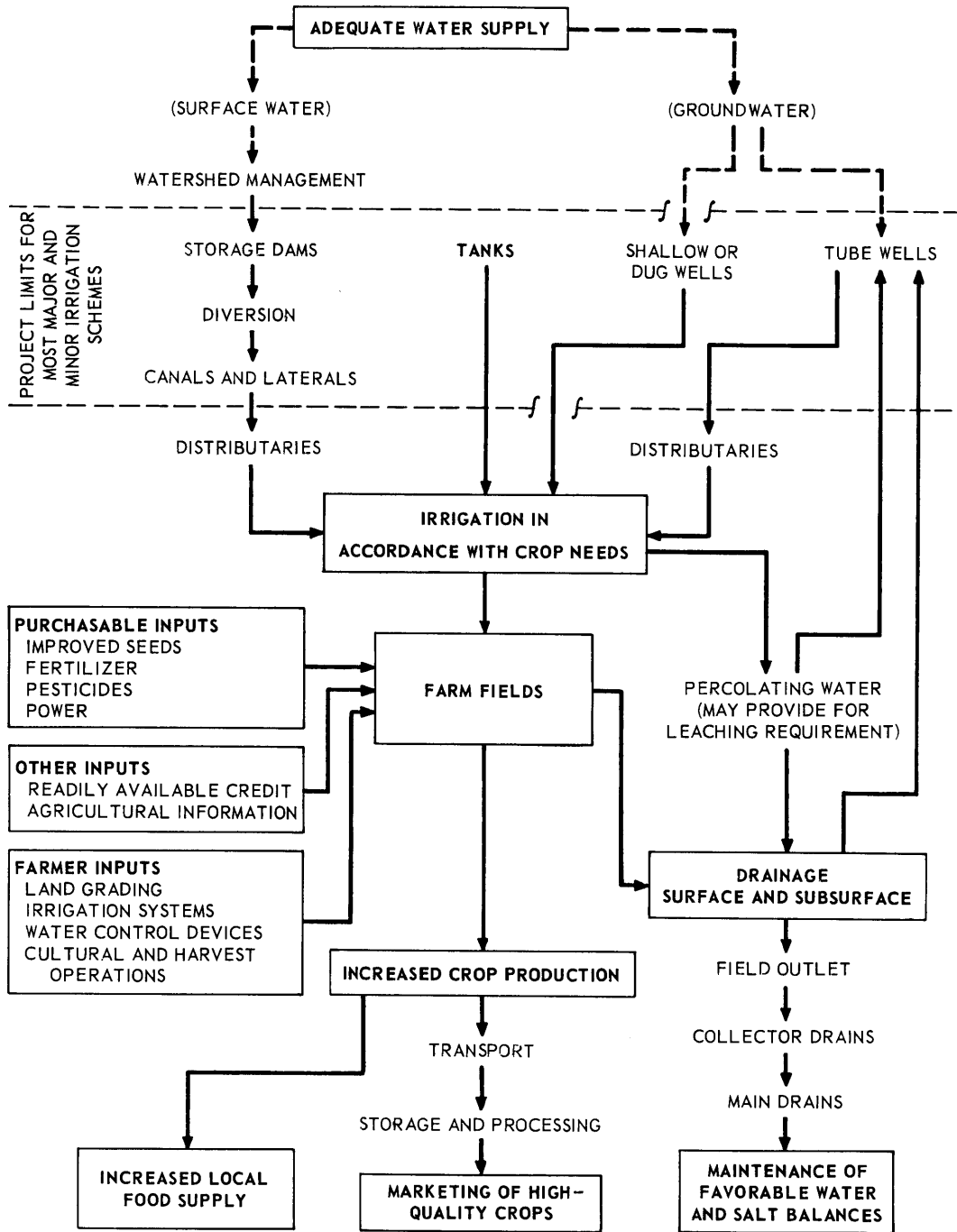
Water Needs of Crops

Four factors--the potential evapotranspiration during the growing season, the permeability of the soil, the quality of the water, and the salt tolerance of the crops--determine the amount of irrigation water that must be applied for maximum crop yields in a particular situation. Whether the supply of these amounts is economic in a given situation is of course a different question, depending on the cost of water supply, the value of the crops to be produced, and the consequences for yields of less than optimal water inputs.

Evapotranspiration depends largely on the length of the growing season and the amount of sunlight. The amount of water required by different crops varies over a wide range. Winter wheat in West

Chart 1

PHYSICAL INPUTS AND PROCESSES FOR IRRIGATION AGRICULTURE





Pakistan, for example, needs about 14 inches of water to meet the evapotranspiration requirement, while sugar cane and cotton, because of their long growing season, which extends from early spring through the high water-demanding months of summer to late fall, may demand 50 or 60 inches.

In sandy soils much of the water will be lost by downward percolation, and hence for any particular crop the amount of water required will be far greater than the evapotranspiration requirement. In a tight silty or clayey soil little water will be lost by downward percolation.

Sufficient additional water must be supplied to prevent salt accumulation in the soil. The dissolved salts can be carried off in the return flows or leached into the underground. With salty irrigation water and crops of low salt tolerance, a great deal more water must be applied to the fields than is required to meet the evapotranspiration potential. For crops of medium salt tolerance, such as maize and sugar cane, irrigation with water containing 2,000 parts per million of salt, the excess of applied water must be about 70 per cent over the evapotranspiration requirement.

#### Sources of Irrigation Water

Water for irrigation can be gathered from a large or infertile area to be used on a relatively small fertile area, or water in excess of evapotranspiration during the wet season can be stored for use during dry parts of the year. It may be stored either on the surface behind dams or bunds or underground, usually in porous alluvium or limestone.

Without storage the farmers are dependent for their irrigation water on variable and unpredictable river flows, which cannot be timed to coincide with crop growing seasons. If water can be stored, the farmers are able to use it when their crops require it; consequently they can plant crops whose growing season does not match the rhythm of the rivers. When the river flows are peaked during part of the growing season, a combined use of river flows and stored waters makes it possible to use more river water, and a

larger area can be planted and harvested. Stored water can also be used during low river stages and thus double or triple cropping becomes possible on the same fields.

#### Short-Term Water Development

Small-scale water improvements can be accomplished by the farmers themselves. They include the construction of earthen tanks and small hillside dams, the construction of water spreading structures to increase recharge of the underground aquifer, digging and rigging shallow wells, the construction of water courses to carry the water from government canal systems and from wells to farm fields, terracing, building bunds, and water guidance structures to conserve rain water, and digging drainage ditches to carry off irrigation return flows.

Larger structures require engineering design and special equipment and often help from the government. These include tube wells, which must be drilled and fitted with casing, pumps, and motors by specialists; collector drains for return flows; underground drains, such as tile drains, ditches, and sumps for salt and water table control; and small deep wells for village drinking water. Reclamation of saline or sodium damaged soils by leaching with surplus irrigation waters may require government guidance. The farmers also need instruction in land leveling, the construction of water distribution systems in their fields, and proper irrigation practices.

Tube wells can be privately constructed, owned, and operated, but the spacing, the depth, and the quantity of water pumped must be controlled by the government through licensing arrangements, and the quality of the pumped water must be continuously monitored to prevent salt damage. Tube wells on a large-scale pattern involving hundreds of thousands or even millions of acres must be government projects.

### Long-Term Water Development

Large-scale water development, involving the construction of dams on major rivers, diversion structures, and canal systems, takes many years and often involves bringing new lands under cultivation. Planning farm villages and building roads, schools, marketing, storage, and other facilities must be part of the project, as well as the preparation of the new lands for cultivation. The costs are usually so high that only the national government can bear them.

Attention is often focused on the construction of major public works while other aspects are neglected. These include conservation of the watershed above the dam and provision for drainage to carry off canal leakage and irrigation return flows.

Neglect of the watershed may mean that silt from rapid erosion will quickly fill up the reservoir back of the dam so that its life will be limited to a few decades. Erosion control can double or triple the life of the reservoir.

Many irrigation projects fail because of lack of drainage. Excess water, instead of draining off the irrigated fields, simply seeps into the underground and raises the water table. The water table may also be raised by canal leakage. When the underground water has risen sufficiently, water is sucked up by capillary action and evaporates at the surface, a residue of salt accumulates in the fields, and the productivity of the land gradually diminishes. Drainage of excess irrigation water to maintain salinity control is as important in the long run as providing the water in the first place.

### Supply and Pricing of Irrigation Water to the Farmers

In many countries government pricing and distribution policies for irrigation water are not designed to lead to optimum agricultural development. Instead of water being supplied on the demand of the farmer it is provided on a regular schedule to each farmer in sequence. The price he pays is based not on the amount of water

used but on the area of land irrigated. The ideal water delivery policy would be to make the water available to the individual farmer in the quantities and at the time he needs it for his crops and to charge him for the amount of water actually used. At a minimum the farmer needs better advance information than he often gets on the probable availability of water for the coming growing season.

#### Already Cultivated Land Rather Than New Land

In many areas greater benefit in relation to costs will be obtained from an increase in the productivity of already cultivated land than by attempting to bring new lands under cultivation. This is particularly true in monsoon tropical areas where one very wet season is succeeded by seven to nine months of dry season. In the Ganges-Brahmaputra Plain of India and East Pakistan, productivity could be increased several fold by developing irrigation water supplies so that two or three crops could be grown instead of the single monsoon crop.

It is commonly assumed that agriculture is such a simple human occupation that the farmer will immediately be able to move in and start a wholly new productive economy. This is usually very far from reality. Pilot agricultural trials need to be undertaken in the area where extensive development of new land is planned in order to gain the knowledge and the experience necessary for profitable and economically sound operation. Such pilot trials can often be made with ground water available locally in the area or by diverting a portion of river flows through small inundation canals. These pilot trials of irrigation practices are an illustration of the principle of local experimentation stressed in Chapter Six.

#### Value of Short-Term, Small-Scale Projects

Water storage for irrigation is one of the principal justifications for such spectacular public works as great dams and aque-

ducts. These structures, though enormously popular with local politicians and with project-minded administrators of aid-giving agencies, and necessary to take full advantage of river flows, require a high degree of centralized operation and a uniform timing of water supplies over large areas. This seriously inhibits the flexibility and freedom of individual farmers to vary their cropping patterns. Major irrigation works place a strain on both the villagers' social structure and the government apparatus that has at time proved unbearable. Villagers may refuse the new forms of social organization (in land tenure, for example) required by irrigation; the government may prove unable to devise and impose the necessary new patterns of behavior.

Underground storage of water and withdrawal by means of wells give far more freedom. The drama and impressiveness of large-scale projects should not blind us to the immense value and the great potential of less conspicuous projects.

#### IMPROVED SEED

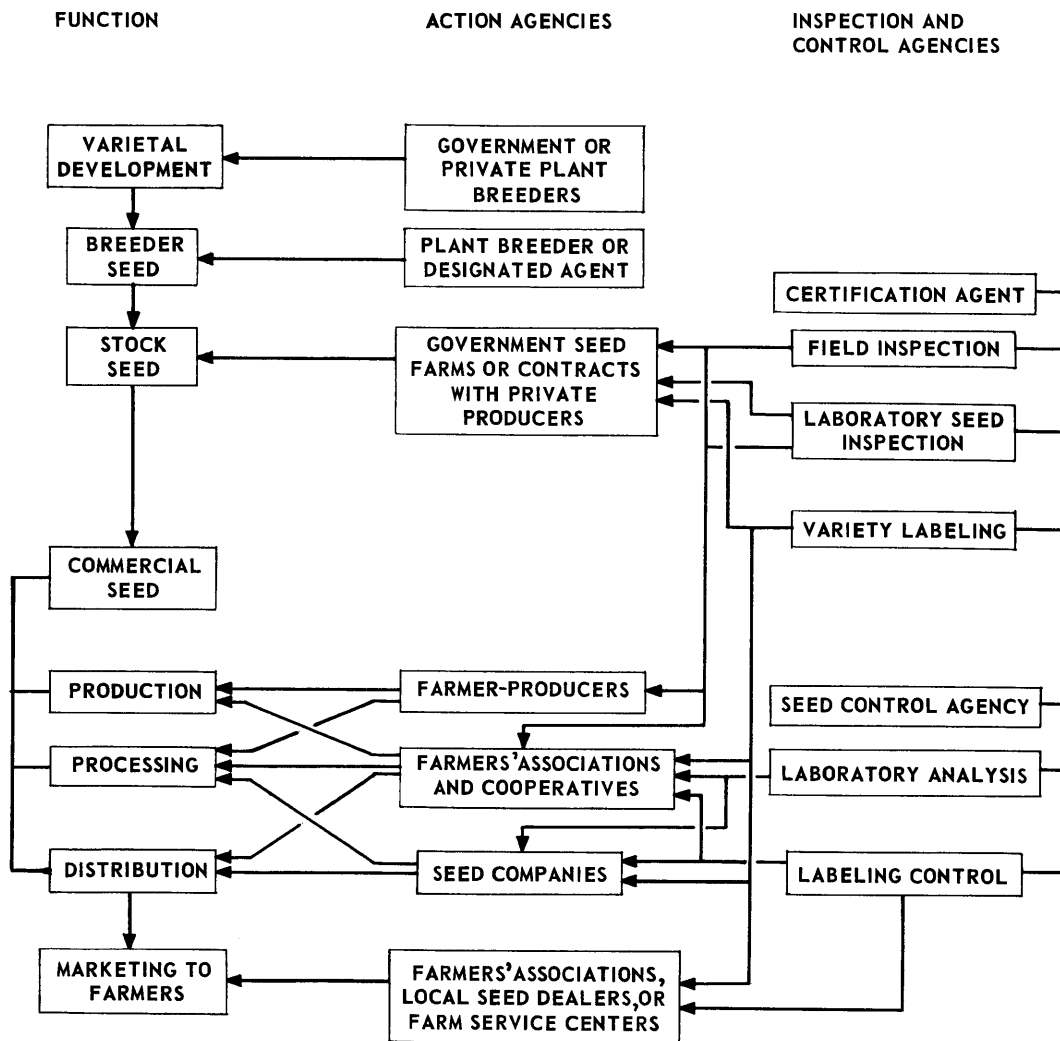
Superior varieties of crops are fundamental to the program of supplying improved seeds. So long as only the common unimproved varieties are used, little profit is usually gained from giving special consideration to problems of seed supplies. Common seed for planting is available to the farmer within his own community. Limited exceptions occur among some of the vegetable and fodder crops whose seeds are not routinely harvested.

When a variety has been developed through selection or breeding and has proved superior, producing and distributing its seed become important to agricultural productivity. Improved varieties, however, are superior with reference to only a particular set of environmental circumstances. The best varieties for one region may be completely useless in another. A proven variety is superior because of genetic characteristics bred into it that give

adaptation to specific conditions of soil and climate, high yielding capacity, resistance to drought or cold, resistance to diseases and insects, nutritive value, acceptability of taste and texture, desirable growth habit, and other characteristics that enable it to perform better than other varieties. Highly improved varieties tend to have limited geographical adaptation and therefore limited distribution patterns. The factors involved in the marketing of seeds are illustrated in Chart 2.

Chart 2

THE CHAIN OF IMPROVED SEED MARKETING



Unique Characteristics of Seeds

Because of the special characteristics of seeds, the requirements for their successful production and distribution are somewhat different from those of other purchasable inputs. Among these characteristics are the following:

1. The fundamental qualities of the variety can be maintained only by the use of authentic planting stocks and careful production practices. Its characteristics cannot be assessed by research station tests, but only by the field performance of plants produced from the seed.

2. Seeds are living entities that require special procedures and handling in all steps of production, processing, storing, and distribution to ensure that the seed reaching the farmer will be viable.

3. Since the origin of farmer seed supplies is a small selected lot of pre-existing seeds, several generations are required to multiply the stocks from the original nucleus of breeder seed to the thousands or millions of pounds required by the farmers.

4. Seed-borne diseases and contaminants such as weed seeds will reduce the productivity of the crop and must be avoided.

Methods of Reproduction

Crops vary widely in their methods of reproduction or seed multiplication.

Such crops as potatoes, sugar cane, and rubber are propagated by asexual or vegetative means, that is, by cuttings, budding, grafting, or tubers. Aside from mislabeling and mechanical mixing, the main precaution is to avoid contamination with systemic diseases such as viruses.

The naturally self-pollinated crops such as wheat, rice, and beans are relatively free from danger of contamination of the variety by natural cross-pollination. With sufficient care to prevent

mechanical mixing, seed of varieties of this kind of crop can be easily reproduced through successive generations of the multiplication process.

The naturally cross-pollinated crops present special problems for seed production. To prevent genetic contamination from other varieties due to cross-pollination, seed fields of either open pollinated varieties or hybrids must be isolated by as much as one-fourth mile from other fields of the same crop. Furthermore, as the open-pollinated varieties are subject to genetic shift during reproduction, special precautions must be taken in selection and breeding to maintain the genetic integrity of the variety.

#### Classes of Seed

Several classes of seed are generally recognized in the stages from the plant breeders' program to the farmers' fields. Breeder seed is maintained under rigidly exacting conditions and serves as a source for producing the stock seed. Stock seed in turn is used to produce the commercial seed that is distributed to farmers. Maintenance of an adequate supply of breeder seed is normally the task of the experiment station at which the variety was developed. In the case of proprietary varieties the company that owns the variety normally maintains the breeder seed. From the nucleus of breeder seed there must be an orderly program for multiplying the stock seed. This step may be carried out by governmental seed farms, by individual farmer-producers under appropriate supervision, or by seed companies under contract with producers or in their own fields, also under supervision. Since any changes in genetic characteristics that occur during multiplication of the stock seed will be passed on to the commercial seed produced from it, it is essential that great care be exercised during this stage. Commercial seed is preferably produced by farmer-producers independently or under contract with seed companies.



Seed Marketing

The major requirements for successful seed marketing procedures include:

Facilities for processing (including drying immediately after harvest), cleaning, grading, treating, and bagging.

Facilities for storage and distribution at the wholesale level.

Facilities within easy reach of individual farmers for the retail distribution of properly labeled seed of good quality. Because of the localized nature of varietal adaptation and of seed production, wholesale facilities may in some cases be less urgent. Individual farmers, cooperatives, or small seed firms may produce and sell to farmers in their areas.

A merchandizing and information program that takes the seed to the farmer.

Supervisory and control work should be carried out by establishing seed laws and seed quality standards with an enforcement agency, seed laboratories, and seed certification agencies.

## TOOLS AND MACHINERY

Tools and machinery multiply the power of human muscle. They give the farmer greater control over his production environment and make possible new forms of cultivation and the farming of greater areas per farmer. Animal-drawn and motor-powered equipment are also used for transport. Improved hand tools are likely to be a useful input at the earliest stage of development; motor-powered machinery, with its much higher capital and operating costs, usually comes late in the process, though just when it should come is subject to debate.

Tools

Tools in most underdeveloped lands are few in number, crude, and apparently inefficient. Since in some areas the only tools in use today are those used two thousand or more years ago, there would seem to be room for considerable improvement. Here again, however, technology is not easily transplanted. Many efforts to transplant tools have failed, often because the tool was designed for different conditions--metal plows that are effective on temperate-zone soils but not in the tropics are one example.

Yet opportunities exist for providing farmers with better tools. Adaptive research is needed, and it must take into account all the factors involved. The new tool must of course be tested. The innovating agency must determine also whether the tool can be conveniently repaired in the village, whether its use clashes with the farmer's custom or habit, and whether he has the skill to use it. Animal-drawn equipment must be adapted to the strength and bodily structure of the local animals. The most attractive innovations in tools would be cheap, simple to operate, and such that they could be maintained (or if possible made) in the village itself. These may be single inputs that can raise yields without forming part of a package.

The design and distribution of such simple tools has not attracted much manufacturer interest. The long research time needed and the low profits to be gained (particularly in the case of a tool to be made in the village) make such tools commercially unattractive. Thus it is likely that at least the early stages of tool development will have to be carried out by the government. Once the tool has proved to be successful it may be desirable to interest private companies in its manufacture and distribution (including maintenance).

Some examples of promising areas of innovation are:

Plows. Bullock-drawn plows often fail to use the animal's potential power and do not prepare the soil as well as required for

maximum yields. Different methods of hitching could increase the animal's effective power and therefore the depth of plowing, and in some cases it would then be possible to plow with one instead of two bullocks.

Harvesting implements. Sickles and scythes, little known in the tropics, are efficient for harvesting grains on small farms. They could replace straight-blade knives and the hand-picking of rice heads.

Threshing equipment. Machines operated by foot pedal (or motor), now used in Japan and Taiwan, are efficient for threshing on small farms. They could be useful in other countries where rice or wheat is grown.

Multipurpose equipment with rubber tires. A French-designed form of animal-drawn equipment called "tropiculture" has been successfully introduced in Senegal and Madagascar. It has a draw bar to which various implements--plows, disk, a lift--can be attached. Despite its many uses, the equipment has no nuts or bolts to lose and is simple to maintain. It also rides on rubber wheels. Rubber wheels to replace traditional narrow wooden wheels are an attractive possibility in many areas. They greatly increase the range of the cart (and the farmer's access to markets) because they are easier for the animal to pull, and they avoid the damage done to roads by wooden wheels. Such wheels can often be made from discarded automobile tires.

### Machinery

When to introduce motor-powered machinery is a complex question. After a period of overhasty and often disastrous attempts to mechanize, the trend of thinking in many quarters has turned in the opposite direction, and it is often assumed that machines such as tractors have no place in most underdeveloped nations at the present stage. The argument is that these nations are short of capital but have abundant surplus labor (unemployed or underemployed); therefore an expensive labor-saving machine is not what they need.

We found that this assumption needs to be re-examined, for the issues involved are complex. We found that machinery may sometimes be the only way to raise yields and that, far from saving labor, such machines as tractors are often labor-complementary-- that is, their use increases rather than decreases the demand for labor.

Two key factors here are planting dates and soil preparation. Multicropping may in some cases be possible only with powered machinery. This is true if planting dates are critically short or if the soil for the second crop cannot be prepared except by machine. Machinery often makes it possible for the farmer to prepare the soil better and to seed more precisely. Thus significant yield increases may require machinery even when surplus labor is available.

Often the time during which a crop must be planted for maximum yield is limited to a few days of the year. That time is the farmer's limiting factor. That he is underemployed much of the rest of the year is irrelevant, for he can plant only in those few days. This is a fairly common situation in the underdeveloped world. The use of a tractor at the planting season can break through that limiting factor. For soil preparation the ground may often be too hard to plow with animal-drawn equipment at the optimum time of year.

When machinery permits double cropping, or larger plantings of a crop such as rice that is labor intensive in other stages as well as planting, the effect is to increase the demand for labor. What happens is that the farmer's effective labor is increased at those key times when he is fully employed in any case. His larger crops then require more labor at other times of the year. Another example of labor-complementary machinery is pumps for irrigation, which make possible more intensive cultivation and therefore raise the demand for labor.

Another consideration is that many machines replace draft animals. While many draft animals in underdeveloped countries now subsist largely on wastes or on the products of uncultivated land, there is a requirement in some areas for land for growing feed for

draft animals. If their tasks were mechanized, that land could be devoted to food crops or to grazing for meat animals. This consideration may be important in densely populated areas, where arable land is scarce and where people do not get enough protein in their diet.

There is also the question of prestige. As noted earlier, one of the most subtle barriers to agricultural progress is the low status of agriculture. Farming is drudgery and it is "primitive"; the bright innovative people needed for its progress flee instead to the modern world of the city. Machines are a symbol of that modern world. The presence of tractors and other machines in rural areas may serve to demonstrate that being a farmer and being "modern" are not mutually exclusive. The status of the farmer may be raised. Even if he does not have a tractor himself, he may see it as an eventual goal--his "horizon of the possible" is widened. A young farmer may stay and work for a tractor instead of emigrating to the city, and to get that tractor, with the status it symbolizes, he may be willing to innovate.

For all these reasons we believe that mechanization must be examined in the light of the full range of issues involved, not summarily dismissed on the single and oversimplified issue of labor saving. We do not, however, underestimate the formidable problems it raises, and we certainly do not advocate quick and catastrophic policies of hasty mechanization.

We would emphasize that the question of status must be handled carefully, for if the proposed mechanization is uneconomic the return in status (and the effect on productive attitudes) may well prove illusory. Maintenance is an acute problem that must be solved before any degree of mechanization is possible. Repair facilities do not exist; the supply of parts is erratic; mechanics are scarce; and, perhaps most important, farmers in underdeveloped nations have not grown up around machines and therefore do not understand such requirements as oiling that are familiar to people

from mechanized cultures even if they are not themselves mechanics. Under these circumstances the life of the machine will be short.

Nor are many individual small farmers going to be able to afford to own a tractor. Tractors may be provided by a government-operated station that gives custom service to the farmers, or they may be bought by farmer cooperatives (the latter being more likely to succeed if the cooperative is already a going concern). If the government station also provides drivers who perform the actual operations, the maintenance is simplified since the station, not the farmer, is responsible for the care of the machines. It should be expected that such tractor pools will run at a loss for one or more years until farmers become familiar with the potential uses of machinery. Comilla in East Pakistan (see Appendix A) has found that under its conditions the minimum size of the tractor pool for economic operation is likely to be 12-15 machines, but the question deserves study in other locations.

The machines must also be adapted to local conditions. The innovating agency should be imaginative in choosing machines that are versatile in their potential use (tractors have proved useful for transport in East Pakistan, for example). Such secondary uses may make the difference between profit and loss. Machines developed only in temperate-zone climates and with ready maintenance available are likely to break down quickly in tropical conditions. It may well be advisable to sacrifice some other assets, such as power, in order to have a machine that is durable in the tropics.

#### PEST CONTROL

Pest control is the art of protecting crops and harvested farm products from being destroyed by disease or eaten by insects and rodents or choked by weeds.

Pest control in many situations could be a valuable single input. Probably the best example is rats. In India, one observer

has estimated, there are about ten rats per person, and they eat an estimated 27,000,000 tons of food annually--one third of the country's production. Even if the estimate is far too high, the potential saving from rat control is enormous. Much of the food is eaten by rats in the fields, and the rest in storage. In West Africa an estimated 25 per cent of the food produced is lost to pests in storage. Cattle cannot be raised in large parts of Africa because of the tsetse fly, which carries sleeping sickness. In such situations pest control can be successful as a single physical input, provided the means exist to control pests.

Pesticides interact strongly with other inputs in the later stages of agricultural development. The need for pesticides rises steeply as development proceeds, because the other inputs often create conditions that favor the growth of disease and pests.

Take, for example, an irrigation project to which fertilizer and improved crop varieties are added. Multicropping is now possible where before only one annual crop was grown. This provides a year-round supply of plant life for disease and pests. Thicker foliage and solid stands of single varieties support more pests and make the entire wiping out of a crop more likely. In Egypt, in areas where multicropping has been achieved, army worms move from corn to sorghum and back again with the change in crops.

In these cases, pest control is a "late" input. The return on investment in pesticides is likely to rise rapidly after the other inputs are in use; and so does the potential danger of massive crop destruction. Pest control is likely to be an indispensable input in a package providing for intensive cultivation.

Being poisons, the use of some chemical pesticides involves dangers, which are likely to be much greater in underdeveloped nations where the rate of illiteracy is high, for the farmer cannot read the warnings attached to the package. Poisons designed, say, for rats may kill human beings or domestic animals; or pesticides applied to crops may upset a natural equilibrium by killing, along with the insects that feed on the crops, other insects that normally

eat these insects. By removing the second insect the pesticide application ensures that an increasing amount of pesticide will be needed. For some cotton crops the increasing need for pesticides has driven the cost of production beyond an economic return on the crop. The dangers involved in using poisons can be avoided where biological controls are possible. An example is the breeding and release of wasps that feed on the rhinoceros beetle that attacks coconuts in Africa and in the Pacific.

Pest control in many cases shares an important characteristic with major irrigation projects: the need for a high degree of social control. Many forms of pest control cannot be usefully adopted by a single farmer or even a majority within a community. This is true for controlling migratory insects and diseases that spread from one field to the next. In order for the pest to be successfully controlled, each farmer in the area must be convinced or coerced to join the program.

Widespread pest-control programs can be carried out by the government, and it can recover its costs fairly easily in the case of export cash crops. When the cacao trees of Ghana were attacked by swollen shoot, the government carried out a compulsory control program, first by cutting down the stricken trees, later by spraying. The program was financed by an export tax on cacao. But with subsistence crops the government would be unable to recover its costs in this way.

A notable success in social mobilization was scored in the Taiwanese campaign against rats. Before the campaign Taiwan lost between 150,000 and 200,000 metric tons of food annually to rats. The saving from the campaign is estimated at about 140,000 tons of food a year. The main problem was to secure popular cooperation in setting out rat poison and then to find out what had in fact been accomplished. The program was a voluntary one directed at communities rather than individuals. The government and the Joint Commission on Rural Reconstruction (JCRR) provided materials, and the community put up its labor. (See Appendix A.) In 1956 the program



was successfully tested in 14 communities. The following year 309 communities asked to participate. To find out if the rats were being killed, as well as to provide motivation for putting out the poison, the government offered a bounty for each rat tail turned in. In 1957 the farmers of Taiwan turned in 6.9 million rat tails. Since only about one in every four dead rats is found, this represented the extermination of about 27 million rats--more than half the island's rat population.

## Chapter Four

### THE ECONOMIC ENVIRONMENT

In framing any policy for agricultural development, agricultural as well as industrial fundamentalism should be avoided. Some of the most chronic difficulties of agriculture can be effectively resolved only by developments in the nonagricultural sectors of the economy. On the other hand, the agricultural sector is too important to be left to develop by itself while national planning concentrates on industrialization. It is therefore necessary that a plan for agricultural development be designed and carried out as an integral part of planning for general economic development.

We recognize that measures to increase productivity may come into conflict with measures to realize other important objectives of policy, for example, equity in income distribution, self-sufficiency (independence from foreign aid at the very least, autarky at the very most), political stability, and fulfillment of certain wants such as education that are above and beyond the levels dictated by market tests. Economists need not restrict themselves to making productivity-oriented recommendations while merely mentioning other objectives. They have to recognize the multiplicity of, and conflicts among objectives of public policy. In the field of agricultural policy the concentration of limited developmental resources on a few regions that promise the greatest returns, or on large farms, may be desirable from the point of view of productivity but run counter to the objective of equity in the distribution of gains from growth. Economists should face such conflicts squarely and try to clarify and quantify the implications of feasible alternatives for various objectives. The allocation of

funds should depend on both technology and tastes--on the technological possibilities that determine the rate at which gains in terms of one objective can be traded for gains in terms of the other, and the policymakers' tastes or value judgments that determine the rate at which they are willing to trade gains toward the achievement of one goal for gains in terms of the other. Given a reasonable amount of data, which can be collected, economists can order alternatives according to their efficacy in realizing a number of objectives. Meanwhile in developing our proposals we have kept both efficiency and nonefficiency objectives in view.

We would like to emphasize that, in order to obtain satisfactory rates of improvement in the living standard over the longer run, measures to increase food production must be coupled with measures to control population growth. The governments of poor countries should not only expand and improve the administrative efficiency of current population control programs but also seriously consider the introduction of such additional measures as legalization of abortion under specified conditions, sterilization, and the possible use of recently discovered cheap and effective intrauterine devices.

We have focused our attention on the following aspects of agricultural policy: product and input price policy, credit policy, farm insurance, market reform, and policy concerning the size, tenure, and organization of farms. We have also set out some considerations relevant to using surplus agricultural commodities imported under special arrangements, and to schemes for rural public works.

Current policies relating to all these subjects require urgent review and revision. The relative importance, or priority, to be given to individual policy changes would depend on the particular situation of every country and on its political will and administrative capacity\* to make those changes.

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\*The requirements of administrative capacity are elaborated further in Chapter Six.

## PRICE POLICY

It cannot be asserted that all farmers everywhere respond strongly to economic incentives. However, a growing volume of evidence shows that with a minimum degree of monetization and the development of transport a fairly large proportion of farmers do respond to them in some aspects of their behavior. It follows that while all necessary techno-organizational measures should be taken to increase the physical outputs obtainable from given inputs, these measures should be combined with economic policies designed to take advantage of the price responsiveness of supply and factor demand wherever it is positive. In many situations the rate of absorption of new knowledge and inputs may depend critically on the price and risk milieu.

Any policy to improve the price milieu of developing agriculture should take into account and, if necessary, influence the variability of agricultural prices, which affects the riskiness of farming; the relative prices of various crops, which affect the allocation of land and other inputs among crops; the ratio of the general level of agricultural product prices to the level of agricultural input prices; and the ratio of the general level of agricultural product prices to the general level of nonagricultural prices.

Although these price relationships are distinct in theory, any set of price regulation measures will simultaneously affect all of them to some extent. For example, if the government successfully establishes price floors for two or three major crops of the country, the downward price fluctuation will be restricted and relative prices, the output-input price ratio, and the terms of trade of agriculture will all be altered in some degree. Therefore it is necessary that the price policies followed be based on a consideration of their effects on all the key price relationships.

About the desirability of price stability there can be little argument. Price fluctuations add immeasurably to the risks facing the cultivator and do not afford sufficient offsetting advantages to the community as a whole. A fall in the price of wheat between

planting and harvesting or over a series of harvest years can render an apparently profitable investment in fertilizer or pesticides or new capital equipment uneconomic. And the adverse effects of declines may not be balanced by gains from price increases of equal number and magnitude in later years because of the limited capital that most peasant farmers possess. Hence the need for the administration of floor prices for a few selected crops.

Price stability cannot be willed by legislative fiat. An adequate warehouse and transportation network is required for stock operations designed to reduce price instability. Of course price stability need not, and should not, be absolute. Besides normal seasonal fluctuations reflecting carrying charges, flexibility should be allowed between fixed minima and maxima in order to remove some of the burdens of changes in demand and supply from the storage system.

An alternative to direct price stabilization from the viewpoint of reducing risk is a system of forward markets that would enable the cultivator to ensure the price of at least a part of his crop prior to planting. But it should be remembered that futures markets in the more advanced countries have been of much more help to processors than to growers in reducing price risks. In any case the problems of making futures markets accessible to peasant farmers in the developing countries are formidable enough to rule out futures markets as an alternative to direct price stabilization operations in the immediate future.

Studies of the effects of changes in the relative prices of different agricultural products on the allocation of the existing stock of inputs among products show that farmers respond to changes in prices by redirecting their efforts in accordance with shifts in profitability. Therefore, insofar as it is desired to increase the output of a few important food and fiber crops by a transfer of inputs among competing crops, the objective can be realized through the manipulation of the relative prices of competing crops.

The shortages of such essential commodities as wheat, rice, and cotton are so acute in some countries that in addition to other

measures it is absolutely necessary to administer floor prices for these major crops both to stabilize their prices and to obtain some increases in output by improving their relative prices.

The fixing of floor prices requires technical studies and some experimental action. The floors at the very least should prevent price crashes in case significant output increases do materialize. Preferably they should cover the cultivating costs of at least the more efficient farmers using improved practices. If necessary they may include an incentive element over and above the cost of cultivation. The levels fixed will have to lie somewhere between the anticrash level and the cost of cultivation (with or without an incentive element), depending on the responsiveness of output. More investigation is needed to determine the magnitude of that response, either by examining reactions to price changes that in fact have taken place or by experimental manipulation in selected regions. Price floors should be held stable for several years--say, three--and should be adjustable or removable after each such period; and the government must make arrangements for direct purchase at the floor prices from farmers in a sufficient number of primary agricultural markets.

When we consider the growth of the over-all level of agricultural output rather than the output of individual crops, it is clear that the price ratio of outputs to inputs is as important as the relative prices of outputs, if not more so. Price ratios more favorable to cultivators can be brought about both by raising output prices and by lowering the prices of inputs to the farmer. Each course of action has its positive as well as its negative features.

The outstanding advantage of subsidizing purchasable inputs like fertilizers, pesticides, equipment, and livestock rather than raising product prices is that the cost of the subsidy program is directly related to the utilization of practices that increase productivity. The cost to the economy as a whole of increasing agricultural output is likely to be lower in the case of subsidies and can be borne through the tax system. More resources are available

for development of the nonagricultural sectors of the economy as well as other purposes; the government can avoid the political consequences of higher food and fiber prices to the nonagricultural population; and, equally important, the cultivator must employ purchasable inputs to reap any advantage whatsoever from input subsidies. By contrast higher product prices add to the income of both noninnovators and innovators. This windfall income may to some extent vitiate the incentive provided for increasing production by the improved ratio of product to input prices by increasing the marginal preference for leisure relative to labor of at least some farmers.

The case for higher product prices can turn some of these very arguments to advantage. The very fact that a program of input subsidies costs less than a program of product price supports means that the agricultural sector derives a smaller income from the first program than from the second. This is an important consideration, for it can be argued that at current price relationships agriculture receives less than its "fair" share of the national income, and that a major obstacle to innovation in peasant agriculture is the lack of a capital cushion to absorb the added fluctuations in income produced by many innovations, such as fertilizer in areas dependent on variable weather. A second argument for higher product prices is that input subsidies are of no avail in situations in which increases in agricultural productivity come from additions of nonpurchasable inputs that are not complementary with purchasable inputs--for example, the farmer's labor in better cultivation, weeding, clearing, and local irrigation and drainage channels. Third, if the use of purchasable inputs is already widespread, the costs of input subsidies mount. Moreover, since noninnovators as well as innovators benefit, the argument for input subsidies on the ground that they do not increase the preference for leisure is weakened. If, however, the use of improved inputs is not widespread, it is doubtful whether the mere cheapening of inputs will by itself induce more farmers to begin to use them.

Thus it should be clear that a blanket preference cannot be given either to general price supports or to input subsidies. The relative efficacy of the two means of improving the price ratio of outputs to inputs depends on the existing level of input use, the technological character of the measures necessary to increase productivity, the relative importance of low cost and provision of a cushion for risk-taking to the cultivator, and a value judgment with respect to the distribution of incomes between the agricultural and nonagricultural sectors. All but the last-named aspect of the problem can be resolved by specific empirical research in each country facing the choice between price supports and input subsidies, and even the question of rural-urban income distribution can be illuminated by such research.

The rural-urban question is of course most important when we consider the relationship between the levels of agricultural and nonagricultural prices. In this connection it is important to remember that policymakers may be less free to depress the terms of trade against agriculture during industrialization in democratic countries with a peasant franchise than in the already industrialized countries.

In summary, a feasible price policy mix for the near future would include floors for a few selected crops determined on the lines suggested; perhaps a program of subsidies for fixed as well as working capital inputs; and an over-all policy to prevent a serious deterioration of the rural sector's domestic terms of trade. As a part of such a policy it would be desirable to grant tariff protection to infant industries only when their output actually attains a certain proportion, say, 10 to 20 per cent, of the domestic demand. (Until that time subsidies might be granted.) This action would prevent undue and premature increases in the prices of many industrial products.

Countries depending mainly on a single export crop would continue to need international commodity agreements to have some short-run price stability, but the provisions of these agreements



must not jeopardize long-run price flexibility lest resources remain overcommitted to the crops even when demand conditions change.

Finally, the case for export subsidies on selected agricultural commodities exported by developing countries is as economically valid as that for industry protection. Properly designed subsidies should therefore not be frowned upon by international agencies.

#### CREDIT

Three types of production credit may be distinguished: short-term credit, for periods of a year or less; medium-term credit, for periods exceeding one year but less than five years; and long-term credit, for five years or more.

In order to be most productive, short-term credit from official and cooperative sources should almost always be "supervised," that is, tied in with the farmer's performance. Loans should be granted on condition that the borrower agree to adopt a "package" of recommended inputs and practices. Second, loans should be made primarily on the basis of the increased production potential of the package rather than upon the security of land or other assets, so that credit is accessible to tenants and small farmers as well as to larger farmers. Third, as far as possible they should be made in kind in the form of the inputs themselves. Since official credit cannot possibly meet the full credit requirements of the agricultural sector, it should be channeled primarily to meet the financial needs of innovation.

In order to facilitate loan recoveries, it may be useful to link the provision of credit with marketing. However, where marketing is undertaken by a governmental or semiofficial cooperative agency, care should be taken to provide the services and conveniences provided by alternative private agencies such as boarding

and lodging for farmers coming to sell grain in the town, prompt payment, and emergency relief. Otherwise new agencies fail to attract farmers. Alternatively the government may provide only a storage service to farmers at a nominal charge. Official warehouses may give them negotiable warehouse receipts so that farmers may market their produce whenever they can get a good price for it.

It is necessary to examine the possibility of revising the current practice of charging a uniform interest rate for all short-term official credit. The introduction of differential interest rates on loans for different purposes might improve the use of loan funds and recovery rates.

The actual role of traditional moneylenders deserves careful empirical study as part of a broader study of the relative efficiency of alternative systems for providing credit. Moneylenders have many operational advantages such as intimate familiarity with borrowers, readiness to grant risky loans, quick and low-cost loan management, and a high rate of loan recovery. Since they provide such a large proportion of the total rural credit needs on such a wide scale the aim of eliminating them is utopian. Measures should therefore be devised to build upon the advantages of their system while eliminating any monopoly power or gains enjoyed by them. One possibility that needs to be tried is the establishment of a system of rediscounting credit instruments between the farmer and the moneylender under specified conditions. Such paper could be rediscounted by government agencies or commercial banks under certain governmental guarantees against a part of the losses. The rediscount system would increase the flow of funds through the traditional system, facilitate the entry of new moneylenders, break the islands of monopoly, and lower the level of interest rates. It might also induce commercial banks to enter the agricultural money market as wholesalers if not as retailers of credit.

Any research studying alternative systems for providing agricultural credit should distinguish and if possible separate the three components of the gross interest charge--real interest, risk

premium, and the cost of administration and collection. Quantitative comparisons of these magnitudes will help improve the credit system.

As a rule, provision is made for a far greater proportion of the short-term credit needs of the rural sector than of the medium- and long-term needs--for land improvement, minor irrigation, equipment, and livestock--even though the longer-term needs are no less urgent and important. More research is needed to estimate the real degree of risk involved in medium- and long-term loans. It may be that on the whole they are no more risky than short-term loans. Since the traditional and commercial banking sectors fail to meet medium- and long-term credit needs adequately, special new credit agencies must be created to meet them.

The principle of linking loans with a "package" should be fully extended to cover medium- and long-term loans. Medium- and long-term packages as well as short-term packages should be supervised. The new agencies will need trained personnel to draft, evaluate, and supervise medium- and long-term projects. Again, commercial banks can also be induced to participate in the retail or wholesale side of longer-term lending to farmers if they are guaranteed against a part of the loss, and if they are provided with technical help from the public sector. They may also need some guarantee against losses due to inflation.

Special study is needed to improve long-term land mortgage banking. Where land statutes, judicial decisions, or traditions have clouded land titles and thus adversely affected the volume of mortgage lending, it is necessary to clarify tenure for the purposes of lending.

#### INSURANCE\*

The risks of farming in poor countries may be classified into

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\* In this section, risk and uncertainty are not distinguished,

the overlapping categories of weather risks, pest risks, price risks, risks of innovation, and administrative risks.

Although in principle almost all risks are insurable for a certain premium, it is evident that the cost of weather and pest insurance is likely to be prohibitive in developing countries until normal loss-preventing technological developments--irrigation, flood control, and widespread use of pesticides--have reduced risks to a manageable magnitude. For a considerable time to come, therefore, development schemes themselves should be regarded as the main form of insurance. Some insurance against widespread crop losses due to drought, floods, and the like is and may continue to be provided through ad hoc land-tax relief, water-rate relief, and famine and flood relief measures. At a subsequent stage of development direct and regular weather and pest insurance might be undertaken at a reasonably low cost, which will be less if the insurance is compulsory than if it is voluntary.

The remedy for price risk is guaranteed purchase at minimum prices. It has already been suggested in a previous section that if major food and fiber crops are in short supply efficient systems of purchase at minimum prices should be established.

But the kind of insurance most urgently needed in developing countries is "innovation insurance,"\* that is, insurance against loss following the use of new inputs and the adoption of improved

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and the word insurance is used to mean any scheme of reduction or sharing by public agencies of losses due to the uncertain behavior of natural, economic, or other factors. It is not restricted to mean only actuarially self-financing insurance.

\*"Innovation insurance" is a convenient term to describe the scheme proposed here. But strictly speaking it is the innovator who is insured, not the innovation. The scheme is described in greater detail in Appendix B.

practices requiring substantial additional outlay. Farmers who have little capital to fall back on are reluctant to incur this cost, fearing that the additional return may not cover it. Even if at the input and output prices prevailing in the market, or determined by the government by means of input subsidies and output price guarantees, the expected additional return is many times the additional cost, as in the case of some innovations such as hybrid corn seed, the rate of adoption may remain very low due to initial uncertainties. Often the government experts recommending the innovations are themselves uncertain about the results that farmers may expect from them because the innovations have not been adapted to and tested under the specific conditions in which the farmers operate. In such circumstances it is necessary that the package of recommended inputs and practices carry some insurance with it in the initial years of trial.

We considered two alternative ways of providing the needed cover. One proposal was that imported surplus commodities be delivered as compensation to farmers in the event of the net return from the package being less than an assured minimum, but it did not find favor in view of the many serious operational difficulties it would entail. The proposal eventually preferred by us was that, since any program aiming at the widespread diffusion of a package is and ought to be linked with a supervised credit system that makes loans to farmers covering the bulk of the cost of the package, risk coverage be provided in the form of the promise of relief from a part of the total loan in case the additional yield per acre turns out to be less than the yield equivalent of the cost of the package. Only packages with a high ratio of returns to costs--say, not less than three to one--should carry this insurance, and the insurance fund should be distinct from the loan fund.

