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ABSTRACT

The agronomist views the problems of worldwide rural poverty as having common underlying causes including soil erosion and nutrient depletion, low-yielding varieties, weeds, and plant diseases. Often these problems are ameliorated by use of new or improved techniques. Agronomic research aims, nevertheless, to facilitate the development of human resources and potentials from three humanistic perspectives, i.e., the family, community, and population (demography). For example, the Chinese Agricultural Technical Mission in the Dominican Republic directed its efforts to increase rice (*Oryza sativa* L.) production by establishing substations where crosses were made, and foreign and domestic rice varieties were introduced, selected, and tested. The effort markedly increased rice yield, particularly after the introduction of hybrid varieties developed at the Mission. The techniques were taught to farmers at the community level, increasing their expertise and productivity without major innovations.

In West Africa, the research effort was directed to the family unit. Under shifting cultivation, maize (*Zea mays* L.) was grown as a second crop in the same year after rice on the identical site (multiple cropping). This provided the family unit with increased revenue without drastically altering work patterns.

In general, to be acceptable, an innovation must 1) serve a basic need, 2) be easily evaluated, 3) be highly recommended, and 4) require only minor changes in life patterns. Primarily, agricultural technology must be directed to increase the quality of life for rural people.

Additional index words: Rural poverty, International development, Agronomic innovations.

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RURAL poverty and the problem of no or low income of people who live in open country, small towns, and villages is a problem not only of highly developed countries, but is a problem of worldwide dimensions, particularly in the tropics. From the agronomists' point of view, poverty, although masked by cultural differences, can be accounted for by common underlying causes. Such causes as soil erosion, depletion of nutrient reserves, deterioration of soil structure, increased incidence of soil-borne diseases, weed infestation, and the use of low-yielding varieties are the main contributors. Prairie View A&M College in Texas is aware of these factors and, in an effort to help solve them by new techniques and/or improved technological know-how, has directed its agricultural research program towards improving opportunities to better the social conditions and economic resources of the rural poor (11, 20). The College's mission-directed research is oriented to the social and material needs of the underprivileged by focusing its research efforts at the grass roots level.

In resolving the problems of the low-income populations and to facilitate the development of human resources and potentials for constructive self-realization of individuals, these problems are being viewed from three different perspectives.

1) *Demographic*--Viewing problems involved in aggregate populations relative to crucial life chances, geographical mobility, and distribution or location of these populations.

2) *Individual and Family*--Viewing problems involved from the perspective of individual values, motivations, attitudes, capabilities, social orientations, and life experiences.

3) *Community Structure*—Viewing problems in terms of the community structure, regardless of life chances, of individual attributes, and the nature of family circumstances, the rural poor are either limited or facilitated in the development of their potentials by social and economic forces inherent in the community.

It is obvious that any broadly significant long-run solution to basic problems facing the rural poor will require consideration and synthesis of all these perspectives to ameliorate negative conditions for development of individuals, families, and communities.

The report by the President's National Advisory Committee on Rural Poverty (18) clearly documents the need for this kind of understanding of the problems of the rural poor and of applied, experimental research, and action programs that will help them to alleviate these problems and improve their critical life chances.

Since the late 1920s Prairie View A&M College has been trying to study the needs and problems of the politically, socially, and economically disenfranchised. Research received a great boost during those times in the form of "Educational Conferences." These conferences were designed to seek vital information, through surveys and questionnaires related to education, health, and socio-economic problems of blacks in Texas.

The increasing concern for the "rural poor" and their problems is currently being translated into planned research programs and projects under a multidisciplinary approach involving home economics, social and natural sciences, and agriculture. This program is being supported by funds allocated to the Texas A&M University-Prairie View A&M College Cooperative State Research Service for the 1890 land-grant colleges.

The Soils Team of Prairie View A&M College has extensive experience with range soils, and because Prairie View is situated on the prairie soils of South Texas, it was given responsibility by the Agency for International Development under a 211 (d) Grant to accumulate information and develop competency in managing Savannah soils of the tropics.

The soils team has focused their effort in helping to improve the environment of the rural poor by focusing on the solution of basic agronomic problems which contribute to rural poverty in the Gulf Coast Prairie area. As one solution, a program of intensive cultivation of fruits and vegetables by rural people living close to large urban centers is being investigated as a means to better the quality of their lives through generation and improvement of income. These scientists have extended their concern to the impoverished areas of other countries as well and have extrapolated their experiences to tropical and subtropical areas of the Caribbean and West Africa.

