AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AE10-0000-0000

B. SECONDARY: Agricultural economics

2. TITLE AND SUBTITLE

The Green Revolution: income distribution and nutrition

3. AUTHOR(S)

Lele,U.J.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1971	19p.	ARC 338.1.L537

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Cornell

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

(In Occasional paper no.48)

9. ABSTRACT

10. CONTROL NUMBER

PN-RAA-484

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Food supply
Income distribution
Nutritional requirements

13. PROJECT NUMBER

14. CONTRACT NUMBER

CSD-2805 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

September, 1971

THE GREEN REVOLUTION:

INCOME DISTRIBUTION AND NUTRITION

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Reference Center
Room 1656 NS

Occasional Paper No. 48
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USAID-Employment and Income Distribution Project

THE GREEN REVOLUTION: INCOME DISTRIBUTION AND NUTRITION

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The Problem

Over the past few decades, the state of nutrition in the developing countries has generally worsened. This has been only partly due to the failure of food production to grow rapidly. A more significant explanation is that large sections of the population still do not have adequate incomes to purchase the daily minimum requirements of food, or to acquire a balanced diet. The already large income disparities between economic classes have widened over the years so that they are now the center of attention in the economic plans and political platforms of most low income countries. The election victories, won on slogans of "down with poverty" in countries as far apart as Chile and India, reflect this problem.

The extent to which the goal of improved nutrition can be accomplished must, therefore, depend upon two factors: (1) The degree to which the growth rate of food production can be accelerated in the near future and (2) the effectiveness with which the increased food production can be transferred into the hands of the poor people. This latter will first require a broad participation of the low income people in the developmental process, so that they can have the purchasing power necessary to increase their food consumption. The increased food production and a better income distribution will of course have to be coupled with various nutritional programs including

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* This paper was presented at the Western Hemisphere Nutrition Congress III held at Bal Harbour, Florida, August 30 to September 2, 1971. The paper was prepared while Dr. Lele was associated with Cornell University. She is now with the World Bank.

education. Education will serve to inform poor people about nutrition and to eradicate the many institutional barriers that come in the way of improving diets. Education, however, can only be effective if the poor have access to an adequate supply of food and purchasing power.

The recent technological breakthroughs in agriculture have not yet had a very substantial impact on overall food production. Numerous difficulties must be overcome before the new varieties become more widespread and yields show a consistent increase. The Green Revolution has, nevertheless, been a revolution in the concept of growing food. This revolution in the approach to agricultural development holds an immense potential for simultaneously solving the problems of food production and income distribution. The development of this potential of course depends on proper policies followed on a variety of fronts.

The Production Front: Performance, Problems and Prospects

The term 'Green Revolution' originated in the context of the changing agricultural scene in Asia. This is where major technological breakthroughs occurred in the sixties. In order to acquire a broad perspective on the agricultural sectors of low income countries, it is instructive to examine the impact of the new technologies on Asian agriculture.

Asia produces nearly 90 percent of the world's rice. Although wheat relative to this is much less important, both its production and consumption are highly concentrated in certain regions. Nearly a third of Asian wheat is produced on the Indian subcontinent. The significant spread of new varieties of both these cereals allows us to assess their relative impact on Asia's agriculture.

Table 1 below shows the increase in wheat and rice production at the end of the sixties, in several Asian countries, over 1960-64, the period prior to the introduction of high yielding varieties. Although weather may explain the variation in yields to some extent, it is evident that the production of

Table 1: Contribution of area and yield to production growth of rough rice and wheat for selected Asian countries, 1960-64, 1968-69 and 1969-70