An insurance scheme of this kind has some obvious advantages. It will make the package-promoting administration a risk partner of the innovating farmer instead of a mere adviser and thereby increase its interest in the rapid and successful diffusion of the package. Where loans are already being granted, the administration

of the scheme would require only additional inspection and book adjustments. But the inspection system to check the actual application of package inputs in the fields and to settle relief claims will have to be designed with care. Base yields of insured farmers will have to be fixed on the basis of average prepackage yields estimated from revenue records and other evidence. The insured farmers should be responsible for notifying the administration that their harvest may generate claims. The fields of notifying farmers will have to be inspected at appropriate times to determine their actual yields and settle their claims. The administration will have to have adequate technical staff and equipment for all these purposes.

Although these administrative tasks are difficult, an existing supervised credit administration can be expanded to handle them. The provision of innovation insurance is such a crucial requirement for the success of an agricultural program that the difficulties of administering it must be faced and resolved.

The experience of agricultural programs in some countries makes it necessary to identify another class of risks in addition to the ones already discussed. These are the risks that arise from the failure of the government machinery to render its services to the farmers in an efficient manner. If the seed, fertilizer, and pesticide deliveries, the deliveries of irrigation water, and the grant of loans and material permits and other permissions by the government agencies are slow, untimely, and uncertain, farmers depending on them incur losses. These risks due to the poor performance of the administration are comparable in their incidence to the risks due to the poor performance of the monsoon. And, like the monsoon, they are so widespread that the main remedy must be preventive. Direct insurance against them will be prohibitive for a long time. However, an awareness of these risks should underscore the dire need to expedite administrative reform. Also as far as possible farmers should have access to alternative sources of the supply of their inputs. Reliance on monopolistic suppliers, official or nonofficial, can be extremely risky.

## MARKETING

Market reform ought to be an integral part of any policy for agricultural development. Normal economic incentives to induce farmers to increase productivity can operate only to the extent that the marketing system enlarges the market for their produce and brings them a reasonable price for it. Their desire to earn larger cash incomes can be stimulated by a marketing system that brings them cheap consumer goods, and their effort to increase productivity can succeed only to the extent that the marketing system delivers the needed inputs. Marketing is as critical to better performance in agriculture as farming itself and should be regarded and developed as such.

The government has the primary responsibility for providing the essential elements of the infrastructure required for an efficient marketing system: a good transport system, particularly a network of arterial and feeder roads; public storage to supplement private storage; a market information system; and a commodity grading system. The direct and indirect effects of transport development on agricultural productivity, through the expansion and activation of the markets serving farmers, cannot be overemphasized. Efficient storage can cut the current heavy losses due to bad storage. The government can build warehouses of its own and provide technical assistance to private stockers to improve their storage facilities. If produce brought by farmers is stored for a nominal charge in public warehouses as their (the farmers') property, for which they are given negotiable warehouse receipts, they can liquidate their stocks into cash as and when they like and thus obtain a better price for them. Better market information also enables farmers to realize a better price for their produce by removing market imperfections due to their ignorance of alternatives.

A public grading service enables the farmers producing higher-grade commodities to obtain correspondingly higher prices

and induces others to improve the quality of their output. At the same time it enables consumers to know what they are getting and to get what they want. Often the expansion of commodity exports depends critically on grading. It should be remembered, however, that grading should be refined only pari passu with the refinement of demand. It is necessary to beware of the danger that certain types of quality control intended to raise the technical quality of the product may have the effect of contracting the market if, as a consequence, the price rises beyond the reach of a sizable part of the market in an early stage of economic development.

It is easy to find fault with existing distribution agencies but difficult to make new agencies perform all the necessary functions that the old agencies are performing at a lower cost per unit of sales. Therefore new marketing agencies promoted or run by the government should aim at supplementing rather than supplanting the existing agencies wherever the latter operate on an extensive scale. The concept of extension must be broadened to cover the further education of traders, particularly small traders, who abound in developing countries, and an information service should be set up to help them improve their operations. In particular, traditional dealers should be educated to operate on a low-price and high-turnover basis rather than a high-price and low-turnover basis.

The relative efficiency of different kinds of marketing agencies (private, public, and cooperative) should not be ideologically prejudged. Empirical studies need to be undertaken to estimate and compare the efficiency of marketing under different arrangements. The efficiency of marketing can be measured by two magnitudes: the cost of marketing per unit of a given turnover, and the rate of growth of the turnover.

The existence of monopoly in agricultural marketing should not be assumed but empirically established. Prima facie, in many developing countries it seems that underemployment causes small-scale trade to be very overcrowded and hence competitive. But



where monopoly is definitely found to exist the government should either open its own agencies to increase competition or, preferably, take measures to facilitate entry by more marketing units.

In any marketing policy, special attention should be given to the improvement of the processing of agricultural commodities, particularly the processing of perishable foods for city markets. Modern processing plants in a short time can create substantial additional income for farmers and stabilize, expand, and improve the food supply of cities. Governments should establish processing plants if they do not exist and/or help private agencies to establish them.

If marketing is deemed to be fully as "productive" as farming, the view of marketing margins current in some countries needs revision. It is often believed that "high" marketing margins always represent exploitation of the farmer. Although everything should be done to minimize the cost of marketing, often the new marketing agencies cannot really lower the cost of marketing if they perform all the operations performed by the traditional agencies. Moreover, the marketing margin and the return to the farmer for his resources or his total revenue need not be negatively related. If the improvement of marketing (including processing) raises the marketing margin but expands the market, the return to the farmer or his total revenue may simultaneously increase.

If in some countries adequate technical and managerial skill and financial resources are not available for large-scale processing and marketing operations, it may be desirable to allow foreign firms to collaborate with domestic firms under specified conditions. In addition to the conditions that are usually stipulated in contemporary collaboration agreements--providing for joint capital contributions, training of senior technical and managerial personnel, repatriation of funds, and so on--it may be useful to specify that foreign collaboration will be definitely withdrawn after an agreed number of years. This provision would emphasize the strictly temporary, educative purpose of collaboration and allay suspicions

of continuing domination by foreigners. If conditions are propitious, on the termination of a collaboration agreement a foreign concern may shift to another neglected field on the basis of a similar collaboration agreement. Thus foreign skill and finances can improve a number of marketing sectors in succession.

#### ECONOMIC ASPECTS OF SIZE, TENURE, AND ORGANIZATION OF FARMS\*

Four general types of size-tenure situations may be distinguished: First is the small-farm situation that characterizes densely settled regions. The ownership distribution is highly skewed, but the overwhelming majority of operating units are small. The large owners have leased out most of their lands. There are relatively few large, owner-operated farms. In some areas, holdings have been so fragmented by inheritance that an individual may farm several tiny plots, often widely scattered.

Second is the plantation situation. There are many large-scale plantation units--some very efficient, some inefficient--each employing large numbers of hired workers. There are some owner-operated small-scale plantations. There are also "mixed" haciendas where a part of the land is cultivated for the absentee owners by laborers working under agents and a part is let out to workers in small patches for cash, kind, and/or personal service rent.

Third is the settlement situation, in which an area is newly reclaimed and settled by a public agency.

Fourth is the forest and shifting cultivation situation, in which a farm is hardly definable.

With respect to the small-farm situation, where individual holdings are fragmented, a strong case can be made for consolidating the plots tilled by an individual into a single unit. A quite different question is whether the size of the individual

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\* See also Appendix F on land reform.

holding is too small to be efficient. In many small-farm and plantation situations one often comes across a confused argument that asks for the liquidation of large estates on the ground that they are too large to be efficient and at the same time for the consolidation of small farms into cooperative or collective farms on the ground that the farms are too small to be efficient. Evidence across nations as well as within individual countries, however, shows that in densely settled areas the enlargement of farm size is not an absolute precondition of increased agricultural productivity per acre. Farm management data for individual countries show that yield per acre does not increase and often diminishes with size over a considerable range. In countries like Japan and Taiwan, productivity per acre has been raised many fold without any significant enlargement of farm size.\* And it can be similarly raised in most small-farm situations. For the technological changes that are relevant in the immediate future as well as economically most efficient at current factor prices, such as varietal improvement, better water management, and fertilizer use, do not necessarily require the enlargement of the farm. The mechanization of some operations (for example, land improvement, pumping, plowing, and haulage) may also be necessary and efficient in spite of labor density if the improvement of these operations--particularly timely plowing and irrigation--increases income many fold by making multiple cropping possible without diminishing employment. (Engineering-economic studies to identify these processes and select the techniques most suitable for small-farm situations are urgently needed.)

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\*The conventional measurement of farm size in terms of a single input, the area of the farm, and the measurement of productivity as productivity per acre are questionable in theory and may be misleading in some situations. But they continue to be used in this discussion on the assumption that in labor-surplus, small-farm situations they are adequate for operational purposes.

The central principle is that the economies of scale do not obtain to the same extent in all operations that are defined to constitute farming. The economies may be significantly large in the case of some operations and unimportant in others. It follows that the farm may be enlarged in some dimensions while the dominant managerial unit remains small. Thus the scale of some of the land improvement, irrigation, input purchase, output sale, and fund-raising operations may be enlarged while the plowing, tilling, and harvesting operations continue to be performed on a small, family-farm scale.

The recognition of this principle of selective enlargement of scale will open up numerous possibilities of farm organization that are now blocked by bipolar ideological controversy. This principle is implicitly embodied in the farm reorganization patterns that have proved to be most successful in raising productivity in many western as well as eastern countries. It is the core of every agricultural structure of small family farms served by large-scale cooperative and public agencies, but it needs to be enunciated and applied as an explicit principle. One of its great merits is that it makes it possible to leave untouched those dimensions of the family farm with which interference has the most damaging effects in terms of farmers' incentives in schemes of cooperativization and collectivization.

Conversely the principle implies that large estates can be broken up in respect of the land unit of some operations without much damage to productivity, provided that some large-scale common services are maintained intact.

Where the ownership distribution of holdings is very skewed, it may be a necessary condition in order to induce the majority of farmers to raise productivity and also a requirement of political stability and social justice that landownership be redistributed. Numerous precedents of fairly successful redistributions of land in small-farm situations leave no room for doubt that, given political will and administrative zeal, redistribution can be

carried out without much short-run damage and with remarkable long-run gains in the productivity of land.

When redistribution is undertaken, two aspects should be sharply distinguished: the promotion of existing tenants to ownership, and the settlement of the landless on land appropriated from ex-owners. As regards the promotion of tenants to ownership it is desirable, in the first place, that the "ceilings" to be applied for the appropriation of land for redistribution be differentiated according to the intensity of cultivation.\* In addition the ceilings should be defined per adult in the owner's immediate family so that their evasion through intrafamily transfers is minimized. Second, compensation should be set at a relatively low level; a small proportion of it may be paid in cash and the rest in long-term, low-interest bonds that should not be negotiable except for the purpose of industrial investment. However, the receivable real value of the bonds should be protected against inflation by being linked to a price index. Tenants who are promoted to ownership may be required to pay compensation to the government in convenient, small annual installments.

Redistribution along these lines is desirable and practicable. However, it may be useful to set out an alternative scheme of fiscally induced voluntary redistribution. It is possible to devise a scheme of progressive taxation of landholdings that rises steeply with the estimated "potential yield." The tax on large farms with low productivity can be made so heavy that large farmers are forced either to attain the potential yield or to sell parts of their holdings to others at prices which, if many large

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\* An example of such differentiation is to be found in the Italian agrarian reform law of 1951, which provides that the greater the intensity of cultivation of an estate the smaller is the proportion of its area to be expropriated.

owners are forced to do so, are likely to fall very low. This scheme is no better than a scheme of direct redistribution of land. The political will required to implement it is no less. The administrative difficulties are equally serious. The dangers of evasion are equally acute. But policymakers can choose the scheme that in their judgment has a better chance of success in a given situation.

Although the abolition or near-abolition of tenancy has been the ideal of many land reform movements, it is debatable whether tenancy can ever be entirely abolished even if the man-land ratio in agriculture is favorable for its abolition, for a variety of circumstances may necessitate its continuance to some extent in all situations. When the man-land ratio is extremely unfavorable, and is likely to remain so for a long time to come, the early abolition of tenancy is a utopian hope. Even if a redistribution of land is carried out, every rural family cannot possibly be given a piece of land sufficient to provide subsistence; therefore the landless are bound to take, and the landowners bound to offer, land under tenancy arrangements of one kind or another. In the short run, then, the only realistic course of policy is to recognize the inevitability of some tenancy and to legalize and promote the most productivity-oriented form of tenancy, not to attempt to outlaw it (and thus promote the worst and most insecure forms of illegal tenancy).

Almost all tenancy arrangements have some adverse effect on the incentives of the operator and cause him to employ fewer resources than he would if he did not have to give a substantial part of his output for the mere right to cultivate. But empirical research is urgently required to determine the precise manner in which alternative tenancy arrangements affect input use and productivity in developing countries. Some conditions of efficient tenancy, however, can be safely set out a priori. A money rent fixed for a long period is most likely to induce the tenant to intensify cultivation, but the reason for the widespread prevalence

of crop-sharing tenancies in many areas is that this system reduces the tenant's burden in the event of crop failure. Thus, although a shift to fixed money rent contracts would be highly desirable, it is not likely to come about on a large scale unless the risks of cultivation are reduced.

As a second-best alternative, crop-sharing tenancy can be improved in many ways. The law should require that all tenancy contracts be written and registered. The landlord should be required to share a part of the cost of cultivation, varying with the proportion of crop received as rent. Managerial decisions should lie with the tenant operator, but the landlord might give informal advice. Tenancy should be secured neither for very long periods nor for very short periods, such as one or two harvest years. An intermediate tenure of five to ten years, subject to renewal, might be desirable so that the inefficiency of tenants is not perpetuated. In the event of a shift of tenancy, outgoing tenants should be entitled to compensation for enduring improvements made on the land. There is a case for legislating rent maxima, but in general it is nearly impossible to enforce them if the pressure of excess demand for land makes them unrealistic. The maintenance of unrealistic legal rent maxima on paper only causes widespread evasion and brings law into ridicule. It would therefore be desirable to impose rent maxima only after considerable empirical evidence is collected about actual rents and enforceable rents. Ultimately the only way to make rent maxima as well as other provisions of tenancy legislation effective is to organize strong tenants' associations in all areas where tenancy is widespread. The case for such associations is analogous to that for trade unions.

For dealing with the plantation situation many of the basic principles set out in the foregoing discussion are relevant. An additional principle that may be stated is that it is inefficient to break up integrated, well-managed, large plantations. They should be treated like indivisible industrial enterprises; and the promotion of distributive equity should take the form of income

redistribution through wage bargaining, taxation, and social security arrangements rather than property redistribution. If necessary some of them may be nationalized, but as far as possible they should continue to be managed as integrated units. The case of large, inefficient plantations is different. The demesne parts of haciendas will usually fall in this category. They may need to be broken up except for some common services. The workers on haciendas may be given ownership of their small patches as well as of parts of the broken-up demesnes.

When newly reclaimed areas are settled, experiments with alternative forms of organization are possible and should be conducted. In general the balance of advantage would seem to lie in arrangements that give the settlers ownership or long-term leases of family-size units but provide them with a network of common services for technical knowledge, irrigation, input purchase, output sale, machine services, and the like. The Gezira scheme in the Sudan has many lessons to offer for the evolution of mixed arrangements that utilize both the drive of the farmers' individualism and the advantages of large-scale services.\*

The selection of settlers should receive careful attention. At all stages of the development of the settlement, organizational arrangements should be based on realistic assumptions about the settlers' skills.

Consolidation of holdings is the known remedy for fragmentation. Recent experience with consolidation, however, has revealed that in some areas an important reason for fragmentation is the need to give every family a patch of land in each of many locations if the land in different locations in the same village receives varying amounts of water over the season (owing to the location of wells, canals, or seasonal flood water). Consolidation

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\* See Appendix A for a description of the Gezira scheme.



schemes should take such situations into account and may have to consolidate the holding of every farmer in more than one but less than the original number of fragments.

Provisions restricting the subdivision of very small inherited holdings among inheritors can be enacted, but it is nearly impossible to enforce them in areas of intense demographic pressure. It may be desirable instead to promote partnership arrangements for preventing the subdivision of very small holdings.

Satisfactory tenure arrangements governing forest and shifting cultivation situations can be developed only on the basis of further research.

#### USE OF IMPORTED SURPLUS FOOD

Stocks of surplus food imported by some developing countries under special arrangements, such as the U.S. PL 480 agreements, can be used by them for a variety of purposes.

Basically, surplus food should be regarded as a subsistence fund (which is the original meaning of capital)--an addition to the other investible funds of the recipient country. It enables the government to reduce to some extent the pressure on food prices exerted by the additional effective demand generated by large-scale investments in development projects. Although food prices may rise, sales of the surplus stocks can prevent them from rising to intolerable levels. Thus the effect of these sales may not necessarily be a lowering of the relative price of food and hence a discouragement to the growth of food production but simply a partial relief of the hardship caused by developmental inflation to some of the landless workers and city dwellers. This role of surpluses as a counterinflationary lever has crucial importance, for without this lever it might be necessary for the government to reduce non-agricultural investment and/or divert more foreign exchange for the import of food, thereby slowing the rate of growth. By and large,

surplus food has performed the function of supporting expanded investment in many recipient countries.

Surpluses can also help reduce rural unemployment and accelerate rural capital formation if they are used to pay a part of the wages of workers employed in rural public works, as we propose in the next section. Although the possibility of undertaking such projects with surplus food is widely recognized, and has been tried in North Africa, it could be done on a much larger scale. It has, however, been difficult to organize the distribution of food as a part of wages in rural project areas. An alternative procedure with similar effects is to sell the imported surplus in regular food markets and use the local currency proceeds to pay the wages of workers on large-scale capital projects that would not have been financed otherwise. This procedure avoids the technical and administrative difficulties of organizing a large number of small works projects with wages paid in kind.

Surplus food can also be used to build buffer food stocks to be employed to narrow the range of food price fluctuations and relieve abnormal shortages that may develop in particular regions of a country.

It is important that the availability of surplus food not be allowed to cause any complacency among planners about the need to attain a satisfactory rate of growth of domestic food production. It should not underwrite the deficiencies of agricultural policy and administration. Neither should it permit a downgrading of plan allocations for the agricultural sector.

Although surplus food may be used to reduce price instability and provide emergency relief, it should be treated primarily as a resource supplementing other resources committed to a comprehensive plan of investment.

## RURAL PUBLIC WORKS

In overpopulated countries with an annual income of less than \$100 per capita, there does not seem to be a prospect of reducing the substantial volume of open and disguised unemployment within the next decade. Even if, for instance, all the objectives of the third five-year plan in India were to be fulfilled, unemployment would not be reduced and might even increase slightly. Since realization may fall short of targets, unemployment may increase considerably. Nor can it be said that a thorough reshuffle and change in design of the five-year plans in India can markedly change the situation. The notion of labor-intensive methods producing more goods by handicraft and small industry remains a dream on the basis of today's technology. The productivity per man-hour in handicrafts is so low that it cannot provide a rise in per capita income. It is true that there is a tremendous reservoir of manpower; but labor without capital can produce nothing--and capital is scarce. Under these circumstances there is--at least for the short period of the next two or three five-year plans--a conflict between the objectives of maximum output (income) and maximum employment.

Only one course might permit the creation of substantial additional employment without diverting considerable amounts of capital from more "productive" uses: a massive program of rural public works using labor with only minimal amounts of capital. These are activities like bunding, terracing, fencing, and building secondary roads (if they are not washed away by monsoons) with spades only, like the Burma Road.

Five million workers in India could, for instance, be organized in such rural public works for two hundred days a year. The works could "pay" if they increase agricultural productivity. Although they would not produce an immediate increase in the output of consumer goods, they would pave the way for higher production in

the future. The wage bill\* for such works--presumably one half would be spent on food that could be supplied under PL 480 agreements--is not a problem even for India.

The really scarce factor is organization. The academic approach of first studying how many people are in disguised unemployment (although one cannot hope to absorb more than a quarter or a third of them), then committee paper work on the design of pilot projects, and so on serves as an escape from the need to take real and energetic action. Reliable sources report that there is no doubt that an ample supply of rural labor would be forthcoming for public works under the stated conditions. But digging is not enough; there must be people who will plan and supervise the digging. If only a half of India's villages (that is, 300 thousand) were to be covered, cadres of at least 100 thousand people would have to be formed to supervise and direct such public works. Although there is a host of problems relating to the payments (delayed or contingent liability payments) to be exacted from the owners of holdings on which public works are executed, these problems can be solved with a proper will and drive. The potential benefit is great: rural works seem to be the only way in India to reduce unemployment in the next five years from 20 to, perhaps, 15 million.

Organization of such rural public works in overpopulated countries is urgent and must be given the highest priority.

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\*The right wage will have to be determined through experimentation. It should be high enough to attract a sufficient number of the unemployed to the works program in every region and, at the same time, low enough not to divert labor from essential agricultural harvest operations. The works will have to be located within short walking distance of villages where the unemployed live; or transport will have to be organized for them.



## Chapter Five

# RESEARCH AND KNOWLEDGE

## RESEARCH

To meet the needs of an expanding population and at the same time provide for some improvement in per capita food consumption, agricultural productivity must increase at the rate of 4 to 5 per cent annually. This is a larger rate of increase than any country has sustained over a period of years. Only vastly improved technology developed by research and applied by a large part of the world's farmers will enable agriculture to meet this challenge.

What kind of research will be most fruitful? Should the major effort be on short- or long-term projects? Here we were faced with a difficult problem in priorities. The underlying questions are: How much can agriculture advance by the diffusion and adaptation of existing knowledge, and how much is advance dependent on new knowledge--knowledge that we do not have now and that must be acquired by fundamental long-range research?

The conference was impressed by the great areas in which our knowledge is so limited that little if anything can be done. The soils of the tropical rain forests are an example; present knowledge does not seem to provide any alternative to the existing methods of cultivation.\* Only much fuller understanding of rain-forest ecology, demanding a long-term research effort, would make possible a substantial advance in production.

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\*The rain-forest area is described in Chapter Eight.

In other areas our basic knowledge is good and needs only adaptive research to apply it to local conditions to produce substantial increases in yields. The opportunity for wider use of fertilizer in some areas is an example. Yet even such short-run gains will provide only short-term solutions. Almost everywhere, it seems, yields based on adaptations of existing technology would reach a ceiling in the relatively near future.

The gestation period of basic research is long. Development of new plant varieties, for example, takes years, yet only through such research can new advances in technology be available when the yields from short-term measures are exhausted. We believe therefore that a major effort in long-range research must be gotten under way at once, and that developing nations must make a higher commitment of money and of scientific and trained manpower to agricultural research and education.\*

In a society currently doing little research the additional expenditures required for agricultural research may appear large even though they are not in comparison with the costs of a steel mill or a major highway. For the total costs of research must include expenditures for efforts that produce no results and for the

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\*Our feeling about the importance of research increased during the weeks of the conference. Two questionnaires, one filled out by us on the opening day of the conference, the second at its close, documented this shift in our opinions. One question asked whether we would give first priority to research or to the implementation of existing knowledge. Thirty-six per cent chose research both times, and 33 per cent chose implementation. In the second questionnaire, however, 23 per cent who had given priority to implementation now gave it to research, and only 8 per cent switched their preference from research to implementation. This net swing of 15 per cent meant that what had been a majority for implementation was by the end of the conference a majority for research.

extraordinarily demanding requirements of human resources. Moreover, the time lag between the initial step and the establishment of a steady flow of useful results may be considerable. Such commitments should be viewed as investments in the country's future.

The research program should have as its main focus the solution of problems and the development of new scientific and technological information that would have an immediate bearing on agricultural production. With such a focus of objectives no distinction need be made between fundamental and applied research. The scientists should have the freedom and encouragement to probe into the fundamentals of a question when necessary, but the program generally would be heavily field and problem oriented.

Research will be required on each of the many factors that have been identified as influencing productivity. (Table 1 in Chapter Two lists these factors.) Since their relative importance will vary over time and in different countries, it is not possible to generalize regarding the priorities for research. Such decisions will instead have to be made for each country and perhaps for different regions within countries in accordance with needs and opportunities. The chapters on ecological regions (Part III) list specific problems in the respective areas on which research is especially needed.

In addition to research of the more conventional kind dealing with the various aspects of the production and marketing of agricultural commodities, we emphasize the need for research on the problems of organization and administration of training, of research, and of services to agriculture. Such research should involve both the study and analysis of the effectiveness of existing institutions and the creation of experimental models or pilot units in which new ideas and techniques can be tried. Results of such studies would do for public administration what conventional agricultural research does for crops and farming practices: provide an opportunity for continuing evolutionary improvement.

Agriculture, as we have emphasized, is dominated by interactions. Hence all its operations and all the institutions that serve it must



be studied and designed with that fact in mind. Agriculture is conditioned by localized combinations of natural resources. Hence great importance is placed on the decision-making ability and managerial skills of individual farmers. Agriculture is capable of dynamic growth. Hence the kind of training needed by all engaged in it must be geared to change. It is in this context that we make the following generalizations.

A broadly interdisciplinary analytical diagnosis of existing physical, biological, economic, and social conditions and of the institutions serving agriculture is an imperative prerequisite to the planning of an agricultural research and educational system.

Only with the aid of such a diagnosis can government officials plan the allocation of the nation's own resources to the sector of agricultural research and education. With this information, external resources from foreign assistance programs can be made to fit together into an effective mosaic instead of forming, as too often happens, scattered, unrelated, and sometimes competitive pieces.

The precise blueprint of an effective agricultural research organization for any given country will be determined by many factors, including the size of the country, the variety of its soils and ecological situations, the variations in its present and potential agricultural enterprises and types of farming areas, political considerations, the present and potential financial resources that can be invested in agricultural development, and the present and prospective scientific talent.

Sustained growth in agriculture depends on the creation of a broad-based research and educational system that is responsive to the needs of rural society.

This responsiveness can be facilitated by maintaining a close linkage between the research system and farmers both directly and through the extension service and other public and private groups that serve the agricultural sector. A two-way flow of problems, ideas, and information through such an interconnected system will

do much to keep the research program focused on the needs of rural people. It is unwise, however, to have the scope and emphasis of the research program wholly determined by information from the field. New ideas from outside the experience of traditional agriculture must be sought and examined if the "horizon of the possible" is to be raised. Often, particularly in the early stages of agricultural development, it will be necessary for the research worker not only to develop the new variety or system of weed control but also to make sure that the improved seed or new tools are produced and made available to farmers at the time, place, and price necessary for their effective use. The researcher must take as part of his job the responsibility of putting his research to work in farmers' fields.

To provide a two-way flow of information, provision should be made for close liaison between research and the extension organization. New practices and new technology flow into farm practice, and there is a return flow of information on the applicability or weaknesses of research findings; information on new problems encountered in farm practice is thus brought to the attention of the research scientists.

Major intermediate-stage production increases can be obtained by adaptation of technologies from more developed countries to local conditions through experimentation.

Any program aimed at increasing agricultural production can be successful only if profitable and acceptable alternatives to traditional practices are available. Without critical examination it has too often been assumed that sufficient alternatives are readily available in the technologies of the advanced countries and that all that is needed is to apply them in the new situation. This is a dangerous fallacy. Experience has shown that crop varieties, cultural practices, fertilizer applications, water management systems, credit schemes, or organizational patterns from one region often fail to give the expected increases in productivity when introduced into a new ecology. It is then necessary through research to adapt them to the new environment.

The response of grains to fertilizer in India is an example, among many, of the difficulty of transferring methods from one ecology to another. The grains do not respond as well as they do in the United States. Although the reasons are not fully understood, experience has provided some clues. In northern India, maize is grown principally during the monsoon rain season. Methods of cultivation designed to conserve and store rainwater in the soil appear to have the effect of restricting growth of the root system. This in turn affects where the fertilizer must be placed in order to be utilized by the plants. Thus fertilizer placement principles developed in the United States must be re-examined in the Indian context. It is also possible that effective use of fertilizer in India will require new techniques of cultivation, of handling the soil surface, and of weed control.

Significant early increases in production may be possible in some areas through the more uniform and effective use of existing resources and technologies.

The more able and progressive farmers often produce far more than neighbors who have similar soil and climate and access to the same production inputs and markets. Similar differences may also exist in the effectiveness of the individuals and firms that are serving the farm sector. An analysis of the rural scene should uncover many ways in which existing superior methods could be more fully exploited. The successful use of leading farmers in Japan during the early stages of development should not be overlooked.

Research dealing with problems of major significance can be undertaken that will yield results of great immediate value without sacrificing progress toward long-range goals.

Research tends to involve successive advances. The early evaluation of existing or introduced varieties will show some that are superior to those in common usage. Such knowledge can be used at once to upgrade crop yields. Initial studies of cropping systems

may reveal rather simply controlled diseases or pests. Initial studies of fertilization systems may yield consistent patterns of response with certain crops and not with others or when used in a particular way. A research scientist working on field problems will find a variety of ways to use his data and observations even in their early stages.

The transformation of a traditional agriculture involves important and fundamental changes in the attitudes, values, and orientation of farmers and of those who work with them. Research is needed on these topics.

There is a wide range of phenomena relating to the structure and dynamics of society that bear on the ways individuals and groups react when placed in situations of change. Behavioral science research (dealing with social, cultural, and psychological phenomena) can aid in promoting the adoption of more productive practices by analyzing the structure, the values, and the operations of agricultural administrative units and of peasant society and by investigating the precise ways in which social institutions, individual attitudes, and personal values hold back or stimulate the innovative process.\* The Cornell project at Vicos in Peru illustrates the successful use of behavioral science in agricultural development.† The problem was to shift a serf-bound population on a large hacienda in Vicos from their dependent and unproductive state to membership in a self-reliant and productive community. The program that successfully accomplished this transition was based on a careful anthropological study of the hacienda people.

To be effective a research unit needs to reach a certain minimal size and to operate in an environment that encourages individual

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\* Appendix E discusses the potential uses of behavioral science research.

† The Vicos project is described in Appendix A.

initiative, intellectual discipline, and responsiveness to the needs of society.

It cannot be assumed that a research organization transplanted from a developed to an underdeveloped society will thrive and be productive. The stimulation that comes from contact with other educated people, the intellectual discipline imposed by dialogue with fellow scientists, the opportunity to see the results of one's research put into action, and the opportunity to work closely with and help train keen young minds are some of the features of the environment that will stimulate and make productive an agricultural research unit.

The basic organization should provide for one or more strong centers at which a substantial group of well-trained scientists from the various scientific disciplines can be assembled. The main center or centers should be linked with a system of substations whose principal functions would be to test the applicability of materials or practices in various ecological situations and to discover problems peculiar to these various subareas. The number of such substations will vary with the size of the nation and with the number of major ecological and farming areas to be served. These substations should also form an important link with the extension officers in their respective areas.

The division of research activities among the various levels may be along the following lines:

Research at the central location. Emphasis should be placed on the kinds of research that (1) require concentrations of scientists of refined laboratory and field techniques, (2) are concerned with development of new knowledge, practices, and materials, and (3) have broad nationwide or interregional applications. Scientists of the central station should also provide leadership and coordination (but not direction) for research at the regional stations.

Research at the regional locations. Emphasis should be placed on trials and modifications of practices and materials developed at

the central location and on the integration of these practices and materials into enterprises and combinations of enterprises adapted to the region served. Less emphasis should be placed on the development of new knowledge, practices, and materials. Concentration should be on the solution of problems particularly pertinent to the region that the station serves.

Research at the local fields. Simple trials of single practices or simple enterprises should be conducted to determine or refine adaptation to specific sets of local conditions of a few selected variables judged from regional trials of local farm practice to be adapted to local conditions. These trials should be under the supervision of the scientists at the regional or central location, and they should be designed to serve as both demonstrations and the final stage in adaptive research. Ideally there would be an extensive network of such local field trials so that one is within reach of each farm community. In practice, such an extensive network would exceed in cost the resources that are likely to be available in the early stages of agricultural development. It is suggested that the first local fields be established on the basis of (1) areas in which the biological and physical potentials for improved agricultural productivity seem best, and (2) communities in which local interest and hence likelihood of adoption are highest. Local fields may take a variety of forms, such as trials in the cultivators' own fields, village or other publicly owned and operated lands, and stations specifically established for that purpose.

Research at the pilot farms. Research should emphasize the biological and economic aspects of integrating systems of enterprises evaluated on a farm scale. These farms should be under the direct control of staff members of the farm management unit of the central station or of a comparable unit of the regional station. Immediate operations should be in the hands of the most competent farmer available or of a college graduate who has had actual "on-farm" experience. The primary purpose is research. Ideally these pilot farms would serve as demonstrations, but experience to date

does not give much cause to believe that they will be particularly effective in this respect. The pilot farms could serve as focal or training centers for farm leaders, in-service training of extension personnel, and farm experience for college and university students.

The temptation to fragment and disperse scarce human resources should be avoided. Unless a sizable group of scientists from the various disciplines can be assembled in one center it is doubtful whether a sustained flow of new technology can be expected, and certainly such a group would be essential to provide the training suggested below. It is our judgment that this will require at least 15 to 20 well-trained front-line scientists and preferably somewhat more. In institutions offering graduate programs in several disciplines the "critical mass" for the academic staff will be considerably higher. Experience indicates that a minimum of 4-6 senior staff of coordinate rank and academic stature is required for each subject-matter area. Where talent and resources are limited the principle of concentration must be kept in mind and, if necessary, only one such main center should be developed, at least initially. It should be possible to move progressively from a simple but productive research organization to a much larger and more complex organization as the requisite resources in funds and trained scientific manpower make it feasible.

Some very small nations probably cannot support even one such central station. They should, however, support a substation drawing information and materials from major stations in other countries. A somewhat larger nation might meet its requirements with one main research station plus a variable number of substations for testing in its major ecological subdivisions. This pattern might represent that to be followed for individual states or regions in a large nation, with a complementary research organization at the center serving a coordinating function among the various states on problems and commodities of concern to more than one state and providing re-

sources and staff that would add strength and flexibility beyond what is attainable in the individual states. In a very large country such as India, which at the same time has developed a quite substantial body of trained agricultural scientists, it may sometimes be necessary and desirable to develop more than one main center per state, at least in the larger states. The principle of concentrating the core staff in a limited number of locations should still be kept clearly in mind.

The research program should have a strong training component.

This might include in-service training of younger staff members, postgraduate research for Masters and Ph.D. candidates, and perhaps part-time employment of undergraduate students in some of the simpler and more routine tasks of the research program. A research program focused on significant problems forms one of the most effective vehicles for training the new generation of scientists who are to carry on this tradition. This suggests a close linkage between an agricultural college and the main research center. At the substations, if the staff is sufficient, the scientists should also teach, perhaps at the subcollegiate level, and give short courses for extension workers or farmers.

The research and educational needs of agriculture will change as development occurs; hence the number, size, composition, and program emphasis of the institutions should also change.

An example from plant-breeding research may serve as an illustration. The first step is to assemble and evaluate lots of seeds being used by farmers from other areas having similar environmental conditions. Selections from those are compared with new combinations of introduced germ plasm. A third step is to initiate the more refined procedures such as hybridization and inbreeding. As these steps proceed, problems of disease and insect control, fertilization, cultivation practices, and harvesting will arise that require the expansion of the research team and its program. Throughout the entire



process the proposed package must be evaluated as to its economic viability. Similarly the institutional structure to support the expanding program must evolve to meet the requirements of the expanded research and to enable it to study problems with increasing scientific intensity.

#### RESEARCH AND THE DEMAND FOR HUMAN CAPITAL

The role of new knowledge, or research findings, as a principal source of economic growth is coming to be better recognized. Research findings become a productive factor in the economy only when they are incorporated in capital goods or when people incorporate them into their work habits and procedures. Increases in productivity take place because the improved production processes reduce the unit costs of labor, of capital resources, and of natural resources.

In the agricultural sector new knowledge increases the demand for skilled manpower. New knowledge requires applied research to adapt it to particular sets of conditions, and development and design activities to incorporate it with more productive new inputs. A credit system is needed to provide credit on terms that will facilitate the farmers' use of the new inputs or the new information. A marketing organization is also needed to assemble, store, and distribute the additional output from the new inputs or new information. Also needed are educators to train the additional research workers, the managers and staff for seed multiplication and for marketing organizations, the extension workers, the credit supervisors, and the additional teachers.

In many underdeveloped countries the initiation of a flow of useful research findings will increase these manpower needs greatly because many of the organizations into which this new knowledge must flow in order to become effective do not exist at all or exist only on paper. They must be built from the ground up, and this process is

not only slow and often painful but also requires a concentration of human resources that are very scarce.

Take the example of a new plant variety produced by a research station. If capacity for seed multiplication does not exist, then plant breeders and other agricultural scientists will have to be allocated to this task. A great deal of research will be needed on the interaction of the new variety with water, fertilizer, pest-control measures, cultural practices, and other inputs. When the seed is available in volume, an organization will be needed to distribute it to points of need, along with other inputs that are complementary. Extension education is then needed to disseminate all the relevant information to cultivators.

It is likely that the demand for skilled personnel will grow much more rapidly than the flow of useful research findings. Failure to foresee these manpower needs will frustrate for a time the contribution that the new knowledge could make to agricultural productivity.

#### EDUCATION AND AGRICULTURAL DEVELOPMENT

Education is like a general-purpose investment that can be directed toward a large number of essential needs when it matures. A society with a substantial number of high-school graduates can meet its needs for research, extension, credit, and other supporting workers much more rapidly than can a society with only elementary-school graduates. Many types of specialized training can be designed and grafted with little loss of time onto a good program of general education.

The advantages of general education extend far beyond the capacity to fill positions already known to be essential to development. Central to development is the idea of change; and education in its broadest sense is the cumulative impact of experience that leads to change in future patterns of behavior. Thus education, by

increasing an individual's "perception of the possible," can condition and predispose him to change. It can create in him a new level of dynamic behavior that is essential for innovation.

Because much of the educational process involves the transfer of knowledge from one person to another, the availability of diverse channels through which the interchange can occur is important. Illiteracy, by ruling out the channel of the printed page, greatly impedes the diffusion of knowledge. Hence the removal of this obstacle should be a high-priority objective in the strategy of development. Modern technology in mass communication by aural and visual means offers many opportunities for transmitting information to those unable to read. Radio and television may be imaginatively used as complements to personal communication, demonstrations, and formal schooling.

Institutions concerned with agricultural education must be responsive to the needs of the rural sector. Classical education concerned with purely academic matters must give way to the concept of education for service to the nation. This is important all the way from the primary schools to the universities.

Teaching programs must be designed to stimulate at all levels a spirit of inquiry, inventiveness, and constructive thinking. This will require modern concepts of teaching with emphasis on understanding rather than memorization. It will require dedicated, enthusiastic teachers freed from stifling restrictions that force a rigid mediocrity on the whole system.

In-service training, short courses, on-the-job training, and other devices are important and effective supplements to formal classroom teaching. They are particularly pertinent where large numbers of trained people are needed quickly and where many of the students in agriculture are from urban areas.

General education through primary and preferably through secondary school is obviously a desirable objective. However, it may have to take second place to the needs for trained agricultural

technicians and other workers if personnel shortages are seriously impeding agricultural development. In such cases vocational and technical agricultural schools will be more important than general secondary-school education of the classical kind.

The importance of the education of farmers as a means of a increasing agricultural productivity in both the short- and long-term time scale cannot be overemphasized. The phenomenon of interactions is brought into sharp focus by the decision-making ability and managerial skill required at the place where production occurs--the individual farm. To talk about production inputs and package programs in aggregative terms is useful in planning national programs and goals, but their effects on production are determined by the way in which the individual farmer is able to put all the technologies together on his farm. On each farm the particular "mix" may represent a unique combination of all the components of a complex mosaic. The ultimate effectiveness of any program depends on the ability of farmers to make sound decisions based on an understanding of the alternatives open to them and an appraisal of their consequences. It is for this reason that at all stages in the development process, whether with the villagers of highland Luzon, Dahomey, or Bolivia or the farmers of Taiwan, Israel, or Illinois, information and technology should be extended in such a manner that the farmer--the man who puts the information into the production machine--is himself improved by learning the "why," not merely the "what" or "how," of the innovation.

Only in this way will he grow in his ability to evaluate alternatives, to adapt the input mix to the unique environment of his farm, and to improve steadily in his ability to adapt to changing circumstances.



## Chapter Six

### ORGANIZING AGRICULTURAL DEVELOPMENT

Let us assume that we now have a package of viable new inputs to offer the farmer, economic policies to make their adoption feasible, and a research system that steadily improves and adds to our supply of technology. The need remains for means to bring the package to the producer, from ministry and research station to the farm itself. Without this factor our package is incomplete and the other factors will remain barren. The factor of organization is perhaps the least tangible and least clearly understood of all the factors that go into the "systems problem" of agricultural development.

The key actors here are the farmer and the bureaucrat, for the state must play a role in catalyzing agricultural development. Private firms and traders may play a greater or lesser role in different nations, but in this chapter we are concerned with those crucial responsibilities that fall on government. The profit in many agricultural enterprises cannot be recaptured by the private entrepreneur because it diffuses through society. We cannot expect private concerns to build farm-to-market roads, create and staff an extension system, or manipulate prices in the general social interest. The state may often aid the private sector so that it can better serve agriculture, notably in marketing. One example is the training of rural merchants, who can be a crucial force for change. Even when the state enters the marketing process it will usually be useful to preserve and stimulate the private sector in order that the farmer will benefit from the flexibility of competition rather than suffer from the rigidities of monopoly.

The bureaucrat must therefore be an agent of change. In the form of extension agent, cooperative organizer, or local official he must bring innovation to the farmer. The encounter between farmer and bureaucrat is a crucial point in the process of development. If that encounter does not appear fruitful to the farmer, then the most attractive of packages will remain on the shelf, unsold.

The nature of the encounter between farmer and bureaucrat requires close study in the evaluation of any developmental program. All too little is known about what actually happens when the producer meets the agent of change. Is the farmer approached in language he understands, in terms that are relevant to his experience and desires--and by people he trusts and respects? Are his customs and beliefs insulted? Is he subject to humiliation, red tape, and delay? How many people must the farmer see in order to get his new inputs and learn how to use them, and does he have reason to believe that his fertilizer, for example, will be delivered when he needs it? These are essential questions that cannot be answered by examining a table of organization in the ministry of agriculture.

#### THE INNOVATION PACKAGE

We have seen that the strain of innovation on the farmer is great. In the case of a package, he is required to master new physical skills (in cultivating a new variety, for example), to learn the use of credit, and at times to accept unsettling changes in his social order, all in a limited space of time. Since such change is difficult at best, it follows that any further barriers in the relationship between farmer and bureaucrat-innovator will drastically reduce the chances that the package will be accepted.

The bureaucracy must design and implement its package of innovations in such a way as to reduce as much as possible the barriers

to its acceptance by the producers. Experience from various sources suggests the following as desirable characteristics to have in a first package of innovations:

1. Profitability.
2. Novelty. Contain at least one key innovation.
3. Complementarity. Include all of the practices complementary to the key innovation(s).
4. Appeal. A strong motivation toward adoption should be induced both on the part of the farmer, whose felt needs it should tend to satisfy, and on the part of the agent of change, who should feel a personal challenge in promoting the package.
5. Compatibility. Collision with the culture must be avoided. Furthermore, it must be borne in mind that propensity to accept the package might be seriously hampered by previous failures.
6. Simplicity. Elements included in the package should be easy to manage, demanding as little as possible in skill prerequisites.
7. Availability. Knowledge, materials, and credit must be readily available.
8. Immediate applicability. Packages with long gestation periods should be saved for later phases.
9. Inexpensiveness. If possible, relatively little or no additional costs to the farming operation should be involved; this consideration will be less important later.
10. Low risks should be involved for the farmer.
11. Short payoff period.
12. Expandable. Adjustable to operation on different scales.
13. Spectacular impact. Preferably on cash crops.
14. Communicability. Results should be easily visible to everybody.
15. Residual effect of self-reliance on farmers.

Such a package, including both tangible and intangible factors, can be designed in the ministry, but it can be implemented, particularly in its intangibles, only by agents of change who are fully aware of



and committed to its requirements. Only their tactics in dealing with farmers can guarantee its success.

Thus bureaucracy faces a task as difficult and complex as that of the farmers themselves. The government's need for human resources to accomplish this task is acute. That need takes two forms. First, and most obvious, is the sheer need for large numbers of skilled people. As we saw in Chapter Five, agricultural development causes a steeply rising demand for people to man the structures serving the rural sector. The personnel requirements exist before the increased agricultural yields occur that are eventually to finance their costs; research and extension, for example, are needed before the farmers begin to innovate.

The organizational problems and therefore the personnel needs of agriculture are far greater than those of industrial development. The introduction and operation of modern industrial plants depend on the decisions of relatively few people. The large scale of operation can support the cost of personnel in the specialized functions of integrating production, supplying inputs, and marketing. By becoming employed in a factory, labor is taken into a new environment. The tasks to be learned are standardized, relatively simple, and not substantially different from production tasks in the same industry anywhere else in the world. Supervision of labor to achieve productivity is more a matter of achieving a well-integrated flow of materials and semifinished goods through the production process than a matter of incentives and sophisticated decision making on the part of the workers.

On the other hand, improving the efficiency of agricultural production depends on the decisions of millions of small producers. The tasks are not standardized, conditions vary from area to area and even between fields on the same farm, and account has to be taken of weather and the occurrence of diseases. Even the smallest farms usually diversify their production. The supply of inputs and marketing of products have to be organized to serve the many producers spread over the land, and requirements are usually seasonal. Provision of

credit is also complicated by the need to serve many producers and by the seasonal character of income and production expenses. The poverty of most rural people increases the risk of experimenting with new practices. Lack of transport and communications makes it difficult to reach the dispersed millions of the farming population. Roads are few. The multiplicity of languages impedes communication; cultural differences between educated elites and farmers hinder effective communication even when a common language exists.

