The Social and Economic Implications of the Green Revolution in Asia

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Introduction

RECENT TECHNOLOGICAL DEVELOPMENTS in agriculture, often referred to as the " Green Revolution ", have aroused great expectations at different levels—as offering governments a solution to the critical problem of cereal shortages, as ensuring that farmers in outlying villages are not cut off from the play of market forces and as promising millions of farm workers—owners, tenants and labourers—a higher standard of living and a share of the good things of life. The purpose of this article is to clarify these hopes for the future raised by the Green Revolution and to study them in the context of the actual situation as evolving in the different countries of Asia; to determine to what extent these expectations are in fact on the way to realisation; and to discuss measures for ensuring their fulfilment.

In order to appreciate the reasons for the confidence placed in higher-yielding seed varieties (referred to from here on as HYV), it is necessary to be clear about what is in fact involved in the use of these new seeds. In addition to their intrinsic value—yield increases ranging from 50 to 300 per cent—HYV are conducive to labour-intensive farming methods, at least in so far as individual holdings and specific crops are concerned.[2] In the case of wheat, for example, higher labour input is caused by the increased number of ploughings, intensive weeding, a higher level of fertiliser application, and the harvesting of a higher volume of produce. Rice, especially the IR-8 variety, is even more demanding of labour, the increase in man-hours being necessitated by the picking of the seedlings, which are deep-rooted and short but which require

[1] International Labour Office.

[2] The over-all employment impact is still not easy to discern—for example, it may be found to be profitable to replace a more labour-intensive crop such as cotton with higher-yielding varieties of wheat (cf. Walter P. Falcon: " The Green Revolution: generations of problems ", in *American Journal of Agricultural Economics* (Lexington (Kentucky), American Agricultural Economics Association), Vol. 52, No. 5, Dec. 1970, p. 705).

delicate and careful handling; line transplanting; more intensive interculture; higher applications of both fertilisers and pesticides, etc. Moreover, the new seed varieties ripen more quickly, which means early harvests and early preparation of seed beds, making it possible to grow a second and at times a third and fourth crop on the same piece of land. The demand for labour is thus further increased because of multiple cropping, which also sets a premium on timely operations. It has been estimated that the growth in labour requirements may amount to nearly 60 per cent, especially over short periods, i.e. during the monsoon months.[1] In view of the fact that at present manpower remains underutilised for considerable periods of the year in most countries of Asia, the potentialities of fuller labour utilisation held out by HYV are of particular significance for the region.

Directly related to the greater use of labour is the hope not only of producing more food (cereals) for all classes in the rural areas, but also of achieving higher cash incomes, which will enable the rank and file to purchase all kinds of consumer goods and lead, in turn, to more employment in industry. Assuming that increased production results in higher incomes for the mass of the cultivators, the consequent dispersion of incomes will bring about the effective demand required to balance the increase in supplies and will eliminate the already emerging problem of surpluses.

A third benefit deriving from HYV is that they can be introduced just as effectively on small as on large holdings, with little, if any, advantage to be gained from making economies of scale. The Green Revolution, frequently referred to as the Seed-Fertiliser Revolution, implies the judicious use of HYV and fertilisers in combination with water, labour and other inputs, together with improved techniques of production and farm management, culminating in considerably higher levels of production. So long as these basic ingredients are available to farmers, it is of little importance for the desired result whether these farmers operate large or small-sized holdings. The hope has thereby been aroused in the hearts of small owners and tenants throughout Asia that there is at last a prospect of increasing production levels and producing surpluses for sale. The fact that they share this belief has made the governments relax their attitude towards the implementation of land reform and land redistribution. It is easy to see why the urge for land reform has diminished: when a smallholding can be operated as efficiently as a large estate, when a tenant can have access to the same inputs as a landlord and when there is the possibility of increased employment opportunities for landless labourers, where is the need for land reform measures, which are in any case difficult to implement?

[1] M. G. Ghosh: " Investment behavior of traditional and ' modern ' farm—a comparative study ", in *Indian Journal of Agricultural Economics* (Bombay, The Indian Society of Agricultural Economics), Vol. XXIV, No. 4, Oct.-Dec. 1969, p. 80.

Unfortunately, however, for many reasons the optimism of the early years of the Green Revolution has not proved to be well founded. Generally speaking, small cultivators, share-croppers and landless agricultural labourers have not benefited from the revolution; regional inequalities and income disparities have been accentuated; there is a widespread fear and danger of labour displacement as a consequence of mechanisation; large and medium-sized landowners have resorted to wholesale eviction of tenants and share-croppers, while those who continue to have their land cultivated by tenants insist on higher rentals. With the introduction of HYV there has been an upsurge in the purchase of agricultural land by " gentlemen farmers ", comprising in India and Pakistan, particularly, ex-servicemen, retired civil servants and urban-based businessmen, who have taken up farming as a business proposition and because the discovery of HYV makes investment in agriculture profitable. Another attraction for businessmen lies in the generous taxation concessions granted in respect of agricultural ventures. The increase in the investment value of agricultural land has meant that land is gradually being priced out of the reach of small, subsistence or semi-subsistence farmers. The Green Revolution appears to be benefiting primarily those farmers who are already engaged in commercial production rather than subsistence farmers and, among the commercial farmers, the big ones more than the small producers.[1]