Country	Annual Production 1960-64	Annual Production 1968-69 or '69-70	Increase in production	Change in production due to change in Area	Change in production due to change in Yield
1	2	3	4=3/2	5	6
	Thousand metric tons		Percent		
		Rice			
Burma	4611	4976	13	62	38
Ceylon	972	1348	38	29	71
India 1/	53309	60000	14	57	43
Indonesia	12686	16200	28	61	39
Korea, Rep. of 1/	4733	4792	1	N.S.	N.S.
Malaysia	850	1035	22	68	32
Nepal 1/, 2/	2131	2410	13	154	-54
Pakistan	16524	20065	21	55	45
Philippines	3883	5231	35	- 6	106
Thailand	8994	10895	21	65	35
Asia	146489	168193	15	53	47
		Wheat			
India	10815	20100	86	43	57
Pakistan	4052	6477	59	39	61
Asia	32629	44431	36	31	69

1/ Data for 1969-70

2/ 1961-64 average

N.S. Not significant

Source: 1. FAO Production Yearbook
2. Rice Policy Conference: Country Papers, The International Rice Research Institute, Los Banos, Philippines, May 9-14, 1971.

wheat has increased considerably more than that of rice. Rice has also shown greater variability in average yield increase. It is, however, a moot question as to how much of the increase in rice yields is actually due to new varieties and how much is simply due to the increased use of purchased inputs such as fertilizer on traditional varieties. Despite the considerable evidence which emphasizes the importance of the latter phenomenon, little systematic research has so far been conducted to analyze the various sources of production increase (3).

The relatively poor performance of rice is due to the problems of environmental control specific to the cultivation of paddy. These problems, however, illustrate the difficulties encountered in the spread of the new varieties. The immense diversity in the physical conditions and cultural practices of rice is a major problem. While rice is grown in dry climate and with assured water through irrigation in West Pakistan, it is grown in high rainfall areas in some regions under deep water conditions in still others, and on upland areas elsewhere in Asia. Numerous rice varieties must thus be evolved to meet the problems of water control, photo period sensitivity and insect and pest control, which vary in each of these physical conditions.

Investment in adequate water control through proper irrigational systems will of course take care of a major environmental constraint. The existing irrigational facilities extend only to 20 percent of the total area under rice in Asia. Much of the irrigation in Asia is in the form of diversion dam systems. Therefore even the irrigated areas suffer from floods and droughts and are often unsatisfactory in providing proper water control. Water control also affects response to fertilizers and other cash inputs and thus strongly influ-

A related environmental problem is posed by the high humidity in rice growing regions during the main growing season which increases susceptibility to pests and insects and affects yields. In the dry season, under similar cultivating conditions, net return and yields per acre of high yielding rice varieties are much greater compared with local varieties. In the wet season, the difference in the net return from new and old varieties is much less significant. Since the bulk of the rice crop is grown in the wet season, the overall rice production will increase only when (1) more acreage is brought under new varieties in the wet season, and/or (2) rice acreage in the dry season is expanded. The former requires the development of varieties that would show a good response in the wet season. The latter would necessitate a substantial expansion of irrigation for use in the dry season (7).

Despite such initial problems, the biological revolution holds an immense potential for achieving a truly dynamic and diversified agriculture. The short duration crop varieties have provided an opportunity for multiple cropping of land. Where once a single crop of rice was grown, two or three short duration crops of rice may now be grown. Such intensification of agriculture provides opportunities for increased employment and hence a broader income distribution, which in turn would aid in improvement of the nutrition of the poor people. In many cases, multiple cropping has provided opportunities for shifting from a monoculture to a diversified agriculture. If these opportunities are exploited, a better balance in the food basket will result. It is estimated that in India short duration wheat varieties have released 10 million acres of land for the cultivation of soybeans, a food that is rich in protein and also provides an additional supply of edible oil. Efforts are also underway to develop short duration varieties of pulses, also

a major source of protein. Short duration grain crops will allow more production of fruit, vegetables, animal and dairy products. Thus multiple cropping of land would mean not only an increased yield of calories per day from an acre of land, but also an opportunity to provide a better balance in the diet of the people in low income countries.