#### THE BUREAUCRACY

Yet the skilled human resources of developing nations are typically scant. Almost by definition they do not have a pool of trained manpower available to staff new or vastly expanded organizations. The demand is many times greater than the supply. The issue then is: How can these scarce human resources be allocated--knowing they are far from adequate--in such a way as to make the best possible use of them?

The second problem in the supply of human resources is less tangible than the sheer lack of numbers. It is implicit in our earlier statement that the "bureaucrat must be the agent of change." What makes a successful extension agent? Obviously he must know the technical side of his job if his advice is to be worth hearing; that much can be accomplished in his training. But he must also be deeply committed to innovation, which means that he must accept the painful personal adjustments (by himself as well as the farmer) that come with rapid social evolution. If he is not committed to change or is afraid of it, if he is content with the status quo, or if his primary commitment is to, say, his personal status, then the agent is hardly likely to be an effective promoter of innovation. Although easy to state, this principle in practice gets less attention than it deserves, perhaps simply because it is an intangible. We cannot measure the "innovation response" of an official as we can

measure the fertilizer response of a plant. But the fact that we cannot assign numbers to this quality does not excuse us if we disregard it in our planning.

However, to draw up lists of the qualities desirable in an agent of change is of little help. We can say that an extension agent should seek farmers' opinions in order to understand the community in which he is working; or, to put it on the simplest level, we can say that the manager of a cooperative should not steal the funds. Such statements do not advance us far, for we are then dealing with agents of change as individuals rather than as a class. For example, an outstanding individual will often be cited with the wistful comment: "If only we had a hundred more like him our problems would soon be solved. . . ."

Whether there can be "a hundred more like him" depends on the values prevalent in the bureaucracy. Most officials, like most farmers, are conditioned in their behavior by their environment. Thus the human environment of the bureaucrat, like that of the farmer, must be conducive to innovation if development is to take place. Otherwise the exceptional individual remains just that--an exception. What is needed is a system of values in which the unexceptional individual can be an effective agent of change; only then can a society mobilize such agents in the numbers that agricultural development demands. Technical training in itself is not enough.

Put in other terms, the environment of the bureaucracy must encourage the growth of the "will to develop" that was listed in Chapter Two as a precondition to agricultural development. The "will" must be distinguished from the mere "wish" to develop. The wish is evident in the public statements and development plans of the developing nations, yet it alone does not guarantee the will to overcome the barriers that often exist in the bureaucracy itself.\*

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\*Appendix C tentatively explores ways of measuring the will to develop in the field of agriculture, in the hope that yardsticks

Values that are not conducive to innovation are generally prevalent in the bureaucracies of the developing nations. The bureaucracies are typically characterized by elitist and authoritarian attitudes; rigid adherence to rules is valued over accomplishment, and there is great concern with symbols of prestige and status; and agriculture is seen as a despised occupation. These attitudes may be seen in terms of the bureaucrat's response to what he views as threats to himself or to the civil service as an institution. Even where some will to develop exists, these bureaucratic characteristics hinder effective implementation of any innovating program.

We do not offer any organizational panaceas, any administrative technology to be transplanted whole from one society to another. It is useless to draw up the table of organization of an "ideal" extension or credit system, for no such bureaucratic shell would guarantee that the agent of change would perform in such a way as to achieve the goal we have stated: to make fruitful the farmer's encounter with bureaucracy.

In the past, claims have been advanced for particular forms of organization: cooperative credit and community development are examples. Our view is that--entirely aside from the issue of the will to develop--the variation in the factors involved is far too great to put forth any single technique as having general applicability or, for that matter, to reject a technique because it has failed in one situation. The priorities in the needs of agriculture vary from roads here to fertilizer there and to research in the third place; the variety of local cultures in which the innovations are to be introduced is almost infinite; different nations have different

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can be devised to make it possible to decide (in allocating aid, for example) whether enough will exists to give any agricultural program its needed bureaucratic support. A specific case of the will to develop is discussed in the appendix on land reform (Appendix F), which points out that the precondition to effective reform of land tenure lies not in any particular legislative measures but in the will to carry out the reform.

bureaucratic resources. If both problems and resources vary, it is normal that the best techniques for solving the problems should also vary.

We found ourselves divided on one issue in our approach to the bureaucratic barrier: whether to try to work primarily within or primarily outside existing bureaucratic organizations. Some participants argued that human resources for development do exist within the bureaucracy and that in any event the bureaucracy is indispensable since it is the locus of decisions determining the fate of any agricultural program. Accordingly the existing bureaucratic machinery must be made use of. Others felt that the nature of the bureaucracy makes it impossible for development-minded individuals to accomplish anything within its structures. They therefore proposed the establishment of new administrative entities alongside of but outside the existing framework, designed to concentrate on particular programs of innovation.

All agreed that the organizations that deal with agriculture need to have the capacity for effective interaction and coordination. The conventional bureaucracy usually emphasizes line authority and responsibility through various hierarchical levels within a more or less rigidly defined set of functions. The services needed often do not fit neatly into the existing organizational "boxes." Furthermore the actions taken in one "box" may strongly affect what happens in other "boxes." Hence some provision must be made for the operational combination of elements from two or more "boxes" into task forces, especially at the local level, which in the main should be ad hoc in nature. We came to refer to these ad hoc combinations, either of elements of existing organizations or of specially constructed new ones, as administrative "disposable plastic bags." We recognized the danger that these "disposable bags" would tend to become "boxes." Indeed in some cases perhaps they should, but in general such rigidity should be avoided because the birth of each new "box" creates a new set of "interbox" barriers and thus further complicates the very situation the "plastic bags" are designed to correct.

We were impressed with what had been done at Comilla (see Appendix A) to organize the local representatives of the various ministries concerned with agriculture into an effective working team, housing them in the same building, drawing them together in working parties and seminars, and ensuring frequent consultation on common problems in the local community while leaving unchanged their formal responsibilities to their respective ministries. Different ways of forming these "disposable bag" task forces will have to be experimented with in each country and often in each local community. But the complex of factors affecting agriculture in any area is so interconnected that we felt that organizational experiment and innovation in reshuffling elements selected from the formal organization chart were necessary features of any successful program.

The ad hoc group or task force is of course in no sense a substitute for the regular civil service. Rather, it particularly commends itself for dealing with special priority problems such as an emergency fertilizer campaign or a resettlement scheme. In every possible instance the establishment first of an investigation and study unit to appraise the situation may save much effort, funds, and possibly reputations. One task of such a unit is to define and delimit the terms of reference of the task force. For example, in an emergency program for food production through immediate fertilizer use, a country-wide approach is scarcely viable. Specific areas must be selected on the basis of precise criteria. The same unit may provide the objective evaluation of the performance of the task force that is essential if this method is to be fully effective.

The task force may take the form of either an interdepartmental body or an autonomous corporation, including private citizens, that can establish a routine and cadre specifically suited to the job. Which it is depends on the type of undertaking. If it is the second alternative, there is the ever-present danger that the governmental departments will be reluctant to assist the new body, and good staff will hesitate to transfer to it. Both alternatives have two essentials. First, a senior, time-honored public servant of considerable

ability who commands the respect of contiguous departments must be appointed as its head. Second, if a large area of the problem is to be tackled at once, the combination of inputs must be reduced to the minimum.

The question of the "boxes" is still the one stated earlier: how best to group scarce human resources. An analogous question is that of diffusion or concentration: Should the available personnel be spread thinly in both geography and function in an attempt to bring benefits to as many farmers as possible? Or should they be concentrated in the hope that they can bring greater total benefits in a relatively small area? Whatever choice is made can only represent a compromise between great needs and scanty resources.

On the whole, however, we tended to favor concentration over diffusion. Our reasoning was pragmatic. We were convinced, as stated in Chapter Two, that only in rare cases can a single new physical input provide more than small or transient benefits. Most agricultural situations require a package that is typically complex. The package in turn requires considerable numbers of scarce human resources if it is to have any chance for success. Most developing nations can man such a package over only a relatively small area and often with benefit only to the better farmers. On the other side, that of diffusion, the available manpower could at best staff a program bringing a single simple input to great numbers of farmers. All the force of social justice of course sustains the case for diffusion of effort and benefits in desperately poor societies. The only possible counterargument, and it is the one we adopted, is that in most situations diffusion of effort will provide virtually no benefits for anyone. We do not argue that concentration is socially attractive or equitable--but that it is usually the only method that can hope to succeed.

Our examination of successful agricultural development programs, and they are all too few, confirmed our skepticism about administrative panaceas. Appendix A describes the salient features of four successful schemes: the Comilla Academy for Rural Development in

East Pakistan, the Joint Commission on Rural Reconstruction (JCRR) in Taiwan, the Gezira scheme in the Sudan, and the Vicos project in Peru. Even these do not have much in common. Comilla is primarily a farmer-training project that started with a single factor--cooperative credit--in a single district and has expanded very cautiously. The JCRR, on the other hand, operates nationwide and covers a broad spectrum of activities. Gezira is a capital-intensive irrigation scheme involving a high degree of paternalism and enforced change in land tenure and farming patterns. Vicos is a community project that grew out of a study by foreign anthropologists.

The lessons of such success stories do not lie in the form of the project or in any particular techniques. Many similar projects have failed. (Gezira has been imitated unsuccessfully.) They are dependent on local conditions. The success of the JCRR may simply tell us that Taiwan is a small island with a high proportion of skilled people that received much foreign aid. The wise management of Comilla and Gezira is not a quality that can be exported. Thus the effort to transplant any specific techniques is extremely dangerous.

Although they provide no readily exportable panaceas, the success stories point to some underlying principles of general validity. We examined the successful projects in the light of our previous exploration of the complex series of factors influencing agriculture. We then arrived at the general principles that follow. They are closer to hypotheses than to dogma, yet we believe that they provide criteria by which the organization of agricultural development can be evaluated.

## ORGANIZATIONAL PRINCIPLES

### Bureaucratic Feasibility

This precondition is as essential as technical and economic feasibility. Before any program is approved, this question must be



answered: Are the needed organizational resources likely to be available, and is this their optimum use? This principle has all too often been disregarded with the result that otherwise attractive projects failed. Basic decisions may turn on answers to these questions. The choice between large- and small-scale irrigation is an example. One may have the choice between one big dam serving large numbers and, on the other hand, many wells and small village dams, each serving at most a few fields. The big dam, as noted in Chapter Three, requires vast social change and a high degree of imposed discipline; for example, the Gezira scheme was paternalist not by choice but by necessity. Landholdings have to be reshuffled; all farmers must conform to rules governing the use of water; they may be required to grow specified crops by specified techniques. Thus the local culture, the farmers' patterns of living, is bound to be drastically remolded. The administration of the irrigation project must plan and enforce these far-reaching changes. This is precisely where so many irrigation schemes have failed in the past: The dam is well built but the farmers are not organized and the services are not provided to make efficient use of the water possible. The success of the project diminishes in proportion to the distance from the site of the dam. By raising the organizational question early in the planning stage the state may find that it does not have the needed human resources, and it may then abandon a project that is feasible in every other dimension. Other areas in which the organizational issue is especially important are pesticides and land settlement schemes, both of which often involve a high degree of social control.

#### Pilot Projects

Any organizational scheme should be tested on a pilot basis before it is generally adopted. Like the concept of bureaucratic feasibility, the idea of field tests in bureaucracy needs far wider acceptance. As we pointed out in Chapter Two, the case for adaptive research in institutions is similar to that for adaptive research in crop varieties. Our knowledge of all the factors involved is not great enough to transplant crop varieties without testing.

This statement is even truer of institutions. Our knowledge of the complexities of local cultures and of their interaction with any proposed innovation is far too limited to permit us to design in the laboratory an organizational structure so sure of success that it can be generalized without running unacceptable risks. Alternative ways of approaching the farmer with an innovation may be possible; he may, for example, be approached either as an individual or collectively through the village leadership. Which alternative is more effective should be determined by field tests, not a priori in the ministry offices.

Pilot projects have other advantages. They accord well with the concentrated regional packages that we have already advocated. Pilot studies do not engage the prestige of the national bureaucracy. If one proves unworkable--and it should be stressed that a high proportion of such experiments will probably fail--it can be abandoned or drastically altered without serious loss of face. An important characteristic of an organizational "plastic bag" is that it is disposable. Thus inertia is less likely to force the continuation of a scheme that has failed but to which the nation's leadership has committed its prestige. (The failure of an agricultural project to make barely visible changes on countless fields in remote areas is less likely to be widely noticed than, say, the failure of a steel mill to produce steel.) It is easier to find capable people to staff a pilot project because it is small. Finally, if the project involves radically new values or reforms, it is likely, again because it is small, to arouse less resistance from entrenched interests or bureaucracy than a large-scale project. This was the case in Comilla.

Yet the success of a pilot scheme does not necessarily mean that it can readily be generalized. Institutions grow more slowly than most plants. There is a difference in kind--not just in scale--between a pilot and a national scheme. The advantages we have just cited tend to vanish when the pilot scheme is generalized. Manpower needs multiply. When one examines existing pilot schemes, one typi-

cally finds a very high extension-farmer ratio: a relatively great number of skilled people is being used to provide new knowledge and services to relatively few farmers. Usually the manpower is not available to generalize the scheme at that ratio, and it may not work at a lower ratio of skilled people to farmers. (This problem suggests the need to devise and test schemes using a low ratio of skilled manpower.) Bureaucratic opposition, skirted at the pilot stage, may arise when the scheme becomes large enough to be perceived as a threat to the customs or status of the civil service. That it is possible to unite a small group of bureaucrats devoted to development in the special conditions of a pilot scheme does not prove that it is possible to animate a whole sector of the civil service.

A pilot scheme is by definition an exception to the rule. When it becomes the rule instead of the exception, then a whole new set of considerations emerges. Thus the expansion of a pilot scheme, no matter how successful, must proceed slowly and in full awareness of the new problems to be faced. This also has been the experience of Comilla; it has gradually expanded as its techniques improved and opposition diminished.

#### Farmer-Bureaucracy Communications

Two-way communication between farmer and bureaucracy is essential for bridging the present gap between the producer and the agent of change. The stress here is on the need for return communication from farmer to bureaucrat. Extension is often seen as a one-way process in which the educated person instructs the ignorant farmer, a view that accords all too well with the despised status in which agriculture is usually held. Communication is all one way and down, from research to extension to farmer. Research does not listen to the relatively "lowly" extension agent; nor does the agent listen to the "ignorant" farmer. The agents do not discuss; they instruct. New institutions, such as cooperatives, are imposed on the farmer without consulting him.

Lack of two-way communication undoubtedly is a major cause of the farmer's reluctance to listen to his advisers. It is often observed that the better farmers get yields on their fields that are higher than those at the research station, and that "the farmer knows more about local conditions than the extension agent." In such situations the farmer is unlikely to value the agent's advice.

Nor is the farmer likely to accept advice that--in its form if not its content--is either offensive or irrelevant to his own way of life. This may be particularly true of subsistence farmers, who do not respond to economic motives as much as farmers who are already in the market economy. To reach subsistence farmers, to convince them that a better life is in fact possible through innovation, the agent of change must thoroughly understand the workings of the local culture--the forces that motivate the farmers. Such an understanding can be gained only by lengthy dialogue in which the agent of change listens more than he speaks.

We have emphasized the need for innovations that respond to the farmers' felt needs and for research directed to that end. It is clear also that the method of introducing an innovation that clashes least with local customs or values has the greatest chance of success. Finally, people of different cultures perceive words and ideas in different ways; it is therefore essential that communication with the farmer be in such terms that he, as well as the agent of change, perceives the utility of what is being offered. If these criteria are to be satisfied the agent of change must learn as well as teach.

The process of two-way communication must be institutionalized. Again the agents of change must be viewed as a class rather than as individuals. Exhorting the agents to listen will not be enough, for if educated people as a class despise agriculture and farmers, then extension agents will be reluctant to listen to those they consider ignorant and primitive no matter what they have been told. The channel of feedback must be built into the system as a function as necessary as the instruction of the farmer, which may require drastic

change in the values prevalent in the educated class.

Once it is a part of the system, feedback can automatically correct the mistakes of research and extension. When the gap between farmer and bureaucracy is effectively bridged and information and opinions flow automatically from farmers to decision makers who must take them into account in their decisions, then the latter's policies are far more likely to be adapted to local physical conditions and to local social structures and to respond to the farmers' felt needs. Mistakes are more quickly identified and acted upon if there is pressure from below, and a package of innovations can be varied to suit a multitude of local conditions. An example is the Package Program in India, which offers a complete package of new inputs in selected small areas. By experimenting with the ingredients of the package (more or less fertilizer, for example), farmers are constantly refining the package, producing new combinations better suited to their areas. Thus when two-way communication exists, the chances for a viable package of innovations--for a fruitful encounter between farmer and bureaucracy--are vastly increased.

#### Local Leadership

The strain on scarce supplies of skilled manpower can be lessened by local leadership. This principle is a corollary to the bridging of the communication gap between farmer and bureaucracy. Often the question is befogged by ideological controversy over "statism" or "paternalism" as against "democracy." We attempted to look at it from a pragmatic viewpoint. It is true of course that new programs require impulsion from a decision-making center. Static local cultures require a constant input of outside initiative in addition to technology. Such forms of development as major irrigation works require a high degree of regimentation since all farmers must adopt the new practices.

Yet the pragmatic arguments in favor of using or developing local leadership, combined with outside stimulus, seem to us com-

elling. Since the human resources of bureaucracy are so scarce any technique that would stimulate local energy for development would have the welcome effect of reducing the burden on the center. It can also reduce the financial burden by making it possible to raise capital locally. To the extent that village initiative can be aroused, overcoming apathy based on the pessimistic view that man is helpless before his environment, the responsibility for development passes in part to the local community. An excellent example, cited earlier, is that of marketing. Providing rural merchants with technical assistance and training in innovation can make them powerful and continuing agents of change in the village community.

In an overly paternalist program in which all decisions are made for the farmer at the center, village apathy may persist, and any progress may be viewed as a gift from outside. Development then is a fragile plant that is dependent on the constant input of stimulus from the center. On the other hand, a village participating in decisions concerning the program may sooner become committed to development and innovation, and the process may eventually become self-sustaining in human if not in financial terms. The farmer participates in development as a partner of the elite, not as a client or dependent. Once this stage is reached, lapses on the part of the elite need not necessarily halt the process of development.

The use of local leadership combined with outside initiative characterizes three of the successful programs that we examined. The JCRR works through elected farmer associations. Farmers themselves choose fellow farmers to attend the Academy at Comilla; these farmers are key agents of change. At Vicos, where the Cornell team successfully stimulated a rise in farm yields on a former hacienda, opinion leaders among the Indian serfs were sought out and given a share of the responsibility for designing the program. These three projects differ in their techniques, as they differ in many other respects; we do not advocate that any of their techniques be adopted as such. In many places existing local leadership may be a brake on development; this would be likely where land is held in latifundia. Finding

useful community leadership may then require an overturn of the local power structure.

The principle we advocate holds true in all three projects despite differences in technique. Farmers are given an essential role in deciding what is to be done and in carrying out the decision. By using farm leaders as agents of change, the influence of the scarce supply of skilled manpower may be multiplied. As suggested earlier, any such technique that expands the effective supply of agents of change may help a developing nation break a particularly tight bottleneck. Moreover, any method that results in stimulating village decision making, in releasing human energies now bogged in apathy, is more than a technique of development. It is a goal itself, the goal of human development.

The principles we have stated here are not likely to be put into practice without profound and painful changes in attitudes. Successful innovation in agriculture, as we suggested in Chapter Two, ultimately depends on diffusing through the society a spirit that welcomes innovation. Applying the principles we have stated will at times prove painful, for they run counter to attitudes that are now prevalent. Establishing two-way communication with farmers implies a respect for their opinions that is often lacking today; granting responsibility to local leadership means taking power away from the center; raising the status of agriculture implies lowering the prestige, at least in relative terms, of the elite. Such changes cut deep into a society.\* They will not be effected by technicians or researchers, and still less by foreigners. They can be accomplished only by a determined political leadership.

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\* Appendix D discusses possible ways of reducing the risk to bureaucrats of innovating. This scheme is analogous to the innovation insurance for farmers described in Appendix B.

Thus we have traveled from physical inputs to nation building. That this sequence is logical--that putting fertilizer on a remote farmer's field is intimately linked to the values of officials in an urban ministry--is an illustration of the extraordinary complexities of the agricultural problem. What makes it particularly difficult to grasp these complexities in a useful manner is that no common measures exist. We can calculate the relative value of two kinds of fertilizer, or fertilizer and pesticides, but on what scale can we weigh both pesticides and politics? This interaction of different kinds of factors was the keynote of our conference.





Part III

AGRICULTURAL POLICIES: FOUR ECOLOGICAL REGIONS



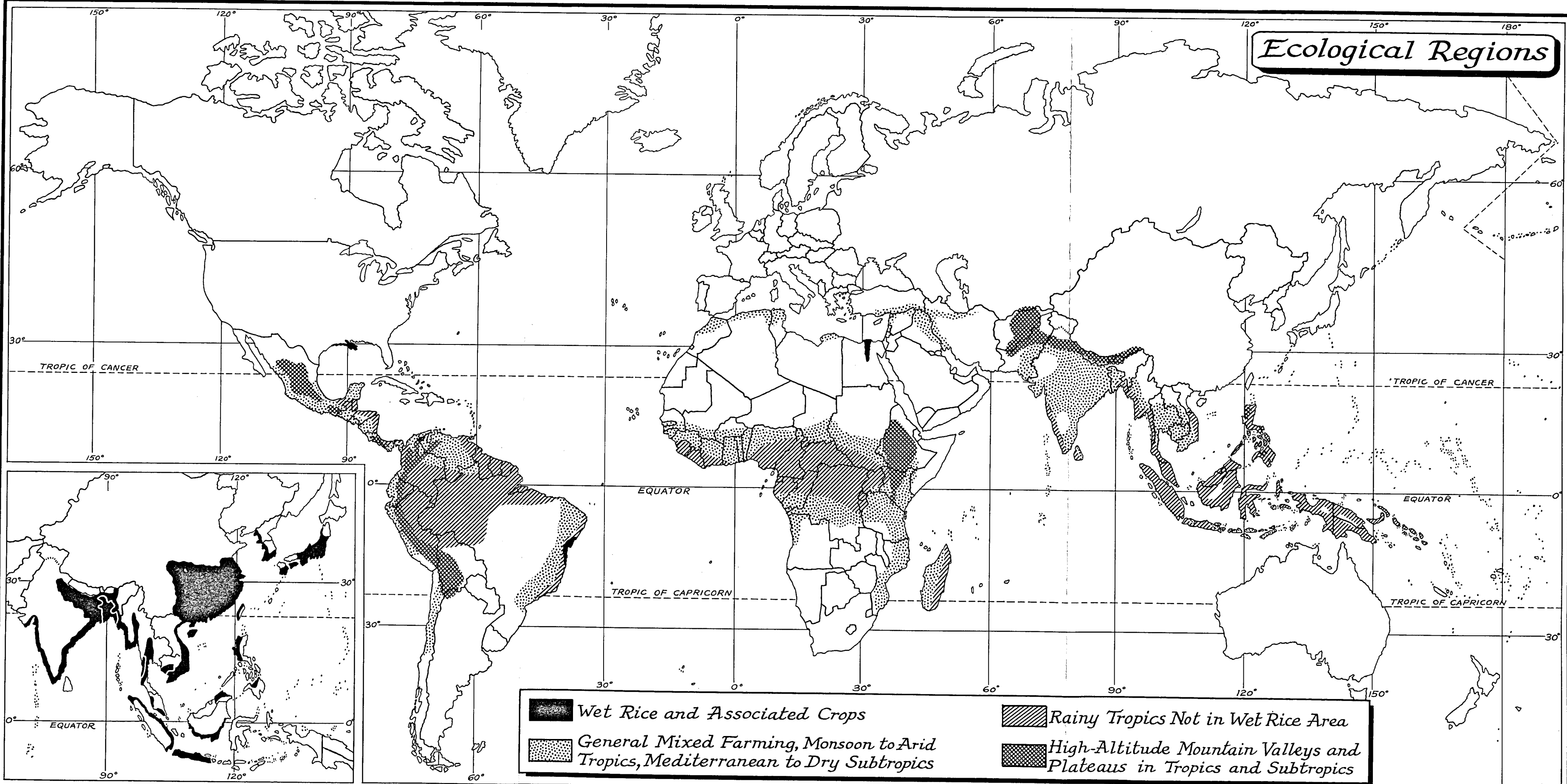
## INTRODUCTION

The following four chapters report on the studies made by conference subgroups on four major ecological regions: the region of wet rice cultivation, the rain-forest tropics, the monsoon and subtropical region, and the mountain valley and plateau region of the tropics and subtropics. These regions are shown on the map that follows.

Taken together, these regions contain a majority of the world's inhabitants. However, each subgroup focused its discussions on those parts of each region with which its members were particularly familiar. The areas actually reported on are stated in each chapter. The areas studied and the wider regions shown on the map are both approximate and overlapping. Ecological regions shade imperceptibly into each other, and, as the inset map shows, wet rice cultivation occurs in the rain-forest tropics and in subtropical regions.



# Ecological Regions





## Chapter Seven

### THE WET RICE REGION

#### THE REGION AND ITS PROBLEMS

Wet rice regions predominate in the rainy tropics and subtropics of East and Southeast Asia where the rainfall is adequate for paddy cultivation. Here we consider the rice growing regions of Japan, Taiwan, the Philippines, Thailand, Indonesia, Vietnam, Laos, Cambodia, Burma, East Pakistan, and Southeast India.

Projections of the demand for food in most of these countries indicate that, assuming the present regional population growth rate of about 2.4 per cent and the present degree of self-sufficiency, an annual increase in food production of from 4 to more than 5 per cent is necessary to meet the demand associated with a modest rate of economic growth. But the actual rates of increase have averaged only about half this required rate. Little additional land is available, and yields are increasing slowly because changes in traditional methods of farming and water management are slow.

We therefore set ourselves the task of identifying the "package" of measures--of technological improvement as well as socio-economic policy--that could increase production per acre more rapidly over the next few years and at the same time provide the foundation for sustained growth over the longer run.

Although this report concentrates on means to increase productivity per acre we recognize that measures to promote equity are very important and should receive special attention. Such measures are valued in themselves; they are required to maintain social and political stability during the period of agricultural development,



and in some situations they make a necessary contribution to incentives for increasing production. It is also our belief that raising the level of living over the longer run requires that measures to control population growth be coupled with measures to increase food production.

An important objective for the wet rice region should be diversification of the human diet. The need for proteins and vitamins is acute in these areas. Therefore the program should aim at a progressive shift from rice monoculture to diversified agriculture as well as at an increase in the volume of rice production. Such a shift is also an essential condition for any substantial long-run growth of output in these areas.

Five types of problems were identified as being of general importance in the region. They are economic incentives, the use of fertilizer and other improved practices, multiple cropping and water, improved organization for agricultural development, and land tenure. Significant differences exist among the wet rice countries in the effectiveness with which they have handled their problems. These differences and the associated differences in productivity underline their critical importance to the effective intensification of agriculture in the wet rice region.

#### Economic Incentives

The ratio between the market price of rice and the cost of fertilizer and other purchasable inputs is much less favorable to the farmer in most of these countries than in Japan or the United States. The price-cost ratio is particularly unfavorable in the export countries of Thailand and Burma, where domestic rice prices are held substantially below world export prices. In India the spread between the prices in producing and consuming regions is high, and price fluctuations are wide because of regulations hampering grain movements and the lack of effective price guarantees. Wide variations in rice prices are characteristic in several other countries, whereas price supports have stabilized rice prices in Taiwan and Japan.

In contrast to the relatively low price of rice, fertilizer prices are substantially higher in most of these countries than in the United States or Japan. In several countries the price reflects import regulations or higher-cost domestic production. High distribution costs represent another important factor in the cost of fertilizer to the farmer.

Measures to improve economic incentives will be necessary. These may include raising rice prices, price supports, reduction in input prices, and innovation insurance schemes, depending on the situation in the various countries. (See Chapter Four.) However, in exporting nations where domestic rice prices are significantly below the export price, and in importing countries where the price is low relative to other imported goods, we believe that a case can be made for raising prices. We feel that higher prices will promote the use of yield-increasing practices and are simpler to administer than input subsidies. The general association of prices with yields and fertilizer consumption is shown in Table 6.

TABLE 6. RICE: PRICE, YIELD, AND FERTILIZER CONSUMPTION

Country	Price of Rough Rice (U.S. Cents Per Kg.)	Kgs. of Rough Rice Equiva- lent in Price to 1 Kg. of N	Total Con- sumption of N, P, K (Kg. Per Hectare)	Yield (Kg. Per Hectare)
Japan	18.5	1.44	204	4,750
Taiwan	10.0	4.10	144	3,080
India	8.6	4.40	2.43*	1,510
Malaya	8.3	3.98	23	2,390
Vietnam	7.1	5.98	5.0	2,120
Philippines	6.3	4.83	11.0	1,100
Indonesia	6.1	5.39	13.2	1,720
Thailand	4.7	6.70	.012	1,390
Burma	3.0	9.53		1,620

\* Average for all crops.

### Fertilizers and Other Improved Inputs

Present usage of fertilizer on rice is much higher in Japan and Taiwan than in the rest of the region. The importance of fertilizer and improved practices in increasing production, however, is recognized in virtually all countries, and in several of the countries fertilizer production is being rapidly expanded. Substantial results can be obtained with known fertilizer and technology. For example, the Indian Council of Agricultural Research has recently summarized the results of an extensive series of fertilizer trials on farmers' fields. For rice they indicate returns of roughly 200, 120, and 20 pounds of milled rice, respectively, for 20-pound inputs of N,  $P_2O_5$ , and K. Comparing these figures with those in Table 6 shows that the 10 to 1 return on N provides an economic incentive in some countries but not in others.

Effective distribution and pricing of fertilizers, pesticides, and improved seeds require study and action. Both the availability and costs of fertilizer present major problems; improved varieties of seed have been developed, but seed multiplication is a major problem.

### Multiple Cropping and Water Management

This factor deserves special emphasis in the wet rice region area. Most rice is still grown under a system of uncontrolled annual flooding that limits production to a single crop a year. Multiple cropping of rice and other changes in the cropping pattern can be introduced only if water management is improved, which would give much wider scope for increased fertilizer use and varietal improvements. However, water management also increases the needs for research extension and credit.

The use of irrigation and multiple cropping varies greatly in the region. Most of the riceland in Taiwan is irrigated and multiple cropped; in some parts of India and East Pakistan there is considerable flooding and supplementary well irrigation together

with substantial areas serviced by improved canal irrigation, drainage, and tube wells. In most other wet rice areas, irrigation development is under way, but the portion of the land benefiting from the controlled use of water remains small.

#### Organization for Agricultural Development

In contrast to the rain-forest tropics (see Chapter Eight), considerable fundamental research has been done on the problem of the wet rice region, particularly in Japan, Taiwan, Thailand, India, and the Philippines. This research effort has recently been bolstered by the establishment of the International Rice Research Institute. A major gap in the research program, however, appears to be in providing a continuum from fundamental research to applied research and to use in agricultural development. Much more applied research is needed on crop rotations, high yielding varieties that will respond to fertilizer and water management, the use of high-analysis fertilizer, and pest control.

The organization of government services in the wet rice countries generally displays three characteristics: multiple ministries and departments servicing agriculture; commodity-oriented research and extension; little involvement at the local level. Increased governmental responsibility in agricultural development has given rise to several experiments with ways of improving coordination and making local assistance to farmers more effective. We found four kinds of organization particularly noteworthy: the JCRR organization in Taiwan, which has the role of planning, acting as a catalyst, and providing financial support for programs of agricultural development at all levels working through public, cooperative, and farmer organizations; the Comilla project in East Pakistan, which has successfully emphasized a program of training farmer leaders and the development of integrated local programs;\* The Indian Package Program, which is attempting, but with

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\* JCRR and Comilla are described in Appendix A.

considerable difficulty in some areas, to work through the existing agency structures in securing adoption of a package of improved practices in selected regions; the community development programs in the Philippines and India, which have attempted to achieve coordination of a broad spectrum of programs relating to rural development.

The experience of these programs indicates the importance of organization at the local and the national levels. In most countries further improvements in administrative machinery and in training workers are needed to implement effectively rapid agricultural development.

#### Land Tenure and Agricultural Productivity

The region is characterized by a large agricultural population and large numbers of small farms, and in most of the area a substantial land-tenure problem exists. We believe that these two questions--size and tenure--are decidedly different in character.

A change in farm size was not felt to be of priority importance. Available evidence suggests that small farms now make more intensive use of the land than larger farms. The relevant inputs for increasing agricultural productivity, such as new varieties and improved water and crop practices, involve no substantial direct economies of scale in terms of land. Much of the mechanization needed--irrigation pumps and transportation, for example--will not involve change in farm size. Increased use of tractors is desirable in places, but group ownership and custom rental can effectively provide power for the critical operations on small farms.

The existing structure of land tenure, on the other hand, is an important barrier in many wet rice areas.\* Japan, Taiwan, South

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\* See Appendix F on land reform and Chapter Four on the economics of land tenure.

Vietnam, Thailand, and Burma, nations where the percentage of tenancy is low, are the major exceptions. In the other countries the prevalent tenancy practices, such as the payment of share rent without any sharing of the purchased inputs, are important deterrents to increased productivity.

In India, Pakistan, and the Philippines, land reform legislation has been passed but not fully implemented. Owing to the complexity of the individual cases and the need to determine the specific modifications that are both required and feasible, we do not recommend a detailed program for immediate action. Empirical study is needed and should be given high priority.

#### General Considerations

Our review of current problems suggests that actions need to be taken to alter the physical, economic, organizational, and knowledge environment of the wet rice region. We also suggest that these actions must take account of the varied cultural and communications problems existing in the different areas and villages. The differences in cultural values, village attitudes, and family and social organizations are great, and these variations directly influence the means used to attack the problems we have discussed.

The major question is not what in general should be done in the wet rice region; rather, it is how a more effective program can be mounted in specific countries and areas. What this means is that any action program must take into account limitations of human, financial, and other resources and the nature of the organizations that now exist. It should involve the design of a minimum effective package fixing the priority and complementarity of different measures, setting the timing sequence for action and study, and the identification of specific methods that will be both effective and feasible.

Since the design of the package will vary among areas and countries, the study group analyzed specific situations in order to gain insight into the critical elements of the package. We

examined the history of the successful program in Taiwan. We then outlined a program for the Central Plain in Thailand.

#### AN ILLUSTRATIVE CASE: THAILAND'S CENTRAL PLAIN

We selected the Central Plain of Thailand as the area for our attempt to outline the relevant variables and priorities in a "systems" approach to agricultural development. The program we present here is not a blueprint to be applied in other situations. It is neither the only nor perhaps even the best possible program. It does, however, illustrate the factors that go into the package.

Most of the rice cultivation in this area depends on annual flooding. The total area under rice in Thailand is about 15 million acres; in spite of the existence of an extensive network of irrigation, dams, and canals serving about 4.3 million acres, a second crop of rice is raised on not more than 100,000 acres. However, irrigation projects that are now under way with aid from the World Bank are likely to make multicropping possible in the near future on over 1.5 million acres of paddyland in the Central Plain and to provide or improve wet-season irrigation on almost 4 million acres.

Traditional farming methods persist. Many farmers hesitate to use fertilizers both because of a lack of water control and because of their belief that the fertilizer they apply will flow over to other farms. The marketing and milling of rice also continue to be traditional. Rice exported from Thailand has the reputation of being poor in quality. The government levies an export "premium" tax of about \$50 on each ton of rice, which, by depressing the price received by the farmer, discourages an increase in fertilizer consumption.

Many credit cooperatives have been organized by the government, but they are small and do not adequately provide production

credit. The Rice Department of the government has also organized farmers' clubs in some villages. They help spread the knowledge of better farming practices, and in some places they engage in informal lending and group marketing.

Traditionally the government supplies free irrigation water from its works. The Rice Department carries on a number of research, pest-control, and educational activities.

#### Assumptions of the Program

Keeping this perspective in view we have outlined two packages of measures that should be taken, the first in the shorter run and the second in the longer run. The measures are classified under five headings: physical, economic, organizational, knowledge, and psychocultural. We must emphasize that most of the measures suggested are highly complementary; they can increase productivity much more in combination than in isolation. It is also necessary to state the basic general assumptions of the program for agricultural development. These are as follows:

The national leadership will be committed to such development.

The administrative system will be reorganized to meet its needs.

The need to create local structures to secure the maximum participation of the people will be recognized.

The following criteria have been used in selecting and timing the recommended measures: Priority is given to measures that can bring about immediate increases in crop yields and that will provide strong economic incentives to farmers to increase productivity. Immediate action should include measures that may have enduring long-range effects, in particular, research to prepare the ground for measures to be taken on a large scale at a later date.



Short-Term Measures

Rice production could be substantially and economically increased by the greater use of fertilizer and other improved practices. Short-run measures should be directed toward the economic, organizational, and knowledge environment of the farmer in order to increase the use of these inputs. Equally important will be the steps taken now to provide the basis for the longer-term development of an intensive irrigated agriculture.

Physical

1. Fertilizer. The principal measure concerning physical inputs should be the use of fertilizer. Since this input depends largely on the ratio of the price of fertilizer to the price of rice, the main action to be taken is economic and is discussed below under "Economic" heading. However, studies should be undertaken immediately to determine yield responses to fertilizers and to explore economies in their mixing, handling, and distribution.

2. Seed. Supplies of the presently known improved rice varieties should be multiplied and distributed more extensively. These varieties are expected to increase yields by 10 per cent. Existing seed multiplication stations should be used, and outstanding farmers in the farmers' clubs should also be enlisted to produce approved seed.

3. Fish and livestock. The practice of raising fish in rice paddies, now prevalent in some areas, should be expanded, and farmers should be helped to expand home poultry flocks.

4. Pest control. Immediate action should be taken to strengthen pest-control research and regional pest-control services. Additional pest specialists should be trained and posted to rice areas.

5. Water management. In anticipation of further irrigation development, one or two farmers in each district,

chosen from among those who already receive off-season water, should be assisted to become pilot farmers within about two years. (See fourth measure under "Knowledge" heading.)

6. Public works. Old local roads should be repaired and maintained and new local roads built to link up with roads constructed under the irrigation development program. This construction would reduce underemployment in the short run and facilitate the marketing of additional produce in the longer run.\*

### Economic

1. Price incentives. One of the most effective measures would be to increase the domestic price of rice to the world level. The farmers' price would thus be raised from the present level of \$40 to about \$74 per ton of paddy and would make it profitable for the farmers to use moderate amounts of fertilizer, as the following calculations show:

Cost per acre of 200 lbs. of fertilizer @ .04 per lb.	\$ 8.00
Value of 500-lb. yield increase @ domestic price	\$10.00
Value of 500-lb. yield increase @ world price	18.50

Thus the farmer's net return per acre would increase fivefold from \$2 to \$10.50. The application of pesticides would also become more attractive, and farmers would be induced to invest in irrigation pumps and the leveling of land.

The question of the advisability of maintaining or dropping the export tax is a complex one that involves fiscal and other considerations on which we cannot pass an

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\* The use of public works programs to reduce rural unemployment is discussed in Chapter Four.

informed judgment. If the Thai government feels it necessary to keep the tax, an alternative would be to grant a subsidy of about 50 per cent on the price of fertilizer. In the preceding example this subsidy would result in a farm income gain of \$2.30 for each \$1.00 spent on fertilizers, and the cost to the government would amount to \$20 for each ton of increase in paddy production. Since nearly all the increase would be exported, the government would receive a tax revenue of \$34 per ton of paddy exported.

2. Supply of inputs. The domestic price of fertilizer is unduly high in Thailand--nearly twice the world price--because of the deficiencies of the transport and distribution system. Therefore a study of the processes of fertilizer transport and distribution should be undertaken with a view to removing the deficiencies discovered.

3. Marketing. A similar study of rice milling operations should be made with a view to improving the efficiency of the marketing system and the quality of milling.

4. Credit. The comparative efficiency of various alternative farm credit agencies--production credit associations (cooperatives), state-aided local private banks, and farmers' clubs--should be evaluated. In anticipation of future needs, supervised credit experiments should be organized in cooperation with each type of lending agency.

### Organizational

1. Discussions and negotiations should be initiated for the establishment of rural development boards and related institutions in accordance with proposals outlined under "Organizational" in the section on longer-term measures.

2. The number and the functions of farmers' clubs should be expanded, and a few pilot farmers' associations should be organized. Each association would serve a number of farmers' clubs, channel credit and farm supplies through them, and eventually undertake marketing.

3. A cadastral survey and a survey of landownership should be organized to expose such problems as imperfect titles and fragmentation.

#### Knowledge

1. Applied research. Government support should be obtained for the establishment of a general regional research center to study all aspects of the cultivation of rice and other rotation crops relevant to Thailand--soil fertility management, engineering, farm management, marketing, and possibly livestock production. This center may be one of those recommended in the World Bank program for Thailand.

2. Local units. Government support should be obtained for the establishment of farm research units in the districts. These units would be directly associated with the regional research center, and each would be operated by a farmer.

3. Extension officers. Recruiting and training of the substantial number of additional officers needed for the expanded extension program in the area should be begun.

4. Training. One or more district centers should be established for the training of extension officers, farmers' club leaders, and farmers' association leaders and for the training of key farmers selected by local clubs as pilot farmers. Initial training courses for these men should be started within a year.

5. General education. Plans should be made to expand general adult education and to improve the use of mass media for rural education.

Psychocultural. A series of studies should be launched with the following objectives:

1. To determine optimal approaches and points of attack (or nonintervention) for the program.

## The Wet Rice Region

2. To help identify potential rapid innovators (both individuals and groups), who can be effective in the diffusion process.

3. To identify, encourage, and enlist local leadership, both formal and informal, and local institutions in support of the program.

4. To identify locally "felt needs" as well as externally perceived needs.

5. To identify existing channels of communication and if necessary suggest new ones.

6. To provide on-going evaluation and feedback on program impact for possible reorientation, substitution, or recombination of program elements.

The knowledge gathered through these studies should be continuously used to improve the priorities of the program, the methods of introducing innovations, and the administrative and institutional structure of the program.

### Longer-Term Measures

In the longer term the physical milieu will be characterized by an enormous increase in the supply of dry-season irrigation water and better water control in the rainy season through irrigation, flood control, and drainage. Efficient use of this added resource will require large increases in all physical inputs. In the following list of measures required to achieve this balanced increase in inputs, it is assumed that the short-run measures will be continued and that the results of studies undertaken in the earlier phases will be translated into action programs.

#### Physical

1. Fertilizer. The use of fertilizer should be increased to about 80-100 pounds of plant nutrients per acre on suitable soils. Progressive use of mixed higher-analysis

fertilizers can greatly reduce fertilizer costs; it should be stimulated.

2. Seed. Research on new varieties of rice and other crops will have to be accelerated. New varieties should be able to stand high-analysis fertilizer doses and should have early maturation and other characteristics required by a multiple-cropping system.

3. Multicropping. Multiple cropping of rice and new crops should be extended on the basis of studies of their economic and agronomic feasibility. Green manuring should be introduced wherever feasible.

4. Mechanization. Increased farm output will require a re-examination of the role of mechanization. It may be advisable to introduce mechanical power and equipment for pumping, for deep plowing, for turning green manures, for shelling, threshing, and drying, and for transportation. The specific processes to be mechanized and the equipment to be used will have to be determined on the basis of engineering-economic studies.

#### Economic

1. An effort should be made to evolve a consistent tax and price policy consisting of a lower rice export tax and/or higher minimum price guarantees. Then the fertilizer subsidy can be reduced, and perhaps a charge for irrigation water can be levied. Alternatively the fertilizer subsidy and the free water policy will have to be continued, and perhaps new subsidies will have to be added. It will always be necessary to minimize the cost of fertilizer distribution.

2. With the expansion of new crops, some of which will have only national or regional markets, action will be necessary to limit price instability of a few selected crops.

3. A market information program should be inaugurated.

#### Organizational

1. The main long-run organizational proposal is an approach to coordinated rural development in the Central Plain. The irrigable land under the existing or planned irrigation projects will comprise all or parts of fourteen provinces. An effective system of farm services will be necessary to capitalize on the opportunities for an intensive irrigated agriculture. These opportunities justify a special concentration of effort in this area.

Diffuseness characterizes the ministries and technical departments that would be involved in irrigation development. The present Coordination Committee for Rural Development is concerned only with the rural development program in the northeast. Some liaison and coordination of technical services are provided by governors at the provincial level and by the district officers at the district level.

Traditionally in Thailand water is free to the cultivator, and there are no irrigation districts or devices other than a few land development cooperatives of limited effectiveness to elicit self-help from farmers for constructing or maintaining small local works.

In connection with the World Bank loans for the Chaophya and Petchburi projects, to help farmers utilize the water the Thai government has proposed action along the following lines:

- (a) A water management staff, including a supervising engineer for each major canal and one for each lateral canal, and part-time ditchriders selected by the farmers but paid and supervised by the Royal Irrigation Department.
- (b) For crop improvement and farm management two experiment stations, involving some pilot-farm features, near Chainot and Petchburi.

(c) For extension advice to farmers more extension offices, and some farm management advisers may be added.

In view of the major expansion in agriculture that is required and the new crops to be introduced, a major expansion and coordination in government services is called for in order to assist farmers in the use of improved practices and in the selection of crops on the basis of scientific knowledge and economic feasibility. Farmers' organizations are needed to help farmers plan their operations and make known to the Irrigation Department their water demand schedules. More outlook and marketing services will be required, as will extension advisory work on production practices and farm management. As economic development proceeds, there will be additional demands for improved health and social services. Any plan that involves group action at the level of the farmer should be developed in consultation with the farmers and local officials that will be involved in it.