Another is to show how multiple-cropping systems, using indigenous plants (adapted to unfavorable ecosystems) and simple cultural practices such as weed control by use of mulches, fertilization, (mineral and organic), and other simple cultural improvements that do not alter the life patterns of the people, have increased yields in some tropical areas. Further, this discussion shows how innovations can be introduced by demonstration-education methods through the joint endeavor of the farmer and the agricultural officers in a Caribbean nation and indirectly through a change in the land tenure system so that the small farmer can benefit.

A CARIBBEAN EXPERIENCE

The Chinese Agricultural Technical Mission was requested by the Dominican Republic Government early in 1963 under a cooperative program to increase rice (*Oryza sativa* L.) production in the country.

For years, the similarities in the environment and agricultural products of Taiwan and the Dominican Republic had been recognized. Both nations are predominantly agricultural and both produce sugar, rice, bananas, peanuts (for oil), sweet potatoes, beans, corn, pineapples, and a number of other fruits (4, 5).

Before the Mission was established, the rice industry had progressed very rapidly, especially along the lines of land development, irrigation, establishment of rice mills, and the installation of short-term credit (4). During that period, the cost of rice production was then rather high because of low yield per hectare. It was foreseen, then, that to increase yields, further land development should be directed to increasing rice acreage, technical improvements, and innovative practices that would increase yields per hectare. Therefore, to establish a sound, national rice program, four criteria were suggested and/or adopted:

1) A long-range rural policy
2) An adequate scientific research center with field stations in all important regions

3) An active extension service for teaching farmers to use modern technology
4) An appropriate rural organization for helping the farmers to help themselves

All of these planning and functional organizations for a successful rice program had either been lacking or were inadequate. This paper will describe the efforts to implement criteria 2) and 3); 1) and 4) are under consideration by the Dominican government.

The immediate project was to set up the Dominican Rice Experiment Station at Juma located in the rice-producing area with the aim of developing all phases of rice production. One center could not fully represent all environmental conditions. Therefore, several branch centers for regional studies were also established.

The Experiment Station had unique functions. First of all, the station aimed to improve rice production by developmental programs based on the established social patterns. Secondly, the station adopted an open-door policy in cooperating with farmers, industrialists, economists, educators, and others for the exchange of new information. Thirdly, the station formulated pilot plans for the solution of special problems of rice production such as processing, marketing, and the training of young professional men in technical knowledge, practical experience, and above all, the right spirit of service for the total rice program.

The rice breeding program was quite successful, and resulted in the development of rice with the following characteristics: high-yielding capacity, resistance to lodging, resistance to diseases (particularly blast), adaptability to diversified conditions, suitability for multiple cropping system and, finally, good milling and table quality. The establishment of a seed multiplication program also proved successful.

A seed certification program was established including the development of extension seed farms and the production of foundation and certified seed (2, 4).

Already there are several varieties which have shown these good qualities and have been released from the station. The most outstanding ones are 'Juma 34' and 'Juma 57'. Both of these varieties are hybrid and give very high yields. Under good management and fertilizer use, Juma 34 and Juma 57 have commonly attained yields of 6,882 and 8,993 kg/ha, respectively. Under the seed multiplication program referred to above, adequate seed of these two new varieties and other selections was made available from the station to meet 20% of the total rice acreage requirements.

The rice program was successful as evidenced by a surplus of rice production at present compared to a situation of underproduction several years ago. This is mainly because the people used the seeds released from the station. They adopted the cultural practices which the station recommended and they came to the station periodically to request help. Consequently, increases in yield per unit area were reported (2). Encouraged by the increased revenues and the favorable climatic conditions for rice growth, the farmers expanded their rice acreages.

Large acreages coupled with increased yield per hectare has resulted in surplus rice and the problems associated with a surplus crop. However, this situation is only temporary since a land reform program which was initiated in the Dominican Replubic in 1972 is underway. The aim of the reform is to divide the land among the poor farmers. Because of this land reform program, the problems associated with the surplus will be ameliorated for the following reasons.

1) During this transition period, the land may not be in production for one or two cropping periods.
2) When the small farmer is settled, it is likely that he will have neither the technical know-how nor the financial means to maintain previous levels of production (4).
3) Small farmers are not likely to plant rice on much of the area, instead they will diversify to other crops.
4) The people that are settled on the land are likely to increase their local consumption of rice.