No doubt there are a host of problems which must be tackled before multiple cropping becomes widespread enough to have a substantial impact on the total food production. Proper water control is of prime importance. The type of water control required would depend on the nature of the crops to be grown and hence on physical conditions.

The new varieties may also provide better food through an improvement of the intrinsic value of the grain produced. Plant breeders have developed a high protein, high lysine maize which, when substituted for the traditional varieties, will greatly improve the nutrition of the maize consumers. Similar efforts are underway in breeding other food grains.

Efforts are also underway to produce grains that are more palatable to the culture bound, discriminating consumer in low income countries. Considerable headway has been made in developing varieties with the quality characteristics of the traditional varieties as well as high yields of the new dwarf varieties.

Not the least important contribution of the breakthroughs in plant breeding has been the resulting focus of attention on the factors crucial for increasing food production. National resources will have to be centered on several key factors such as biological research, water control, input supply, etc. if agricultural production is to increase a great deal more rapidly than population.

Distribution: A Case for Economic Policies

Appropriate policies followed to sustain the momentum in the agricultural revolution will fulfill only one of the necessary conditions for the improvement of nutrition. The second condition is, of course, better distribution of this increased and diversified food supply to the lower income classes.

Income and Nutrition

Much apprehension exists among nutritionists about the excessive emphasis placed by economists on increasing incomes as an automatic way of solving the nutrition problem. They contend that such an overemphasis on incomes has caused a neglect of nutritional programs and seriously affected allocation of resources to these programs (1). The overemphasis on incomes, if any, may partly spring from a confusion among economists between the phenomenon of undernourishment and malnourishment. However, it mainly arises (a) from the evidence of hunger and malnourishment, both of which are most widespread among lower income groups in the developing countries, and (b) from the neglect of distribution problems in the nutritional plans.

Several Latin American countries provide dramatic examples of a statistical illusion of high average per capita incomes while large proportions of their population live at income levels not adequate to allow consumption of minimum required calories. This is particularly disturbing since some of these countries have been experiencing a high rate of growth of national income, while at the same time showing a high growth rate of unemployment. Statistical evidence is overwhelming in its volume and disturbing in the consistency with which it shows rapidly widening income disparities in much of the underdeveloped world (11). Over two-thirds of the agricultural population in Latin America, i.e., nearly 70 million people receive an average income

less than $100.00 per person. About 35 million people earn a per capita income not more than $50 to $60. Also, according to available data about one-third of the rural labor force in Latin America is unemployed while 2 percent of the farm families own half the agricultural land.

The evidence of positive correlation between levels of income and food consumption is also widespread. The National Sample Surveys show that in India in 1960-61, the poorest 5 percent of the rural population consumed only 0.6 lbs. of cereals per capita per day, with little else of other foods while the richest 5 percent of the population consumed 2 lbs. of cereals a day added to a substantial amount of other foods (9, 10). Evidence also shows that the population that is protein deficient is also often calorie deficient. Further, whereas a considerable proportion of the population receives adequate protein, it still is deficient in caloric consumption (8, 10).

When a quarter to a third of a country's population does not have enough income to purchase adequate calories, two alternatives are open to a low income country: massive food distribution programs or increasing employment and incomes of the poor people.

The alternative of massive food distribution is politically unfeasible in low income countries unless food production provides at least marginal surpluses at an aggregative level or unless the countries are centrally controlled. With production shortages, the food market cannot be replaced with an effective food procurement system without alienating big farmers who produce the marketable surplus, and upon whose support political systems in most low income countries depend. This is why in India for several years in the sixties, the rationing of food in the poor crop years had to depend largely upon PL 480 wheat imports (5).

Nor can most low income countries afford massive commercial food imports, given their chronic balance of payments difficulties. A distribution program that continuously depends on food aid is unworkable because of the political pressure for economic selfsufficiency from within the low income countries. This has of course been brought about by (a) the unreliability of food aid programs and by (b) the use of food aid programs for political arm twisting by major food aid givers in the past.