The following recommendations are suggested to serve as guides to the reorganization and coordination of the agencies involved in rural development:

Provide for the identification of local farm leaders, preferably by their fellow farmers.

Provide for these leaders to receive training for the responsibilities of group action and leadership in educational programs relating to improved production practices.

Encourage farmers to form associations or clubs (perhaps building on the present farmers' clubs) in which they can work together to plan water deliveries and crop rotations and to act jointly in the procurement of farm supplies and credit and in marketing.

Provide for the federation of those clubs on a scale adequate to permit high-quality management for farm supply, credit, and marketing services.



## The Wet Rice Region

Establish a strong permanent national body to plan, direct, help finance, and coordinate the regional program for irrigated agriculture. This body might be specific for this purpose, or it might cover rural development generally. Leadership in this body should be outside any existing ministry. Each affected ministry should have membership on the new board, which would be responsible for developing an over-all plan and budget and for seeing to it that necessary actions are taken by the appropriate agencies at the right time. As required, it would provide supplementary funds for the various agencies to perform the special jobs called for by the program.

Emphasis should be placed on interministerial coordination at the provincial and district levels, utilizing and strengthening the present arrangements for such coordination.

The central board should make maximum utilization of existing agencies. It should be primarily a coordinating and perhaps a financing body for the work done by the technical ministries.

A credit system should be provided so as to facilitate new inputs in accordance with approved farm plans. If a central agricultural credit agency is not established, the board should provide funds to local credit agencies such as farmers' associations and local cooperatives.

2. Land tenure. Action should be stepped up to clarify titles, and provisions should be made to exchange land needed for irrigation works.

3. Local government. Steps should be taken to strengthen local self-government by giving local bodies greater responsibility for the administration of local affairs. The farmers' associations and clubs should be encouraged to press local government units to build and maintain local public works.

Knowledge

1. The regional research center should be developed.
2. Applied research and training centers will be expected to provide a continuous flow of adapted and proven new information and to give in-service training to the extension workers of the area in subject matter and teaching techniques.
3. Farmer leaders will themselves act as vital disseminators of new ideas absorbed in the course of training at the district training centers and at farm demonstrations run by the pilot farmers.

Psychocultural. Evaluation of current programs and feeding back the results of evaluation should be a continuous aim of the psychocultural studies suggested in the short-run program.

## RESEARCH AND RESEARCH-ORIENTED ACTIVITY

Despite an extensive literature on various aspects of wet rice production, wide gaps in knowledge still exist. Research is needed in the areas of agricultural technology and economics as well as in rural social organization and the behavioral sciences. A selected list designed to help fill the gaps between present research efforts and the knowledge needed for effective action is presented here. It should be pointed out that the items are not listed in order of priority. Moreover it is assumed that, no matter how narrowly stated, the broader social aspects of any problem will also be investigated. It is recognized, for example, that in developing locally adapted varieties of rice an investigation of the social milieu in which the new varieties would be introduced is also necessary in order to resolve the attendant problems of dealing with farmer attitudes and formulating effective extension techniques.

To derive conclusions that will be relevant to specific situations and will also have some generality, we suggest that, wherever possible, research projects with a common design be undertaken in several regions. What is already known must be collated and evaluated both to provide some guidance to actions that must be taken now and to limit research to the critical unknown factors.

On some of the topics listed we suggest that experimental action research be undertaken in addition to the usual survey-and-analysis studies.\* Thus, for example, the yields of different farms deliberately organized on different patterns and following different sets of practices can be analyzed; village plans with different priorities and institutional structures can be implemented and evaluated; alternative subsidy, price support, and insurance schemes can be administered and evaluated; alternative marketing agencies, fertilizer distribution agencies, and tenancy and loan contracts can be promoted and their performance evaluated.

#### Suggested Research in the Natural Sciences

##### Crop improvement

1. Cereals. Local adaptive, problem-oriented research coordinated with the regional research on rice, wheat, maize, and sorghum being conducted in the Philippines and India.

2. Other food crops. (a) Vegetables: coordinated regional research on the development and production of disease-resistant, nutritive, and high-yielding varieties. Special attention should be given to crops that could be used along with rice in multiple-cropping systems. (b) High-protein crops: coordinated regional research on pulses and oilseed crops for human consumption, with emphasis on disease resistance and yield potential.

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\*The topic of adaptive research in institutions is discussed in Chapter Two.

Soil and water management

1. Local adaptive research on the nutrient status of soils and on the use of local and chemical fertilizers. This should include trials on rates, kinds, and methods of applying chemical fertilizers.

2. Research on the development of more intensive farming systems. This will involve a range of crop rotations going up to four crops per year and will require major adjustments in the use of land, water, fertilizer, labor, and management.

Farm power and equipment

1. An aggregate engineering-economic study of current and prospective requirements for farm power. It should include the costs and benefits of using off-farm sources of energy, as compared to on-farm sources, and the effects of mechanization on land productivity.

2. Farm equipment suited to small as well as large-size operations should be improved or developed.

Storage and processing

1. Storage: local adaptive research on improved storage at the farm and in market centers, which would include studies on the control of insects and rodents.

2. Processing: adaptive research on the processing and utilization of by-products.

Research Projects in Economics

Six major problem areas in economics are considered to warrant high priority in any program of research designed to aid the formulation of agricultural policy:\*

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\* See Chapter Four for a general discussion of economic factors.

Farm yield variations. In almost all rice regions, yields realized by farmers vary widely. Sometimes the best farmers realize yields that are higher than those at experimental stations. The reasons for interfarm variations in yields should be studied. The high-yield farms need special attention in order that transferable items in their practices may be identified and incorporated in recommended "packages" for general diffusion. In India the high-yield, innovating sector of ex-landlord farms should be surveyed.

Supply response. More wide-scale quantitative studies of the responsiveness of acreages and yields of individual crops and groups of crops in specified regions to movements in the relevant prices as well as to important nonprice factors are urgently needed to guide price policy decisions. Studies of the responsiveness of yields--particularly in areas where they have registered significant upward trends--will involve, first, the identification of input changes associated with yield variations, then the effects of price changes and other factors on the use of inputs. Studies of supply response will reveal how far the responsiveness of supply to price movements is related to the stage of development that different regions have reached. The comparative efficacy of input subsidies and product price guarantees and of alternative forms of "innovation insurance" also needs to be investigated.

Marketing. Empirical analyses of the cost of marketing (the so-called "spread" between the farm harvest prices and the wholesale market prices) major staple crops and of the individual components of the total cost of marketing are badly needed to indicate the type of marketing reform really required. Price variations from year to year, from month to month within a season, and from region to region need to be analyzed and accounted for in terms of the costs of processing, transportation, and storage, borrowing practices, interest rates, and public policies. The nature and extent of monopoly in marketing should be identified.

Where alternative types of marketing agencies operate side by side, it is necessary to quantify and compare their respective marketing costs and efficiency.

Fertilizer distribution. In many countries substantial quantities of chemical fertilizer have become available from imports and/or domestic production. But the fertilizer distribution machinery is reported to be very inadequate. As a result, fertilizer supply cannot have its full effect on production. The cost and efficiency of fertilizer distribution by different kinds of agencies should be studied. The extent to which existing agencies can handle--or new agencies are required to handle--fertilizer distribution should be determined. Recommendations should be developed for coordinating sales, demonstrations, and the supply of credit. Measures required to improve mixing, storage, delivery, and application facilities should be highlighted.

Tenancy. Although there is a large body of literature on the evils of existing tenure systems and on the laws enacted to remedy these evils, very little empirical material is available about the actual tenancy arrangements prevalent in different areas and the particular schemes of sharing output, inputs, and managerial decisions implicit in them. (See Appendix F.) Often traditional tenancy arrangements of various kinds persist in spite of their legal abolition; legislation changes only their formal description, not their actual content. If large numbers of actual tenancy contracts are empirically documented, their productive and distributive effects can be analyzed with a view to selecting the ones that are the least undesirable and at the same time are enforceable in practice in specified areas, assuming the short-run limitations of public administration and the bleak prospect of changing the man-land ratio.

Credit. The knowledge of loan contracts is not very much better than that of tenancy contracts. Therefore similar empirical

studies of actual lending terms in a large number of actual transactions are needed. The extent of monopoly in moneylending should be determined. The risk element, the real interest element, and the cost of collection in the actual interest rates charged need to be separated. These data would provide a basis for improving the operations of the new agencies created to channel government funds.

#### Social and Organizational Studies

Maximum value will be derived from the studies proposed here if they are carried out in farm communities in which comprehensive understanding of social organization has been obtained. Ideally then they should be made in selected communities representative of key types in the wet rice regions (for example, subsistence and cash crop, and monocultural and diversified land use) where intensive community analyses have been initiated. There is little need to present a detailed outline of the subject coverage of community studies; they are sufficiently well known. However, it should be stressed that any research program leading to actions designed to obtain increases in agricultural productivity must take into account the existing social system with its local interlocking of religious, political, economic, and cultural features and must assess new knowledge factors in the program of change with respect to their possible harmony, neutrality, or incongruence with present cultural beliefs and practices. This presumes the availability of ethnographic and sociological information about the community or about similar communities against which consideration of proposed new knowledge or new technique inputs would be made. In the many wet rice regions where such data are scant or do not include recent cultural changes, systematic studies are necessary. Even when ethnographic information is available, special studies are generally needed on the methods of program implementation and on the agents of change.

Methods of program implementation. Studies are needed in a number of areas, but only a few are suggested here:

1. The timing, sequence, and combination of program elements.
2. The applicability of various extension techniques and methods, such as working with individual "farm cooperators" versus traditional groups.
3. The determination of effective incentives for change--communication, health, economic factors, and the like.
4. Experimentation on motivation and social effectiveness in innovation with those who conform to and press others to conform to local ways; those who conform but would readily change if motivated and not subjected to negative sanctions; and the local innovators (deviants and nondeviants).

Agents and agencies of change.

1. Analysis of agricultural information-transmitting agencies such as extension services and community development agencies, including their relative success or failure at the village level; farmer perception and evaluation of their programs and personnel; role analysis and experiments to secure optimal criteria for selection of village-level workers.
  2. How needs for agricultural research are communicated from the village level to researchers.
  3. Experiments in training requirements of village-level workers.
  4. Analysis of local institutions and leadership, both traditional and externally created, with respect to potential roles in an action program.
  5. Study of the farmer's encounter with bureaucracy.
- In the final analysis the effectiveness of any program depends



upon its facilitating the farmer's effort to innovate, enabling him to absorb more knowledge and resources. It is necessary to articulate his experience with bureaucracy--his cost in time, money, energy, and self-respect in his efforts to obtain permits, loans, supplies, water releases, and resolution of disputes.

#### Integrated Research Studies

Village planning. It would be extremely instructive to attempt some experimental planning for a single village. Such planning would reveal the changes in a given situation that can and should be made at the individual farm and those that can be made more effectively through group action at the village level. The spheres of efficient micro- and macro-activities can thus be demarcated clearly. Experimental planning would also indicate the resources that can be mobilized for development by individual farmers and village communities and the resources that have to come from outside the village. Finally, an institutional structure most suited to the needs of development can be designed as a part of village planning.

Farm research units. Experiments should be made with the development of owner-operated farm units in selected key communities that would put into practice the results obtained from small-scale research trials and combine them into a farming system. Such a unit, associated with agricultural research stations, would provide a larger-scale test of various practices for crop, poultry, livestock, and fish production and of their compatibility. It would make possible an economic analysis of the new system and serve as one proving ground for the development of program "packages."

## Chapter Eight

# THE RAIN-FOREST TROPICS

### THE REGION AND ITS PROBLEMS

The region consists for the most part of a belt around the world some five degrees north and south of the equator interrupted in places by higher elevations or by the effects of those elevations on the movement of the tropical air masses. It includes much of Indonesia and Malaysia and the delta of the Ganges in Asia, a strip across most of Africa including the basin of the Congo, the Amazon basin and the western lowlands of Ecuador and Colombia in South America. We examined in detail the present status and relative importance of the factors affecting agricultural productivity in Malaya and in southern Nigeria. Some attention was also given to the needs of the Amazon basin, and the situation in Malaya was compared with that in Sumatra and Java.

The climate of the region is characterized by high temperatures during the whole year, generally high humidity, and high rainfall that tends to be distributed throughout the year.

Most of the soils are latosols--very old, highly leached, low pH, and low organic matter types. Characteristically, few available plant nutrients are held in the soil. Nutrients must be captured by growing plants as they become available and held in the biological cycle; otherwise they are rapidly lost by leaching. Interspersed with these latosols are smaller areas of younger alluvial and hydro-morphic soils.

Agriculturally the region may be subdivided into four major types:

1. Wet rice culture, where feasible because of availability and control of water. This part of the rain-forest tropics is discussed in Chapter Seven.

2. Tree crop agriculture, where primary emphasis is placed on tree cash crops (rubber, cacao, oil palms, coconut, bananas) with food crop production as a minor, ancillary sector for subsistence purposes. Such areas are densely populated, have well-defined farm units and well-developed local social and other institutions. They are typical of much of Sumatra, Java, Malaya, and parts of East and West Africa.

3. Traditional agriculture based on the "slash-and-burn" or land-rotation method. It is dependent largely on subsistence crops. Only a fraction of the total area is cultivated at any one time. Soil productivity declines very rapidly under cultivation, and years of "bush fallow" are required to restore productivity. In general such areas are sparsely settled. Enterprises that can be identified as farm business units, as the term is commonly used, generally do not exist. Existing social organization and structure tend to be those characteristic of the extended family and tribal systems.

4. Vast areas of unsettled jungles that contain nomadic isolates. Such areas are found in parts of the Amazon basin and in parts of Africa. Even in the regions of settled tree crop and traditional agriculture there are substantial areas of unsettled land that can potentially be developed.

#### The Primary Problem

The primary problem appears to be the development of a system or systems of mixed crop-livestock farming suitable to soil and climatic conditions that will make it possible to (1) expand food production in the settled areas of tree crop and traditional agriculture, (2) provide profitable diversification in these areas, and (3) develop in the presently unsettled areas a settled agriculture that is not so critically dependent as at present upon the tree cash crops.

Historically agricultural development in the rain-forest tropics has depended largely on the introduction of tree cash crops or the superimposing of these crops on traditional agriculture. This has generally been successful because, first, the tree crop agriculture closely approximates the original ecology of the region and it has therefore not been particularly difficult to develop cultural and soil management patterns conducive to maintenance of high levels of productivity and, second, the products of the tree crops have been important sources of revenue owing to world market demand.

In the settled areas predominantly dependent on tree crops several factors point to the need for change. First, rapid population growth is placing severe strain on domestic capacity to meet food requirements. Food imports in some nations have already reached a significant proportion of total imports. Food imports obviously reduce the foreign exchange available for the capital inputs needed for the modernization of agriculture as well as for industrialization. Second, the tree crop sector has largely been oriented to export markets and has been concentrated in one or two crops. In many instances it has become the dominant force in the economy. Export dependence on one or two crops has made these countries highly vulnerable to international demand and to market factors beyond their control. Fluctuations in prices and income have had important consequences for government revenues and rates of capital formation. Third, several of the tree crops face an adverse or undecided future due to the development of synthetics or competing natural substitutes from temperate zone agriculture. The gradual erosion of the market for tree crop exports and the development of synthetics threatening further decline lend special urgency to the need for diversification. Most of the future growth in output should be in food crops. Nevertheless exports from tree crops will continue to be a major source of foreign exchange for many years, provided the efficiency of production can be increased. Continued attention must therefore be given to improved technology and to lowered production costs in the existing tree crop complex, and to measures for stabilizing the

international markets in these commodities. Extensive opportunities exist, for example, in the form of new, higher yielding varieties that would permit lower production costs. Important as such efforts are, however, they should not deflect attention from the long-term goal of diversification.

Population pressures are also beginning to be felt in the areas where traditional slash-and-burn agriculture predominates. With presently known methods the increasing food needs of the rural population tend to be met by shortening the "bush fallow" part of the cycle. In areas such as Eastern Nigeria the point has already been reached where yields per acre of cultivated land are declining. Although food deficiency is not as acute in Africa as it is, for example, in India, serious problems of malnutrition, particularly protein deficiency, already exist. Growing population and the decline in productivity with overcropping in the slash-and-burn system will rapidly bring about a desperate situation unless remedial measures are taken soon. Modernization of the traditional agriculture by superimposing tree crop agriculture, the only procedure that is now known to be effective in the tropical rain forest, will lead these areas to the situation faced by the settled areas where tree crops now predominate. The tree crops will not provide for their increasing food needs. A diversified food crop-livestock agriculture seems to be the best answer.

Development of unsettled areas is an immediate necessity in some countries, such as Malaysia, to relieve the population pressures in the settled tree crop areas and to provide food for the growing urban population. In still other areas, such as the vast reaches of the Amazon basin of Brazil, there is less urgency for settlement except along the fringes of the rain forest.\* However, the demands created by growth of the world population will in less than a

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\*See Chapter Ten on migration from the Andean highlands to the rain forest.

generation make necessary the development of some of these zones for food production.

The great need in the rain-forest tropics, then, is a system or systems of diversified agriculture based on appropriate mixes of tree, food, fiber, fodder, and soil-improvement crops and the necessary associated livestock enterprises. Such systems of mixed crops plus livestock are needed in all three zones of the region: for diversification in the settled tree crop areas, for modernization and increase of production in the traditional "slash-and-burn" areas, and for providing a stable productive agriculture in the new land settlement areas.

#### The Knowledge Gap

Our studies revealed that many factors and institutions required for agriculture are poorly developed or lacking. Some are immediate impediments; others are potential impediments that can be expected to assume substantial importance as soon as the immediate impediments are removed or reduced. Three factors of special relevance in the rain-forest region--extension, roads, tenure--are discussed later in this chapter.

The major immediate requirement is research on the biological-physical and socioeconomic factors prerequisite to the development of the system or systems of mixed cropping plus livestock just described. Tree crop agriculture has benefited from close ecological similarity to natural conditions and from relatively extensive research. As a result, improved varieties of rubber, cacao, and other crops have been developed. Cultural practices are available that result in good levels of productivity. Fertilizer needs and responses are well enough known to justify fertilizer use. Many of the major insect and disease pests have been identified, and control measures have been developed.

In contrast very little is known about the annual food and fiber crops beyond the accumulated wisdom of the traditional cultivators. No one has yet found a method of growing such crops successfully over

a period of years except in the traditional bush-fallow manner. No one knows how to handle the latosols under culture of annual crops without disastrous losses in productivity and irreparable damage to soil structure. There are few improved varieties for these soils. Disease and insects are prevalent, but little is known about their control. Power sources other than human are essentially unused. Productive livestock as an adjunct to a mixed cropping system is almost nonexistent. Its effective use will require much more knowledge than is now available about management practices, adapted breeds, nutrition with local feedstuffs, and disease and parasite control.

The deficiency of knowledge on the economic farm management aspects of developing a viable mixed cropping-livestock agriculture is equally great. Little is known about the economics of specific practices. As the individual enterprises are developed from the standpoint of their biological and physical feasibility it will be necessary to test their economic feasibility and their social acceptability both alone and in combination with other enterprises. Market demand studies are needed to guide those working on developing enterprises and combinations of them. No one yet knows the size of an economic farm unit. Information is vitally needed on two questions: What should be the pattern of "farm" organization? Given the desirable pattern how can it be developed out of the existing patterns? The socially acceptable units of operation for a diversified agriculture may conflict with the agroeconomically determined optimal form. Special care should be taken to allow for the continued evolution of farm patterns. It must not be assumed that a single revolutionary pattern will serve for all time.

An important question is whether diversification should be regional or within the individual farm. No clear answer can be given at this time, but several factors may be important in the final decision, including:

1. Single-enterprise farms resulting from regional diversi-

fication may require less managerial skill and may have economy-of-scale advantages over multiple-enterprise diversified farms.

2. Conversely, multiple-enterprise farms may be less affected by economic fluctuations of single commodities.

3. Inadequate roads and infrastructure may make regional self-sufficiency a short-run necessity and microdiversification a temporary but important stage toward eventual specialization.

4. Soil and microclimatic considerations may favor regional diversification with food crops grown on the "good" soils and tree crops relegated to soils unsuited for food crops.

5. Conversely, it may prove impossible to develop soil-crop management techniques for sustained food-crop production except in rotation with tree crops, thus making microdiversification mandatory.

Faced with the existing vast deficiencies in knowledge, we concluded that only relatively minor improvements in food production can be made with what is now known. Under these circumstances we concluded that the single most important requirement at this time is a research program to provide the required knowledge and materials.

This is not to deny the potential importance of, for example, farm and village storage structures, cooperatives and other farmers' organizations, extension and community development, arrangements for providing and financing inputs, marketing systems, land tenure practices, transport systems, support prices and subsidies, and many other requirements for productivity increases. It is simply that such factors can have little impact until the farmer can be shown how to diversify his tree crop enterprise, to increase the productivity of his food crops, and to develop a related and integrated livestock enterprise. Once the requisites of production technology are provided by the research-education-extension program, immediate steps will be required to provide the other necessary factors. Research to determine the optimum time sequence of these steps would be valuable.

Closely related to the needs for research and its utilization in the agricultural sector is the need for large numbers of trained



people: research scientists, teachers and professors, managers and administrators, technicians, extension workers, and, finally, educated farmers.

Fortunately the development of the necessary knowledge and the development of the trained people are complementary enterprises that can be designed to work hand in hand at the various levels at which research must be conducted.

#### THE RESEARCH AND TRAINING PROGRAM

Scientific principles have broad applicability and are generally transferable from one part of the world to another. On the other hand, specific technologies must commonly be developed for or adapted to the ecological, economic, and social context in which they are to be used. The degree of transferability and hence the place along the continuum from basic research to adaptive research at which research in agriculture in a particular area must commence is determined by the magnitude of the differences between that area and another in which knowledge and technology are far advanced. In this respect the problems of the tropical rain-forest area are quite different and for their solution require more basic research than is characteristic of most other underdeveloped areas. Less of the knowledge and fewer of the technologies from developed areas can be transferred profitably to the rain-forest tropics. For example, soil management practices adapted to the temperate zones are not useful and are actually harmful in the tropical rain-forest areas.

Research in agriculture is a continuum from the basic biological studies of soils, plants, and animals to demonstration and research trials in farmers' fields of fertilizer or pesticides or new varieties. A parallel continuum also exists for the economic and social sciences. Moreover the continua for the biological, physical, and social sciences are closely linked and interrelated, with the usefulness of any one limited by the lack of the other. By its very nature,

research on the problems of agriculture is an enterprise requiring long-term commitments of support and often many years for the ultimate solution of important problems. Small quick gains may be available, for example, from generalizing the practices of the better farmers. But planners must not allow such gains to distract them from the need to develop immediately the institutions and people required to provide the much greater benefits that in the longer run can accrue from an intensive research and education program.

The integration of research and training at all levels is particularly pertinent in the rain-forest area. There is of course the usual symbiotic effect of the two: The research man is a better researcher if he has the disciplinary benefits of teaching; the teacher is a better teacher if he has the intellectual stimulus and the practical realities provided by research. In-service training at all levels in the research program will increase the number of hands available for research and will provide effective training for future research and extension workers and technicians. But in most countries in the wet tropics another factor is even more important: The supply of well-trained, competent agricultural scientists and teachers is pitifully small. If the best of them are sealed off in separate research institutes--an all too common practice--they become academic eunuchs.

#### Institutions for Research and Training

The nature of research and training requires that these functions be institutionalized for effectiveness, continuity, and perpetuation. The kinds of institutions required and their interrelationships with one another will differ in different countries depending upon local factors. Since one is unlikely to find any country in which some institutions are not already carrying on agricultural research and training, it will always be necessary to plan the future in the light of what exists. Insofar as possible, new developments should build on and be related to already existing structures. Only when it is clearly shown that existing institutions cannot be modified and

enlarged to meet the need should planners yield to the temptation to start something new.

In most countries of the wet tropics the existing agricultural research has developed mainly along commodity or problem lines. The central thrust of agricultural research has generally been directed by government rather than universities. In fact, in many of these countries, colleges of agriculture with research potential are recent developments, and research programs at the universities are uncoordinated with those of other universities or government. In countries that have a federal government, both it and state governments usually sponsor agricultural research.

Aside from shortages of facilities, funds, and research personnel, an urgent problem is this lack of communication, coordination, and mutual planning among existing research institutions. In Nigeria, for example, we find the following kinds of more or less independent research efforts:

1. Three of the four regions have agricultural research stations, but there is little planning and indeed little interchange among them.

2. Each region has a federal agricultural research station with general substations. In addition there are a number of special research institutes supported jointly by the federal government and the regions:

- Forestry Research Institute (Ibadan)
- Rice Research (Badeggi)
- Oil Palm Research Institute (Benin)
- Trypanosomiasis Research Institute (Kaduna)
- Cocoa Research Institute (Ibadan)
- Stored Products Research (Ibadan)
- Rubber Research Institute (under construction)

3. Universities. (1) The University of Ibadan is expanding its agricultural research program, (2) the University of Nigeria in Nsukka is preparing to do agricultural research for which the EDI

(Economic Development Institute) serves as a semiautonomous agent in association with the Eastern Region government and the university, and (3) the University of Ife in Western Nigeria intends to participate in agricultural research but plans to coordinate existing research in the Western Region and in time anticipates becoming the focal point of regional research.

In other African countries the research units are similarly dispersed, though they may be fewer in number. In Brazil each university is doing research; however, there is great diversity and much variety in quality and relevance. There are also federal research institutes and state research institutes with similar or other defects. In Malaysia there are research institutes in rubber, pineapples, fisheries, and agronomy. Research is also carried out by the Faculty of Agriculture at the university.

In this context we recommend that the planning of research institutions be guided by these general principles:\*

1. Each country should develop a research-education plan detailing the research problems in order of priority and the desired institutional structures with definition of priorities for their establishment. There are many external sources for financing research and education on a grant or loan basis. Often these external sources seem to be in competition, providing duplicate financing for separate and not well-related parts of the total institutional structure. Much of the fault is to be found in the lack of a well-defined plan within the country.

2. A joint research commission consisting of government, university, and private (including farmers and business) and foreign personnel should be established immediately. Its job would be to define problems, allocate responsibilities, determine terms of reference, and sort out the administration, resources, and application of the research to be conducted.

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\*See Chapter Five for a general discussion of research.

3. The size and complexity of the research-education institutions should be determined by, first, the complexity of agricultural problems and the nation's ecological diversity and, second, the potential ability of the country to staff and finance the institutions. Whereas external financial resources of considerable magnitude are available, the size of the research-educational complex should not exceed that which the country itself can reasonably be expected to finance sometime in the near future--say, ten to twenty years. Countries may be expected to range all the way from those in which two or more central locations are indicated (for example, in each of several states in Brazil), with the related network of regional stations and local fields, to those countries that can support no more than some local field trials.

4. In countries or regions where agricultural universities are prepared or can be developed to carry out research, governments should gradually provide them with support and facilities through grants in aid and cooperative research so that main experimental stations can be developed in association with the university.

5. Administrative arrangements and facilities should also be established to permit the research workers in the country to meet at least annually in groups according to disciplines and according to the problems on which their research is focused.

#### International Cooperation in Research

Many countries will not be able to support even one central location of the depth and complexity required to solve the basic problems of agricultural diversification in the rain-forest tropics. In fact some countries will not be able to support even regional stations of the needed magnitude. Yet regional stations must be fed with basic knowledge, concepts, and materials from central locations, and local field trials must be fed with further refinements and adaptations from the regional stations. International cooperation

can solve the problem of the smaller nations and can strengthen the total research effort in the rain-forest tropics. These are some possibilities:

1. Completely international institutions such as the Inter-American Institute of Agricultural Sciences (IIAS) of the Organization of American States.

2. An institution in one country that undertakes to serve its neighbors. The international activities and services of the institution could be financed by multilateral, bilateral, or foundation sources.

3. An agreement between a number of countries whereby each country agrees to a joint plan of research and to the pooling of research results. An intercountry research group would meet periodically to review progress and to make plans. Such intercountry groups could be served by one or two specialists who would act as the secretariat and who would be available to give expert advice. A model of this kind of international cooperation is the FAO grain improvement program in the Near East.

#### IMMEDIATE RESEARCH POSSIBILITIES

The kind of research required to raise knowledge to minimal standards is extremely broad and basic. Indeed any listing of the elements requiring research in the wet tropics appears to embrace all the traditional categories for agricultural research in the biological, physical, and social sciences. Thus overriding priority must be given to organizing a research system capable of conducting basic research in each category and in the interrelations and interactions among them. This is a long-run effort. In the meantime, however, some short-term research can provide quick benefits. Among the short-term possibilities are the following:

Collecting and Organizing Unpublished Material

Although little published or organized information is available on the problems of annual crop and livestock production in the rain-forest tropics, many ideas have been tried and useful observations made by the research and agricultural development officers of the colonial services. Unfortunately in countries where these research and development activities were disrupted and the personnel returned to their home countries, much of the information was stored in inaccessible places, left in unpublished reports and records, or taken home by the departing officers. We believe that the assembling and synthesis of this unpublished and often fragmentary information would be useful in providing the basis for immediate action programs and guidance for expanded research efforts.

All information that is not now in published form in the libraries should be located, classified, and organized for the use of current researchers. For this purpose the rain-forest tropics might well be divided into four or five areas, each including two or more countries. In each region a researcher with a broad knowledge of agriculture might visit all research institutes, universities, libraries, and ministries of agriculture and organize all relevant unpublished research findings. In addition he might obtain the names and current locations of earlier researchers and inquire of them as to what may be in their files. This information also should be retrieved and organized for current use.

As a first step in this process of retrieving and assembling currently available information a series of symposia might be held to which expatriates and others with research experience in the area would be invited as the key participants. Among the topics of such symposia might be the following:

Soil management, fertility, chemistry, and microbiology with annual crop production.

Crop potentialities for diversification and their uses.  
Crop rotations, intercropping, mixed cropping.

Diseases, insects, weeds, and other pests of food, fiber, and fodder crops and their control.

Problems and potentialities of livestock production. Management, breeding, nutrition, disease, and parasite control.

Farm organization and management for diversified agriculture.

Evolution of farm types; cultural and social barriers to change.

Power sources, tools, and equipment.

#### A Survey of Land Settlement Schemes

Land clearing and settlement are now going forward in most countries in this region--usually without benefit of systematic analysis of the most efficient methods of land clearing, land preparation, and settlement based on experiences in other countries having similar climatic conditions and forest cover. A research program to evaluate the procedures, experiences, and outcomes of land settlement schemes that have been carried out in the past or are currently in progress would provide valuable information on alternative land clearing and settlement practices. The results of the research should be summarized as rapidly as possible and made available to all interested countries in the region.

#### Other Short-Term Research

Many other short-term research activities might be undertaken with the prospect of being able to make use of their results in the next few years. These include the following:

Surveys of existing production practices.

Surveys of existing marketing practices.

Surveys of existing peasant attitudes and felt needs.

Crop variety yield tests.

Simple fertilizer trials.



Analyses of the economic effects of specific changes in production and marketing practices.

#### EXTENSION, ROADS, AND TENURE

As we have seen, the agricultural prospects of the wet tropics are limited by a host of factors. In our discussions we found that three of these factors--extension, roads, and tenure--are particularly important barriers in the wet tropics.

##### Agricultural Extension

Change in agricultural practices requires informed decision making in the adoption of new technology, in farm organization and operation, and in adjusting to change in the economic and physical environment. This is also true of nonfarm agricultural businesses providing inputs and markets to the primary producers.

A necessary (but not sufficient) condition to the improvement of the "batting average" of the farm sector in this respect is the existence of an educational service that effectively performs two functions. First, it improves the ability of the decision-making unit of the farm and business accurately to recognize problems, seek and obtain information relevant to the solution of such problems, analyze alternative courses of action, decide, and act. Second, it provides the decision makers at low real cost with a continuing and reliable source of the kinds of technical, economic, and institutional information essential to improved decision making and subsequent change.

There are several administrative and organizational structures within which such an educational function might be performed. The particular organizational structure that will be most effective in a given situation will depend on the specific nature of the agricultural sector and its ancillary institutions. However, any successful agricultural educational service must have, regardless of its

administrative organization, certain fundamental characteristics.\*  
Some of the more important ones are:

It must be conceived as a continuing educational function designed specifically to improve the ability of the rural population to solve its own problems on a sustained basis with an ever-increasing degree of efficiency.

It must be staffed with adequate numbers of professionally competent, dedicated educators who clearly conceive their role in these terms.

Its structure must include a system of rewards based on this same criterion of improving rural self-reliance.

It must be concerned with the real problems of agriculture and have the flexibility to adjust to the ever-changing set of problems with which agriculture is faced.

It must have direct access to a "research arm" that effectively provides the kinds of information needed in decision making at the production unit level in a form and at a time most appropriate to the existing set of problems.

It must have the ability to influence, directly or indirectly, the content of the research arm.

It must be able to influence, directly or indirectly, the policies and programs of educational institutions producing the manpower required for sustained development in agriculture.

It must have access to a training program that continuously upgrades its staff.

We strongly recommend that consideration be given to the creation of an adult education service integrated with the research and training institutions in such a manner that the above criteria can be met.

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\* See also the discussion of institutions in Chapter Six.

Roads and Agricultural Development

The tropical rain-forest region contains the world's largest undeveloped land area. Successful development of a settled agriculture in regions such as the Amazon basin, Borneo (Kalimantan), and others, will require considerable public investment in roads and agricultural infrastructure.

Although there are a number of unresolved empirical issues as to the role of agricultural infrastructure in the development process, there is general agreement that some level of infrastructure is an absolute precondition to the development of a settled agriculture with surplus production that can be siphoned off to urban areas. Of all the forms of such infrastructure we believe that roads are probably the most important both in already settled areas and for the development of new areas.

The general nature of the contribution of roads is readily appreciated: Roads open up wider markets to the producer and increase the efficiency of price communication and product distribution. They reduce the delivered cost of farm produce to the urban areas. They facilitate the provision, at lowered costs to the farmer, of urban-produced farm inputs such as chemical fertilizers, machinery, equipment, and fuel. They reduce losses in the transport of perishable farm products by shortening delivery time and by lessening damage in shipment.

Despite our general and intuitive knowledge of the importance of roads in the development process, several issues and questions of strategy are as yet unresolved and require empirical research. Very few empirical studies have been made to measure the economic role and value of rural roads. What criteria should be used to determine when a road should be built and where it should be located? Information is needed as to the proper timing and sequence of road construction. For example, should main roads be built prior to the development of settled agriculture or before an agricultural surplus emerges as a stimulus to agricultural development--or should the construction of roads follow agricultural development of the region

and the consequent pressures for improved transport systems? When and where should access and feeder roads be built?

Further, very little information is available on the rates of return for capital investments in road construction. Such estimates have an obvious use in the allocation of governmental expenditures among various other public works such as irrigation and drainage schemes, storage and warehouse facilities, and electricity and power installations.

### Land Tenure

Discussions of land reform and tenure generally center on conditions in Asia and Latin America. The argument usually turns on conflicts of interest between landlords and tenants and on the disincentives that flow from these relationships and depress agricultural production. The equally urgent land tenure problems of sub-Saharan Africa are therefore bypassed since these conditions do not fit the African situation.

The basic point to be made about Nigeria and much of West and Central Africa is that form rather than "reform" is at the core of land tenure problems. (The discussion here is based on southern Nigeria, but similar land tenure patterns are common in the African rain-forest region). It is more a matter of actually piecing together as it were viable farms out of vast areas occupied by tree crops, mixed food crops, land in bush fallow, and land that apparently is relatively empty. The difficulty in attacking this problem is suggested by the disorderly layout of tree crops and cultivated patches of food crops; by the practice of shifting cultivation and accompanying bush fallow; and by the fact that every foot of land in southern Nigeria is owned whether or not it is used for agriculture. It is becoming clear that customary tenure practices are incompatible with rapid increases in productivity and that they fail to provide sufficient legal protection for farmers now that land is becoming scarcer as population grows and agriculture is gradually becoming more commercial.

Tenure of land in southern Nigeria centers on the extended family, including chiefs' families, within the social context of a larger community (usually a village or a small group of villages) that in effect holds loose trust rights. Use rights in land are allocated by heads of extended families to nuclear families. The chief, representing the community, holds loose trust rights to farmland surrounding the village, but the historic allocation of land for use was to families. These rights were inheritable. As sons grow up and marry, the father (family head) provides them with land for cultivation from family holdings. The extended family never becomes completely independent of the larger community, nor is there clear independence of younger generations within families. Up to the present at least, southern Nigeria has no landlords and consequently no tenants on farms. Rural land is seldom bought and sold outright.

In parts of southern Nigeria there is considerable population pressure on farmland with as many as 1,000 rural inhabitants per square mile. It seems clear that under traditional tenure, available land is poorly distributed, a problem that may become intensified; and tenure practices possess built-in disincentives and difficulties of adjustment to higher production.

#### Competing Interests in Customary Tenure

Land rights in southern Nigeria are customary rather than legally sanctioned. In the normal course of agricultural development such customary rights tend to crystalize into property rights. Southern Nigeria is now approaching this critical point in tenure practice, and much of the success of general agricultural development may depend on how the transition is guided.

A basic dilemma to contend with is that the existing system tends to make for group security and survival at the expense of economic progress. For example, while land is inheritable, making for family security, the ownership rights that attach to a person within the family are seldom strong enough to leave him entirely free to dispose of his holding by lease contract or outright sale.

He may within limits exercise the right to pledge his allotted land or abandon it, but the family holds the right of redemption and reversionary rights. This in effect discourages one who acquires land by loan-pledge from making improvements. The burdens that customary tenure places on transfers and alienation of land outside the family make it extremely difficult to gain economies of scale, while family farms are becoming smaller through inheritance and population growth.

In southern Nigeria there is a tradition that anyone who plants a crop should be permitted to harvest it. When this idea is extended to tree crops, the person who is allowed to plant cacao or palm trees may claim a permanent right to harvest. This means in effect that a stranger to the village would hardly be permitted to plant trees on land where he is a temporary occupant.

The process of inheritance within the family, restraints against the alienation of land outside the family, and restrictions on permanent plantings by strangers on family lands were all well chosen devices to preserve family cohesion and survival. They would perhaps continue to serve this purpose and maintain a reasonable balance among families in the village if the community were completely static.

In Nigerian villages a higher order of prestige and influence and corresponding access to additional land were always available to chiefs. This caused no difficulty so long as land was in plentiful supply. But in recent years the increase in population, the growing commercialization of agriculture, the growth of cities, and the demand for agricultural development have all combined to make land scarcer and consequently more valuable. The basic contradiction between tenure measures for group survival and economic development is increasingly exposed. The old devices of tenure are precommercial; their design never anticipated the consequences of an exchange economy. Being customary, many tenure practices have no clear-cut sanction in law and may leave peasants unprotected against the pressure of new commercial forces.

Excess village lands were traditionally held in trust for use in event of need. In their role as trustees of such village reserve land some chiefs appear to be sealing it off as their property, thus circumscribing the traditional right of others to occupy it on the basis of need. It is clear that a few individuals with above-average knowledge and resources are finding ways to evade customary tenure and are accumulating land in their own behalf. These signs of converting customary rights in land into negotiable property rights, if allowed to continue unrestricted, could lead to a few large landholders instead of many small ones. We would have an explosive situation similar to those in Asia and Latin America.

The transition to a viable form of tenure must be made while there is still time. Among the creative tasks of research would be the discovery of ways whereby the combination of tree crops and mixed farming, now without design, could be transformed into a pattern of viable farm units, each with the prospect of generating adequate income. In Nigeria at least it would be a mistake to push other research and development of institutions very far without attention to the fundamental problem of land tenure. Conditions in Asia and Latin America have not revealed insights for solving this problem in Africa.

## Chapter Nine

# MONSOON AND SUBTROPICAL AGRICULTURE

### THE REGION AND ITS PROBLEMS

The monsoon and subtropical region includes most of the Indo-Gangetic plain, the northeastern part of Thailand, much of the Philippines, belts across Africa north and south of the rainy tropical belt, the Near and Middle East, northeast Brazil, and other smaller regions. Those areas where rainfall is sufficiently high that wet rice cultivation is currently the predominant form of agriculture are dealt with in Chapter Seven.

This is a region of long growing seasons; temperatures in most of it are never so low that crops cannot be grown throughout the year. But almost nowhere is the rainfall sufficiently high or well distributed through the year to take full advantage of these favorable temperatures and abundant sunlight without irrigation during at least part of the year.

It is a region in which the lands at present under cultivation are in general cropping, with grain crops other than rice predominating: maize, sorghum, millet, wheat, barley; peanuts, cotton, and sugar cane are common, as are grain and forage legumes.

Wherever rainfall is sufficient for at least one crop a year and the soils and topography are suitable, most of the land in this region is already under cultivation; in much of this part of the region population is dense, farms are small, and the level of technology is relatively low. In these areas agricultural development must be evolutionary, starting with the present pattern of cultivation and the already established population with its accumula-



tion of traditional values and forms of social, legal, and administrative organization.

Elsewhere in the region there are substantial areas, mostly arid to semiarid, with soils and topography that are amenable to cultivation if irrigation can be provided. Here the capital costs of establishing a productive agriculture are high, but there is far greater opportunity to choose the type of agriculture and the type of economic, social, and administrative climate within which it can operate.

We did not attempt to consider all the varied sets of conditions to be found in different parts of the region. Instead we concentrated on areas of which the members had personal knowledge. These were for the most part the Indo-Gangetic plain, East Africa, the Middle East, and the Philippines.

We concentrated our attention primarily on three problems. We gave most of our attention to measures to increase agricultural production in the regions of high population density. We examined also the problems, alternatives, and requirements for development projects to establish or intensify production in semiarid to arid regions of low population density, usually through the introduction of large-scale irrigation. Because of the limited or maldistributed rainfall and the importance of irrigation throughout the region, we went also into the multiform problems of water management. (See Chapter Three.)

We found in considering these two sets of circumstances--high population and already settled agriculture on the one hand, and the possibility of a wholly new pattern of development projects in low-population regions on the other--that a different set of first-priority problems emerges in each case. In the first the predominant problems center around the task of reorienting social and administrative patterns locally and nationally in order to be able to conduct effectively the variety of developmental activities that are essential to the evolution of presently existing agricul-

ture. In the second a precondition to being able to begin is a very substantial amount of agronomic, economic, and cultural research.

#### HIGH-POPULATION REGIONS ALREADY UNDER CULTIVATION

The farms are already there, and they are small. The farm operators are already there, and they are members of established cultures with their own distinctive values, customs, and forms of organization. The better farmers are already making the best use they can of existing resources, techniques, and knowledge. Only a very limited (though not to be underestimated or ignored) increase in production might be brought about by raising the performance of the less able farm operators closer to that of the best. For the most part, agricultural development in these areas must depend on the availability of new physical inputs (seeds, fertilizers, pesticides, implements, and sources of power), new knowledge and skills in husbandry and management, new attitudes with respect to the nature of farming, new interconnections between farming and the rest of the economy, and adequate incentives to farm operators to adopt both new, more productive inputs and cultivation and management practices.

While the monsoon and subtropical region cuts across many countries, few countries lie wholly within it. More frequently part of a country is in wet rice cultivation, part of it may be in upland or mountain agriculture, and part of it, lesser or greater, is in the type of ecological region we are considering here.

For some of the measures bearing heavily on the rate of agricultural development the nation must be treated as a unit, and uniform policies or national programs must be established. Research and manufacture of inputs are examples. For agricultural development not to be inhibited by imposing national patterns that do not meet the specific needs of different ecological regions within the

country, certain activities should be designed specifically for each of the major regions. Even within ecological regions in each country there are substantial differences that call for varying patterns of public programs if a maximum rate of agricultural development is to be achieved in each varying part of the region.

The principles governing national policies and organization for agricultural development are discussed in Chapter Six. In this section we shall focus on these questions:

What are the activities for which particular attention must be paid to "locality-units" of public services to agriculture? What do experience and existing knowledge indicate should be the size and operating characteristics of these "locality-units"?

By "locality-units" we mean the unit of each activity closest to farm operators and village communities. These are the "cutting edge" of any program to accelerate agricultural development. Only through effective locality-units can any regional or national program succeed. The operating unit in agriculture is the farm. Increases in agricultural production come about only as each of many farm operators makes decisions to change his farming practices. In part the farm operators may be encouraged to do this by the climate of general economic conditions and policies of their national government, but the necessary instruments must be readily available to them where they live and work if they are to take advantage of this general climate and actually increase their production.

#### Some Functions of Locality-Units

Six functions need to be performed through appropriate locality-unit activities: arrangements to give farm operators ready access to new purchasable inputs; ready access to markets for increasing amounts of farm produce; a program to encourage and stimulate farmers to adopt more productive inputs and practices and to train them in the new skills of husbandry and management involved

(the function commonly called "extension education") and to organize their cooperation for such enterprises as water management and pest control, a program of local verification trials of proposed new practices, access to adequate supplies of production credit, and access to a new power source or sources for activities related to production and marketing.

In addition to these functions, but not unique to any one of them, is the need to develop stronger incentives for farm operators to adopt more productive methods and incentives for members of the staffs of the locality-units to perform their duties with increasing vigor and competence.

Access to purchasable inputs. Two functions are absolutely essential at the locality-unit level: One is making improved seeds, fertilizers, pesticides, and equipment readily available for purchase by farmers; the other is equally accessible markets for the increasing farm produce that the new inputs make possible. There can be little agricultural development without increasing involvement of farmers in a market economy. Most farm operators in the region already sell some products and buy some consumer goods, but only the more progressive farmers in the more progressive areas now buy production inputs. For all farmers agricultural development will require more and more buying of production supplies and equipment and more selling of farm produce.