Hopefully, the land reform program will recognize that no nation has ever achieved a surplus food status while maintaining its traditional historically primitive food production practices, and will work to help achieve a better life for the rural population while creating surplus rice production once again.

Adapting technology from other nations is promising, but unpredictable. When the technology and the yields of the developed nations are compared with those of developing countries, it would seem that a transfer of methods would result in great advances in agriculture. But the long record of failure of such transplants is a warning that the process is not as easy as it appears (13). Agriculture is a system that performs effectively, NOT if one or

two or several requirements are met, but only if a whole range of interacting conditions are satisfied.

With limited human and material resources, it is particularly difficult for the government of a developing country to act simultaneously on several fronts. It is imperative that the priority projects are understood and established to make them useful to the rural people in order to justify the efforts and expenses of development.

The experiences of the Chinese Mission to the Dominican Republic showed that agriculture is dominated by interactions, and any research or development program should adopt a broad, interdisciplinary approach taking into account the physical, biological, economic, and social needs and conditions, as well as the institutions serving agriculture in the country (15).

A WEST AFRICAN EXPERIENCE

Agricultural development in Sierra Leone, a tropical, agrarian country, should be committed foremost to the immediate improvement of the quality of the lives of the rural families. The success of this thrust, as in any developmental program, must be predicated on seeking reasonable goals in harmony with traditional life patterns and fully utilizing the indigenous and manageable resources of the country. Unlike Sierra Leone, many tropical countries require land reform as a prerequisite to any steadfast and evolving agricultural development (1, 16).

In 1970, the Food and Agricultural Organization of the UN initiated a study in Sierra Leone that culminated in a program designed to increase farm production and revenue for subsistence farmers. About 5 million Leones (6 million dollars) was recommended over a 5-year period to develop 40,000 ha of diverse soils, primarily inland swamps (14). The project included a comprehensive program of education, extension, and credit facilities, and introduced only simple innovations based on traditional cultural mores of extensive agricultural systems.

The program was not fully implemented by the Ministers of the Sierra Leone government because to make the project successful for the family unit, roads, a marketing system, and water control planning were also needed. Development is a many-sided proposition targeting on the rural family, but it also necessitates major national improvements.

In West Africa, population has been increasing by 2.3% annually and by the year 2000 will have doubled (19). So far, there are no indications that people are suffering from food shortages (6). There may be temporary periods of dearth at certain times of the year and the quality of the diet may be wanting, particularily due to the low protein level, but agricultural production and caloric intake has been rather constant with rising population (17).

Estimation from demographic data (8) indicates that West Africa could meet food requirements not only for the present population of 160 million, but would permit expansion of 485 million at present dietary levels (21). By increasing the subsistence output of rice, West Africa could improve the peoples diet and override the annual population increase of 2.3%.

Increasing the subsistence output of rice from the present average level of 1,200 kg/ha to 1,260 kg/ha for Sierra Leone (a 5% increase) would *initially* be relatively easy to achieve; for example, a single early weed eradication, a step entailing only a minor modification of their work patterns, would probably result in the higher yield. However, progressive yield increases are achieved at a *compounded* rate and cannot continue indefinitely. Eventually more complex steps must be continuously introduced until a time is reached when population growth either becomes stabilized at near zero rate or yield levels have reached the maximum potential inherent in the crop and soil.

For rice, yields of 2,400 kg/ha could probably be achieved under present shifting agriculture systems (short cropping periods following natural fallows) providing the fallow period is not too severely curtailed (under 5 years). Greater yields or consistently higher farm revenure would require more complex steps. How is this to be done?

A society whose population is increasing requires additional resources and/or innovations to maintain stability (10). If the resources are relatively fixed, such as arable land under shifting practices, innovations must be introduced to compensate for the population pressure. An assistance program which introduces an innovation, such as increasing grain production of the rural family unit, should meet the following criteria:

1) The acceptor must have an awareness of the need for the innovation.
2) The innovation must serve a basic need for the acceptor.

3) The innovation must be highly recommended i.e., sanctioned by elders, educators, or institutions *within the country.*
4) The innovation must require only installment usage; for example, a farmer may allocate only a small portion of his land for the innovation.
5) Innovations must be easily and rationally evaluated.
6) Innovation must be a modification of existing systems requiring only minor changes in patterns of action and thoughts, and few learning inputs.