The alternative of massive food distribution is also unfeasible because of the meager financial, administrative and physical resources at the disposal of the low income countries and because of the unlimited demands on these resources for general developmental programs. To argue otherwise would be absurd. For, if these countries were capable of organizing massive food distribution programs effectively with their limited resources, their developmental problems would not have been as overwhelming. It must therefore be recognized that, despite justification for these programs, massive physical distribution of food can only be a short term emergency strategy.

That providing more calories to masses through direct food distribution programs is neither economically nor politically feasible is strongly evident. Nor is there a satisfactory justification yet on nutritional grounds for distributional programs that would alleviate special nutritional problems of the masses, such as the protein deficiency. A considerable body of evidence exists to challenge the position that the much discussed protein gap could be eliminated by introduction of unconventional, high protein foods and amino acids and without solving the problem of calorie deficiency (8). This, thus, reinforces our contention that in the long run income distribution is an absolutely essential condition for solving the problem of nutrition in the low income countries.

Prospects for Improving Incomes

Possibilities for a broader distribution of income through technological changes are numerous. First, if food production increases, it may become available to consumers at lower prices, thus increasing their real incomes. The new technologies can also benefit cultivators and agricultural laborers directly through increased incomes and employment. The nature of the technologies and the new inputs that they require do not themselves restrict their application to large farms. Increased labor is required in planting, weeding, harvesting, threshing and marketing of the additional grain. Employment may also be generated indirectly through a spurt in investment in irrigation as well as in the expansion of marketing of new inputs and output.

Little precise information exists on the extent to which employment and incomes of lower income people have in fact increased in the agricultural sector with the coming of the new technology. However, a considerable body of evidence suggests that due to political and institutional factors farmers with irrigated lands and large farms have benefited the most from the new technologies. This phenomenon is much more strongly evident in Latin America than in Asia. The evidence shows that three-quarters of the increase in agricultural production in Mexico between 1950 and 1960 took place on large farms. These farmers have traditionally been the politically and economically powerful rural elite who control the developmental agencies. They therefore have a free access to the short supply of fertilizers, chemicals and improved seeds. This is particularly so because they control the credit which is so vital for the purchase of new inputs. They also have a better capacity to bear the risk of innovation.

Often the direct increase in employment for the cultivation of new varieties has been proportionately much less than the increase in output resulting

from cultivation. Thus although absolute incomes of the agricultural laborers and small cultivators have increased somewhat, relative income disparities have increased creating much political tension in rural areas. These relative income disparities are sometimes further exacerbated by indiscriminate governmental policies that have encouraged mechanization at the cost of employment. Again the evidence in Latin America shows much greater disparities than in Asia.

Despite such apparently undesirable first round effects of the new technologies, they still hold considerable potential for accelerating the overall rate of growth of employment in a low income if proper developmental policies are followed.

Causes of Low Employment Growth

Employment generates income and hence provides purchasing power for consumption of food. The slow growth of employment in low income countries in the past can rather simplistically but succinctly be attributed to three major constraints: 1. The food constraint, 2. The capital constraint and 3. The technological constraint. The green revolution provides opportunities for expanding the employment and incomes of the poor through influencing each of these three factors.

The Food Constraint

If food supplies to the industrial sector are not adequate enough to meet the rising demand for food of the newly employed labor force, food prices rise sharply. Thus without a technological breakthrough in agriculture, employment expansion is not a feasible goal. It is unfeasible economically because of rising wage costs and politically, because of the urban unrest it generates through rapidly rising food prices. But with a

technological change in the agricultural sector, the increased marketed supply of food may reduce food prices and maintain industrial wages. If the technological change benefits large cultivators more than small ones, this may further reinforce the effect on prices and wages. First, little of the increased food production would be consumed by cultivators who are already well-off, thus increasing marketed surplus more rapidly than if technological benefits were more equitable. Second, if the real income of lower income classes does not increase substantially in the agricultural sector, it will be possible to withdraw labor from the agricultural sector, for the expansion of other sectors at wages lower than would otherwise prevail. For after all, income in a family depends not only on the wage rate but also on the number of people employed. Both of these factors will maintain low wage costs in the nonagricultural sectors, thus facilitating a more rapid increase in employment in these sectors.