The question arises as to whether any governmental program is needed in these fields. Private merchants are one alternative. Farmers' cooperatives are another.

In the case of production inputs a special problem at the beginning, when a new input is recommended, is that there is not already an established demand sufficient to attract private merchants. Moreover, if a merchant has previously handled only consumption items, he has not had experience with the building up of inventory to meet special highly seasonal demands, in many cases for items that, if not available at a precise time, will remain unsold for a long subsequent period.

Under these circumstances widespread experience indicates that, even where there is preference for the handling of production inputs by private merchants in the long run, it is essential to have these inputs made available through a governmental program when their purchase is first becoming established (and to have their use stimulated by a program of extension education). One practice successfully employed in parts of Latin America has been for each extension office to stock farm supplies for sale to farmers at a price slightly above what a private merchant would have to charge to make a reasonable profit. As demand increases, private merchants begin to stock the supplies, charging slightly lower prices. From that point on, the small stocks (if any) still kept by extension offices serve only as a standby reserve, a source if the private merchants run out of supplies.

Whether this function of providing purchasable inputs can be performed by a farmers' cooperative in the beginning is discussed later in this report.

The two distinctive features of the region on this point are that the small size of the individual farms means that purchasable inputs must be available in small amounts for individual sales, and that the general lack of any road transport vehicle faster than a bullock cart owned by individual farm operators means in practice that the locality-units for the sale of purchasable inputs are useful only within the radius of easy walking distance.

Access to markets for farm products. The other essential function that must be adequately provided by locality-units is access to outside markets for increasing amounts of farm produce.

Here again options are available: private merchants, governmental programs, and farmers' cooperatives. The problem of low initial demand does not arise for this service as it does for purchasable inputs because in most parts of the region a network of private merchants already exists for farm produce. Instead the predominant problems are:

1. A lack of feeder roads to reduce the costs of haulage and therefore to increase the at-the-farm price of farm products and to widen the area within which perishable products can profitably be grown.

2. A lack of competition between primary buyers, and a lack of central market information to ensure a "fair price" being paid to the farmer.

3. A large number of intermediaries in the marketing chain.

4. A lack of good farm or village storage facilities to allow farmers to hold nonperishable products after harvest until an advantageous time to sell.

Extension education. Whereas access to inputs and markets is essential to expanding production, extension education is an important accelerator of this process. Innovations, if they are effective and profitable, spread slowly under almost any circumstances; extension education accelerates their diffusion by stimulating and encouraging individual farm operators to adopt new practices and helping them learn the necessary new skills of husbandry and management.

Generally speaking, there is no one preferable form of locality-unit for extension education valid under all circumstances, or any one ideal amount of agricultural land that it should try to "cover." Instead, both the form and the area served by such a unit should be adjusted in accordance with two controlling factors. One is the size and degree of previous commercialization of individual farms (two features of farms that are closely associated throughout most of this region). The other is the laws of learning as established by long experience in many countries both in extension education and in schools. These laws apply at two points in the extension education process: in contacts between the extension teachers and the farm operators and in the training of extension teachers.

These considerations point to two alternative forms of locality-units for extension education in the high-population small-farm areas: the central training unit, and a staff of extension agents who go to farm operators on their farms and in their villages.

The central training unit has substantial advantages in localities made up almost exclusively of quite small farms. In such a locality there are so many farmers per square mile that taking extension to all of them becomes prohibitively expensive. Moreover, where farms are too small to have their own work animals, it appears that cooperative effort by small groups of farmers is essential if the rate of development is to be accelerated. Under these circumstances extension education can be conducted through these same forms of cooperative organization, as in the Comilla project. (The Comilla project is described in Appendix A.)

The Comilla pattern of extension education is to have each cooperative union (described later in this section) select one "model farmer" to attend weekly training sessions at the federation (thana) headquarters, then for him to pass on to other farmers of his union the knowledge and skills he has acquired. These model farmers are depended upon to serve the extension function to other farm operators within their village.

In this type of locality-unit the crucial size factor is the number of model farmers per class. In Comilla this number may approach 50, but educational experience elsewhere indicates that classes of 30 to 35 are preferable.

In localities where the farms vary more in size, with an appreciable number as large as 10 to 20 acres, a staff of extension agents is the alternative to total reliance on a training center but should not necessarily entirely displace it. On farms of this size, already somewhat more commercial, there is more scope for each individual farmer to try out new methods without so much joint agreement by his neighbors. This possibility is even greater where farm

operators live in dispersed farmsteads, each on his own holding. Since each farmer has more land, new learning by one farm operator can have a larger productive effect, and therefore the visits of extension teachers to individual farmers become less costly in terms of potential increases in production.

There are two crucial points in determining the optimum size for locality-units of extension education operating primarily through a staff of extension teachers. The first is that there should be one member of the extension staff for each three hundred farm operators. This is an approximate figure based on experience; it takes into account the fact that for teaching to be effective, for learning to occur, there must be frequent contacts between each farm operator and any one new idea. While these contacts need not all be individual visits (some may be meetings) and need not all be personal (some may be by radio, printed matter, or pictures), frequent contact between potential innovators and the extension teacher is essential. No extension teacher can normally have effective teaching contacts with more than perhaps 100 farmers per week, even using several group meetings, and effective influence at early stages of agricultural development requires at least one personal contact every second week. This would indicate 200 instead of 300 farm families per extension teacher, but many farm operators will not be responsive.

The other factor in the optimum size of the locality-unit for extension education is the number of extension teachers working together in each unit. This optimum number is 30 to 45. With more than 45 the "staff conference" form of combined in-service training and administrative device becomes unwieldy, and there cannot be enough learning by each member of the staff to be effective. With fewer than 30, training by administrators can be more intensive, but there is likely to be less learning from each other among the extension workers themselves; the latter point is at least as important as the former.



Just as effective teaching and learning between extension teachers and farm operators depends on frequency of contact, so the staff conferences of extension teachers, a prominent feature of in-service training, need to be frequent: at least once a month and preferably every two or three weeks. Frequent staff conferences at the headquarters of the locality-unit have the additional advantage of providing extension teachers with a periodic recreative withdrawal from village conditions to a larger town.

Thus one locality-unit for extension education, using a paid staff of extension teachers going to farmers, would ideally cover as much area as is farmed by 9,000 to 13,500 farm operators. Where such a unit must cover a wider area, greater use must be made of radio and other mass media to try to compensate for too-light coverage.

Where extension education depends entirely on training model farmers at a training center, the size of the area will depend on how much is covered by the farms of members of each union and on how many classes of 30 to 35 model farmers each can be accommodated weekly by the center.

The teaching at the center must honor the laws of learning. If farm operators are actually to learn, the staff of extension teachers must also constantly be learning, and the system must be so devised that this happens. Frequent in-service training is imperative. So is intimate constant contact with the latest findings of agricultural research.

Verification trials. Some members felt strongly that wherever there is a program of extension education another essential locality-unit is one devoted to conducting verification trials, under conditions faced by local farm operators, of changed practices being recommended to farm operators by extension teachers. These include comparative yield tests of varieties of crops already being grown in the locality and tests of allegedly "improved" varieties being recommended by experiment stations. These trials should also include

fertilizer and water application recommendations. The results of these trials should be analyzed economically in terms of costs and returns at local on-farm prices as well as agronomically.

The purpose of such verification trials is threefold:

First, to find out whether the recommended practices are really valid under the conditions of that particular locality.

Second, to provide a constant example and reminder to extension teachers of the nature of experimental science, and a caution as to the necessity of being absolutely sure about what is being recommended.

Third, to have available in the locality technicians who know how to lay out plots, how to apply new inputs with precision, and how to measure results in order that they may assist extension teachers in setting up valid and effective result demonstrations on the fields of farm operators.

In addition to verification trials the staff of this unit should conduct surveys of crop yields at regular intervals. It might also handle the analysis of records of their activities kept by the extension staff.

Each locality-unit for verification trials would need a staff consisting of one trial plot technician, one interviewer, one survey and records summarizer, and one research methods technician who should be somewhat more highly trained and would be the director of the unit.

Since the kind of personnel needed for such a staff is not normally produced by existing institutions, they could be trained largely by in-service apprenticeship, first working as assistants to experienced locality-unit staff and then being promoted and transferred to start another unit, with each such unit having a new apprentice staff each year as long as may be necessary to multiply the number of units.

Whether or not there should be one locality-unit for verification trials associated with each extension education locality-unit or whether one unit for verification trials could be associated with two or three units for extension education would depend on the homogeneity or heterogeneity of the different adjacent extension areas and the distance to the farthest part of each extension area, since the verification plots should be accessible for observation by farmers on occasional inspection tours.

The verification trials might be conducted on the farms of cooperating farmers. Where farms are small, however, it may be necessary to conduct them on separate fields operated specifically for this purpose.

The program of the verification trials locality-unit should be worked out in consultation with the extension education unit and with the technical advice of research specialists from the regional research station.

Access to adequate supplies of production credit. We feel that the pattern of organization for credit developed at Comilla is an excellent one for a high-population locality of predominantly small farms. The features of that scheme relevant to our consideration here are the following:

1. The locality-unit for credit in the Comilla project has two dimensions:

- a. Cooperative unions of 20 to 60 members each.
- b. A "federation" of unions that supervises the accounting of, holds deposits for, and makes loans to the unions. A federation can service up to perhaps 300 unions by having a staff of appropriate size. One inspector or supervisor is needed for each 10 or 12 unions.

2. The union is a democratic cooperative in which:
  - a. Each member must attend each weekly meeting.
  - b. Each member must deposit some savings in the union at each meeting.

c. The union decides on the amount of the loan to request from the federation, the loan being secured by the joint unlimited liability of all members.

d. The union decides how much of each such loan will go to which members for what productive purpose and is responsible to secure payment of the loan.

e. The union decides what loans to request from the federation for such joint purposes as a tube well or a pump.

f. Only members of the union may borrow from the union, and only unions may borrow from the federation.

g. The union ascertains that loans by members are used for the productive purpose or purposes for which they are made.

3. The federation may not be a cooperative in the beginning. With respect to credit it is a bank that borrows from the government and lends to cooperative unions. As unions purchase the federation's stock it can become a cooperative.

4. While one federation might be able to service more unions than exist in the beginning in a single minor governmental administrative unit (in the case of East Pakistan, the thana), it does not do so; it restricts its operations to the thana. One reason for this is to be able to utilize officers of the government's technical departments at the thana level in its training activities.

5. No effort is made to try to enroll all farm operators in unions or to establish a union in every village. It is considered satisfactory if after five years 75 per cent of the villages in the area have unions and 50 per cent of the farmers in villages with unions are members. When more than 60 farm operators in a single village wish to be members, a second union must be formed.

Access to new power sources for activities related to production and marketing. We devoted considerable discussion to the role

of mechanization in localities with dense population and exclusively small farms. We took as a given the impossibility of reducing the absolute size of the labor force in agriculture in such localities in the next generation. We therefore ruled out any type of mechanization that is primarily "labor saving."

There are, however, types of mechanization that may be highly beneficial in such localities, namely those that are complementary with the use of large quantities of labor: pumps to provide irrigation water, and engines (or motors) to run them; tractors to allow plowing when the soil is dry or to speed seedbed preparation during critical short periods; tractors to be used for road transport. These are examples of types of mechanization that allow more productive and more intensive cultivation and the use of more, not less, labor.

In introducing new power sources in such localities it is important both to think broadly of the uses to which they may be put and to seek to introduce types that can be versatile. It is also important to take into account their impact on drudgery and on the nature of agricultural operations from the standpoint of social status. From these standpoints "riding" tractors are preferred to those requiring the operator to walk, particularly in the cultivation of wet rice and for road haulage.

In localities of small farms, availability of tractors on hire is necessary in order to make their use economic. In most such localities the key factor in the size of the locality-unit for mechanization is the necessity for adequate repair and servicing facilities. Where these must be provided, a pool of 12 to 15 tractors is probably the minimum number.

Particularly with regard to mechanization it is important to realize that the operation of tractors will involve a financial loss over at least one to three years while farm operators become accustomed to it and find additional uses for the new source of power, though it should be adopted only where it can ultimately pay its own way.

Coordination of Locality-Units of Different Activities and a Minor Administrative Unit of Government

We have discussed the need for locality-units of each six activities and some of the considerations bearing on their effectiveness. Two points should be stressed in conclusion:

One is the importance of organizing each activity in locality-units appropriate to its own function rather than forcing each of them into the strait jacket of a "block" of predetermined size. In some cases, having each locality-unit of a size optimum for its own function may mean that several locality-units of one activity may operate over the same geographic area as a single locality-unit of another activity. For example, the area covered by one federation for credit might be the same as that for two to four extension units, one or two verification-trial units, or one for mechanization.

The second point is that some adjustment may need to be made in these specific optima in order that all activities can be coordinated by a single minor administrative unit of the government, whether pre-existing or newly created.

It cannot be stressed too strongly that an effective local "cutting edge" is unlikely if each of the six activities is administratively related to only a more central unit of that same activity. The complementarity and interdependence among these activities is so strong that all of them must be administratively integrated in a minor administrative unit of the government if any one activity is to be even reasonably effective.

Progressive Initiation of Program in Different Localities

We noted earlier that the localities within any one country in the region vary markedly in agricultural potential, size of farms, present degree of commercialization of agriculture, and other characteristics.

A program of well-articulated local programs of locality-units of optimum size and intensity cannot be initiated everywhere simul-

taneously. We feel that the priorities in initiating programs should be as follows:

1. Start with integrated sets of locality-units of optimum size in one or a few contiguous localities within a region (a) of high agricultural potential, (b) possessing a reasonable proportion of larger, more commercial farms (whatever the range in sizes of farms may be).

2. Proceed next to multiplying the locally integrated program in other similar localities of the same type and add one or a few integrated programs in other localities where somewhat smaller farms predominate.

3. Move next, while multiplying integrated programs in the above areas, into a few localities where only farms of the smallest size exist.

4. Having established the full range of locality units of all six activities in a few localities having only small farms, extend the services not made available in the beginning in localities with larger farms to those localities also.

The reasons for this order of initiation are two. First, the potentiality for early increases not only in total production but also in marketed production is greatest in localities having the larger farms. Second, a smaller, simpler combination of activities may be reasonably effective there. For example, while adequate supplies of purchasable inputs and market access for farm produce are always necessary, these may be easier to provide for farms that are already partially commercial; credit may not have to be provided through special new agencies in the beginning; and operators of larger farms are likely to be more responsive to extension education. On the other hand, in localities made up wholly of quite small farms it may be nearly useless to provide any service until all can be provided and integrated in a manner similar to that of the Comilla project.

This progression in initiating programs in different types of localities is depicted in Chart 3.

#### LOW-POPULATION CULTIVABLE REGIONS

Just as it must be taken as given that the density of the population at present dependent on agriculture for a livelihood cannot be reduced in the next twenty years in the high-population areas of this region, so it must be recognized that with minor exceptions large-scale development schemes in areas with a low population at present will not decrease the density of the agricultural population in the high-population areas. Emigration is seldom sufficient to have this result, particularly where farm units in the new scheme are larger, as they must be in most cases if efficient and maximum production is to be achieved.

The case for development schemes in low-population cultivable areas is not based on emigration. It is based on the fact that there are places in which modern technology, frequently including irrigation, can add substantially to the present land resources of a country, thereby allowing for extension of agricultural production. With this end in view the development of new lands, particularly in association with irrigation, is going on in many countries of the region of the world with which we are concerned--in India, Pakistan, Iran, Iraq, Syria, Egypt, Sudan, Mexico, and elsewhere. It is also going on without irrigation in Malaysia, Indonesia, and Assam; in many parts of East and West Africa; and in Brazil and other countries in Latin America.

Two considerations make it important that extensive and intensive feasibility studies precede any such program. One is that the capital costs are always high, and frequently the same level of investment would yield greater returns if applied to increase productivity in regions already under cultivation. The other is that a wide variety of factors affects the actual productivity to be an-



Chart 3

INITIAL ACTIVITIES OF PUBLIC SERVICES AS INFLUENCED BY SIZE OF FARMS

ACTIVITY	FARM SIZE		
	ALL UNDER 3 ACRES	UP TO 8 ACRES; 40% OVER 3 ACRES	UP TO 25 ACRES; * 60% OVER 3 ACRES
TRAINING	TRAINING CENTER ONLY	CENTER OR EXTENSION AGENTS	EXTENSION AGENTS PLUS SOME TRAINING AT CENTER
VERIFICATION TRIALS (RESEARCH)	YES	YES	YES
CREDIT	YES	?	USEFUL, BUT NOT OF HIGHEST PRIORITY IN THE BEGINNING
PROVISION OF NEW INPUTS	YES	YES	YES
MARKETING OF PRODUCE	YES	TRAINING FOR MARKETERS	TRAINING FOR MARKETERS
POWER CULTIVATION	MOST USEFUL	USEFUL	? IN BEGINNING STAGES
VILLAGE WELFARE ACTIVITIES	START HERE --	--> MOVE INTO THESE --	--> THEN MOVE INTO THESE

IF A WIDER REGION CONTAINS SOME LOCALITIES OF EACH OF THE ABOVE THREE TYPES, THEN:

- |   |   |   |
|---|---|---|
| 3. START UNITS HERE AFTER OTHERS ARE GOING WELL | 2. THEN START SOME UNITS HERE, PERHAPS ADDING POWER CULTIVATION | 1. START THE FIRST UNITS HERE                               |
|   | 4. EXTEND CREDIT AND MARKETING TO THESE                         | 5. EXTEND CREDIT, MARKETING, AND POWER CULTIVATION TO THESE |

\*THE OMISSION OF CREDIT, MARKETING ACTIVITIES, AND POWER CULTIVATION HERE IN THE FIRST INSTANCE IS NOT BECAUSE THEY WOULD NOT BE USEFUL BUT BECAUSE THEY MAY NOT BE ABSOLUTELY ESSENTIAL IN ORDER TO GET SOME DEVELOPMENT STARTED.

anticipated from the settlement of new lands. A somewhat similar situation arises whenever and for whatever reason it is proposed that large estates be broken up into smaller units with a changed pattern of cropping.

The major types of feasibility studies and major questions with respect to the organization of the new production, and the scope and administration of the project itself, are as follows:

#### Agronomic Potential

The first step is to estimate the agronomic potential of the area being considered for development.

This is influenced, first, by factors of the physical environment: climate, topography, soils, water supply (both surface and underground supplies and a hydrological survey of river waters potentially available for irrigation), sources of power, and the accessibility of the region.

Taking these factors into account the next step is to consider what crops might be grown in the region, what yields of these crops might be anticipated, what pests and diseases would have to be controlled, and what market is available or might be developed to absorb the new production.

In making these estimates it is a serious mistake ever to omit the setting up of a number of model farms at points representative of different sets of microsoil and climatic conditions within the region to test whether the proposed crops can in fact be grown successfully and in what crop combinations. Research is a continuous process and takes time, while time in itself often seems a pressing factor in the consideration of new development schemes. It is not easy to choose between waiting for research and getting something going in the present known circumstances. It may be wise in one case to start by recommending both the seeds and the practices of better farmers already in the area without waiting for the improved varieties that research may later bring. In another case it may be fatal not to know the hydrology

of a river, or the readiness of people to move into a new area, or the system of farming on a consolidated unit that will really bring them a better net income, or the degree of extra effort in new practices that people will tolerate.

For these reasons a pilot farm is a useful device to test intelligent guesses and to condition both organizers and people to change. Moreover, the function of a pilot farm need not be limited to the start. There are advantages in regarding it as a site for continuing to test processes of improvement. Although its first task is to gauge initial difficulties and possibilities, it can work after the project is fully in operation as a site for training institutions as well as for further modifications in both administrative and production methods.

#### Cultural Feasibility

Before proceeding to determine what types and sizes of farms should be established within the area, it is important to take cognizance of whatever cultural restraints may be present. One set of restraints has to do with current political, social, and ideological pressures. Another involves the genuineness of the government's desire for planned development and its readiness to accept the patterns of management essential to the scheme's success. A third has to do with the degree of willingness of farm operators to exert effort and accept both the technological and the managerial routines that will be necessary.

#### Types of Farming

The cropping patterns, rotations of crops, and feasible degrees of diversification that can be projected are functions of the foregoing considerations. Emphasis on one or two cash crops is imperative if modern technology, involving the use of purchasable inputs, is to be introduced. There is seldom justification for starting a development scheme that simply reproduces the low-technology agriculture of already settled areas. Such a

procedure only expands the area of presently difficult problems, and once such patterns become established they are hard to change.

While diversification has advantages in some places, it multiplies the problems of providing appropriate purchasable inputs and new technical knowledge and skills. The simpler the pattern of cropping can be kept in the beginning, the easier it is for the project to be successful. The initial cropping pattern should be based only partially on considerations of maximum production; it should also take into account the current level of skills of farm operators in husbandry and management.

#### Size and Organization of Individual Farm Units

Generally the sizes and types of individual farm units to be considered are large-scale private enterprise units, large-scale state or collective units, and smaller-scale family farms supported by common public services.

At one end of the scale protagonists of large-scale private enterprise units may claim that their contribution to national production and to taxation and savings will be greater than that of any other system and that, because they find their own capital, national resources can be devoted to other purposes, primarily infrastructure. Opponents may point to many private estates that have been anything but productive and may deprecate the extreme inequality in incomes among the large estate owner, the workers on it, and the rest of the rural population.

A desire for social equality leads many who believe that a large unit is the best base for modern production to favor state or collective management. The efficiency or inefficiency of this solution, and indeed the claim that large estates are best, might well be a subject for research if it could be divorced from ideology. A negative answer in Russia may be due to transitory factors like poor management and unattractive price differentials between town and country products. A positive answer in Yugoslavia may be connected with decentralization and independent contracts

between farm and factory. Israeli experience, on the other hand, where freedom of choice is available and where the purely collective kibbutz has been largely superseded by the more individual-oriented moshav, may suggest that individual incentive is a vital ingredient and that, when combined with supporting services, it can include both efficiency and a reasonable distribution of benefits.

Although all three methods may well continue in many countries, the huge numbers of the rural population, the constant increase in these numbers, and the fact that they are mainly small subsistence farmers make the selection of a family farm unit attractive, provided that supporting services and suitable layout can enable efficient production and satisfactory income. In choosing the size of the family unit, however, a dilemma sometimes arises, as recently occurred in Kenya, between satisfying more people in smaller units (a solution that may lead only to equality in poverty) and planning units that can produce higher incomes, savings, and taxes--but not enough units for all. Where land is plentiful a ladder of farms of increasing size can provide farmers with a progressive opportunity as they emerge from subsistence into increasing competence.

#### Provision for Supporting Services

Particularly if the decision is to establish family-sized farms of reasonable acreage, an integral part of the scheme must be the provision of adequate supporting services. Far too often when the search for greater equality has led to the breakup of large estates, no adequate supporting services have been provided to the peasant inheritors so that no improvement in income or production has taken place. Examples are the Potemkin reform in eighteenth-century Russia and the present situation in Iran and other countries. By contrast the supporting services provided after land reform in Japan and Taiwan are a striking example of what can be achieved under a family farm system in spite of small units and great shortage of land. Even in the Punjab, in one of the biggest settlement movements in history, where irrigation enabled great improvement at first, the

absence of supporting services was one of the factors responsible for the result that the largest irrigated region in the world now gives one of the lowest returns from auxiliary water. It seems clear that to permit farmers to settle new land or old estates without an organization plan and without supporting services is likely to be a major mistake.

Many irrigation projects have included only canalization, leaving farmers to make their own field distributaries and do their own land leveling. Often this is ineffectively carried out, and an expensive national investment in dam and canalization ends in high water loss and low yield because field distributaries and leveling were omitted from the supporting services.

An example outside irrigation is that of the Malayan settlements where no provision was made at first for schools, and the farmer was expected to clear the jungle himself. Having no school, he sent his children to school elsewhere and was frequently absent visiting his wife and children; nor were they available to help him. Reliance on the farmer to do the clearing resulted in delay and costly irregularity in what needed to be a uniform planting pattern for rubber production. Only when clearing, planting, and schools were included in the combination did the settlement begin to be a success.

One of the lessons from crowded areas has been the sometimes baneful influence of the large landowner-moneylender-trader. It would seem that credit should be closely allied with other inputs, but this requires trustworthy supervision and accountants.

Yet another lesson from settled areas is that the owner of the store or processing factory, or means of transport to market, or pump, or machinery for the preparation of land tends to have a stranglehold over the farmer. Should the organizational pattern for a development scheme therefore be so arranged that these key entrepreneurial points are operated at cost for farmers (as in the Gezira scheme) pending transfer to their ownership? If this is the choice, is the capital available to create these assets and are qualified personnel available to manage them and to handle the marketing

beyond them? If not, provision for additional capital input and additional training has to be envisaged. Lack of foresight in these areas and a tendency to assume that private enterprise is in all circumstances competitively beneficial may wreck the whole investment of the other services because if the farmer does not receive a substantially higher income his interest will cease. But such a result may equally emerge if the management of these operations by the responsible organization is inefficient and uneconomical.

The proposal to embark on a development scheme therefore involves not only the provision of one or a few major capital investments such as irrigation, land clearing, and drainage to make a region physically cultivable; it also involves designing a total pattern of cultivation, the creation of a wholly new network of supporting services, and provision (direct or indirect) for a whole range of facilities and arrangements for settled human habitation.

Not every settlement scheme need include within it governmental provision for all of these. However, the feasibility studies prior to starting such a scheme need to include consideration of all of these factors, and hard decisions must be made with respect to each of them. Moreover, the cost of all the elements that must be financed by the government needs to be taken into account in estimating the capital needs for the project.

#### How Much "Paternalism"?

Here the issue is really one of deciding on the extent to which reliance should be placed on providing opportunities for higher productivity to farm operators, leaving the decision whether to seize these opportunities largely to them, and on the extent to which the new agriculture should be managed by officials of the scheme itself. To leave decisions largely to farm operators is likely to result in lower productivity in the early years of the scheme because of the lack of experience of farm operators with the new agriculture if for no other reason. To have all major

production decisions made by officials of the development scheme, on the other hand, defeats itself in the end because farm operators lose all initiative and wait for the government to do everything. At the same time, it is abundantly clear that the weakest link in the development chain is actual implementation, and farm operators may willingly accept a considerable amount of regulation provided that it actually results in steadily rising net incomes.

The decision is therefore a difficult one to make. Surely some participation by farm operators needs to be fostered from the beginning. Naturally where people are highly educated and experienced they can freely participate without loss in efficiency, although even in Japan and Taiwan, no less than in Southern Italy, strong inducements, like monopoly purchase of the main crops or monopoly access to credit, were necessary to fortify the loyalty of farm operators to the cooperatives that in the first instance were set up by the government. Where resources in competent manpower are scarce, it is open to question whether the competent organization of at least supply, processing, and marketing by some external instrument should not be the first priority, leaving the grafting in of full participation by the people themselves to some later time when successful routines have been established.

#### Implementation of the Plan as a Whole

Very often, and particularly in ex-colonial countries, the instrument at hand is that of the routine government services. In many cases these services were not designed for implementing development, a comparatively new field for government action (as opposed to mere advice) that before World War II was left largely to private enterprise. The regulations and attitudes prevalent in regular government services, and the type of man they recruited, are thus not automatically those that might be chosen to implement development schemes by a business institution. Yet the modernization of agriculture, and especially the provision of a package of inputs, is



primarily a matter of competent managerial organization. It also requires a continuity of policy and a staff geared to the objective of increased rural production and incomes. Frequent transfers of staff, preoccupation with other objectives, varying interests or indifference of staff members, and absence of coordination among departments or between national and provincial administrations make it difficult to get things done through regular governmental services.

The question is whether to try to adapt the government services to development purposes or to set up some alternative instrument such as an autonomous corporation that can establish a routine and a cadre specifically suited to the job. Since each procedure has advantages and disadvantages, the choice is one to be made with extreme care. (See Chapter Six.)

#### Economic Feasibility

Only after all the foregoing considerations have been fully explored has the time come to make a study of the economic feasibility of the scheme. How much will it cost? Not for capital investments alone but for all the supporting services that it has been decided must be provided under the particular local circumstances. Is this amount of capital available or can it be secured? Could it be made available for alternative investment in measures to increase agricultural productivity on lands already under cultivation? In which case would the national gain be the greater? Or can both be done?

#### Administrative Feasibility

Assuming that the economic costs and returns suggest going ahead with the scheme, are adequate administrative resources of trained personnel available to operate it? Here the problem is not so much one of supervising the construction of dams, canals, drainage structures, and so forth; that kind of managerial talent can be hired from abroad if necessary. More important is the administrative talent required to operate the scheme after it has been launched.

Circumstances in many places in the monsoon and subtropical region probably warrant such schemes to bring new lands into cultivation. But any such scheme is a costly, risky, and complex undertaking to be decided upon only after all of the facts are in.

#### WATER MANAGEMENT

As we noted at the beginning of this chapter, the region is one of year-round temperatures favoring plant growth but with rainfall less than optimum at least part of the year and excessive, leading to the need for drainage, during part of the year in some areas of the region.

Under these circumstances efficient water management is a primary need throughout the region. Although much of the region has some irrigation already available, much of it is in systems designed more to prevent total crop loss in bad years than to support maximum agricultural production.

Substantial new research is needed on water management in the region. This must include experimentation to find ways to use local rainfall to better advantage, ways to evolve from protective irrigation to irrigation for maximum production, surveys of groundwater aquifers and the hydrology of rivers for new storage irrigation facilities, improved methods of water distribution, and a host of other problems.



## Chapter Ten

# THE HIGH-ALTITUDE REGION

### THE REGION AND ITS PROBLEMS

#### Agriculture and Economic Development

High-altitude valley and plateau areas in the tropics are found in South America, East Africa, and parts of Asia. Here we shall discuss only the Andean regions of South America.

The three countries in which most of the Andean region lies--Ecuador, Peru, and Bolivia--include, in addition to the Andean highlands, the lowland areas on the Pacific coast (except Bolivia) and the largely unsettled lands to the east of the mountains.

A large part of the population of the Andean countries is made up of agriculturists and their families. The proportion ranges from 53 per cent in Ecuador to 72 per cent of the total population in Bolivia. More farmers live in the mountain areas than in the lowlands. In Peru the ratio of population of the highlands to that of the lowlands is over 2:1, and in Bolivia the ratio is even wider. The per capita income of the highland people is much lower than that of the lowland people. Peru, for example, with a relatively low average per capita annual income of \$179, has a coastal lowland/highland per capita income ratio of 3:1.

In Peru in particular the agriculture of the Pacific coast is highly productive and responsive to economic conditions, while the Andean highlands, with 60 per cent of the population, are characterized by a traditional agriculture, less favorable ecological conditions, and much less responsiveness to market demand. In this kind of an economy the possibilities of developing highland

agriculture are very much conditioned by two factors: Economic development of the national economy can proceed without participation by the area of traditional agriculture, and the development effort in the highland agriculture needs to be tailored to emphasize products in which the Andean region can compete with the more developed coastal area.

Economic development in Peru has not been held back by lagging agricultural production. Coastal agriculture has provided the agricultural production for both increased domestic demand and increased exports of sugar and cotton to the rest of the world. Incomes of those who remained in traditional agriculture probably have not changed, since there has been no increase in yields and thus no increase in production and income per worker.

Since the three countries are similar ecologically and face similar social problems, opportunities exist for applying research results and administrative techniques to the whole region. Lessons from experience in settling eastern lowlands in one country are likely to be relevant to settlement in other countries. Ecuador and Peru face similar problems in reorganizing highland haciendas under land reform programs. Intensive approaches to local development, like the one in Vicos,\* provide lessons of general applicability in aiding highland Indians in all three countries.

The Andean countries not only contain three distinct ecological zones; the high ranges of the mountains also divide each country into many smaller zones. It is a costly task to develop transportation that would better integrate small producing areas with cities and link up larger regions with the major city markets. Even when transport is more fully developed its costs are likely to remain greater than in regions with less difficult terrain.

In such circumstances it might be worth while to direct some research to the opportunities of stimulating nonagricultural investment in the highlands and in areas of settlement to the east of

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\*The Vicos project is described in Appendix A.

the Andes. The purpose would be to increase local demand for farm products as a stimulus to agricultural development. In principle the attempt would be to build stable regional economies with regional agricultural and nonagricultural sectors providing markets for each other and with a proper mix of products, both agricultural and nonagricultural, exported out of the region to pay for importing necessary products into the region. The point is that with a difficult terrain the optimum proportion of interregional trade to total production of the region might economically be smaller than with the same resources and more level topography. Local demand for agricultural products is more important as a stimulus to local production where the terrain is difficult than in places where transportation costs are lower.

#### Diagnosis of the Region's Problems in Agriculture

Physical and economic factors are discussed in this section. Important problems exist also in tenure patterns and in the human environment, which are discussed later in this chapter.

1. Limitations of the physical environment. Mountain agriculture exhibits a great deal of variability in types of crops and their yield potential as one proceeds upward from the lowest altitudes to the highest. At lower altitudes mean temperatures are higher, frost is absent or very unlikely, soils are deep, flat, and productive in valley bottoms, and irrigation exists or is possible. At higher elevations frost danger and the likelihood of hail damage increase; the growing season is shorter, and average temperatures are lower. Usually the soils are less productive if they are on slopes; if flat they suffer from conditions also associated with low productivity. At very high altitudes in the punas or jaleas (regions above 3,500 meters in Peru and Bolivia and above 3,000 meters in Colombia) and in the altiplano (above 3,800 meters in Peru and Bolivia) there are extensive areas where only very hardy range grasses and creeping vegetation prevail. Due to the low

quality and productivity of the range grasses, millions of hectares of range land are adaptable to sheep and auuchenid (for example, llama and alpaca) raising only with very extensive grazing areas.

Throughout the Andean highlands of Chile, Argentina, Bolivia, and Peru the rainfall, in addition to being low, with local rates ranging from 497 mm (Jauja, Peru) to 1,144 mm (Cajamarca, Peru), is highly variable (up to 25 per cent--around mean values--from year to year), with irregularities at the planting periods that cause delays in planting and increased likelihood of harvest losses due to frost.

The reduced length of the growing season and the low average temperatures and short photoperiod require crops with short vegetative seasons. Since these crops are more vulnerable to environmental hazards and require more care and greater labor inputs, they bring forth a lower output/labor input ratio than crops in lowland tropics or temperate zones. Large absolute yields are possible, however, with grain, tuber, and forage crops under irrigation and with the addition of improved seed, fertilizers, pesticides, and appropriate cultural practices.

2. Physiographic limitations. The rugged Andean terrain is characterized by considerable fragmentation of agricultural zones and a continuum of finely graded differences in ecologies over short distances. It is not an exaggeration to state that farms located less than 300 meters apart on a slope may require different varieties and cultural practices for efficient crop production.

These mountains are formidable barriers to commercial traffic in the magnitude required for the establishment of modern integrated markets. The highway systems in the mountains of Bolivia, Peru, Ecuador, and Colombia are inefficient, of limited mileage, poorly maintained, and leave most of the area without intraregional road communications other than pack trails. Most highland agricultural areas lack feeder roads transitable by trucks, resulting in the isolation of large areas from potential markets. Even some of the best roads leading to large towns are made intransitable during

extended periods of the rainy season by landslides and other mishaps. Perishable produce may often be lost when the nonrefrigerated trucks on which it is carried are detained by roadblocks. Very high freight rates are the result of slowness of traffic, rapid rates of deterioration of vehicles over mountain roads, and high maintenance and replacement costs.

3. Economic limitations. The great majority of farm units in the Andean highlands are small and located on less productive lands. Small farmers living at the subsistence level cannot effect any savings. Having in most cases no title to the land, they are not eligible for credit, and, even if they were eligible, they either are too far from a government agricultural lending agency office or they do not know how to proceed to request a loan. Often they would not know how to use it. In many instances the risks and uncertainties involved in growing crops in the highlands and the requirement of land mortgages as collateral discourage knowledgeable farmers from requesting loans. They operate either without additional purchased inputs or with moneylenders' credit at high rates of interest. Furthermore such purchasable inputs as fertilizers, seeds of improved plant varieties, and pesticides are available only in large towns.

The highland farmers on most small farms use their own power or oxen on the less steep slopes or level land. According to the 1961 census in Peru, in three typical highland departments (Cuzco, Cajamarca, and Ayacucho) only 0.7 per cent of farm units were tractor operated, and 36 per cent used human power alone. Data from the Economic Commission for Latin America for Ecuador indicate that early in the 1960's upland farmers produced 1.2 kilos of maize per man-hour, while a farmer in Argentina produced 21 times as much.

Marketing is a major stumbling block to increasing the productivity of highland Andean farmers. With many varieties of potatoes, corn, wheat, and other commodities, each locally preferred, with small quantities of produce being marketed by the majority of small farmers who are usually uninformed about price fluctuations, the



receipts of small farmers are much lower than they would be under other market conditions.

Despite their limitations the highlands could be more productive. Skillful entrepreneurship and investment can be observed in many medium and large farms with irrigation that crop corn and potatoes, and in some of the large sheep-raising haciendas. Productivity on these farms is much higher than on the community-held lands or the properties of small farmers.

There are, on the other hand, large haciendas where land is greatly underutilized, while nearby there may be extreme concentration of population and fragmentation of land property. In ten highland departments of Peru the 1961 census figures list over 300,000 hectares of land in fallow and 800,000 hectares of cultivable land currently not being farmed. With redistribution of population, change in tenancy status, and the addition of physical inputs such as fertilizers on fallow lands, much of this acreage could be made agriculturally productive.

#### RESOURCE SURVEYS AND RESEARCH

Lack of knowledge and information about the essential characteristics of the physical environment and the biological types that are best adapted to it is a controlling bottleneck in most of this region. The Andean highlands have not been properly surveyed in regard to soils and hydrological and natural vegetation resources. Soil type maps of a rough first approximation nature exist only for whole countries. Areas that have been surveyed make up a very small proportion of the region.

Soil capability and correlation studies with fertilizer inputs are being organized at the present time. Ecological maps based on the Holdridge ecological system (rainfall, evapotranspiration, and temperature) have been completed for Peru and Colombia and will shortly be available for Venezuela and Ecuador.

The development of a productive agriculture in the Andean highlands will require a better knowledge and use of scarce resources, both native and introduced. For the best use of natural resources it is essential to know their dimensions and whether they are quickly depleted or are renewable or reusable.

Agricultural programs in the rough mountainous terrain of the Andes are risky at best, but they can be made more successful by assigning the land to its most appropriate use. Natural resources surveys lead to conclusions regarding land capability. The farmer and his advisers will perform their tasks of production more efficiently when the farm plan includes a land capability map backed up by full information on its endowment in natural resources.

Surveys are generally carried out by plotting field data on aerial photographs. Some of the factors mapped in agricultural resources surveys are soil types, geologic formations, surface waters, groundwater, climate, vegetation, human resources, infrastructure, existing land use and tenure, and finally land capability. For specialized agricultural surveys it is necessary to gather additional kinds of data.

The resources survey of a region is usually general in nature, leading to further detailed investigations later. For example, discovery of good soils, adequate stream flow, and suitable sites for diversion dams may lead to the close examination of an area for irrigation. Another area may combine forest resources and a railroad, which might suggest detailed forest inventories leading to the development of sawmilling. Surveys of several different kinds of resources simultaneously tend also to reveal hidden relations between one kind of resource and others. Some basic technological knowledge of fertilizers, cultural practices, and varieties has been obtained at agricultural experiment stations in the Andean area, making possible a beginning in the organization of productivity-increase programs on regional bases. There is, however, a dearth of the information needed for more elaborate, countrywide action on package programs in specific fields, such as

range management, improved corn varieties, frost-resistant and drought-resistant crops, management of irrigation water, residual effects of fertilizers, and sheep, cattle, and auchenid husbandry.

Agricultural experiment stations with a supporting network of substations for verification testing should be created in each major ecological region of agricultural importance. They should be provided with ample land resources, should be well funded, should have freedom of action, and should be staffed with well-trained and well-paid personnel. These are the primary centers for the accumulation of knowledge on the agricultural problems of the region, and additional knowledge is a more acute priority in the highland areas than in most other parts of the world.

The best existing Andean research program has been established in Colombia with outside advice and assistance provided by the Rockefeller Foundation Agricultural Program. It has produced valuable improvements in technology in the areas of grains, potatoes, vegetables, and pastures. Many of the improved varieties from this center are suited to the Andean highlands of the neighboring countries of Ecuador and Peru. These successful crop adaptations suggest that a single central research institution for the Andean highlands, provided with satellite substations representing the major ecological subregions, could achieve plant breeding goals for the entire tropical highland region of Latin America and perhaps for other continents as well.

Existing knowledge is poorly diffused as well as insufficient. Present problems of diffusion of available knowledge are:

Written reports on research results from existing experiment stations are not available or are produced in very small numbers and so do not circulate widely.

Extension specialists are not available or are scarce.

Extension agents are few and concentrated in or near the larger towns. They are confronted with serious transportation difficulties, in general are poorly motivated, lack depth and perspective in their knowledge of their subject

matter, and are not familiar with research results from their own regional experiment stations.

University-trained and intermediate-trained (subprofessional technical assistant) personnel are not available in sufficient numbers.

Mass-media devices for extension are not sufficiently used.

Not enough farmer demonstration plots exist, and the organization of package demonstrations and their field operations is deficient.

Intensive training courses for farm leaders are too few.

Educational resources are diluted in extension as well as in universities by unnecessary duplication of systems or institutions.

#### DEVELOPMENT PROJECTS IN ANDEAN AGRICULTURE

There are many types of farming in the Andean highlands. It is possible to group them according to the major crop associations and livestock enterprises. Or land use systems may be classified according to the existing systems of land tenure. A third way of looking at agriculture is by the markets or consumers for which the production is intended.

After considering all these criteria and looking at the resources picture in the Andes, it seems desirable to divide the effort to develop agriculture into several compartments. These compartments must be considered as closely related development projects that should proceed concurrently in each of the Andean countries if possible. These projects are:

Land tenure: migration and reform

Irrigation

Grazing and pasturage

Forestry development

Market-oriented production

Land Tenure: Migration and Reform

Land available for development. The Andean nations of South America possess several kinds of lands that are available for the development of a more productive agriculture.

Apart from the Andean highlands themselves, areas of vacant land in the lowland regions are available for resettlement of surplus farm families from the Sierra.\* Bolivia, Peru, Ecuador, Colombia, and Venezuela are blessed with extensive reserves of public lands, especially on the eastern slopes and lowlands. These vacant forest and savannah regions are already being used for resettlement of surplus farm people from the highlands. Roads have reached the llanos of Colombia and Venezuela, where farming and ranching have expanded and have created settlement nuclei.

Ecuador has one road into the Oriente from Ambato in the central highlands, reaching Puyo in the eastern foothills. The main agricultural opportunity in Puyo is the Andean fruit crop, naranjilla. Settlement is spreading to many other Oriente communities that still lack motor roads. The Ecuadorian Institute of Colonization is increasingly faced with urgent requests from groups of established settlers to send surveying teams into this region to adjudicate farm boundary disputes and to arrange for granting of titles.

Peru has located 50,000 people along the Central Highway to the eastern Selva. Other penetrations by roads into the Selva have been made in the Marañón valley, San Martín province, San Ramón, Perené, Satipo, Quincemil, and Tambopata. These roads are effectively promoting the marketing of both agricultural products and timber.

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\* Though developing a stable agriculture in the lowland rain forests presents major problems, described in Chapter Eight.

Bolivia has the most ambitious program of spontaneous land settlement in the eastern lowlands. This settlement has come about during the last few years as a consequence of the construction of new highways from La Paz and from Cochabamba. Agricultural markets for the products of new farmers already exist in eastern Bolivia; sugar cane, rice, coffee, cacao, cotton, and corn are beginning to move on the roads. Market and land are a magnet to underprivileged farmers from the highlands, especially those who are landless or who have undersized plots. The government is assisting with limited extension activities in the newly settled areas. Migration to lowlands has been going on for some time, but it may be possible to speed up the rate of settlement. Technical and social science research oriented toward problems of settlement may be an important factor in increasing the rate of migration. Research on size of farm, tenure institutions, and the organization of service agencies to aid settlers may help to make the opportunities in settlement areas more equally shared.\*

However, because of the size of the highland population, migration is unlikely by itself to enable the people who remain in traditional agriculture to participate in the benefits of economic development for some time to come. The Andean highlands themselves have the potential for greater productivity. The lands may be classified by the nature of their ownership. All can be examined and evaluated by resources surveys.

Public lands. The governments of the Andean countries have already acquired large areas that are available for agriculture, grazing, or forestry once their capability is known. Some are from the residual public domain and others have been expropriated. These lands are ready for assignment to private homesteaders or communities, or to be held and managed by the government for public benefit, as in the case of national forests.

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\* See the discussion of settlement schemes in Chapter Nine, and the research proposal in Chapter Eight.

Institutional lands. Such semiprivate institutions as the Social Security Agency, universities, and the Church are holders of extensive highland areas, usually in the form of old haciendas. These lands are becoming available for more desirable forms of land use. The institutions are often willing to consider sales in the form of family farms in order to promote the establishment of a sturdy farming people working their own land. The institutions are usually better off with investable capital than in trying to operate the haciendas for their own profit.

Vacant private lands and underutilized haciendas. The Andean highlands have barren stretches of grasslands and moorlands for which a truly productive agricultural use has never been found. Similarly, on Andean slopes there are forested areas that contribute little economic benefit to their owners. These private lands can be inventoried by resources surveys and adapted for development at low cost. A watershed covered by heavy vegetation can be extremely valuable as a regulator of stream flow, though its forest products may remain inaccessible and unutilized for lack of roads.