A study to illustrate how these ideas have worked can be cited in Sierra Leone, West Africa. This West African country is strongly committed to agrarian development. Nearly 77% of the people are subsistance farmers operating 2 to 3 ha of land each year. However, this large segment of the population contributes only 31% of the national product and per capita production has risen only about 2% during the last decade.

In 1968, a soil survey had isolated a Boliland site, a land depression supporting grass and widely-spaced oil palm trees, near the small village of Kenema. The site was slightly undulating and possessed diverse drainage patterns that could apparently be utilized without land leveling or drainage ditches. The soil was granular-structured and of fair fertility. Traditionally, each family cleared about 3 ha for rice production. The yields averaged 800 to 1,000 kg/ha. In 1969, mechanization for rice production was proposed for the site. This innovation was formulated and presented to the village elders indicating that the college would be responsible to mechanically clear and plant 70 ha of rice in this site.

Each family was allotted up to 5 ha of land and assessed 2 Le ($2.40)/hectare for clearing and planting. The plan was initiated during the dry season when a rough road 6 kilometers long was built from the campus to the site for transport of tractors, equipment, fertilizer and men. Both indigenous and selected rice varieties were used according to the hydrology of the site and to stagger maturity dates (12). Basic slag and ammonium sulphate at 112 kg/ha respectively were applied at planting. The yields averaged a generous 2,400 kg/ha. In 1970, planting was increased to 150 ha and the rice averaged about 2,000 kg/ha, slightly less than the year before. However, in 1971 the college facilities were not sufficient to allocate and service the tractors for this project. Unusually severe rains also flooded part of the site which had previously been used for upland rice. In that year, the plantings were reduced to 30 ha and farmed by indigenous methods. Why was the innovation unsuccessful after such an auspicious start? Two principles were violated. First, mechanization as a *major* modification was introduced without providing adequate back-up technology and equipment to sustain the innovation. Secondly, the vicissitude of the climate rendered large portions of the site unusable since land leveling and drainage were not carried out resulting in considerable financial loss to those whose portion was affected. In other words, installment usage was not practiced, but innovations that had not been completely checked under field conditions, were used on excessive acreages.

In contrast, a project which is achieving some early success where the criteria previously listed were met involved maize (*Zea mays* L.) as a second crop after rice each year. This change afforded the farmer an additional 50 to 70 Leones per year which in some cases is a 100% increase in cash income over the revenue usually earned. This multiple cropping innovation was developed from research started at Njala University College in 1969 when a date-of-planting trial was initiated (3). Buried moisture sensors indicated that sufficient residual soil moisture extending far enough into the dry season to insure against moisture stress during the most active growth period, provided maize was planted at certain critical dates[3] Further research, both at Njala and on several farms of responsible village administrators during 1971-72 (7), substantiated and modified the original work by extending the concept of two crops of maize per year. By 1972, several farmers in the environs of Njala were experimenting with multiple cropping with maize. The modest success of the innovation at this time can be attributed to the following:

1) The innovation demanded increased labor but only a minor modification of work patterns which necessitated cutting the weed and rice residue cover prior to planting the maize. The practice of planting in stubble has excellent attributes itself.

[3]Massive growth of native grasses adjacent to the farm site provided excellent mulch material which effectively controlled weeds and moisture when placed between the maize rows.

2) The acceptor was aware that the market price of maize in Freetown was 3 cents per pound as a result of an increased demand by a growing poultry industry.
3) The innovation used the same land *after* the basic rice crop was harvested.
4) The adequate yields of maize and the practices which produced this crop were easily evaluated and demonstrated through field days and visits to the farms and the college during the 2.5 years of experimentation.

However, for the multiple cropping system described here to eventually become fully functional and acceptable, land must be cleared of bush vegetation and crop residues, well drained, and fertilizer and early maturing rice employed. If the innovation appears successful in its early stages as this one apparently has, then people will become more amenable to greater modifications of their cultural patterns.

The commitment of agricultural development must be directed toward the family unit. Assistance policy should not overly concern itself with the disparity of Gross National Product between nations, for it is ever-widening and may never be reconciled (9, 10). Rather, the expertise and resources of more technologically developed nations should be used in such a manner that the real income of each rural family can be raised in their terms now.

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