However, the extent to which such a potential of new technologies is exploited will depend on what economic policies are followed by the governments of low income countries. If increased agricultural production only replaces food aid imports, no significant improvement in income may result. If increased production is exported or commercial imports reduced and the resulting foreign exchange used for imports of conspicuous consumption items, again no significant improvement in the economic well-being of the masses can occur. This is particularly noticeable in several Latin American countries. If the foreign exchange earned is used for the import of capital goods, employment expansion is determined by the type of industrial investment and the nature of technology used in the investment.

The Capital Constraint

Labor must be combined with capital to start a production process. Capital formation in low income countries has been low for several reasons. First, the mass of the population earns incomes too low to be taxed for producing capital. Second, due to the political power of the rural elite, taxes on their incomes have been unjustifiably low. In India, urban upper income groups pay three times as much in taxes as their rural counterparts. This situation appears much worse in much of Latin America.

Third, the industrialization policies do not channel small savings of the rural elite through market forces into productive investment activities, such as into the expansion of small scale industries. Often the emphasis has been on the development of large public sector industries, while numerous encumbrances in the form of industrial and import licensing and availability of credit discouraged development of the small scale industry.

Fourth, a further transfer of savings away and into the hands of the rural elite has been taking place in many a low income country due to high support prices of agricultural commodities, maintained through political pressure of the rural interest groups.

Only a reversal of these fiscal and industrialization policies combined with the green revolution will increase capital formation and thus expand employment and purchasing power of the poor. The tremendous potential provided by the new agricultural technologies for a broader based and more rapid economic growth will otherwise be dissipated.

The Technological Constraint

The policies which are outlined above have often been further reinforced by a highly unequal income distribution. For example, in the Latin American

countries goods are produced mostly for the consumption of the rich. Thus, a capital intensive, low labor using industrial structure has evolved. Such industrial expansion perpetuates the cycle of low employment and low incomes for the poor, hence low demand for labor intensive products and a low growth of employment.

Many developing countries present another industrial structure which is quite different. It is low labor using and dominated by heavy industry, such as iron, steel and fertilizer. This type of industrial structure has been a result of the low level of exports and consequent foreign exchange shortages which have forced these low income countries to reduce imports and produce capital goods domestically.

A consequence of both these industrial structures, although serving diametrically different types of demands, is a low growth of employment. The green revolution may help increase employment in either of these situations. First, through a more equitable income distribution, it would generate demand for goods consumed by poorer people. Because these goods generally tend to be more labor using, additional employment may be created. Second, through releasing the foreign exchange restraint, the green revolution may help increase the import of capital goods and hence the development of more labor-using industries. The low income countries have a comparative advantage in the export of such goods. Expansion of exports will further help the growth of employment (6).

Selective Nutrition Programs: Improving the Quality of Diet

Raising incomes will help solve the problem of undernutrition but may only partially solve the problem of malnourishment. Malnutrition, unlike

undernutrition, is a problem that often plagues both the high and the low income classes. The problem of malnutrition cannot be solved effectively for those income groups which are already undernourished. However, diets in low income countries vary not only by income classes but also by production possibilities, social classes, religious beliefs, and customs and taboos. The first task must be to evaluate special nutritional deficiencies in these various types of populations before any satisfactory way can be found to improve the quality of their diet.

Education is the next obvious step. Providing people with adequate information regarding their nutritional requirements and regarding the possible sources of these nutrients will do a great deal to improve the diet of the higher income classes. For poorer people, just the knowledge of nutrition will not be enough since often most prevalent protein and mineral-rich foods are expensive and hence beyond their reach. While improving income should be one strategy, reducing cost of these nutrients must be another. This is where the green revolution has an immense potential for providing a two-pronged attack by improving incomes and by providing cheaper and more varied food.