The more intensively cultivated farms. Cultivated lands are divided between private holdings and communal holdings. The large private haciendas have historically secured labor by binding agreements with their peons, who farm an acre or two of land and in exchange work a few days each week on the hacienda. In other areas the prevailing land tenure pattern is small private holdings, as among the coffee growers of Puno province and the small potato farmers of the altiplano.

Communal lands are the joint property of Indian people in the ancient villages of the highlands. Such community-owned land is parceled out for cultivation or may be used for grazing by the animals of the whole village.

Modern technology is lacking, and yields are generally low. One of the best ways to increase productivity would be to provide farmers with farms of 20 to 30 acres legalized by land titles. On the well-cultivated haciendas there is still great potential for

improvement in productivity from modern inputs of fertilizer, pesticides, improved seed and plant materials, and machinery.

The Bolivian revolution and agrarian reform in 1952 was a drastic change that transformed land tenure and the social structure. Peru and Ecuador have not gone through a social upheaval like that in Bolivia. They have a chance to accomplish a more peaceful and better planned change in land tenure, which would accompany measures for wider distribution of landownership with the provision of the necessary government service agencies to stimulate production and income of highland farmers. Peru passed a land reform act in 1964, while in Ecuador the issue is under serious consideration.

Land redistribution. The passage of such legislation for agrarian reform makes it possible to plan development projects on the large haciendas that will be acquired by the government for redistribution to small farmers.

The experience of the Cornell project at Vicos suggests the advisability of retaining two major organizational elements:

Management and advisory leadership supplied from outside the local community. This leadership might have to be shared by several haciendas.

Retention of a substantial block of productive hacienda land that can be worked by the community under the direction of this outside leadership. This land is the source of community income that made Vicos distinctive and successful.

The large hacienda is the main object for agrarian reform and redistribution. As mentioned earlier, there are public lands, institutional lands, and private lands that may be redistributed. An example from the institutional lands is the 77 haciendas in Ecuador that now are held by the Social Security Agency, which intends to carry out a program of redistribution and resettlement. These haciendas extend over 140,000 hectares of the Ecuadorean highlands, not including 60,000 hectares of grazing lands that are



closely related to the properties themselves. The present occupants of these 77 haciendas are 30,000 families, most of whom are located on relatively small plots separated from the main hacienda lands.

There is a need to improve the living conditions of these 30,000 families and at the same time to make use of the land resources to benefit significant numbers of other underprivileged people in the same area. This will require:

1. An aerial survey of the haciendas.
2. A survey of land capabilities.
3. A determination of adequate family-farm size.  
(Ecuadorian and FAO experience suggests 10 hectares per family, as a rough estimate.)
4. A determination of the size of residual hacienda land to be retained for cooperative or community use. If possible, its use should be established during the survey.
5. A selection procedure and method of judging capability of new settlers.
6. A cadastral survey and map showing the ultimate land tenure layout.
7. An assured source of agricultural knowhow and inputs. This will include credit, supervision, and help in marketing.

Reorganization of undersized farms. This is much more difficult and less promising than the redistribution of hacienda lands. There is a good reason for carrying the two out simultaneously, however. There will never be a better time to entice a poor man off his inadequate plot of one hectare than when other lands are available for his use. Ideally farmers should be selected for such thinning out operations by ability, family need, industry, and good character but not by their financial means.

The undersized farms might be acquired by the government or sold to adjoining holders of undersized plots. Any procedure that would eliminate bureaucratic delays is preferable. The experience

in Japan, where the local villagers conducted their own land reform, suggests that there might be a considerable degree of local participation after which governmental action would be more in the nature of a ratification. In Japan the local boards essentially were able to award land to tenants. In the Andes their role would be to help in choosing able and industrious (but underprivileged) people in their community to be given an opportunity to transfer to a better land tenure status.

In every country, then, it is possible to visualize two possible places where Indian farmers, now in the grip of the minifundia problem, can find land for a new start. These are: resettlement on public lands in the lowlands, and resettlement on institutional or government-held haciendas in the Andean highlands. These possibilities give to the land-hungry Andean people an economic opportunity that requires only limited amounts of technical assistance and credit for success.

### Irrigation Projects

Irrigation more than any other single agricultural practice sets the stage for use of all inputs favoring higher productivity. The Andean highlands are well endowed with permanent streams and a scattering of snowy peaks and glaciers. Water resources are highly valued, and irrigation is an ancient art. Development of additional irrigated land consists in overcoming the obstacles that have been limiting in the past. Presently feasible schemes involve four major types:

Construction of diversion canals. In many stream valleys the opening of diversion ditches has been prevented by hard-rock sections that are beyond the capabilities of either hacienda or village capital. With government help, the use of dynamite, air hammers, and heavy machinery may become feasible.

Construction of diversion tunnels. The distribution of river water and rainfall in different basins of the Andes occasionally

permits the use of tunnels from one humid hydrographic basin to another where irrigation is lacking. Such tunnels have become more feasible in recent years because of improvements in rock-breaking tools and tunnel technology. The sites are usually known, and action may wait only upon the availability of external capital.

Construction of storage dams. When a market can be found for hydroelectric power, multipurpose dams to store water during periods of high stream flow become attractive. Where natural lakes are drained by small rivers, building relatively small structures at the outlets will provide storage. Full exploitation of this potential awaits thorough aerial surveys of dam sites and irrigable areas and the completion of newly initiated hydrographic and meteorological measurements in the watersheds.

Development of groundwater resources. The presence of enclosed physiographic basins and lakes in the Andean highlands makes possible the storage of water underground as well as on the surface. Around the Titicaca and Junin basins there may be important potential for tube wells for irrigation. These areas, which are relatively deficient in rainfall, would benefit in the production of potatoes, wheat, and intensive pasture if water could be pumped from the underground reserves (providing this is economically feasible).

Undeveloped hydroelectric resources in the same regions could contribute to irrigation well development by supplying needed power for pumping. Another applicable technique for pumping is the use of windmills.

Where frosts are causing severe losses in the potato crop, as at Puno, it is possible to protect the crop by night-time sprinkling of the vines. This new technique has found wide use in springtime frost protection of similar crops in the United States and West Germany, where it is applied to berries, apple blossoms, early peppers, and tomatoes. The standard equipment for sprinkler irrigation includes a portable centrifugal pump and distribution lines of aluminum pipe fitted with rotary-nozzle sprinkler heads.

In each region offering a supply of water for irrigation there will be a need for surveys to determine the potential of the land for agriculture. The intensive production possible under irrigation also requires careful consideration of the market potential. For example, potato production could easily reach a level exceeding the urban market potential. It may therefore be necessary to plan for alternate crops to utilize the irrigation water. Rotation of crops may serve to avoid buildup of soil diseases and insects. Food processing and food storage may help the farmer to maintain a year-around ability to deliver produce to his urban customers.

#### Grazing Improvement

The cold regions (tierra fria) of the Andes are located above the 10,000 foot contour and may be divided between the drier altiplanos and the humid páramos. In both regions the prevailing vegetation is grass, and grazing by sheep is the major form of present land use.

Because of the extent of this cold region it deserves concentrated effort in several areas where the visible achievements of demonstration projects could exert an influence on the surrounding people and farms. Animal husbandry fell outside the terms of reference of the conference. Therefore, though we gave considerable attention to the subject, here we shall briefly mention only two points about the supply of animal food.

First, inventories should be made of the native and introduced forage crops of greatest value for the specific areas both in the dry altiplanos (with and without irrigation) and in the moist páramos. The inventory must include legumes, which assume crucial importance for livestock feed because their protein content is higher than that of the grasses. Northern Peru, Ecuador, Colombia, and Venezuela have a high proportion of moist páramo highlands on which legume production may be possible even without supplemental irrigation.

Meat, milk, and wool production is essentially a process of converting protein. In the Andes this involves a long slow process of protein accumulation by the animal from the grass upon which it fed. Animals supplied with liberal amounts of legume protein may mature twice as rapidly as their grass-fed counterparts.

Second, there is a novel and economical way to supply extra protein and supplement the carbonaceous grassy intake obtainable from present Andean pasture lands. This technique involves the free-choice feeding of a special cheap mixture of molasses and urea in tanks placed in the pasture with the animals. Developed in the United States, it has permitted cattle feeders to fatten steers to full maturity without using expensive grain or protein supplements.

This direct feeding of a cheap nitrogen fertilizer material, urea, is a technological breakthrough of some importance for the high Andean grassland areas. Any survey of grazing potential should include provision for a few major pilot areas of beef, mutton, and wool production.

#### Forestry Development\*

Rough lands and stony soils, plentiful in the Andes, are usually more suited to forestry than to other uses. Successful forestry depends, however, upon the selection of adapted tree species as well as sufficient skill and resources to prepare the sites for planting. The long time required for growth of a marketable tree makes forestry an unpromising field of endeavor for poor subsistence farmers working alone as individuals. Recent experience with tree-planting programs in the Andean countries has indicated, however, that tree plantations can be established that benefit the economy and the communities collectively.

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\*As in the case of grazing, forestry falls outside our terms of reference. Here again, therefore, we are not reproducing our conclusions in detail.

It has been found that a forest in the neighborhood benefits all the people by providing cheap wood, contributing beauty, stabilizing erosive soil, providing employment, and attracting industries. Forest planting projects have proved that the barrenness of the Andean highlands is not a necessary condition.

The use of aerial surveys to pinpoint areas suitable for afforestation is one of the cheapest and most promising long-range projects for improving productivity of the land in the Andes. These surveys may take place in conjunction with other studies of land for agriculture, grazing, or irrigation. Usually the land least favorable for farming is reserved for forestry if it has proper soil and moisture and if an adapted kind of tree can be obtained.

Forestry projects require local and urban markets for the wood produced. Local markets for firewood, poles, and timber may be satisfied by a few hundred acres of plantations per village. Urban centers, railroads, mines, seaports, and construction projects are much greater potential outlets for well-chosen sites. One thousand acres of a single species of timber planted alongside a railway line is worth twenty times a similar forest 500 miles away by road. Other advantages of plantations are uniformity of product, uniform age, and accessibility to the laborers who will cut and deliver the timber.

Some quick-growing species and the regions of the Andes to which they are adapted are as follows:

<u>Species</u>	<u>Andean Region</u>
Eucalyptus globulus	Dry altiplano, up to 12,000 feet
Abies religiosa	Páramos (moist altiplano)
Pinus radiata	Páramos (moist altiplano)
Pinus ayacahuite	Moist forest belt of northern Andes, especially on steep slopes
Araucaria araucana	Moist forest, 6,000-8,000 feet
Pinus montezumae	Lower montane dry forest, around 5,000 feet

<u>Species</u>	<u>Andean Region</u>
Alnus jorullensis	Lower montane wet forest, around 5,000 feet
Cupressus lusitanica	Lower montane wet forest, around 5,000 feet
Pinus pseudostrobus	Lower montane moist forest, around 5,000 feet

### Market-Oriented Production

Urban markets of the highlands. The five northern Andean countries have at least 34 important urban centers around which it would be possible to organize agricultural production projects oriented toward economic and agroindustrial growth. Planning in each country should take maximum advantage of such major congregations of people and purchasing power.

The produce that could be grown for these markets would require the efforts of millions of farmers. The evidence shows that the food demand of the urban populations is highly elastic. This means that a new class of modern efficient producers of such products as fruit, grain, potatoes, milk, meat, cheese, eggs, chickens, vegetables, and habas beans could expect to build their sales without difficulty. The modern world of communications and rising expectations has set the stage for a new kind of selling in these high-cost markets. Packaging, grading, refrigeration for perishables, and other advances in food preservation and processing are within the reach of these fast-growing communities.

The procedure for market development begins with the basic resources survey of accessible markets and agricultural potential. Then detailed studies must be made of available land areas, public or private, that lend themselves to the market production of good salable foods. Soils, irrigation layouts, farming patterns, the present marketing setup, and community services will need to be examined in detail. Plans must then be made for supplying farmers

with technical advice, planting stocks, essential inputs, and credit.

The selected urban markets must be integrated with the new farm enterprises in order to reduce intermediate costs and to assure fast delivery of attractively packaged goods to the market shelf. Alert urban businessmen should be encouraged from the outset to set up supermarkets.

The farmers must organize in order to standardize a high level of quality and must therefore be shown the advantage of uniform high-yield, high-quality produce. Marketing is the crucial element in this kind of food production enterprise. Trucks owned by the individual farmers or by their association may be purchased under credit supplied by municipal, federal, or private banking sources.

The agency conducting surveys to select areas for rural development-marketing projects must choose for investment those places that have the greatest opportunity for assisting small farmers while satisfying strict criteria of economic returns on scarce investment capital. Some clear opportunities for modernizing market production must exist in the vicinity of every one of the 34 highland cities.

Marketing development will help diversify the economies of the Andean countries. New centers of urban diversity will attract rural populations as an alternative to the present mass migrations from the highlands to coastal cities. The development of the highland economy will favor subsequent development of the eastern lowlands as rural hinterlands with abundant land and a complementary tropical agriculture for trade with the highlands.

Markets in the major lowland cities. In addition, important cities in the lowlands of every country offer tempting specialized market opportunities to producers in well-located farming areas of the Sierras. The development of farm production supplying these



markets is already under way. There are, however, unfilled needs and opportunities. The physical barrier of the Andes mountain wall and the unresponsiveness of Indian farmers to modern market opportunities are hindering both production and consumption of food.

Andean food production areas within transportation range of the lowland cities can be selected for development. The technique is similar to that described for the highland urban markets, with certain notable changes and additions. Before undertaking a land capability survey it is necessary to compile an imaginative list of marketable Andean food items. The proposed new land-use scheme should be built around the marketable items so that a balanced individual farming and management plan can be devised.

Changes in government price and import policy would stimulate Andean production for urban lowland markets. For example, Peru might consider protection and/or support prices for wheat and malting barley, both of which are imported in large quantities though they are also produced domestically. A support price for beef would undoubtedly result in an increased production of creole beef in the highlands of Peru. As long as the policies of the governments are directed at placating political pressures in the cities--going to the extent of importing beef from other countries at "dumping" prices well below domestic prices--beef cattle feeder steers cannot be produced in the Andean highlands.

The following list of import substitution possibilities and foods in rising demand (most of them already existing in the region) illustrates the opportunities that are open to well-located Andean farming regions and the inputs they require:

<u>Urban Food</u>	<u>Andean Product</u>	<u>Needed Inputs</u>
Beer	Malting barley	Seed supply Crop assembly
Bread	Wheat	Seed Weed-control chemicals Irrigation Crop assembly

<u>Urban Food</u>	<u>Andean Product</u>	<u>Needed Inputs</u>
Potato	Potato	Improved seed Pest control Cleaning and packaging Storage and distribution Fertilizers
Meat	Dual-purpose cattle Improved sheep	Abattoir and cold rooms Transport
Milk	Dual-purpose cattle	On-farm grading Collection and storage distribution
Broilers	Chickens	Feed production Credit Marketing
Eggs	Poultry	Collection and grading
Small fruits	Raspberry } Blackberry } Strawberry }	Plant stock Spraying Crop assembly, freezing
Deciduous fruits	Apple } Pear } Peach }	Adapted varieties Pest control Grading and packaging Organized marketing
Breakfast foods	Corn } Oats } Quinoa } Wheat }	Varieties Quality High yield Processing
Pulses	Beans } Habas } Lentil } Chick pea }	Varieties Pest control Yield and quality Grading and assembly
Vegetables	Tomato } Greens } Root crops } Asparagus } Artichoke } Sweet corn }	Cleaning and packaging Grading and distribution Yield and quality

Export markets. Some Andean products are readily salable on the world market if produced in quantity and quality, accumulated in exportable forms, and standardized. The more obvious ones are wool (especially that of the auchenids), mutton, frozen trout, Peruvian flour corn, quinoa flakes, pyrethrum flowers, and lupin for tannin.

In each case the Andean region can capitalize upon its abundant labor force and its special climatic advantages. All these products require a cool mountain environment for their production. Rare and potentially valuable products such as the wool of native Andean animals (llama, alpaca, and vicuña) should be made into finished products for maximum return.

Integration of the production process with market needs and fashionable demands overseas is important in deriving full benefit from textiles if sold in finished form. The tourist industry, which can render many other benefits in the Andean highlands, will undoubtedly create an excellent market for native textile goods and handicrafts.

#### THE HUMAN AND INSTITUTIONAL ENVIRONMENT

##### Government and Bureaucracy

The governments of the Andean countries are aware that Latin America's gains in agricultural productivity in the postwar era are far from adequate. They know that the mountainous agricultural areas are the major laggards and that, since those areas carry such a high proportion of the population, the highlands must participate in the further development of the national economies. Blueprints for regional organization of government action or the beginning of such action in a concentrated way exist or are being prepared.

The will to develop undoubtedly exists in the government elites of the Andean countries. The difficulties confronting the transfer of that will to a coordinated action program are phenomenally great and complex. The main limitations in government bureaucratic organizations are:

Dilution of trained manpower into too many autonomous, uncoordinated, and often competing governmental corporate bodies--ministries, state or local corporations, banking and

credit organizations, authorities, universities, state governments--each one promoting development in its own way, with its own program, and with a small cut of the budget pie, and each inadequate by itself to produce the desired effects.

Lack of incentive in the bureaucracy to apply itself with the fervor and wholeheartedness it takes to get progress moving and to organize, produce, and convey the information, supplies, and credit needed by farmers to break through the "old ways curtain."

Insufficient allocation of public funds to agricultural development by government planning boards.

Allocation of public funds according to political pressures rather than by rational economic priorities.

Incomplete or no governmental action on price control, subsidies, or marketing of farm commodities.

Competition of government with commercial supply channels for physical production inputs.

Lack of cooperation or coordination at the local level among research, credit, extension, and general agricultural promotion activities.

#### Social Values in Highland Communities

There are in the neighborhood of 10 million peasant farmers living on the high plains or the intermontane basins of the highland regions of Ecuador, Peru, and Bolivia. About half of these are Indians who are monolingual in one of the dialects of Quechua or Aymara. The other half are Mestizos, who are for the most part bilingual, speaking either Spanish and Aymara or Spanish and Quechua. A number of dialects of Quechua exist, and a speaker of one dialect frequently cannot understand another dialect.

For the most part the Mestizos dominate in the towns, and they occupy the best bottom lands in the intermontane basins. The Indians occupy the uplands and farm under harsher natural conditions. There is, however, little difference in their respective farming technol-

ogy. If the peasant Mestizo farmer is more productive than his Indian compatriot, it is largely because he occupies better land.

The barriers that exist between the Mestizos and Indians, although in part cultural and social (manners of speech and dress, for example), were established in the colonial period and are likely to persist for a long time to come. One such barrier is Indian serfdom. In Bolivia serfdom of the Indian was abolished after the land reform was carried out, but it still persists, although illegal, in the highlands of Ecuador and Peru where over a third of the Indian population are living under systems of peonage on large haciendas.

The freeholding populations, both Indian and Mestizo, are organized in a variety of social units. For the most part Mestizo farmers live in lowland nucleated villages with fields around them. Indians live both in upland nucleated villages and on dispersed farmsteads where a man may have widely scattered fields. In Peru there is also a class of community called comunidad indígena that enjoys a special legal status and whose lands are inalienable. Some 1,600 of these communities are legally recognized in Peru.

Sharp differences in fundamental values exist between the Indians and the Mestizos. The former generally hold hard work and frugality in high esteem, while the latter are much less prone to manual labor and prefer to live ostentatiously. Indians, however, display great mistrust of the outside world; its encroachments in the past have largely involved exploitation in one form or another by the Mestizo group.

The world view of both Indian and Mestizo farmers is fundamentally fatalistic and pessimistic. Levels of cooperation beyond the family or immediate kinship groups are rare, and until recently government concern for the fate of the peasant has been negligible.

However, the situation is not as bleak as it might at first seem. Changes in the past few years indicate that the peoples of the Sierra are in the initial stages of a social and economic transformation. Roads and schools have been built. New ideas have penetrated the most remote villages through returning migrants and

veterans of military service and the introduction of the transistor radio. This has led to new expectations that another, less deprived way of life may eventually be theirs.

The Andean peasants, in becoming aware of the privileges and standards of living that others enjoy, are now beginning to feel that they have for far too long been deprived of many things that are rightfully theirs: some voice in the decision-making process; a fairer share of the wealth; a position of respect; a right to a decent education; communications with the outside world; and access to modern medicine. Indeed, in most areas demands for some of the benefits of modernization--demands sometimes expressed with violence--have forced governments to focus more attention and more resources on the highland areas.

#### STRATEGIES FOR MOTIVATING CHANGE

Self-government at the village or community level is still incipient and inexperienced. The political authoritarianism of the landlords and the unilateral imposition of programs by the civil service organizations on the farmers have barred the farmers from becoming efficient cooperating subjects in the development programs. Such treatment has tended to make them peons being moved on a checkerboard crisscrossed by pathways supposedly leading to progress but often blocked by interest groups.

In the few cases where liaison has been successfully established between governmental agricultural agencies and associations of small farmers the results obtained justify the pragmatic view that constant flow and feedback between governmental agencies and farmers' groups or independent farmers are prerequisites to any successful program in the agricultural sector.

The crucial issue of bridging the gap between the extension agent and the farmers is receiving attention, but experience is still wanting as to how this can best be done. Extension agents

seem to spend considerable time glueing farmers together in what has the outward appearance of an organized association but in fact fails to provide the members of the young group with sufficiently strong material motives to make them soon become stable and self-supporting and eventually models for other farmer groups.

#### New Means of Communication

In addition to expanded technical and extension services there are other ways of reaching the peasant farmers, ways that are not being currently employed to any great extent. There is, for example, not a single radio station in the Andean area that beams regularly planned agricultural programs to the people in their native languages, Quechua or Aymara. Given the fact that transistor radios are now found everywhere, it would seem feasible (and cheap) to beam agricultural information along with musical and news programs to the Sierra villages in these indigenous languages. Research indicates that most people who have access to a radio would gladly listen to a program oriented toward peasant life in the mountains.

A second mass approach that might have considerable effect is the publication of an indigenous weekly or monthly newspaper or magazine (in Spanish, since Quechua is not a written language) that could be mailed to the personero (legal representative) of every farming community. It could contain agricultural information, could help solve problems of farmers and communities, or tell them where they could go to get the information they desire.

A third approach might be to identify innovative community leaders and bring them into central locations where they could receive short training courses in improved agriculture from a competent staff. On returning to their villages they ought to have considerable innovating effect. Such leaders might even be entrepreneurs who could actually sell new inputs necessary for increased agricultural productivity.

Finally, ministers of agriculture should make available on request mobile teams of specialists in agriculture and associated

activities who for short periods of time could assist villages that are willing to help themselves.

#### Focusing Programs on Agricultural Productivity

Most of the development programs that have been initiated so far in the highlands have not had agricultural productivity as the central theme of their efforts. Yet all of the people concerned are farmers whose greatest felt need is for more food. By dispersing their efforts in such areas as political organization, literacy, and welfare projects in general, past programs have failed to capture the interest of the peasant who saw in them no direct benefit to himself. First and foremost, then, a program needs to be designed with priority to increased food production so as to establish a solid economic base for further development. This is an area in which least resistance to innovation is likely to be met. Moreover, most successful agricultural innovations have the advantage of producing positive results to the farmer--and thus further inducement to innovation--in the relatively short time of one growing season. Programs in other areas do not often show such quick and dramatic results.

#### Developing Community Organization and Leadership

Another central issue has to do with the organization of the communities themselves. Researches on more than 50 peasant communities, Indian and Mestizo, indicate that an intense degree of individualism and only a minimum (and often forced) degree of cooperation exist at the community level. On such matters as irrigation or the use of common pasture lands, cooperation does of course take place because the very survival of the family depends upon it. If a common effort is not made to clean and repair the major irrigation canals, no individual farmer can receive his water; if he does not join with his fellow villagers to maintain the common pasture area, he will have no place to graze his animals. But beyond such minimum levels of cooperation there is little sense of community to which



one can attach a program at the present time. Villagers are very suspicious of their own local authorities, who have so often bilked them in the past.

Decision-making bodies have to be developed in these communities, bodies whose members will identify themselves broadly with the welfare of the community as a whole, not with the special interests of a few. Much research is needed in this area. We know little or nothing of the functional power groups at the local level, or of other levels of government that affect the village. Studies of the provincial and national elites as well as of the bureaucracy are very much in order.

#### Using Religious Values

All over the Andean area peasants are known as muy fiestero (very devoted to religious festivals). Mestizos and Indians alike spend much time, money, and effort celebrating feast days of patron saints who are believed to control the destiny of man. Much fiesta activity is related to the annual traditional cycle in agriculture, the productivity of which depends on the proper celebration of the fiestas; when crops fail because of frost, hail, or drought, it is regarded as a castigation for "sins" committed in the community. This view generally receives reinforcement from priests, whose authority is highly respected in the community in spite of anti-clericalism.

This deep commitment to religious values may in fact be utilized as a way of increasing agricultural productivity. Most communities have set aside certain lands or animals that belong to the saints. The production of the saints' lands is generally used for their annual fiestas; the priests usually work in close association with the traditional authorities to decide how this money is to be spent. If extension personnel were to work closely with parish priests who have entry into the community, they might be able to convince the traditional authorities to try out new techniques on the saints' lands. The lands would thus serve as demonstrator and

model plots for the many individual farmers who are obligated to work these lands for the saint. Demonstrations on such lands would have the advantage of introducing the new techniques through the most prestigious channel in the community.

#### Community Acceptance of the Development Program

The peasant community is not likely to be altered drastically and rapidly in the near future. We therefore explored the degree of cooperation likely to be forthcoming from peasant communities for the projects we have proposed.

Land reform and land redistribution. Perhaps the strongest single value of the Andean peasant is his great attachment to land. Members of the indigenous communities generally feel that they have lost their property to outsiders through exploitation by rapacious landlords taking advantage of special privileges and power accorded them by the political office. Although the land reform laws may eventually change this, we cannot hope for very rapid progress on the redistribution of land in the Sierra. Land-happy hacendados are not likely to give up easily to land-hungry peasants even though a law is on the books.

Any reform that is likely to enlarge the peasant's share of the total pie will be enthusiastically welcomed by him. The proposal to farm the lands expropriated from the hacendado through some cooperative or collective institution is not likely to meet resistance from local people.

Irrigation. There is fairly good evidence that the peasant farmer in the Andes sees water as his biggest problem. And it is precisely in this area that much cooperation has occurred in peasant villages. Studies indicate that over 25 per cent of the free-holding peasant communities in the highlands have constructed irrigation canals in recent years through communal effort.

The cost of getting more water to peasant communities is of course more than any government in the Andes can afford. It must continue largely to be a community effort. With some technical help

it can be expected that cooperation in the form of communal labor for the expansion of irrigation systems would be forthcoming from most Andean communities.

Research is needed on current systems of distribution of water and legal rights to it, which are by no means uniform in highland villages. At the present time, systems of water distribution and legal problems of water rights have been thoroughly studied in only a handful of Andean communities.

Grazing and stock-raising improvement. So important is the ownership of animals to most farmers in the Andes that we can expect technical innovations related to improvement of breed or pasture to be heartily welcomed. A man is frequently assigned status in the community on the basis of how many animals he owns. Indigenous communities still contain rather large areas of pasture land that is communally owned and to which every member of the community has grazing rights. Given this type of organization, it should not be too difficult, with adequate technical help and supervision, to get the community to engage in stock and pasture improvement.

Forestry. Since there is a great shortage of wood for fuel and construction in the highlands, we can expect that resistance to forestation would not be high, particularly if food production is tackled first. The great problem in the past has been a lack of adequate stocks of seedlings and information about their planting and care. The peasant knows the value of tree crops, but he has been unable to take advantage of this resource up to now.

Production oriented toward markets. Once the Andean peasant is able to grow enough food for his own nutrition, he will be more responsive to economic incentives. That he already reacts to such incentives is shown by the local markets that are held weekly in every highland village and town.

We have very good studies of Indian markets in the highlands or markets in Mestizo towns and villages to which Indians go. A few careful studies of these markets by an economically trained anthropologist might be a strategic first step in making recommendations

for what can be done to make peasant farmers more responsive to the market. It should be noted that many communities have already constructed farm-to-market roads without help from central government.



## APPENDIXES



## Appendix A

### FOUR SUCCESS STORIES

The following sketches, based on the descriptions presented at the conference by representatives of the four programs,\* are intended to give the essential facts concerning programs that are referred to frequently in the body of the report.

Our basic thesis that institutional methods are not transferable is illustrated here, for these four successful programs have little in common in their structure. In no case can one point to a single factor as the cause of success. On the contrary, what made these programs succeed is that their operators took into account all the major factors listed in our taxonomy chart in Chapter Two as they applied to their local situations. A program may begin with what appears to be a single input--cooperatives at Comilla, for example. But other factors, notably knowledge of local social structures, were provided so that barriers could be foreseen and overcome as they appeared. Thus, though no technique can be transplanted in itself from any of these programs, they have in common a basic principle: planning that integrates all the necessary inputs in terms of local conditions.

#### EAST PAKISTAN: COMILLA

The Academy for Rural Development at Comilla in East Pakistan was founded in 1959. It took a thana (district) with 200,000 inhabitants and started a pilot scheme in this area characterized by desperate poverty and overcrowding.

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\* Comilla by Akhter Hameed Kahn, Gezira by Arthur Gaitskell, Vicos by Allan R. Holmberg, and JCRR by Yien-si Tsiang.



In 1959 the formal structures for development existed in Comilla and in East Pakistan generally, but they did not function effectively. Cooperatives and extension services were in place but did not produce results. Research had developed and tested improved practices; the farmers did not adopt these practices even when they knew about them. Little coordination existed among the various units of government and technical services. A general hopelessness, a feeling that "nothing can be done," seemed to pervade both farmers and bureaucrats.

The aim of the Academy was to apply social science to the problems of the Comilla area, and its main operating technique has been that of communication. The patterns of village life were studied to determine why improved practices were not adopted and to discover, through consulting the farmers, what innovations were needed and how they could be introduced. The aim in communication has been to provide an interchange of information and ideas among farmers, bureaucrats, and the social scientists on the Academy's staff.

Although Comilla does not replace existing structures, it brings their personnel together in a new environment. Improved practices are still provided by the existing research stations, and programs are carried out by the existing bureaucracy. The Academy does not execute or administer; it analyzes, evaluates, and catalyzes. The technicians who carry out the programs shift their headquarters to the Academy, but they remain members of the regular bureaucracy and responsible to it. At the Academy the technicians learn the results of the Academy's research and are exposed to continuing evaluation of their programs. Less tangibly, in this new environment they absorb new attitudes toward their jobs.

The Academy's first venture was in cooperatives and extension. Early research led the Academy to believe that lack of credit was the prime bottleneck that prevented the adoption of innovations. In addition the extension agent was not viewed by the farmers as a

source of advice; instead, they turned to village opinion leaders with whom the agent was not in touch.

The moribund cooperatives were restructured on the basis of consultations with local farmers. The Academy provided the information, but it was the bureaucracy that decided to promote the new structures. The Comilla cooperatives have several distinctive features, but the essential fact about the Comilla system is that the basic responsibility for its design and operation rests with the farmers rather than with the Academy or the bureaucracy. (The system is outlined in Chapter Nine.) The same principle was applied to the reform of the extension system. Since it did not seem possible that the village extension agents could operate effectively, they have been largely superseded by "organizers" and "model farmers," chosen by their fellow farmers, who attend the Academy weekly and provide the essential link between research and the farm.

Comilla's institutional innovations have proved successful. The cooperatives are growing, and their rate of recovery of loans is high. Comilla has branched out into other fields, not all of them agricultural: mechanization--tractors and irrigation pumps; mobilizing the unemployed for rural public works; reorganization of local government; and, most recently, family planning, educational reform, and village electrification.

However, the Academy has been very cautious about expanding beyond the Comilla area and has refused to supply plans for other areas. Instead, it offers to take bureaucrats on at the Academy to observe its methods and then apply or adapt them elsewhere on their own initiative.

Thus Comilla remains a pilot scheme. Its distinctive features are its constant self-evaluation, its studies of local society, the communication it has established between the farmers and the bureaucracy, and its effort to arouse the initiative of both village society and bureaucracy.

## SUDAN: GEZIRA

The Gezira scheme is an intensive irrigation project in the Sudan between the Blue and White Niles just south of Khartoum. Planned early in this century, the dam and canalization for 300,000 acres were completed in 1925. Gezira now has some 70,000 settlers and covers 1,800,000 acres.

Gezira has succeeded where all too many similar irrigation schemes have failed. It has brought the benefits of large-scale estate management to peasant communities. The settlers' income is significantly higher than that of other Sudanese farmers. The scheme has repaid its costs and now is a major source of foreign exchange and development capital for the Sudanese government. Thus it benefits the nation as a whole, not merely the settlers.

The Gezira project was launched as a three-way partnership of the government of the Sudan (then British controlled); a private company, the Sudan Plantations Syndicate, that provided management and some financing; and the farmers. It was preceded by research and pilot projects.

The land for the scheme was acquired by compulsory long-term rental to the government at the previously prevailing rates. It was then divided into standard parcels and leased to tenants, most of whom already lived in the area. The tenants were required to follow a fixed rotation of food and fodder crops and to grow a new cash crop, cotton. The entire cost of the scheme has been paid from the cotton crop; the food and fodder crops belong to the settlers. The scheme was intended to benefit the peasants, not local landlords or expatriate settlers.

Some of the factors that seem to have contributed to Gezira's success, though once again the important point is that all the factors were taken into account, are the following:

1. The scheme concentrated on the part of the nation with the greatest potential for development.

2. The economic objective was uppermost. The scheme was

planned to make money for each of the three partners. No partner had a prior claim on revenue, and none made a profit unless all did. The claims of all partners were directly related to yield, giving a common incentive for production. The division of the profits among the partners was based on existing local custom.

3. The inclusion of private enterprise capital and management filled a gap in capital needs and provided an element of drive and efficiency often lacking in a bureaucracy to whose members loss or gain is less immediately important.

4. The company accepted a time limit on its participation. Under the contract the government regained full control of the scheme after 25 years.

5. Long experimentation with pilot schemes preceded the actual dam construction, which provided technical knowledge on methods of production and made it possible to determine the optimum farm size (30 acres). It also served to convert the peasants to the scheme. When first proposed, opposition was almost total. A pilot scheme, using pumped water, was conducted on 600 acres, and this demonstration brought a shift in community opinion in favor of the scheme.

6. The scheme was made as simple as possible. Of the three crops grown by the settlers, two--the food and fodder crops--were already grown in the area. The fact that only the cash crop, long-staple cotton, was new to the farmers reduced the burden of innovation on the farmer. It also made the job of extension much easier. Since the new inputs were relatively simple, the extension personnel did not have to be highly trained. It was thus possible to combine several functions in one person. The settler did not have to wander from office to office. A single man in a single office, no farmer being more than eight miles from an office, could provide technical advice, credit, and any other information needed by the farmer. And, since highly trained people were not needed, it was possible to build up a permanent staff that could gain the farmers' confidence.

7. The cash crop, cotton, was known to have a ready market.

8. The social controls imposed on the settlers were designed to protect them against antisocial actions but not to suppress individual initiative. The controls consisted of the planned family holding, tenancy rather than ownership, prescribed rotation, a prohibition on mortgage and fragmentation. Organized services-- research station and seed farm, fertilizer and pesticides, machinery for cultivation and pest control, supervised credit and marketing--made the individual better able to cope with his environment. Nonetheless each settler's returns depended on his own initiative and effort.

9. The elimination of landlord control and land speculation prevented the scheme from benefiting only a few.

#### PERU: VICOS

The Cornell-Peru project, smallest of the four, had its origin with Cornell anthropologists who were interested in the interaction between technological and social change.

The project took place on an 18,940-acre hacienda at Vicos in the highlands of Peru. In 1952 Cornell rented the hacienda. It had about 1,800 inhabitants who were Indian serfs and it was being operated under the traditional feudal system that required the serfs to give three days of labor a week to the land of the patron-- 3,850 acres of the best land in the hacienda. The Indians also had their own plots of land.

In effect Cornell became the patron of the hacienda. Before launching any development projects the Cornell group attempted to gain rapport with the Indian community and to discover its felt needs, motivations, and social structure. Projects were determined by consultation with the community. The aim was to set in motion the general process of modernization keyed to an increase in agricultural productivity.

Contrary to expectations, the Cornell group found that the Indians did not resent the three days of labor a week that they had to give to the patron, but they did object, and bitterly, to the extra services often exacted by him. The first move therefore was to abolish all extra unpaid duties. This action gained support for the new patron.

The three days of labor were used to introduce innovations on the hacienda lands, the production from which was to provide capital for other development projects. Potatoes were the staple food, but the crops were being severely damaged by blight. Research had already established that the blight could be controlled, and pest control was successfully introduced on the supervised fields of the patron. In attempting to spread this and other innovations from the patron's fields to the Indians' individual plots, the Cornell group found that there was a vacuum in community leadership. Eventually the leadership for innovation was found among the younger, disaffected Indians--not in the existing leadership.

A rapid increase in potato production provided capital for such economic inputs as a truck to carry the potatoes to market and for social projects (education, for example). The project was highly successful in purely economic terms. In ten years, per capita income at Vicos rose from \$40 to \$250; the average for Peru as a whole is \$179.

The project also aimed to develop local initiative and self-government toward the day when the Indians could replace the patron. After the five-year rental period was up, Cornell felt that this point had been reached. One sign of this was that the Indians, once obsequious, were now willing to challenge the decisions of the Cornell group. Cornell therefore suggested that the government expropriate the hacienda from its absentee owner and sell it to the Indians. Because of opposition from interests outside the community, this process took five years. During this time it was observed that production at Vicos rose and fell according to the Indians' expectation of getting title to the land. When at last it became theirs, production almost doubled in a single year.

Vicos has continued successfully since then under the management of an elected council based on traditional groups in the Indian community. Cornell now plays only a consulting role. The patron's land is farmed collectively. Labor productivity has increased so that it has been possible to reduce the time spent on the patron's land from 152 to 35-40 days a year. The success of Vicos, both economic and social, has even drawn back to it former residents who had migrated to the cities.

Among the distinctive features of Vicos are these: The agents of change were foreign to the nation as well as to the community and were therefore completely outside the bureaucratic structure; community attitudes were carefully researched before projects were launched; the development of self-government was a primary goal; and community structures such as the hacienda system were not destroyed but adapted to development purposes.

#### TAIWAN: JCRR

The Joint Commission on Rural Reconstruction was created in 1948 by the governments of the Republic of China and the United States. Of its five commissioners, two were American and three Chinese.

The JCRR is distinctive among our success stories. It is the only program that is diffuse--covering virtually the entire island province of Taiwan of the Republic of China--rather than concentrated in a single area. It is by far the largest of the four programs; its staff now includes 89 specialists. It is the joint creation of two governments. It is also a separate organization that does not form part of either the Chinese or the U.S. bureaucracies, which has given the JCRR a large measure of freedom from political pressures and bureaucratic rules.

Agriculture is the main focus of the JCRR's operations, but it is also active in such related fields as marketing and rural

health. Agriculture on Taiwan has progressed dramatically in the years that JCRR has been in existence, with a doubling of production between 1952 and 1964. (One of JCRR's most noted successes, the campaign against rats, is described in Chapter Three.)

Like the other successful programs, but on a much broader scale, the JCRR has dealt with all the factors affecting agricultural productivity. But few if any other nations in the underdeveloped world have the resources, especially the human resources, to mount an operation like the JCRR. Some of the keys to the JCRR's success are to be found in the environment in which it operates: the availability of trained manpower, the relatively small size (14,000 square miles) and population (12 million people) of the island, and the farmers' existing skills and receptivity to innovation. Taiwan is now so well supplied in manpower that it is able to send technicians to aid other nations.

Like Comilla and Vicos, the JCRR has brought the farmers themselves increasingly into the process of development. The JCRR relies heavily on local farmers' associations. Many activities launched at the center by the JCRR have been turned over to the farmers to manage. Though the agricultural four-year plans are drafted at the center, they are revised in consultation with farmer organizations as well as with local government offices. Extension agents are hired by the farmer associations, who bear two thirds of the cost; the JCRR and the government pay the rest. Farmer cooperatives employ some 13,000 persons, many of them trained by the JCRR.

The JCRR has been able to plan and carry out a nationwide program that provides all the inputs needed by agriculture. Chart 4, which follows, shows the sequence in which these inputs were made, from study to action, and going on in many cases to the turning over of partial or primary responsibility to the farmers or local government.

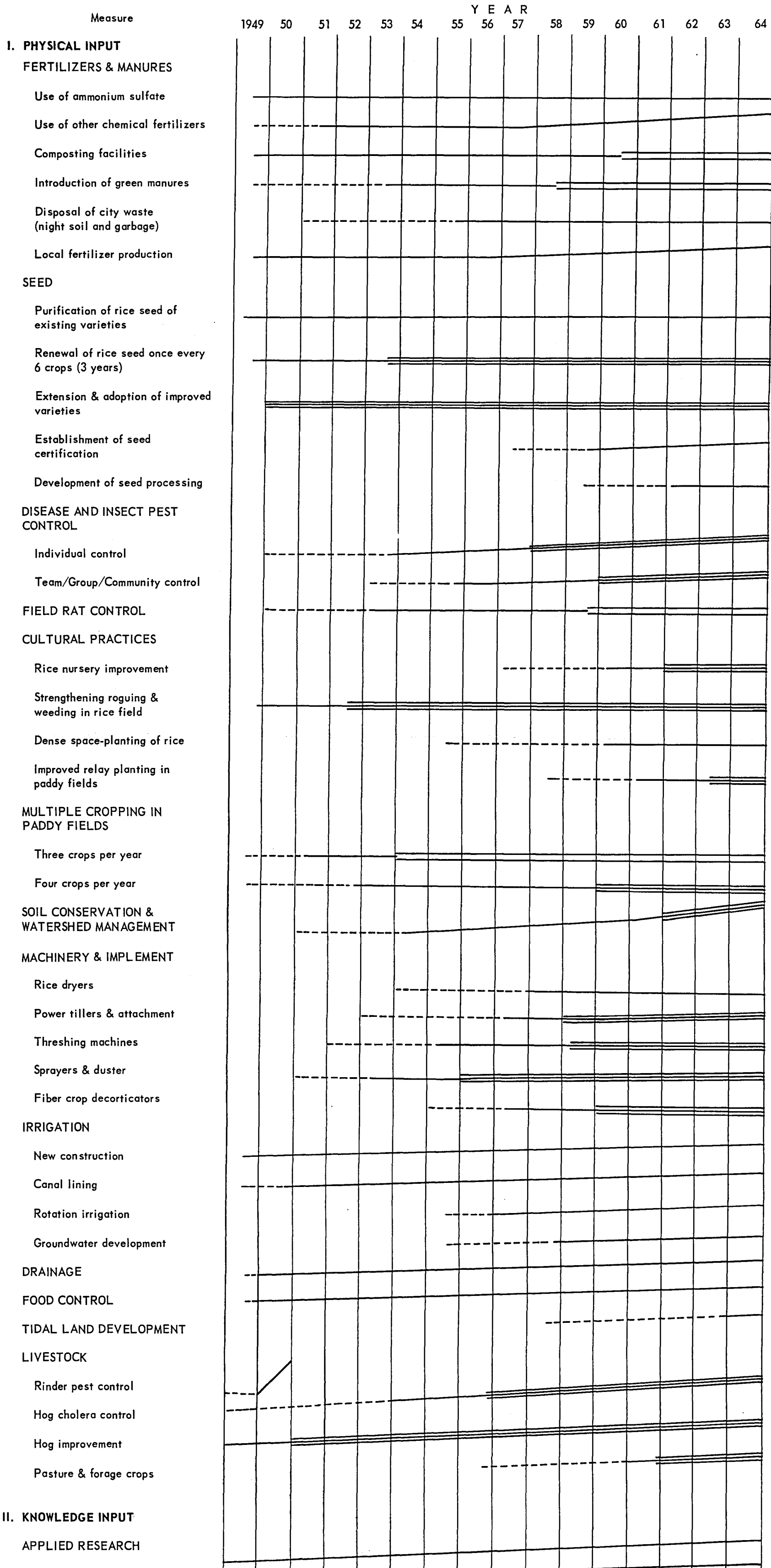


Chart 4

IMPORTANT MEASURES TAKEN FOR AGRICULTURAL DEVELOPMENT ON TAIWAN

----- Study  
 \_\_\_\_\_ Government and/or JCRR action  
 ===== Responsibility assumed by the local people  
 ===== Action taken by the local people with assistance of government and/or JCRR

Upward slope indicates increasing effort, but has no quantitative value.



BASIC RESEARCH

INTEGRATED DEMONSTRATIONS

EXTENSION

Adult farmers

4-H

Home technology

INFORMATION

Leaflets, pamphlets,  
posters, etc.

Biweekly periodicals

Radio

RECONNAISSANCE SOILS &  
LAND USE SURVEY

DETAILED SOILS SURVEY

TRAINING OF PERSONNEL

SCHOOL EDUCATION

General primary

Rural secondary, esp.  
vocational

Agricultural college

III. ECONOMIC INPUT

PRICING

PROCESSING

MARKETING

WAREHOUSING

PRODUCTION CREDIT

FOREIGN TRADE

CENSUS AND STATISTICS

IV. INSTITUTIONAL

LAND REFORM

Cadastral survey

Rent reduction

Sales of public land

Land-to-the-tiller

Land consolidation

Reclassification and lease of  
national forest land

FARMERS' ORGANIZATIONS

Farmers' association

Irrigation association

Fruit marketing co-ops

LOCAL GOVERNMENT

INTENSIFIED VILLAGE  
DEVELOPMENT

HEALTH & WELFARE

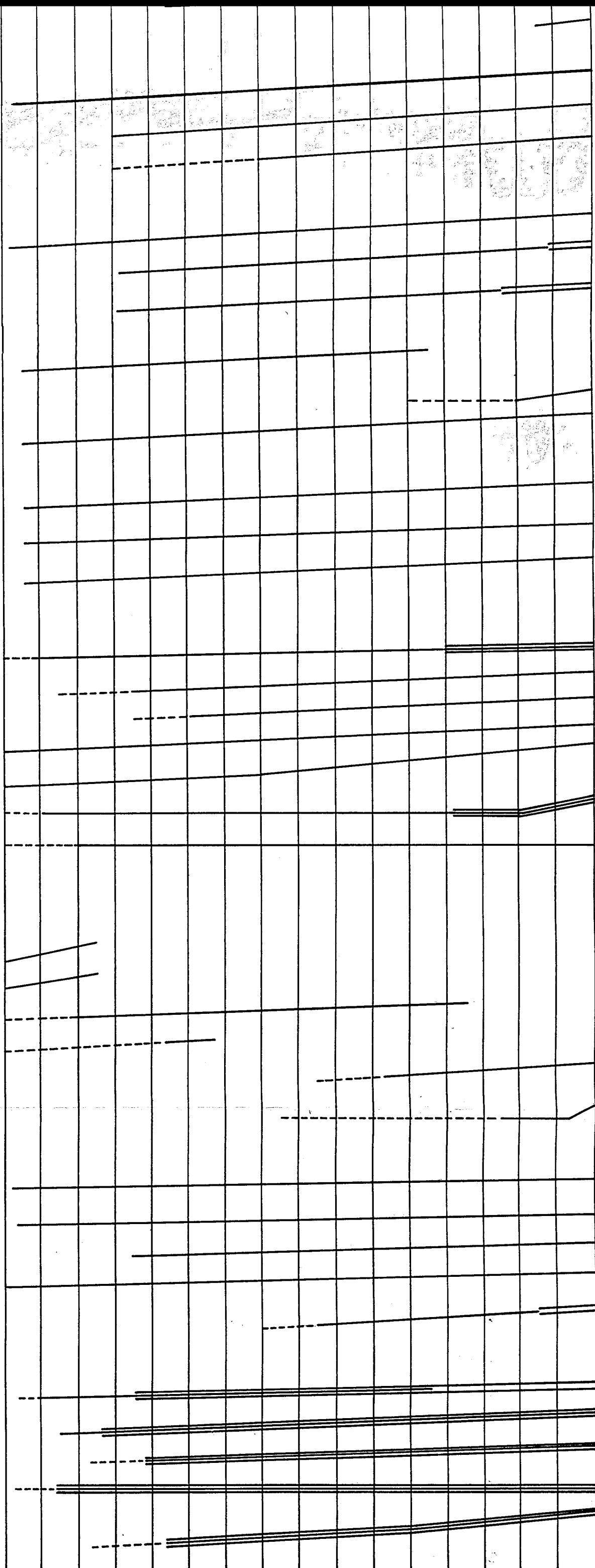
Health stations

School health

Environmental sanitation

Waterworks

Family planning





## Appendix B

# INSURANCE FOR INNOVATORS

by Stephen A. Marglin

Given the widespread aversion to risk that apparently characterizes peasant cultivators from Peru to Indonesia, insurance schemes that shift at least part of the uncertainty attendant to innovation from the cultivator's shoulders have obvious appeal. The chief problems in designing an insurance scheme are to reduce risks to the peasant without removing his incentive to produce, and to keep the scheme's costs, in terms of both money and administrative personnel, within reasonable limits.

The kernel of the present proposal is insurance against the failure of a recommended innovation to produce a sufficient increment in output over the yield of traditional methods to cover the cost of the purchasable inputs required for the innovation. The cost of the inputs is also the limit of liability. In general it is foreseen that this insurance will be offered as an inducement to cultivators to participate in schemes of supervised credit for the purchase of inputs like fertilizers and pesticides.

Before the farmer signs up for credit to cover the cost of a "package" he and the insurance agent would agree on a base yield for each plot on which this innovative package is to be introduced, the base, fixed by mutual agreement, being the average yield of the plot under traditional methods. The farmer would of course have reason to exaggerate the base yield, but the insurance agent would have, besides his general knowledge of the soils and climate of the area and his access to revenue records, the ultimate sanction of refusing insurance if the farmer's estimate of the base is far out of line. In any event, small errors in the estimate of the base yield are hardly disastrous if the recommended innovation is sufficiently productive.

Let us suppose the base on a particular plot of riceland is set at 2,000 pounds per acre. The recommended innovation, let us also suppose, includes purchasable inputs whose extra cost totals \$20 per acre, and the price of rice is \$100 per short ton. Thus an average yield of 2,400 pounds per acre would suffice to repay the extra cost of the purchasable inputs. The insurance contract fixes a target of 2,400 pounds for the cultivator upon compliance with minimal conditions as to use of the inputs. If the target is exceeded, the insurance is inoperative. If the yield falls below 2,400 pounds, the insurer reimburses the cultivators at the rate of \$5 per hundred pounds of shortfall, up to a limit of \$20. When credit has been advanced to the cultivator to cover the cost of inputs, insurance payments are credited to the cultivator's account with the lending agency.

It is the responsibility of the cultivator to notify the agent before harvesting the crop if it appears to him that he might have a claim against the insurer. The agent would then attend the harvest, and samples from, say, one to five hundredths of an acre would be separately harvested, threshed, and weighed to determine the actual yield per acre.

What is being proposed, it should be emphasized, is insurance for innovators rather than innovation insurance. The insurance becomes operative in the event of a crop failure even though the failure--from unseasonal cold, lack of precipitation, closure of irrigation canals--may in no way be traceable to the innovation and even though the innovation may still be profitable relative to traditional methods. The only condition that the cultivator must meet is that he actually carry out the innovation with a minimum of competence.

The limited liability of the insurer--the limit is the cost of the new input--holds costs down to a manageable level. Only in the event of a general crop failure would the insurance become operative on a wide scale, and then some portion of the payments might be looked upon as a kind of famine relief. The limited

liability feature also maintains the incentive for the cultivator to produce: He has relatively little to gain from collecting the insurance.

The scheme should be administratively feasible provided that the mean return from each dollar invested by cultivators in purchasable inputs is sufficiently high--say, \$3. A high mean return will pretty well guarantee that in years of favorable growing conditions only a small percentage of innovators will have occasion to claim benefits. For marginal innovations that barely cover the cost of inputs on the average, the ratio of inspections to innovators would probably require an unfeasible density of agents. In years of general failure, the agent may be able to grant a large number of claims by visual inspection of the fields alone.

If we assume the rate of harvest inspections to be 10 per cent of the number of innovators, the number of harvest inspections to be one per day, and planting and hence harvesting to be spread out over a three-week period, then a single agent might take responsibility for as many as 200 cultivators. Of course this is only a guess, and the optimal density of agents can be determined only by a lengthy process of experimentation.

Even with high-return innovations, it might be impossible to put a scheme like this on an actuarial basis in which the premiums would cover the claims plus the costs of administration. But this defect is not fatal. The government probably can better afford to subsidize the risk-bearing that is attendant to agricultural innovation than to have peasants hold back because of these risks.

Perhaps more than other agricultural insurance schemes this one is open to cheating by the cultivator and to collusion between cultivator and agent to defraud the insurer. The cultivator might, for example, apply only half the package to his plot and sell the remaining half; or he might cut three or four tillers from each rice plant before the harvest. Such devices might indeed prove the undoing of the scheme, but some points can be raised in its defense.

First, some dishonesty occurs in all insurance schemes and is not fatal. Second, unearthing dishonesty should become easier if the scheme proves its worth and gains the support of the community. Third, the insurer need not be stung more than once by a cultivator; if he suspects dishonesty he has the ultimate sanction of refusing future insurance.

Collusion would be much more difficult to unearth; prevention--by paying a sufficiently high salary to the agent to reduce the temptation--rather than cure seems to be called for.

Prudence dictates that any divisible innovation be tried first experimentally, and this rule is as valid for an innovation in risk-bearing as for an innovation in fertilizer. A small-scale test in a few villages would reveal in the course of a few seasons whether an insurance scheme like this one can be administered, what it might cost, and what effect such insurance might actually have on the rate of adoption of innovations. Such an experiment would moreover permit improvement in the details of operation. The lesson of Comilla--to make haste slowly and experimentally--is of universal applicability.

Appendix C

MEASURING A GOVERNMENT'S "WILL TO DEVELOP"  
IN AGRICULTURE

by John D. Montgomery and Stephen A. Marglin

Whatever may be the factual merit of the argument that the West developed without government planning, laissez faire is not the dominant model of action in the underdeveloped countries or aid-giving agencies today. Once the central role of the government is assumed, the "will to develop" becomes a critical variable in analyzing a government's potential to raise the living standard of the people. In most of these countries a will to develop is expressed in national economic plans, but plans reflect as much a desire to mobilize votes and foreign aid as to bring about actual development; they do not necessarily measure the actual will to develop, and possible donors are forced to rely upon intuition in assessing the intensity of the commitment. The purpose of this appendix is to explore the possibility of supplementing intuition with evidence as a basis for judging the commitment to one phase of development--the agricultural sector--on the part of government in the less developed countries.

If it can be adequately measured, the "will to develop" might be a useful addition to the list of criteria that determine the allocation of external assistance to the underdeveloped world. Given the limitation on the amount of aid that the developed world appears prepared to render the underdeveloped states and given the apparent need for a "critical mass" of aid to achieve positive results in any one country, it would seem that hard choices must be made if external aid is to contribute significantly to economic development anywhere. In this light it seems reasonable to make evidence of a will to develop a condition for aid--provided that we succeed in pinning down this somewhat elusive concept.



If actions speak louder than words, then current efforts to use material and human resources in development may be taken as a measure of will. Thus even rough comparisons of the level of indexes among countries with similar levels of per capita gross national product might help answer the question, "Does country X demonstrate a greater national effort to develop its agriculture than country Y?" A time series for country X might also help answer the question, "Does country X reflect a changed commitment to agricultural development?"

Preliminary study of the data available for such an analysis encourages us to believe that significant evidence on these issues can be obtained. A primary measure of governmental effort in agriculture is no doubt the public expenditures in that sector, including the budget of the ministry of agriculture and related agencies engaged in such activities as irrigation and community development. Since the agricultural sector differs in size and composition in different countries, these budgetary figures should appear as ratios of the proportion of the gross domestic product contributed by agriculture. Complete figures are not readily available from published sources for very many countries. Even so, Table C-1 shows fairly consistent ratios over the years, except for a few obvious discrepancies in statistical procedures. The figures suggest that India has been investing a consistent portion of its agricultural gross domestic product in the agricultural sector. The more complete data presented in Table C-4 show that the increases in such expenditures are roughly comparable to the increase in agricultural productivity over a period of seven years (no causal link can be deduced from these facts, of course). In spite of some internal inconsistencies, these figures suggest a much greater investment in these terms in India, for example, than in Argentina, Burma, the Philippines, or Thailand, and a much lower one than in Japan.

TABLE C-1. SUMMARY RATIO OF PUBLIC EXPENDITURES IN AGRICULTURE TO AGRICULTURAL OUTPUT\*

	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>
India	.046	.051	.040	.040	.043	.048	.051
Japan					.107	.452	.451
Argentina			.024	.018	.021	.024	.012
Burma	.028	.033	.063		.015	.018	.015
Philippines				.028	.032	.033	.029
Thailand				.020	.021	.017	.026

\* Sources: See Table C-4.

Further research will be necessary on a country-by-country basis to improve the comparability of these statistics. Clearly the composition as well as the size of expenditure is important. Investment in infrastructure such as imposing buildings in the capital cities obviously produces a smaller return in agricultural productivity than equal investments more immediately touching the farmer; similarly, the assignment of large numbers of people to routine activities surviving from the needs of a colonial society (such as services to plantations in Vietnam) may produce smaller results than equivalent assignments to agricultural extension programs. The fact that such expenditures are politically appealing and require less commitment to the agricultural sector justifies us in concluding that the same investment, differently allocated, may reflect different degrees of the will for agricultural development. But analysis of expenditures in terms of any economic rationale will have to await further refinement of existing budgetary figures.

Governmental effort in agricultural development, including extension, cooperative management, research and field stations, and agricultural credit, is largely reflected in the cost (including wages, salaries, and operating budget) of these activities.

Measuring such costs first in proportion to other activities of government (preferably a relatively fixed-cost sector such as the justice department) over a period of time, then in proportion to agricultural production per capita of the agricultural population, would indicate changes in commitment to agricultural productivity.

TABLE C-2. EXTENSION SERVICES

	Number of Extension Workers (1959)	Farms Served Per Worker <sup>1</sup>
India <sup>2</sup>	48,579 <sup>3</sup>	913 (1954)
Japan <sup>2</sup>	13,566	445 (1960)
Argentina <sup>4</sup>	392	1,395 (1952)
Philippines <sup>2</sup>	1,623	1,010 (1948)
Thailand <sup>2</sup>	328	6,438 (1950)

<sup>1</sup>Number is based on holdings for the year shown in parentheses.

<sup>2</sup>Source: C. W. Chang, Extension Education for Agricultural and Rural Development (Bangkok: FAO, 1963).

<sup>3</sup>Including community development employees.

<sup>4</sup>Source: Informe del Cento Sudamericano de Extensión Agrícola (Rome: FAO, 1959).

Unfortunately no such detailed budgetary data exist. But direct measures of the actual numbers of agricultural extension workers do exist, as of 1959, and these figures may be used as a surrogate for cost in measuring the intensity of the effort involved. Thus Table C-2 shows India offering less extension service than

Japan but more than Argentina, the Philippines, and Thailand (no statistics being available for Burma), at least as measured by the number of farms each extension worker might be expected to serve. Of course these figures give no indication of the quality of the effort in each country, and they should be interpreted with caution in judging the commitment of these countries to agricultural development.

Other measures may also be developed from personnel statistics from the agricultural ministries. The quality of personnel assigned to a sector may measure the intensity of a government's commitment of manpower resources to that sector. Assuming that wage scales reflect the professional competence of the individuals performing given public services, a direct measure of the quality of the effort would be mean base wages, over a time series, of agricultural personnel assigned to specific functions (research and extension) as compared with civil servants' mean base wages.

It is frequently assumed that concentration of agricultural personnel in the national capital and other large cities produces smaller results in output than deconcentration of the same personnel for extension and other services directly to the farmer. This hypothesis could become an additional index of effort: the distribution of personnel according to posted assignments. Such statistics too would have to be gathered on a country-by-country basis. But some relevant information is available through published sources. For example, if it be assumed that posting extension workers in the uncomfortable rural areas indicates a greater institutional effort than leaving them in the cities, it may be significant that India has a higher percentage of its extension workers assigned to the national government (as opposed to intermediate and local posts) than Japan and the Philippines, and a much lower proportion than Thailand. (See Table C-3.)

TABLE C-3. PROPORTION OF EXTENSION WORKERS  
POSTED AT NATIONAL LEVEL (1959)

	<u>Total Number</u>	<u>Number at National Office</u>	<u>Percentage at National Level</u>
India	48,579	500	1.02
Japan	13,566	48	0.35
Philippines	1,623	31	0.19
Thailand	328	96	29.27

Source: C. W. Chang, Extension Education for Agricultural and Rural Development (Bangkok: FAO, 1963).

Allocation of educational funds at all levels could provide another indication of the will to develop agriculture. At the primary school level it may be next to impossible to distinguish agriculture from general education (except perhaps by the composition of the general education provided by rural schools and the rural-urban division of educational funds in proportion to the population distribution). But at the secondary level the budgetary allocation to vocational agricultural education might reflect the emphasis on agriculture. Finally, in higher education as well, the money allocated to agricultural institutions as a proportion of the total budget, or the number of students enrolled in them relative to the agricultural population, could provide a measure of the importance assigned to that sector if compared with similar efforts in other countries.

The attitudes of the civil service as well as its technical capacity and the incentive system surrounding it may be considered in measuring the national "will to develop" at operating levels. Attitude surveys have been conducted for other purposes in both developed and underdeveloped countries and are undoubtedly methodo-

logically feasible. The attitudes of the bureaucracy toward the agricultural activities of the government as compared with developmental programs in other sectors could be surveyed to give some indication of the relative prestige and interest in the various sectors of the economy and to explore the comparisons in outlook between employees of agricultural and other ministries. Standard devices for sampling, for preserving anonymity of response, and for verifying the validity and reliability of survey results have been used in many parts of the world and for a wide variety of purposes. The relevant link between beliefs and performance is less clear, however. It may be presumed that an agricultural agency's collective "will to develop" is related to groups of attitudes of individuals participating in its programs. Such attitudes will not necessarily indicate the efficiency of the agencies' actual performance or the economic usefulness of their programs, but they will bear some relation to future effectiveness.

For purposes of such analysis, the relevant attitudes of individual civil servants would include:

1. Opinion of the importance of the agricultural sector (as compared with other sectors).
2. Opinions regarding the possibility of improving agricultural productivity.
3. Attitudes regarding the propriety of direct governmental action to bring about rural improvement.
4. Attitudes about the assignment of individual civil servants to rural posts.
5. Opinions regarding the capacity of existing or proposed governmental agencies to undertake agricultural development programs.
6. Attitudes toward the role of other critical factors in the agricultural sector (for example, farmers, landlords, and commercial interests) that might affect the political feasibility of major efforts to improve agricultural productivity.

7. Indexes of willingness to participate in agricultural development programs.

Attitudes and beliefs are not, of course, "will." Nor can it be presumed that favorable attitudes on the part of the civil service will necessarily produce action. But some inverse presumptions are surely feasible: that a will to develop has some relationship to the values and knowledge of the principal actors, and that negative attitudes toward the goals of an organization will impair its effectiveness. Moreover, it seems reasonable as well to consider the collective attitudes of civil servants toward agricultural development as an expression of the intellectual ambiance of their agencies or, perhaps, of the society at large.\*

The use of mass media to condition the national consciousness also reflects the efforts of opinion leaders to convey to the exposed public both substantive and volitional themes regarding the agricultural sector. Content analysis of such communications (newspapers, radio, parliamentary debates, and major public addresses) would identify the frequency with which the commitment to development in the agricultural sector was communicated. The specific nature of the commitment (whether in general terms or in detailed references to crops or projects) could also be measured

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\*The classic study of bureaucratic attitudes in an underdeveloped country is Morroe Berger, Bureaucracy and Society in Modern Egypt: A Study of the Higher Civil Service (Princeton, N. J.: Princeton University Press, 1957). A comparative study of attitudes in three aid-related agencies in Taiwan appears in abbreviated form in John D. Montgomery, Rufus B. Hughes, and Raymond H. Davis, Rural Improvement and Political Development: The JCRR Model (Washington: Agency for International Development, 1964), pp. 37-41.

quantitatively. Such measures could probably not be used in making international comparisons, but they would reflect trends in public communications within any one country.\*

The frequency and the intensity of contacts between government and farmer-producers are still another measure of a government's commitment to agricultural development (existing reports, which are already standardized in many countries, would provide part of the needed data), although the nature and content of these contacts may be somewhat more difficult to classify. Studies of such contacts over a period of time could be used both in international analysis comparisons and in assessing change within a single country.

The evidence presently available does not enable us either to classify countries in terms of the intensity of their will to develop or to correlate that will with other factors relevant to the processes of development. But there seems to be enough consistency in published data to justify further research in selected countries and to warrant pilot studies of attitudes and communications to see if hypotheses drawn from the commitment of resources in agriculture and education would be verified by other forms of evidence.

We are encouraged to believe that further examination will produce better definitions of the will to develop, both as a means of measuring its presence and as an analytical and diagnostic device in national planning.

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\* See, for example, David C. McClelland, The Achieving Society (Princeton, N. J.: Van Nostrand, 1961), and Philip E. Jacob and James W. Toscana, eds., The Integration of Political Communities (Philadelphia and New York: Lippincott, 1964), especially pp. 83-84, 209-246.



TABLE C-4. RELATIONSHIP BETWEEN PUBLIC EXPENDITURES  
ON AGRICULTURE AND OUTPUT OF AGRICULTURAL SECTOR

<u>Country</u>	<u>Year</u>	<u>GDP in Agriculture</u>	<u>Government Expenditures on Agriculture</u>	<u>Ratio of Government Expenditures to Agricul- tural Output</u>
India	1956	55,200 <sup>b</sup>	2,514.40 <sup>c</sup>	.0456
	1957	52,800	2,671.40	.0506
	1958	62,400	2,465.80	.0395
	1959	62,500	2,464.90	.0394
	1960	68,900	2,988.60	.0434
	1961	69,600	3,329.10	.0478
	1962	69,700	3,535.60	.0507
Japan <sup>d</sup>	1960	1,778.6 <sup>e</sup>	189.6 <sup>f</sup>	.1066
	1961	1,985.9	898.3	.4524
	1962	2,201.2	992.3	.4508
Argentina <sup>g</sup>	1958	58,100 <sup>h</sup>	1,405.9 <sup>h</sup>	.0242
	1959	130,389	2,322.9	.0178
	1960	159,700	3,315.5	.0207
	1961	170,800	4,007.3	.0235
	1962	218,390	2,598.4	.0119
Burma <sup>i</sup>	1956	2,101 <sup>j</sup>	59.13 <sup>k</sup>	.0281
	1957	2,269	74.30	.0328
	1958	2,179	137.25	.0630
	1960	2,540	37.49	.0148
	1961	2,704	47.59	.0176
	1962	2,795	40.79	.0146

Table C-4 (continued)

<u>Country</u>	<u>Year</u>	<u>GDP in Agriculture</u>	<u>Government Expenditures on Agriculture</u>	<u>Ratio of Government Expenditures to Agricul- tural Output</u>
Philippines <sup>g</sup>	1959	3,384 <sup>l</sup>	94.8 <sup>m</sup>	.0280
	1960	3,523	110.9	.0315
	1961	3,858	127.9	.0332
	1962	4,246	122.7	.0290
Thailand <sup>n</sup>	1959	17,775 <sup>o</sup>	348.0 <sup>p</sup>	.0196
	1960	20,652	423.2	.0205
	1961	21,357	365.5	.0171
	1962	22,216	581.5	.0262

<sup>a</sup>Sources: United Nations, Yearbook of National Accounts Statistics, 1963 (New York, 1964); Statistical Abstracts of India (New Delhi, 1960, 1961, 1962).

<sup>b</sup>Millions of rupees: net domestic product at current factor cost.

<sup>c</sup>Millions of rupees: current and capital expenditures of the central and state governments, including centrally administered territories.

<sup>d</sup>Sources: United Nations, Yearbook . . . 1963, cited; Japan, Ministry of Finance, Budget Bureau, Japan Economic Yearbook (Tokyo, 1962).

<sup>e</sup>In 000 million yen: net domestic product at current factor cost.

<sup>f</sup>In 000 million yen.

Table C-4 (concluded)

<sup>g</sup>Sources: United Nations, Yearbook . . . 1963, cited, and Statistical Yearbook, 1962 (New York, 1963).

<sup>h</sup>Millions of pesos.

<sup>i</sup>Sources: United Nations, Yearbook . . . 1963, cited; Economic Survey of Burma, 1958 (Rangoon, 1959); Revolutionary Government of the Union of Burma, Budget Estimates, 1962-63 (Rangoon, 1962).

<sup>j</sup>Millions of kyats: current factor cost, including fisheries and forestry.

<sup>k</sup>Millions of kyats: including loans to farmers.

<sup>l</sup>Millions of pesos, current factor cost.

<sup>m</sup>Millions of pesos.

<sup>n</sup>Source: United Nations, Yearbook . . . 1963, cited.

<sup>o</sup>Millions of baht: current factor cost.

<sup>p</sup>Millions of baht.

THE BUREAUCRACY AS A MODERNIZING ELITE:  
CAN GOVERNMENT ROUTINES LEAD TO DEVELOPMENT?

by John D. Montgomery

The most dramatic increases in agricultural production have occurred as a result of special efforts under gifted and dedicated leadership. Task forces often succeed where conventional approaches fail, sometimes for the very reason that they are exempt from conventional limitations. But most agricultural development must take place where task forces cannot reach; the need for improving conventional approaches cannot be defined away.

A task force can concentrate on specific geographic or problem areas, and it can succeed nearly everywhere if there is the necessary "will to develop" on the part of the national leadership. Each such effort has its own element of uniqueness, but the essential elements of these successes seem clear: inspired leadership, support from the highest political authority, full participation of local leaders, coordination among different technical approaches, and participation of staff members from appropriate public and private agencies. Exploration of these and other general principles, and of the various ways of applying the "plastic bag" philosophy (as opposed to the more rigid, permanent "boxes" on an organization chart), will indicate when the task-force approach can be generally used. It seems probable that it would be useful in at least two situations: those of greatest agricultural promise, where major increases in productivity are desired; and those representing the most difficult problems, where improvement is necessary to the government for political or other reasons. The task-force approach is adaptable to all levels of governmental operation.

It is the conventional bureaucracy, however, that performs the major role in promoting increased agricultural productivity. It must provide technical and logistical support to any task forces; it often supplies most of their personnel. Its opposition or indifference could hamper the effectiveness of task-force operations, however skillfully led. Its continuing activities represent, and it controls, the largest share of public resources in manpower and capital devoted to the agricultural sector. It is responsible for carrying out the rule of law, a role often deeply resented by political leaders, who see procedure as delay rather than a form of protection. The bureaucracy should not be neglected in any national concentration of the agricultural effort on local task-force operations. It may represent a resource capable of equally important development as an indirect contribution to agricultural productivity.

The limitations of the bureaucratic system in the less-developed countries are well known. They are the subject of bitter acrimony on the part of foreign advisers and domestic politicians. It is safe to say that almost nobody loves a bureaucracy. But the limitations of bureaucratic effectiveness should not be laid to moral deficiencies, lack of good will, or sheer irrationality on the part of the bureaucrats themselves. Like other social institutions, a national bureaucracy behaves as it does because of internal factors and external forces. These are not necessarily immutable, and an examination of bureaucratic behavior patterns and their causes may suggest ways of changing them. Bureaucracies have changed in the past, as the history of U.S. Civil Service legislation demonstrates and as recent postcolonial developments in Ghana, Guinea, and China would suggest.

#### THE "PATHOLOGY"

The symptoms of "pathological" behavior of the bureaucracies in the less-developed countries are to some extent recognizable as

characteristics of any bureaucracy. Any listing of the most frequently voiced complaints about a national civil service seems to produce varying degrees of recognition and assent, no matter what country is being described; and everyone--bureaucrats included--seems ready to agree that these characteristics are an obstacle to economic development, although no one thinks development can take place without administration. Not all of these objectionable features affect development, however, except perhaps in the negative and general sense that they imply failure to reach maximum efficiency and influence. Some symptoms were cited repeatedly during the conference: resistance to change, rigid adherence to rules, reluctance to delegate authority, sycophancy toward superiors, the "target" mentality implying an indifference to "efficiency" and the purposes behind rules, a "generalist" or "elitist" orientation combined with hostility to technology (especially in the despised field of agriculture), insistence on status and prestige symbols, adherence to traditional relationships while desiring to appear modern, overstaffing, corruption, xenophobia, and nepotism. These attitudes and behavior patterns undoubtedly appear in varying degrees of intensity in many countries; amusing and horrifying examples of each could be cited by almost anyone who has tried to lure or bulldoze a bureaucracy into action on a large-scale development operation.

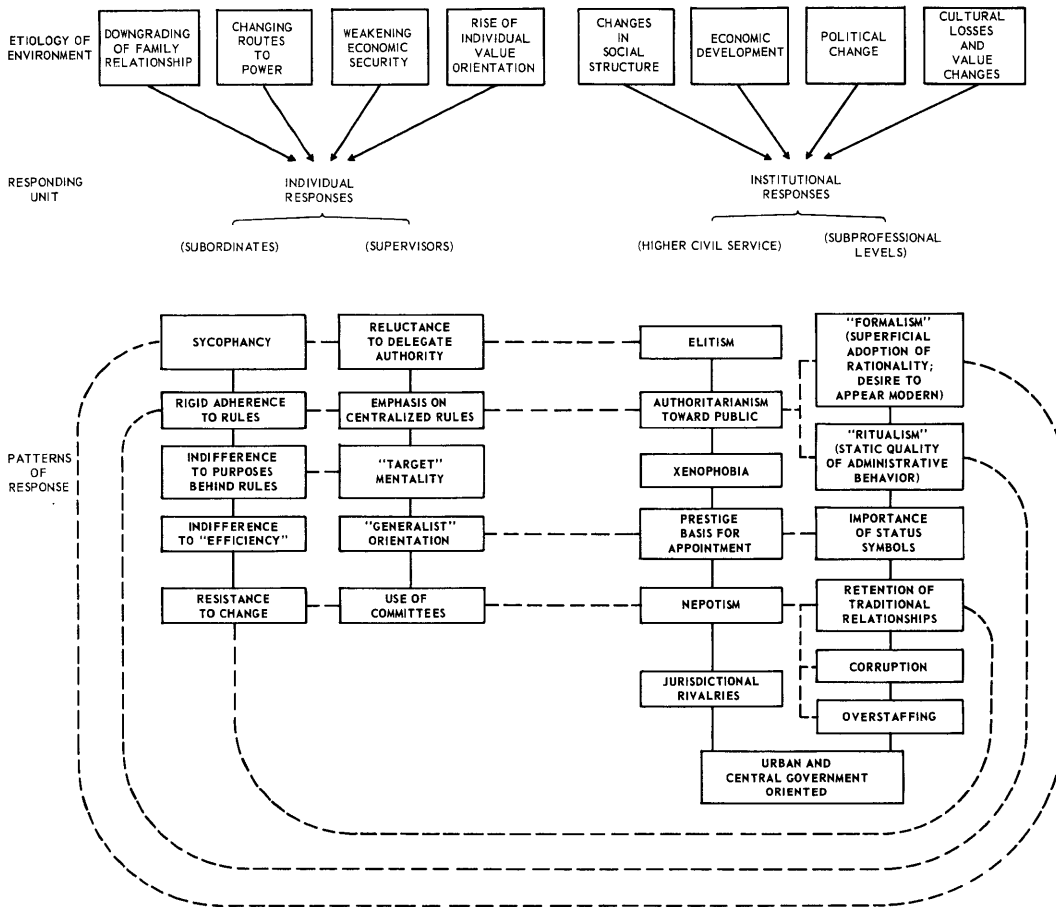
Closer examination of such symptoms suggests that they may be part of a larger system of interacting responses. These responses may be grouped roughly into two categories: those relating to the protection of the civil service as an institution, and those that are individual responses to various perceived threats from within and outside the bureaucracy. (See Chart 5.) In both cases changes in the social order (including those associated with the process of modernization) appear to be regarded as a potential threat to survival.

The whole social order that produced an elitist bureaucracy (whether of the mandarin, feudal, or colonial type) has gradually changed, often to the disadvantage of the former elite groups. The

Chart 5

BUREAUCRATIC SYNDROMES

The "Pathology" of Administration in Less-Developed Countries



changing economy threatens the privileged position of a government administrator as more and more of the basic decisions relating to production and distribution begin to fall into other hands, whether those of technicians, political leaders, or perhaps an increasingly important private sector. Even the changing political situation may threaten the bureaucracy as national (or ethnic) pride begins to affect the staffing of the civil service. "Africanization," for example, may mean new civil service standards as well as personnel, and in a one-party state much of the routine decision-making authority may shift to local party politicians. New cultural values attached to modernization tend further to undermine the self-confidence and authority of the traditional bureaucracy. It is small wonder that the members of a bureaucratic system feel vaguely threatened and seek to perpetuate their elitist claims while at the same time formally adopting the purposes and forms of organization appropriate to a modern society.

In their individual response also, members of the bureaucracy feel threatened by the changes taking place about them. In many countries the civil servant's family responsibilities--as eloquently portrayed by Joyce Cary's Mister Johnson, for example--are attenuated as public employment forces a family man to become an individualist competing for advancement, and then rationalizes his pay to a job-related scale. In return his family becomes resentful at being denied its traditional share in the privileges and duties of public office. Because politics and commerce open up new routes to power, the civil servant often finds his career and even his position threatened, or at least reduced in its importance and opportunity. Even employment security is not what it once was in countries where surplus employees suddenly find that they have no automatic job tenure. Any shift toward an individualistic value orientation threatens the civil servants who had previously found protection in their family or in their status in the bureaucracy.

Any such classification of the interrelationships of bureaucratic behavior (and many others are possible) seems to lead to one



fundamental conclusion: sometimes neither the civil service system nor individual civil servants seem to consider the goals of agricultural development as paramount, even if they are formally assigned to a ministry of agriculture. The problem in using existing government agencies for development purposes is to find ways to remove these perceived threats and encourage more productive attitudes and behavior. Although this is a problem of enormous difficulty, it is not a hopeless one. Human institutions--even bureaucracies--can improve, and institutional changes bring about changes in individual behavior. But resistance to any change that appears threatening may be taken for granted; indeed, any change at all may be resisted unless it seems reasonable and has strong and continuing political support.

#### SOME "PRESCRIPTIONS": INSTITUTIONAL CHANGE

The easiest changes to make in a bureaucracy are shifts of leadership: getting a "new permanent secretary" who accepts the desired development goals, backing him when he encounters resistance, and keeping him in office long enough to carry out his policies. Usually a strong leader in command of an organization can select lieutenants who share his views: countless testimonials can be cited to document the dramatic changes introduced by merely getting the "right man at the top" and keeping him there. But sometimes even the "right man" is helpless when pitted against the system. Leadership changes that merely rotate civil servants among suitable positions seldom achieve any significant reorientation in the system, as the postwar purges of militarists from the civil services in Japan and Germany demonstrate. Neither does the mere assignment of new titles to an existing bureaucracy, as was done under "indirect rule" in the British colonies. Changes in the functioning of a bureaucracy and in its relationship to the society as a whole are necessary if the old elite is to become a modernizing one.

A more ambitious means of changing the bureaucratic institution is to reorganize it. The principles of rational organization are too well known (or perhaps too irrelevant) to discuss here. Organization and reorganization should take place whenever changes in the functions or relationships require them; many governments have established "organization and management" offices to study such problems (but they are often captured by special interest groups). Formal reorganization may not have much influence on the actual routines that seem to dominate bureaucratic behavior. It may even become a delaying tactic itself. Moreover, the connection between government organs and the private sector (even with government-dominated corporations like the Sudan Plantations Syndicate or the Gezira scheme) is often overlooked in organization charts and civil service regulations. Important changes in organization may not be reflected on formal charts at all, such as the introduction of "participative" techniques that soften hierarchic distinctions and make use of group deliberation as a means of reaching decisions and establishing goals. Studies of such organizational approaches in American industry have demonstrated their superiority in achieving high levels of productivity, flexibility, and morale over sustained periods of time. The style of management that involves frequent conferences between a supervisor and his immediate subordinates, at which communication passes freely in both directions, is adaptable to a wide variety of situations. When under these circumstances new organizations and position titles also convey a productivity or service orientation, behavior as well as form begins to change. The staff conference is sometimes--as in Northern Rhodesia--a radical change in the sociology of the bureaucracy.

A third form of institutional change is in its incentive system. Salaries in many countries are tied to years of service, size of family, amount of education, and other factors that may have only a casual relevance to the goals of development. The pay scales involved may be so low that some form of supplementary graft

or corruption is necessary if the civil servant is to achieve even a modest living standard. In any case, the pay scales of administrators and technicians in the field of agriculture are usually attached to a civil-service-wide schedule that cannot be changed without inviting bankruptcy, especially in countries where the civil service is padded as an indirect form of social security. Thus if the governmental will to develop agriculture is real, the only solution is to offer bonuses in the agricultural sector. (In the SCIPA\* organization in Peru, for example, bonuses given in addition to regular salaries brought about an 80 per cent pay increase in three years.) In JCRR (Joint Commission on Rural Reconstruction, Taiwan) the highest takehome pay of agricultural technicians is directly related to their productivity. If what is desired is frequent trips to the villages on the part of the civil servants, adequate travel expenses must be paid (a rarity in most underdeveloped countries); if extension workers are expected to live in villages lacking in amenities important to family life, either some form of hardship allowance should be offered or village assignments should be made an integral part of the career ladder. Nonmonetary incentives can also become part of the civil service system, especially where "participative" forms of organization have been introduced, where local units establish their own goals, and where ways are found to reward appropriate performance. The high esprit of JCRR in Taiwan probably resulted in part from the financial rewards, prestige, and social approval offered as performance incentives.

Some of the most profound changes in the institutions of bureaucracy have to be introduced outside the civil service altogether. One way to gain bureaucratic approval of development goals is to give them social and political value. Creating public awareness of the technological requirements of agricultural produc-

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\* Servicio Cooperativo Inter-Americano de Producción de Alimentos.

tivity will help remove the contemptuous images of the farmer that pervade the thought of the intelligentsia in many underdeveloped countries. In some countries, changes in the educational system, although slow in producing new manpower, have already shown that the role and status of agriculture can be dignified. Changing entry standards to the civil service (especially by deviating from the traditional emphasis on law and literature) can offer new careers to development-oriented candidates who could not qualify under the traditional patterns of recruitment. Closer relations between the central civil service and local government in the tradition-bound rural sector can alter the attitudes of each in making use of the resources the other can offer to agricultural development.

The above approaches to the bureaucracy as an institution offer some hope of changing the behavior of individual civil servants by reducing hampering ties to the past, by removing the sense of insecurity of those capable of contributing to development goals, and by creating an environment conducive to initiative and innovation. Other devices may also be used more directly to influence individual behavior.

#### MORE PRESCRIPTIONS: INDIVIDUAL CHANGE

Daniel Lerner and others have suggested that receptivity to innovation requires a degree of "empathy," or awareness of styles of life different from those of the immediate community.\* In the case of the bureaucracy, the sense of empathy must be twofold: that involved in appreciating village life, and that associated with different styles of development administration. The role of

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\*For example, Daniel Lerner, The Passing of Traditional Society: Modernizing the Middle East (New York: Free Press of Glencoe, 1958).

mass media in creating such empathy is well documented. Applying the principle of empathy to an institution-bound bureaucrat would suggest a program of interrelated activities, including travel, in-service training in which new problems and approaches are discussed, rotation between city and village assignments, the use of internal communications, and the like. Few could quarrel with the proposition that a precondition to adopting something new is awareness of its existence.

Receptivity to innovation can be increased by enlisting individual participation in the search for new ideas. The well-worn notion of the "suggestion box," with rewards commensurate with the value of the suggestions, has been applied with surprising success in Vietnam and other underdeveloped countries. The use of "brainstorming" conferences as an in-service training device at all levels is only an enlargement of the same concept and may be appropriate in some bureaucratic societies. When employees find that progressive attitudes lead to promotions and other rewards (SCIPA, in Peru, includes references to the innovative role of agricultural technicians in personnel rating forms), their receptivity and perspectives change markedly. Innovation for its own sake is not desirable, to be sure; but the tradition of social punishment for innovators is hard to change. (Berger tells of the ostracism inflicted by the Egyptian bureaucracy on the discoverer of the solar ship that made international headlines for the archaeological service.) One innovating civil servant in Vietnam adopted the policy of introducing revolutionary changes in his agency (in this case, moving from a rule-of-thumb bookkeeping system to computer accounting) so that old routines were completely outmoded, and his staff was forced to adopt fundamentally new procedures of postauditing. He feared that the introduction of postaudit controls without changing existing procedures would only double the red tape involved in releasing funds for development purposes because the system would "swallow" the innovation without abandoning the procedures it was designed to replace. Another approach is to keep introducing in-

novations at a fairly rapid pace so that routines never become sacred. There is danger of "jamming" the system with too many changes, of course, but that point is rarely reached in underdeveloped countries.

Motivating civil servants to the goals of development is almost as difficult as motivating farmer-producers to change their traditional patterns of decision making. The risk that farmers must take in accepting an innovation has its counterpart in the bureaucracy. One means of insuring against the risk of failure is to socialize the experiences and the responsibility that each civil servant takes, so that he no longer works in isolation. Frequent meetings of local agricultural workers, attended by high-ranking civil servants from headquarters, can remove the sense of isolation and encourage meaningful exchange of experiences from the "firing line" of innovation. When such meetings are rotated among villages, each playing host in its turn, the role of the local worker is dignified, and new attitudes may be introduced in the host villages themselves. Inviting leading farmers to attend such meetings may also create receptive attitudes toward the progressive elements in the agricultural sector and help modify the traditional contempt for the peasant.

The concept of "reverse influence" requires that higher civil servants receive as well as transmit information. When they do, their own attitudes change; the farmer-producers take on added dignity; the governmental programs themselves begin to show greater relevance to the needs of the agricultural sector. Delegation of authority is possible when no "face" is lost, when the most appropriate centers of decision making in fact make the decisions, and, in short, when mutual respect prevails between the bureaucrat and the farmer. In part at least these conditions obtain when the flow of communications is not impeded by artificial barriers. Changes in bureaucratic attitudes and behavior can be observed just as readily as among peasants or voters. Research into receptivity to innovations on the part of the supposed instruments of modernization--the civil

service--may be just as rewarding as studies of diffusion at the farm.

None of the approaches suggested here can be offered in a "package" program, to use a favorite conference term. The bureaucracy of each country is unique in its history, organization, ability, and requirements. Nor is it prudent to expect that anything approaching a controlled experiment in the manipulation of bureaucracy can be undertaken. These insights--if such they be--may imply appropriate forms of action in a variety of situations. But they are no substitute for judgment, experience, and discrimination on the part of the leadership of any country--and any foreign adviser--that really intends to use civil servants in the interests of agricultural development; and none can bring important changes without strong political support. And they are no substitute for a political will to develop.

BEHAVIORAL SCIENCE RESEARCH AND ITS POTENTIAL ROLE  
IN AGRICULTURAL DEVELOPMENT

by George M. Foster, Milton L. Barnett, and  
Allan R. Holmberg

Behavioral science\* research on problems of agricultural development is justified on two main grounds: It can aid in finding ways to increase agricultural production, and it can contribute to the basic theoretical and practical inventory of knowledge dealing with individual and group behavior that is a part of the scientific infrastructure of every modern society. That is, this type of research can help satisfy the professional needs of agricultural specialists, and it can help satisfy the disciplinary goals of behavioral scientists.

Behavioral scientists are concerned with organized groups of people--with societies; with the ways in which these groups pattern the "rules of the game" whereby they achieve their goals--with cultures; and with the nature of the interaction of the individual with other individuals and with his society and culture--with personality. Behavioral scientists operate on certain assumptions, the most important of which in the present context seem to be:

1. Sociocultural systems (any society with its culture) are logically integrated, functional, sense-making units in which each

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\*The term "behavioral science" is used in the sense of research dealing with social, cultural, and psychological factors in agricultural development. Although in a disciplinary sense the fields involved are sociology, social anthropology, and social psychology, the point of view here is essentially anthropological.



part is related in a definite way to many other parts, fulfilling a specific function, and important in the normal functioning of the sociocultural system as a whole. A corollary of this assumption is that a change in any aspect of the system implies a series of changes in other aspects, and that the associated changes may have both desirable and undesirable effects on the functioning of the total system.

2. Sociocultural systems are characterized by patterned regularities and similarities that are a function both of historical development and of limited possibilities in structural forms. For example, Spanish-American peasant societies show many similarities to Spanish peasant groups, for historical reasons; but they also show strong similarities to Pakistani peasant communities, because there are limited possibilities in the formation of societies at a particular level of complexity. These regularities in structure (and in human behavior) make possible a certain amount of prediction, which is essential in the planning of agricultural and other developmental activities.

3. No two sociocultural systems are identical. Practically, this means that although prediction in a broad sense is possible, it cannot be assumed that an innovation that works well in one system will automatically work well in another. Each system, in a planned change setting, must be examined as a unique specimen as well as a representative of a generic type.

With respect to increasing agricultural production, behavioral scientists can recognize three major foci for their attention:

The socio-cultural-psychological system of the recipient peoples (usually farm communities in this context).

The socio-cultural-psychological system of the innovating organization (usually a government or private bureaucracy).

The two systems as they interact. This is the level of programs and projects.

The significance of the relationship of the individual to the two systems, and to the interacting systems, is implied in this tripartite division.

With respect to research, and speaking now particularly of anthropologists in agricultural programs, there are two main tasks: The first is to determine the relationship of the agricultural subsystem of a particular community to all other subsystems on which it impinges. Stated in another way, this means identification of the places and ways in which agricultural activities fit into the total sociocultural matrix of the community. The second is to determine the patterns of interpersonal relations among all people who participate in a specific program. This means analysis of the structure and function of the innovating bureaucracy, of the recipient community, and of the activities that join the two systems in a particular program.

An important point should be noted here: Socio-cultural-psychological problems in agricultural development are not limited to forms of communication, to public opinion, and to particular psychological attitudes on the part of change agents and farmers. While these are significant elements to be identified and measured, the problem is much broader and involves basically an appreciation of the relationship of subsystems (such as agriculture, religion, leadership patterns, and values) to total systems. For example, agriculture in any community plays many roles and satisfies many needs that are not primarily concerned with food and market sales. In the planning of change, all these roles and needs should be recognized, and the impact on them of proposed modifications should be analyzed, as nearly as is possible, to determine possible harmful consequences for which provision must be made.

Behavioral science research, whatever its particular practical application may be in a given setting, has both structural and dynamic (or processual) dimensions. The structural dimension is the social, cultural, and psychological matrix in which (in this case)

farm activities are carried out. It is here that all the subsystems of the society are identified, where agricultural activities, roles, and functions are placed, and where relations between individuals and groups of individuals are examined. The length of time needed for this kind of research depends on the amount of prior general research available for the community and nation. In a region for which relatively good research data are available it is often possible to obtain the essential information needed for an agricultural program in a remarkably short time. The types of data usually needed for this kind of research are listed at the end of this appendix.