Many of the added nutrients could also be provided at a very low cost through food additives. A 5 percent addition of soy flour to bread or a bread-making flour can greatly enhance its nutritive value. Lysine added to wheat flour greatly adds to its protein quality at very low cost. Similarly, vitamin D added to milk and bread improves their quality at little cost. Adding iodine to salt is a low cost way of arresting the incidence of goiter. However, all these fortification programs will be effective only when poorer people can be reached through a distributional system. Currently, a vast

majority of the nutritionally deprived population grows most of its own food for domestic consumption and relies little on the market system. Fortification programs such as the ones mentioned above, therefore, cannot reach those sections of the population which most need them.

Even among the poor, unborn babies and preschool children need the most urgent attention. Because of poor diets they often suffer from inadequate physical and/or mental growth, and are susceptible to numerous diseases and high mortality rates. The payoff of improving their nutrition is development of physically and mentally healthy citizens. This payoff cannot always be gauged easily by narrow economic and political yardsticks. A case for giving the highest priority to their nutrition is particularly strong, given the very limited resources for nutrition programs at the disposal of the developing countries.

Concluding Remarks

In the preceding pages we argued that increased food production and more equal income distribution are both necessary conditions for improving diets in low income countries. We examined the problems of increasing food production. We emphasized the great potential that is provided by the technological breakthrough (1) for producing a larger and more balanced food basket, and (2) for insuring its equitable distribution. We made a strong plea for following an economic program that will exploit the new technologies in a way which encourages broader participation of poor people in the developmental process. Further, we made a case for selective nutritional programs, such as education, fortification, and child and mother feeding, as ways of improving the quality of diet.

References

1. Berg, Alan, "Increased Income and Improved Nutrition: A Shibboleth Examined," a paper presented at the seminar on Improving Food Marketing in Developing Countries, June 18, 1971, Washington, D. C.

2. Dandekar, V. M., and Rath, Nilkantha, "Poverty in India: 1. Dimensions and Trends," Economic and Political Weekly, Vol. 61, No. 1, January 2, 1971.

3. Desai, Gunvant, "Some Observations on Economics of Cultivating High Yielding Varieties," a paper presented at the Rice Policy Conference, The International Rice Research Institute, Los Banos, Philippines, May 9-14, 1971.

4. Joy, Leonard, "Economic Aspects of Food and Nutritional Planning," a paper presented at the 1st Asian Conference on Nutrition, Hyderabad, February 1971.

5. Lele, Uma J., "Food Grain Marketing in India: Private Performance and Public Policy," Cornell University Press, Ithaca, N. Y., August 1971.

6. Lele, Uma J., and Mellor, John W., "The Political Economy of Employment Oriented Development," Occasional Paper No. 42, Cornell-USAID Prices, Employment and Income Distribution Research Project, Cornell University, 1971.

7. Narain, Dharm, "Rice: Policies and Problems in India," a paper presented at the Rice Policy Conference, The International Rice Research Institute, Los Banos, Philippines, May 9-14, 1971.

8. Payne, P. R., "The Nutritive Value of Asian Dietaries in Relation to Protein and Energy Needs of Man," a paper presented at the 1st Asian Conference on Nutrition, Hyderabad, February, 1971.

References (Cont'd.)

9. Sukhatme, P. V., "The Food and Nutrition Situation in India," Indian Journal of Agricultural Economics, Vol. XVII, No. 2, April-June, & No. 3, July-September, 1962.

10. _____, "The Present Pattern of Production and Availability of Foods in Asia," a paper presented at the 1st Asian Conference on Nutrition, Hyderabad, February, 1971.

11. Thorbecke, Erik, "Unemployment and Underemployment in the Developing World," Columbia University Conference on International Economic Development, Williamsburg, Va. and New York, February 15-21, 1970.