The dynamic or processual dimension, which is especially pertinent to ongoing agricultural programs, can be looked at in terms of the barriers to change on the one hand and the incentives to change on the other. The term "incentive" is actually defective, since it suggests that the problem of changing behavior consists largely of individual and group motivations in the innovation process. In fact, the question is much broader in that the nature of the basic sociocultural "fit" is very important. This refers to the ways in which the several subsystems of a sociocultural system articulate and mutually reinforce each other. The idea of incentives and motivations alone does not suggest the range of factors involved.

Contrary to widely held opinions, the behavioral sciences can now speak with some degree of certainty about the nature of societies and their dynamic processes, so that individual and group behavior can be predicted in a number of areas. As illustrations, we know that the following are significant influences in the process of change:

1. Traditional reciprocal obligations and expectations that bind kin, friendship, and neighborhood groups at the village level often discourage progressive, innovative individuals who are faced with the dilemma of continuing to divide their increased income in the fashion expected of them or of risking censure and sanctions

for failure to do so. Many peasants understand perfectly well that technological improvements can increase their income, but they feel they would gain little or nothing since this income must be dispersed among a great many people.

2. The size and composition of groups have a great deal of bearing on the kinds of activities that can be carried out. There is usually a critical mass, an optimum size that, if achieved, permits activities otherwise difficult to carry out. In Japanese War Relocation Camps, for example, it was found that by permitting face-to-face relationships in blocks of about 300 people, organization and activity were accomplished that proved impossible when the total camp of several thousand persons was viewed as the basic social unit.

3. Symbolic representations vary greatly between cultures, and misperceptions often follow when visual aids used in one society are transferred to another. For example, in a T.B. campaign in Southern Rhodesia posters showing a crocodile, which to a European suggested the great danger of T.B., were interpreted by Africans as meaning that crocodiles cause T.B. and that one should therefore avoid crocodiles!

It is clear that the following motivations are of special importance in changing behavior:

Perception of economic gain, a significant part of which remains with the progressive individual (that is, is not drained off in fulfillment of traditional obligations).

The desire to achieve prestige and status.

The desire to please the change agent who, by the mere fact of being in a community for some time, becomes involved in patterns of reciprocal friendship that entitle him to cooperation from his new friends.

These motivations appear to be universal. Other motivations may be said to be culture-bound, in that they are significant in some places and less so in others. Religion is an example.

These are some of the kinds of contributions behavioral sciences can make to agricultural programs through research. There remains the question of how this can be done, of the organization of resources that is most suited to this task. In general, two broad categories of research are necessary. The first deals with general anthropo-sociological-psychological analyses of typical communities and (hopefully) bureaucracies. These analyses should be general rather than specific, undirected toward particularly practical problems, and designed to cover the widest range of human phenomena. Research of this type provides scientific capital and, depending on its adequacy, permits rapid research on the practical, applied level. This is the level at which general theory is pushed forward, at which basic hypotheses about society and culture are generated without regard to action programs. It is important to note that this level of research is equally important to other fields such as health and medicine, education, and rural or community development.

The second broad category is that in which this general knowledge is examined and augmented and pointed toward the solution of specific problems. Popularly this is thought of as applied research, although in fact this is a limiting concept, since basic contributions to theory often are forthcoming through feedback. The "clinical" model has properly been suggested (as against the "engineering" model) to reflect the relationship between behavioral science theory and research.

Much, but by no means all, of this level of research may be quite properly integrated with agricultural programs. The research should be geared to the needs of the program as determined in agricultural terms. Many of the same facilities used for agronomic research should include behavioral science research, and technicians and research scientists in the several specialty fields involved must come to understand the goals and needs of their colleagues. Since behavioral scientists must research the innovating bureaucracy as well as the client group, this "participant observation" through teamwork is an especially valuable technique.

The behavioral scientist, and especially the anthropologist, also has a basic operational role at this level: He is the most effective communicator between farmer and bureaucracy. In underdeveloped countries there is no effective feedback mechanism between peasants and bureaucrats and between low-level and high-level bureaucrats. The village agricultural agent may have excellent understanding of peasants, their psychology, their needs and desires, but if these involve criticism of his superiors--as is sometimes the case--he is reluctant to pass along such disturbing information. After all, in order to advance in his bureaucracy he must please his superiors rather than the peasants. And, even at best, he usually has such a number of activities, and such a large area to cover, that he has little time to discuss matters in the tentative and leisurely way characteristic of villagers.

The field anthropologist, on the other hand, is often the only person whose role permits him to sit and listen to peasants as long as they wish to talk, and who wants to draw them out in the greatest detail possible. Moreover, his prestige and status permit him to report disturbing as well as satisfying information to the top levels of his bureaucracy. Hence at the operational level the anthropologist's presence at the research institute, or as a team member, is highly important.

#### LIST OF NEEDS IN SOCIO-CULTURAL-PSYCHOLOGICAL DATA ABOUT COMMUNITIES IN AN AGRICULTURAL PROJECT AREA

##### Basic physical-demographic:

1. Population, land settlement (size of units, dispersal, distances between, relations to market and administrative towns).
2. Land tenure and attitudes toward same.

##### Basic technologies, materials, and their sources.

##### Principal occupations:

1. Distribution by villages and areas.
2. Nature of vested interest groups.

Social structure:

1. Families, nature of roles, obligations, size, extension.  
Unilinear segments such as clans?
2. Concept of friendship, fictive kinship, roles, obligations.
3. General nature of reciprocal obligations:
  - a. Horizontal--between people of same status--traditional cooperative units.
  - b. Patron-client.
  - c. Other.
4. Caste and class patterns.

Political structure:

1. Locus of authority. Basic description of system.
2. Techniques by which political leaders achieve position.
3. Decision-making processes (election, council of elders, consensus, etc.).
4. Relationship of local political structure to larger units.  
Where does control really lie?
5. Concept of authority--who legitimately exercises it?

Law:

1. Nature and extent of conflict (e.g., factions, individual quarrels).
2. Conflict-resolving techniques.
3. What constitutes settlement of a quarrel? ("justice"? restoration of status quo?).

Religion:

1. Leaders and influence.
2. Limitations stemming from dogma and doctrine (e.g., Catholics and birth control, Buddhists and pesticides).
3. Basic cultural values stemming from religion.
4. Role of religious activities--entertainment, instrumental in curing, in farm magic?
5. Superstitions, magic.

Communication and mobility:

1. Literacy, radio, newspapers, etc.
2. Possible language problems (multiple languages).
3. Seasonal and other migration to mines, cities--families have relatives in cities?

Basic "patterns" of society and culture:

1. For example, "balance" in Latin America in wealth, folk medicine, etc.
2. Cognitive orientation and world view (perception of role of government and individuals).
3. Basic "values"; aspirations of people.

Dynamics:

1. Patterns of innovation--motivations to change.
2. Resistances to change.
3. "Natural" leaders--who is a "respected individual"?
4. Can innovation-prone individuals be identified?
5. Can innovation-prone villages be identified?

Health:

1. Folk medical beliefs and practices.
2. Vital statistics--basic indexes on health and morbidity.

Socialization:

1. Learning processes in context of this community.
2. Inculcation of dominant values; implicit assumptions about conditions of life of the group.





## Appendix F

### LAND REFORM

by Wolf I. Ladejinsky

Land reform deals with the adjustment of a cultivator's relations to the land in a land tenure system. When the system of land tenure in predominantly agricultural countries provides the cultivator with a reasonable reward for his efforts, it stands for economic, social, and political stability in the countryside and very often, and by the same token, in the country as a whole. The obverse is true when the system of landholding denies the cultivator the conditions under which he can secure for himself a reward for his labor commensurate with his role as a producer. In the main, and with more recent notable exceptions such as Japan, Taiwan, and Egypt, the latter condition still prevails in many parts of Asia, Latin America, and the Near East. This state of affairs was accepted as "normal" only a few decades ago, but this is no longer the case. The pressure for change in the status quo has been rising and most countries beset by tenure problems are now preoccupied with the crucial issue of how to change their land tenure systems in greater consonance with the improvement of the cultivator's standard of living, the improvement of the land, and greater agricultural productivity. The issue is the more difficult because, at least in Asia, the scale of farming is very small, and particularly so on tenant-operated farms. One to three fragmented acres is often the rule. Although Japan and Taiwan have managed to create a technology and economic and social institutions to suit their conditions, for the greater part of Asia this is still a far cry from reality. More often than not they are "uneconomic farms," uneconomic in the sense that they fall below the subsistence minimum rather than the technical optimum.

## THE PRESENT CONDITION

The current search for adjustment of the land tenure systems stems from the circumstances under which vast numbers of farmers live and work somebody else's land. The principal features that characterize the tenants' plight are stagnating agricultural economies; scarce land, yet concentrated in few hands; low yields but high rents; poor farmers but expensive farms; too many people living on too little land, and small holdings get smaller under rising pressure of population with no alternative occupations; inadequate tools, indebtedness and usury, malnutrition and illiteracy; keen competition among the peasants seeking scarce land in the hands of the relatively few who have it; absence of any chance for advancement within agriculture; little margin for risk-taking; and subsistence farming with a lack of dynamic or regenerative capacity.

Many of these conditions are due to institutional land arrangements over which the peasant has no control. An exploitative system of tenancy prevails in most countries of the underdeveloped world. Rack renting and insecurity of tenure are its hallmarks; and governments and their judicial bodies have given official sanction to this type of tenant-landlord relationship through the centuries. The farmers have been obliged to pay exorbitant rentals because the compelling need for any kind of employment depresses wages and raises rents. Nor is their contract of tenancy, which is supposed to ensure security of tenure for the tenant for a specified period, often worth the paper it is written on. In most cases the contracts are oral. But whether written or oral, they can be abrogated at the whim of the landlord. The incentive to improve the land and produce more does not exist, nor is there a place for creative technology on a wide scale. To the extent that these conditions preclude a measure of equalization of opportunities they stifle progressive impulses and tend to underwrite stagnation in agriculture.

Farmers have never been satisfied with this state of affairs. They have often expressed their discontent overtly against persons

and governments that they believed were the causes of their distress. But in the main, until the end of World War II, in Asia, Latin America, and the Middle East the conservatism and inertia of the farmer and his ingrained feudal subservience to the state and the landlord kept the pot from boiling over. More recently, and at least in part under the threat of communism, the bonds that kept the peasant down are loosening under rising agrarian discontent, both covert and overt. Country after country is struggling with these problems: how to relieve the plight of cultivators working for a pittance; how to revive depressed agricultural economies; how to root the peasant securely and beneficially on the land he cultivates. These problems have close bearing on agricultural productivity and economic development in general.

#### THE MEANING OF AGRARIAN REFORM

The answer to the questions posed is broadly known as "agrarian reform." The term conveys many things to many people. To the Communists, agrarian reform is simple enough: It is a means to political power, based on a promise to the peasant of the one thing he wants most--ownership of the landlord's land--in exchange for his badly needed political support. To the non-Communist world agrarian reform involves such issues as who owns or does not own land, how it is used, who gets what out of the land, the productivity of the land, the rate of economic development, and, additionally, social status and political power.

No single panacea will deal with all these issues effectively. In conditions of rural poverty even redistribution of the land will not suffice unless it is accompanied by the necessary means to work and improve the land. It follows that countries that carry out land redistribution programs must make great efforts to increase agricultural investment, particularly if their rate of population increase is fast. The economic opportunity and psychological incen-

tives that come with possession of the land or security of tenure must go hand in hand with a host of other developmental measures. For this reason agrarian reform in the sense considered here encompasses all or most of the following elements: distribution of land among the landless; security of tenure and fair rents; better methods of cultivation through technological improvements, adequate credit, cooperative marketing; and other measures. However, it must be stressed that not all these elements are of equal importance. The most important is landownership. If this is absent, all else may prove ephemeral, including security of tenure and rent reduction--measures extremely difficult to enforce. This explains why in the final analysis the issue is one of land to the landless. This is the real vehicle of security and opportunity upon which a more resourceful economy can be built.

#### THE CONTENT OF AGRARIAN REFORM

In most instances the content of enabling reform legislation is twofold: security of tenure and rent reduction, and the redistribution of land among the tenants. In Asia, except Japan and Taiwan, great stress is laid on security of tenure and rent reduction, while in the Middle East and Latin America the stress is on land redistribution and the creation of peasant proprietorship. No country approaches the content of either main measure in the same way, but the meaning of its approach depends upon the answer to this basic question: For whose benefit and for how large a group of beneficiaries is the reform designed? If the reform is indeed one for the benefit of the great majority of the tenants its specific content and its enforcement will differ substantially from a reform attempting to satisfy both landlord and tenant in the difficult conditions of scarcity of land, land monopoly, pressure of the farm population on the land, high rentals, high land values, and subsistence and unremunerative farming. The Japanese and Taiwanese reforms reflect a thoroughly pro-tenant attitude. Hence they empha-

sized ownership of land for the majority of tenants through the abolition of absentee ownership altogether and a low permissible retention of land (ceiling) for resident landlords; genuine security of tenure and low rentals for the remaining tenants; arbitrary and low valuation of land prices; easy repayment terms; and a type of enforcement in which the tenants play a major role in order to ensure a minimum of evasion of the principal provisions of the reform legislation. These reforms involved drastic redistribution of property, income, political power, and social status at the expense of the landlords. This was the purpose of the reforms, the basic proposition being that half measures or attempts to satisfy both parties could not bring about conditions under which those who cultivate the land would enjoy the fruit of their labor.

#### SECURITY OF TENURE AND RENT REDUCTION

It is axiomatic that great population pressure on scarce land brings about keen competition for the right to cultivate a plot of land. The result is that rents are high and security of tenure is low. Rents in Asia, for instance, of 50, 60, or 70 per cent of the crop are common even when the landlord contributes only the land while all other elements of production are furnished by the tenants. In such circumstances the bargaining power is all on the side of the landlords; they are not obliged, and cannot be compelled, to give tenants binding security of tenure for a specified period of time. Insecurity of tenure combined with high rents adversely affect agricultural productivity, not to speak of the tenant's welfare. If this situation is to be reversed, a situation must be created that leads to a reasonable ratio between the farmer's share in the effort and costs of production and his share in the crop produced. Coupled with this must be the appreciation of the fact that the margins of subsistence are so narrow that tenants can afford little risk; any innovation in production practices that goes wrong may result in starvation.

Rent reduction and security of tenure is one form of agrarian reform. Existing reforms do not reveal any common standard upon which a reasonable rental may be based. Each country, or in the case of India each state, deals with the problem in its own way. Some maximum rentals are 25 per cent of the crop in Japan, 37.5 per cent in Taiwan, 50 per cent in Nepal, and, in India, from 16 to 50 per cent. The "why" of the range of these rents stems from the natural assumption that the smaller the rent the greater is the benefit to the tenant. They have virtually nothing to do with an apportionment of rent among the various factors that go into the growing of a crop. Rents are of either the "fixed" type, a stated quantity regardless of the harvest, or the crop-sharing type, a percentage of the crop. From the point of view of the tenant, crop-sharing makes sense where there is the danger of recurring crop failure, but it has a disincentive effect upon the tenant. Rent regulations under a reform tend, though not always, to effect shifts from crop-sharing to fixed rents, thereby providing the tenant with greater incentive. The problem with rent reductions of whatever type is that they are difficult to enforce. Japan and Taiwan have succeeded in enforcing them as they have much else, but they are very special exceptions rather than the rule. This applies particularly in areas such as India and Indonesia where there is fierce competition for any plot of land in order to eke out any kind of living.

Security of tenure is part and parcel of rent reduction, and all reform legislation aims to give stronger protection to a tenant's occupancy rights. Like rents, such measures vary considerably although they have such common prescriptions as written leases, specified periods of occupancy, and compensation for useful improvements.

#### TENANT RIGHTS ON TAIWAN

Taiwan, more than any other country concerned with the problem, provides the best tenant occupancy rights. The Taiwanese law

provides that farm lease contracts (of six years' duration) shall not be terminated before their expiration except under any one of the following conditions:

1. If the tenant dies without an heir.
2. If the tenant waives his right of cultivation by migrating elsewhere or changing his occupation.
3. If the tenant fails to pay a total of two years' rent.

Such safeguards extend to tenants even after the expiration of the lease. The law provides that the landlord cannot take back the leased land for his own cultivation on the expiration of the contract if any one of the following conditions exist: the landlord cannot till the land himself; the landlord's income is sufficient to support his family; or the landlord's action in taking back the land deprives the tenant's family of its subsistence.

For all practical purposes this means that tenants can remain on the land undisturbed even after the expiration of the contract, which in Taiwan virtually ensured the enforcement of the rental provision. Less carefully worded stipulations might have undermined this part of the reform program. In India, for example, the provision that a landlord can take back land for "personal cultivation" has proved to be a serious drawback in enforcing security of tenure and rent provisions.

#### LAND REDISTRIBUTION

There are regulated tenancies in the United States, England, and even in India that so protect the tenant that he prefers to invest in capital goods to improve the land rather than in buying land. But this is not true in most parts of Asia, the Middle East, and Latin America. What the farmer wants is a piece of land of his own. To the Japanese farmer, one without land is one without a soul.



This mystique about landownership may not be so aptly expressed in other countries, but its validity is there no matter how expressed. Prevailing tenurial conditions suffice to explain it. Where tenants are plentiful and poor and land is scarce, regulated tenancies are almost impossible to enforce. Japan and Taiwan have succeeded, but they are very special exceptions to the rule. Examples to this effect are too numerous to cite here. In one case, that of India, an unwise attempt to regulate tenancies led to still greater insecurities and the driving of tenants to the very bottom of the agricultural ladder, to the rank of agricultural laborers.

The arguments are strong for the diffusion of ownership among the tenants as the main purpose of agrarian reform. As we shall see later, enforcement of a land distribution program in Asian conditions is no easy task either. Yet one cannot but agree with a student of the problem that, "administratively, there is virtually no question but that a system of owner-cultivatorship in which the basic distinction between 'mine' and 'thine' can be marked out on the ground is much simpler to administer than a system of regulated tenancies." This of course assumes that a government, in the first place, devotes itself single-mindedly to the promotion of this kind of a program. There is another reason why agrarian reform should stress ownership. Agricultural practices on most of the would-be new-owner farms need improvement, and this means new investments. Financial institutions, even if they are public, make a distinction between owned land and leased land in making loans. In the first case land is the security for obtaining investment, but this is not so in regulated tenancies with their continuous shifting of rights and duties between landlord and tenant.

#### THE LAND CEILING

There are reforms the sole purpose of which is security of tenure and reduction of rent (Nepal), but in most countries, redis-

tribution of land and the establishment of new owner-farmers is the main objective. This aims toward abolition of tenancy altogether. The immediate problem of reform makers then is to secure enough land to endow a given number of tenants with land of their own. The core of it is the "ceiling." The landlord is permitted to retain a certain amount of land (ceiling), the remainder being earmarked for redistribution among the landless. It is the size of the ceiling that determines how far-reaching the program might be, always assuming that the ceiling is enforced.

Since countries have varying amounts of land available and varying scales of tenancy, it is understandable that the ceiling should differ from country to country. More fundamental, however, is the fact that in some countries the ceiling is made to serve the objective of widespread ownership whereas in others the ceiling can become a device to defeat this objective. In Japan and Taiwan the ceiling was so set that it encompassed all the land of the absentee owners and permitted (in Japan) the resident landowner to retain only 2.5 acres. This is an instance of a ceiling cutting to the very bone of the landlord's holding. It cuts less deeply in South Vietnam with a ceiling of 250 acres, apparently deeply in Iran where a landlord is permitted to retain only one village out of many, while in India the great variety of ceilings might have served their purpose except for lack of enforcement and widespread evasion.

Clearly what matters in extending ownership is not only at what level the ceiling is set but also that it not be evaded. The cases of Japan and Taiwan on the one hand and Pakistan on the other are instructive. The low ceiling in the first two countries made it possible to extract a great deal of surplus land for redistribution. Before the reforms 54 per cent of Japan's land had been owner operated, and after the reform the figure rose to 92 per cent; the respective figures for Taiwan were 60 and 85 per cent. West Pakistan is not Japan or Taiwan, but fixing a ceiling of 500 irrigated acres and 1,000 unirrigated acres in a country where the land of two thirds of the farmers averaged five acres each was not really a

measure for land redistribution. Moreover, exceptions and subdivisions of large holdings among members of a family were permitted on the eve of the reform. This, combined with the high ceiling, meant that the land distribution program was divested of any meaning. It appears that if a ceiling is to provide the landless with land it must be set at a low level; the acreage retained by the landlord must be fixed retroactively, or on a date well in advance of the reform, and; finally, the ceiling must be fixed on the basis of land owned by a household rather than an individual. With a low ceiling, no evasions, and effective implementation, large numbers of tenants can become farmer-proprietors.

#### THE LANDLORD'S HOLDING

Unless a reform is confiscatory--and the ones considered here are not--the question of how much to pay for the land earmarked for redistribution is of great importance. Various countries approach this crucial issue in different ways. Usually the value of the land for compensation purposes has been derived from one or a combination of factors such as valuations shown in land tax records, recorded land revenues, rent collected, landlord's net income, or value of produce. But one thing is common to most of them: Prevailing market prices are seldom accepted as the basis of valuation. If they are considered, it is only as a yardstick for sharp deviation downward. Even where the intent is clearly not to penalize expropriated owners but rather to compensate them adequately for their loss, they are not in the same position as a person under no legal pressure to sell, free to negotiate on the open market for the best available price. This puts the compensation outside the market in the strictest sense. Land prices in underdeveloped and densely populated areas are commonly very high, bearing no relation to the productive value of the land. Low assessments of agricultural land, comparatively low land taxes, and negligence in tax collections

have frequently been the main reasons for high market values, particularly in areas with high population pressure on the land. Added to this are such factors as the social and political prestige and influence gained from the possession of land, and a favored tax position compared with that of investors in commerce or industry. The combination of all these elements has made land values unrealistically high, a fact that must be faced by reformers in deciding what to pay for the land to be purchased from the landlords for distribution among tenants.

In Japan the price of land was fixed by capitalizing the annual rent in a manner to ensure a fair profit for the farmer buying the land (taking into consideration that all rice save his own consumption was collected by the government at fixed prices). In practice this meant 40 times the rental value of a rice field and 48 times the rental value of an upland field. These cash rents were quite low compared to a price level augmented by inflation. In Taiwan the government decided that a landlord would get 2.5 times the annual value of all crops on a given piece of land. In Italy, assessed valuations shown in the land tax records served as a basis of pricing. A number of Indian states used annual tax revenue or net income from the land as a base. But whatever the existing method of pricing, with rare exceptions the price is fixed below the market price. The fact is that land purchase under a reform is not an ordinary real estate transaction where seller, broker, and buyer meet in a free market. If it were, and if tenants were able to pay the "going price," there would be no need for reform. It may be concluded that the price fixed by a government is an arbitrary one, the degree of arbitrariness depending upon how a reformer answers the question already referred to: "For whose benefit is the reform designed?"

#### METHODS OF PURCHASE AND REPAYMENT

There is ample evidence that in order to bring about a land

redistribution program a government must buy the land and resell it to the tenant rather than institute direct landlord-tenant negotiations. This procedure rests on the proposition that where land is at a premium and the economic and political power of a landlord is strong, the bargaining power of the tenant vis-à-vis the landlord is so weak that an agreement can be reached only on the landlord's terms. The two decades of Japanese paper reforms before World War II amply demonstrate this point. This is true in other countries in Asia where purchase transactions are left in the hands of landlord and tenant. In the long run this means prohibitive prices--and no sales--which explains why landlords are usually compelled to sell a certain amount of land at officially fixed prices.

How a government pays for the distributed land is of great importance to government, landlord, and tenant alike. Experience shows that a government, no matter what the price, is not in a position to pay for the land in cash in one lump sum; Colombia and Venezuela are perhaps the only exceptions to the rule. Payments to the landlord are made mostly in interest-bearing bonds spread over a period of years, with cash seldom exceeding 10 per cent of the fixed price of the land. Madras State and the Philippines are exceptions. In the latter a maximum of 50 per cent of the compensation may be paid in cash and the remainder in land certificates, except that full payment in cash is made in certain cases of expropriation through the courts. However, very little land has been thus acquired, especially since land acquisitions are based on "fair market value." Payment through bonds, extended over periods of twenty years or more and bearing an interest rate of 3.5 to 5 per cent, has eased budgetary difficulties and has served to avoid the inflationary impact of large cash disbursements. In some countries the bonds are negotiable and redeemable in equal annual installments, or the bonds can be used for the purpose of industrial and commercial investment, for the payment of taxes, and such.

Taiwan's case is unique. To avoid the effects of inflation, which resulted in virtual confiscation in Japan, Taiwan tied the

price of land to the prices of two principal products of the land and to shares of stock in government-owned industrial undertakings. This meant that 70 per cent of the compensation was in the form of commodity bonds payable in 20 semiannual installments over a period of ten years, and 30 per cent was paid outright in stocks. This method worked well for all parties concerned. The commodity bonds preserved the value of the sales price against fluctuations in the value of the currency for a ten-year period. And an estimated 40 per cent of the total compensation found its way into industrial and business investments. This is perhaps the only known case of an agrarian reform that has consciously planned and succeeded in transferring private capital formerly tied up in the land into the general developmental field.

The methods of repayments to the governments by the former tenants vary from country to country, but the underlying principle is that the payments must not constitute an excessive burden on the new owner. A government's annual recovery from the new owner must be less than his former rent. Usually repayments by tenants and payments by governments for the acquired land are extended over a similar period of years. Since all governments are eager to recover their original outlays, they aim to strike an annual balance between what they pay out and what they take in. This does not necessarily work in practice because of changes in the economic conditions of the farm community; a government's decision to charge (or not to charge) to the new owners the administrative costs of a reform; and, above all, the fact that some governments have realized that, if land redistribution is to be viable, heavy investments are needed to improve the land and to create infrastructure to help the new owners during the formative years of the reform. The recovery of these extra costs is not often charged to the new owners directly.

On the whole the record of repayments is good. This must be attributed to the relatively easy terms set by the governments in question. In Italy, for example, a new owner under the reform pays an annual sum equivalent to \$19 per acre, on the average, as against

\$40-\$50 per acre on similar, nonreform land. In Venezuela the new owners amortize in twenty to thirty yearly installments a predetermined proportion of the cost of the land; improvements and the first year's working capital are provided by the government as a gift. In Egypt repayment is in forty annual installments, and, though the farmers are also charged 1.5 per cent interest per annum and 10 per cent for administrative costs, the sum total of annual recovery is considerably below the level of prereform rent. It is clear that even with good recovery, reform imposes budgetary strains on a government. Two facts must be kept in mind, however. One is that an agrarian reform is not an ordinary commercial enterprise but one involving social justice and political stability, an investment in the future of the nation's people. Second, if the assumption is correct, as it seems to be, that agrarian reform does lead to an increase in agricultural productivity, then it is reasonable to say that eventually the government and the country as a whole will more than recoup the investments called for by the initiation of a reform and its support during the early years.

#### IMPLEMENTATION AND THE POLITICAL CLIMATE

Effective enforcement rather than reform legislation, however well drawn, makes the difference between reform in being and reform on paper. There are too many of the latter kind in the regions under consideration. The agrarian reform movement in Asia anticipated most of those in the Middle East and in Latin America, but this advantage in time did not bring about uniformly good results. With the exception of Japan and Taiwan, the picture of Asia leaves much to be desired. The landlords' property in South Korea has found its way into the hands of the tenants, but the government's failure to come to the financial assistance of the new owners has brought about indifferent results. The civil war in South Vietnam caused that reform to be short-lived. The Burmese tenants are owner-farmers now,

but government after government has failed to capitalize upon this and develop the rich land resources of the country. The Philippines has four reform failures on its record and is trying now for the fifth time with no greater prospects for success than heretofore. West Pakistan and Indonesia have proclaimed reform but with hardly any implementation, while Nepal, after a dozen years of cogitation, is just barely taking the first step. Finally, there is India, significant and encouraging for what it has attained in unprecedentedly difficult and bewildering conditions, and just as significant and discouraging for what it has failed to attain, and for the reasons why.

None of this has anything to do with ignorance of the tenantry's conditions or inability to draft legislation to meet those conditions. Even Nepal, a closed and remote society only yesterday, is skilled enough to write good measures--if it wants to. Surely the same can be said of every country where reform has failed. A number of reasons explain this state of affairs. To begin with there may be insufficient administrative and technical skill to mount a reform; but this is not a crucial issue, and failure to implement a reform cannot be attributed to it. More to the point are inadequate measures or half measures deliberately drafted so as to retard--if not obstruct altogether--the application and implementation of a reform; absence of leadership among the peasants to propagate the reform idea and exert effective pressure on legislative bodies; disinterestedness--if not overt opposition--on the part of intellectuals and molders of public opinion; and, most important, the built-in opposition to reform by the landlords, whose role in the body politic is out of all proportion to their numerical strength. This combination of factors inhibiting reform is hard to overcome.

Landownership as the main point of an agrarian reform is difficult to achieve. Examples are legion, and the reason is not far to seek. Land redistribution under agrarian reform is a compulsory measure imposed by a government upon the landowners on economic and legal terms unpalatable to them. In effect this involves a drastic



redistribution of property and income at the expense of the landlords. It becomes a revolutionary measure when it passes property, political power, and social status from one group in the society to another. This is a real meaning of an agrarian reform where land redistribution is its central objective. Considering the fact that in the areas under discussion legislative assemblies are still dominated by land-propertied classes, it is not difficult to see why both the enactment of appropriate legislation and its enforcement present such formidable problems. Thus land reform, despite its economic implications, commences as an essentially political question involving a most fundamental conflict of interests between the "haves" and the "have-nots."

#### WHO MAKES AGRARIAN REFORM?

No matter how ripe a country may be for agrarian reform, it does not follow that an agrarian reform then occurs. Nor does enactment of a reform always meet popular aspirations in terms of social justice and better distribution of rights and opportunities among the landless. The dragging of the feet on the part of governments and legislative assemblies in enacting reforms is notorious. Technical expertise in preparing and administering the necessary legislation is indispensable, but experts do not make reforms. Politicians, and only politicians, make good or poor reforms or do not make them at all. They control the political climate, which determines the will or lack of will to proceed with the task; the specific measures with which the reform is or is not endowed; the care or lack of care with which the enabling legislation is formulated; the preparation or lack of preparation of the pertinent and administrative services; the presence or absence of technical services with their bearing upon the success or failure of the reform; and, most important, the drive or lack of drive behind the enforcement of the provisions of the law. The "positive" makers of reform must

represent strong political leadership deeply concerned with the land and its cultivators and capable of translating those concerns into action. There is no substitute for this kind of leadership at the crucial stage of determining a reform's main goal and initiating it. The financial, technical, and administrative needs of a reform can prove to be formidable obstacles to its initiation and enforcement. Nevertheless experience shows--and India provides a number of illustrations--that they are not insurmountable difficulties if the concerted will of political leadership is brought to bear. The built-in landlord opposition, abetted by public servants, can be dealt with successfully if the political leadership is bent on carrying out its goals. This is especially important because the peasantry has not developed a popular political movement of its own capable of effectively representing and advocating its own cause.

#### THE CASE OF INDIA

India, which has done both much and little, demonstrates how much can be accomplished when will and determination are present and how little can be attained if they are absent. India's reform objectives were twofold: first, the abolition of the zamindari system;\* second, security of tenure, reduction of rent, and distribution of land to the landless. Despite opposition and administrative and technical problems, the zamindari tenures were virtually abolished. Not all have benefited equally, and not all the 20 million cultivators affected have received permanent, heritable, and transferable rights. Nevertheless the effort was a major step toward a

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\*The zamindari system was a product of early British rule. The zamindar was given the right to collect land taxes and undertook to pay the British administration a fixed revenue. In return he was not only permitted to keep a portion of the revenue but was also recognized as the proprietor of the revenue-bearing land.

reconstruction of Indian agriculture. The measure succeeded because it was politically popular to abolish an agricultural system full of abuses imposed by a foreign power. With the British gone, the government went about drafting the necessary legislation; the zamindars were disestablished despite the opposition of the landlords, lack of financial means, and insufficient administrative and technical staff. Not every t was crossed and not every i was dotted, but the job was done. On the other hand, in dealing with its indigenous landlord system India faltered, and very often badly, both in content of the measures and in their implementation. The nation is not without its bright spots, but security of tenure, rent reduction, and landlord ceiling provisions have not been successfully implemented on the greater part of India's 80 million acres of tenanted land. In fact, perhaps as many tenants have lost their tenancies as have been made secure on the land through deliberate rather than accidentally faulty legislation. Such states as Bombay and Uttar Pradesh have demonstrated that, given strong and willing leadership, many of the reform problems can be dealt with successfully. But where antireform sentiment prevails, as it often does in Indian state legislatures, vague and complicated measures generously seeded with loopholes, delays in legislative enactment, failure to inform the peasants what the law is about, enforcement officers who behave as if reforms are not meant to be enforced, and refusal to enlist the support of the farmer in helping carry out the program--all these become the rule rather than the exception. With variations the same is true of a great many other countries.

#### THE JAPANESE EXAMPLE

Japan and Taiwan, on the other hand, proceeded with their reforms with no vacillation or half measures. They developed their own techniques of initiating and enforcing reform. That the American occupation in one case and the loss of mainland China in the

other were important elements in fashioning the reforms does not invalidate the proposition that above all else a favorable political climate is the precondition of a sound reform and its implementation. In such an atmosphere even the would-be nonenforcers become enforcers, and technical difficulties are only challenges to be resolved. To be sure, reform has an element of coercion. This is so because the key to the implementation of any reform that transfers property and privilege from one group to another is the degree to which the controlling political forces of a country are willing to support these revolutionary changes and ready to use all instruments of government to attain their goals. Government coercion, then, whether practiced or implied, is virtually unavoidable. But so long as this kind of a political wind is conspicuous by its absence, a meaningful reform intended to meet some of the minimum needs of tenants can be neither properly initiated nor carried out.

Even well-drafted measures in a pro-reform atmosphere cannot be easily enforced if the task is left solely to the bureaucracy. There are never enough bureaucrats and reform experts to go around; the experts become experts only in the process of application of the reform. If a reform is to be carried out successfully, it must win the active participation of the people directly affected by the reform, the farmers, who best know the conditions of their rural community. With the exception of Japan and Taiwan, this principle has not been recognized by most countries currently engaged in reform activities.

Japan is the pioneer in entrusting the villagers with the lion's share of the implementation of the reform. A close look at the Japanese experience is very instructive, for it carries a lesson that other countries might well ponder. The device created by Japan for the administration of the reform at the village level is the local land commission made up of five tenants, three landlords, and two owner-cultivators--all elected by their respective groups. The preponderance of tenants was a deliberate move based on the theory that if only one owner-cultivator sides with them a working majority

is ensured for the commission. The commissions were entrusted with the actual purchase and sale of land. They had broad powers that they could exercise with a minimum of governmental interference. These included: drafting the purchase plan for each village, determining the suitability of the land to be purchased, establishing the eligibility of purchasers, deciding cases requiring unusual or special treatment, and appraising cases of exemption from the purchase provisions. The Japanese scheme was based on the fact that no staff could have been gathered to deal quickly with the transfer of 30-40 million plots of land and that only the local people knew at a glance who was who in the village, who owned what land, who leased land and how much, and so forth. The work of the local commissions, coupled with the successful effort to bring to the attention of the farmers the basic points of the reform, more than justified anticipations. It is questionable if the reform could have been carried out so speedily and in such orderly fashion but for the local land commissions. The duties they performed were an important form of adult education and served to stimulate new leadership. Tenant members who were ill at ease and insecure at the beginning of the exercise were seasoned performers a year or two later. The very creation of the commissions enabled all the adult farm population to vote on a matter of utmost concern to all groups in the village. At the same time the composition of the commissions proclaimed the fact that the tenants' interests were to be protected by the tenants themselves rather than by someone acting on their behalf within the traditional pattern of rural Japan. At the height of the reform approximately 150,000 commissioners received this kind of special leadership training; and half of them were tenants. The prereform contention that only landlords could exercise leadership, make decisions, and administer the community proved baseless.

## THE NEED FOR FARMER PARTICIPATION

It may be argued that what Japan could do with a literate farm population is not possible in other countries with less literate farmers. But even illiterate farmers know their own condition and that of others in their community. A judge in court may dispute a farmer's occupancy right because he lacks a written contract, but there is hardly a village where the tenants, like the Japanese tenants, do not know the details of the existing pattern of tenure. This knowledge, if enlisted through some sort of organization (not necessarily the Japanese type), could greatly aid any reform effort. So far, farmer involvement has been conspicuous by its absence unless, as in Bolivia, farmers deal with reform in their own spontaneous fashion. So long as the would-be beneficiaries are treated as mere onlookers, often ignorant of even the ABC's of the reform measure, the reform cannot succeed. The widespread assumption that only white-collar officials can administer a reform is an idea best laid to rest. Reform, if effective, must be carried out at the village level, and the participation of the farmers in an affair that affects them deeply is one of the vital conditions for translating a reform from paper to reality.

## REFORM AND PRODUCTIVITY

Just as insecure and difficult tenure conditions make for low productivity, it is often assumed that agrarian reform with ownership as its objective makes for higher productivity. This is in tune with Arthur Young's statement in the eighteenth century that "ownership is the magic that turns sand into gold." It flows from the idea that investments and productivity are promoted through the incentive of private, individual ownership of land. This assumption may or may not be correct depending upon the circumstances surrounding the fact of ownership. In Latin America, for example, many a

private owner of a hacienda has not proved to be a good producer-- and many a small owner has done no better.

While it is easy to postulate that landownership stimulates productivity, it is extremely difficult to measure its actual effect. While assessment of output is comparatively simple, the contribution of a land distribution program to productivity cannot be separated with any degree of accuracy from that of other factors affecting output. But a close interrelationship between agrarian reform and productivity does exist if agrarian reform stands for ownership of the land or secure tenure and such supporting elements as land improvement, irrigation, credit, marketing, and so on. Without these added inputs agrarian reform is not necessarily the touchstone to a new owner's increased output and higher standard of living.

The pervading spirit of enthusiasm that comes with reform and the will to make the most of the awaited land of one's own are important incentives to production; they play an indispensable role when the supporting services are there to play their role. The experiences of Japan, Taiwan, Italy, Egypt, and India provide ample evidence that agrarian reform and productivity go hand in hand under these conditions. Therefore, if the anticipations of the beneficiaries of agrarian reform are not to be thwarted, a government promoting a reform must be prepared at least in the initial stages to invest in a variety of other measures that promote agricultural productivity. On the other hand, efforts to promote agricultural productivity where tenancy reforms are long overdue are likely to be adversely affected by the existing tenure system. Unless new inputs come to overburdened tenants as a gift or under exceptionally favorable terms, the chances are that they cannot afford to innovate. The reaction of the tenants to the Package Program in India is a case in point. It follows that agencies concerned with ways of building a technical and organizational base for raising productivity must be equally concerned with the problem of reforming existing tenures when these constitute a problem.

## SOCIAL STATUS AND POLITICAL STABILITY

Agrarian reform in its inclusive sense stands for salutary changes in social status and political stability. In Western Europe the changes in tenurial conditions from feudalism to our own day amply demonstrate this view. The changes in Japan since the implementation of the reform tell the same story. The Japanese case carries implications for underdeveloped countries as well. A reform worthy of its name is supposed to strengthen the principle of private property where it was weakest, at the base of the social pyramid. By multiplying the number of independent landowning peasants there comes into being a middle-of-the-road, stable rural society with enhanced status, rights, and privileges. Government then cannot take the peasantry for granted but must perforce pay close attention to the desires of the countryside. This has happened in Japan to a degree unknown in Japanese history, and it reflects the rise in social and political status of the peasantry due to agrarian reform.

Reform can narrow the traditional differences in the class structure of the village. As the tenants step up, the landlords step down. As the landlord loses much of his affluence, he loses much of his influence. This does not presuppose that the resident landlord is completely displaced or that it is necessary to eliminate him altogether. What is taking place now in the Japanese village is the sharing of power between the old and the new leadership. Both are meeting now on the agricultural committees, cooperative and school boards, and in village offices. They rub elbows dealing with common problems. This is a new and welcome development. Japan's agriculture after the reform still is a marginal enterprise with acre and two-acre farmers. It needs all the available skills and social peace and stability to deal with the reality of six million farmers on 15-16 million acres of land. This new leadership and the idea of citizenship rights were both foreign to prereform Japan. The passing away of the old reality of second-class citizenship is



a symbol of the new social order and of greater political maturity and independence. The latter expresses itself in the attitude of the full-fledged citizen toward a government or a party in or out of power. Unlike prereform days, voters pick and choose according to their economic interest. The candidate's own proven concern with farm conditions and the record of his party's agricultural policies are decisive. Whatever action a government in power may choose to take with respect to the price of agricultural products, fertilizer prices, scope of land improvement work, and short- or long-term credit funds now affects the distribution of the vote. No longer is the vote delivered en bloc. Clearly, "We support those who support us" has a modern democratic ring, and it can be traced to the social and political changes ushered in by the agrarian reform.

So it is in Japan, but it need not be only in Japan, due allowance being made for different conditions from country to country. If an agrarian reform is imbued with the meaning ascribed to it here, then, whether it be India or Egypt, Mexico or Peru, changes in social status and political attitudes in the countryside are inevitable. And a government's response to these changes is likely also to be inevitable if remaining in power requires popular support of the peasantry.

#### PROSPECTS OF AGRARIAN REFORM

In the past two decades "agrarian reform" has come to epitomize the problems and hopes of rural people in Asia, the Middle East, and Latin America. In Asia the issue of reform has long since moved from the talking phase to that of action. The old order in the countryside is under attack--vigorously in very few countries, much less so and with results to match in many more. From the record to date, it might be concluded that only in critical conditions, such as defeat in war for Japan or the escape of the Chinese Nationalist government from China to Taiwan, can far-reaching

agrarian reforms be carried out. India disproves this thesis at least in part, as does Egypt in the Middle East. Even in Latin America legislation has been enacted here and there, and the subject is no longer taboo but has become a burning issue. Admittedly, however, a wide gap exists between the anticipations engendered by the agrarian reform movement and its realizations.

What of the future? The answer lies in a combination of an act of faith and certain realities that are likely to induce a more vigorous prosecution of reform in the days ahead. While village communities seem to carry on as of old, the winds of change blowing from all directions are bound to affect them, and the bonds of custom are bound to weaken. In India there are already numerous deviations from the norm, entire districts "going places," reaching out for horizons that only yesterday seemed unattainable. These are still only "islands within," but the drastic changes they presage will at some point touch upon the expectations of all groups of Indian rural society, including the large tenant class. Impatience with present conditions is very likely to come to the fore. Whether in an organized or disorganized form, whether through the due process of law or revolutionary upheaval, the change will come--and not only in India--and an all-inclusive agrarian reform will be part of it. This is the faith part of the argument.

#### PRESSURES FOR REFORM

Agrarian reform will continue to command attention and ultimately action for other reasons. The areas we are discussing are agriculturally underdeveloped, particularly in foodstuffs. There is growing recognition that agricultural production must be increased if the standard of living of the producers is to be raised and if capital is to be accumulated for over-all economic development. In landlord-ridden countries there is a rising awareness that agricultural progress depends upon a set of incentives that the existing

land tenure systems do not provide. This recognition may yet prove to be the augury of the kind of action that makes the difference between reform and "reform." Willingly or unwillingly many countries have been preoccupied with agrarian reform and have drafted reform legislation. Even though its content is faulty and incomplete and its execution poor, the mere existence of the legislation serves notice to the landlords that the issue will not just go away, and that better legislation and enforcement may be fashioned at a later date. Evasion of the ceiling, as in India, does not destroy it as a potentially serious attack on the status quo. Landlords recognize this. They know that their tug-of-war with the tenants is far from over, and many landlords would dispose of their land for something less than its market price. They recognize that the old order in the countryside is not what it used to be and that their best days are over. How soon or how late all these elements will be brought to bear in a more drastic effort to redress the position of the landless still is up to the governments in power. If willing and wise, they can speed up the process; barring that, somebody else will take over this long-overdue task, and much more will be at stake than a new rearrangement of income distribution and status in the countryside.

#### REFORM IS NOT A PANACEA

We must recognize that in overpopulated rural areas an agrarian reform, even with all the supporting services, cannot solve all the problems standing in the way of a better livelihood and greater production. Where the pressure of population on limited land resources is great, agrarian reform can do nothing to change the land-man ratio. With no alternative occupation outside of the village, the rise in the farm population is bound to reduce the size of holdings still further and to increase the number of farms as sons and grandsons take over. These limitations are obvious even in prosper-

ous Japan. While in the United States between 1920 and 1957 the number of farm units was reduced by 22 per cent and the working farm population by nearly 40 per cent, in Japan during the same period both categories increased by 10 per cent despite the country's striking industrial upsurge. The current prosperity of Japanese agriculture cannot hide these harsh realities. Japan's nonagricultural economy has served as a safety valve by providing the farmers with 40-50 per cent of their income. Clearly this is not possible in developing nations without substantial nonagricultural economies.

Agrarian reform in such conditions is not a final solution of the farmer's or nation's problems. Rather it does away with the worst features of a system that has outlived its usefulness economically, socially, and politically. Reform provides a partial escape from the severe handicaps of a resourceless small-scale agricultural economy pressed upon by a large farm population. It is a means of elevating the human condition. We may arrange for all the material supplies of water, seeds, fertilizers, implements, and credit. But we cannot give the peasant the psychological incentives he needs unless he is secure on the land, particularly on land that belongs to him, for uncertainty in this regard is one of the great disincentives under which a farmer labors. In any attempt to provide a better material and organizational base for the rural sector the solution of the land tenure issue is the clearing of the ground, the preparatory step for all else, the sum total of which raises agricultural productivity.