In the next few pages it is intended to enlarge on these and other problems following on the introduction of HYV, with a view to drawing attention to the dangers of a laissez-faire policy in relation to recent technological developments in agriculture. In the final section it is proposed briefly to outline a strategy for development designed to overcome the institutional and other obstacles preventing the large mass of the rural population from benefiting more fully from the many advantages ushered in by the Green Revolution. I believe that the promise of a new life for rural workers in general held out by HYV can be achieved in reality; the problem is to evolve a policy combining agricultural growth with social justice. It has rightly been suggested that, unless the Green Revolution is accompanied by social justice, the revolution will no longer remain green, and that bold and imaginative measures have to be taken on behalf of the underprivileged sections of the agricultural body politic so that they also may obtain the sophisticated inputs, easy credit, technical know-how and other facilities which their richer brethren now get from institutions and government agencies.[2]

[1] United Nations Economic and Social Council, Commission for Social Development: *Land reform*, note by the Secretary-General, document E/CN.5/444 (mimeographed) (New York), 5 Dec. 1969, p. 5.

[2] M. Srinivasan: " Socio-economic constraints and problems confronting the Green Revolution ", in *Economic Affairs* (Calcutta), Vol. 15, Nos. 6-8, Supplement on Green Revolution, p. 348.

The progress of HYV

The available information on the spread of HYV is far from complete; there are some data on the acreage covered by the new seed varieties, but the statistics on yields achieved with the use of HYV are sadly inadequate. In any case, even if there were data on yields, it would be difficult to ascertain to what extent the gains were due to the new techniques adopted, because of the influence of the weather and other factors, including supporting measures such as guaranteed prices.

According to data collected by the Food and Agriculture Organisation of the United Nations (FAO) [1] and the United Nations Economic Commission for Asia and the Far East (ECAFE) [2], eight countries in the Far East are currently growing substantial quantities of the new cereal varieties and have already moved well beyond the experimental stages in the use of HYV. It is believed that the most important single reason for the shift to the new technology has been a strong government commitment triggered off by the urgency of the food shortage problem. A number of factors, especially institutional and structural constraints, have influenced the extent of the use of HYV in the different countries, so that it ranges from the entire crop area, for example in Japan, to only a fraction of the acreage in others.

The area and production of rice and wheat in some of the countries of the region, according to the available statistics, are shown in table I, which indicates the progress made in the four years 1966-67 to 1969-70.[3] Production of rice in Asia as a whole rose from 232.4 million metric tons in 1965 to 260 million metric tons in 1968; during the same period wheat production increased from 61.8 to 71.4 million metric tons, maize production from 40.4 to 43.3 million metric tons and barley production from 29.0 to 30.7 million metric tons, while the consumption of fertilisers of all kinds in the region increased from 4.2 to 6.6 million metric tons.[4]

In many of these countries noteworthy results have been obtained in respect of lesser cereals also, such as millet and sorghum; high-yielding sorghum varieties particularly rich in proteins have been developed in a number of countries. The enthusiasm on the part of governments for the introduction of HYV is so great that the FAO Indicative World Plan has predicted that by 1985 India and Pakistan, for example, will become self-sufficient in cereals and will need either to export the surplus or feed it to livestock.

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[1] FAO: *Production Yearbook 1969*, Vol. 23 (Rome, 1970); idem: *The state of food and agriculture 1969* (Rome, 1969), p. 10.

[2] *Economic Bulletin for Asia and the Far East* (New York), Vol. XX, No. 2, Sep. 1969, pp. 9-10.

[3] In Ceylon indigenous improved varieties of paddy have been extensively planted; by 1970 over 60 per cent of the rice area was already under improved seed varieties—a much higher proportion than in most Asian countries (cf. ILO: *Matching employment opportunities and expectations. A programme of action for Ceylon* (Geneva, 1971)).

[4] United Nations: *Statistical Yearbook 1969* (New York, 1970), pp. 6, 97, 114, 125 and 131.

TABLE I. AREA AND PRODUCTION OF RICE AND WHEAT, 1966-67 TO 1969-70

(In thousands of hectares and thousands of metric tons)

Country	1966-67		1967-68		1968-69		1969-70 [1]	
	Rice	Wheat	Rice	Wheat	Rice	Wheat	Rice	Wheat
India:								
Total area planted	35 251	12 656	36 437	12 838	36 966	14 998	37 000	15 000
Area of HYV	888.3	514.0	1 784.0	2 942.2	2 681.1	4 793.3	4 370.7	6 111.0
HYV as % of area planted	2.8	4.0	4.9	23.4	7.2	32.0	12.0	40.0
Total production	45 657	10 424	56 418	11 393	59 642	16 540	—	—
Malaysia:								
Total area planted	490	—	468	—	561	—	560	—
Area of HYV	42.3	—	63.5	—	90.9	—	127.9	—
HYV as % of area planted	8.4	—	13.6	—	16.0	—	23.1	—
Total production	1 106	—	1 061	—	1 250	—	—	—
Nepal:								
Total area planted	1 030	118	1 119	126	1 200	150	1 200	150
Area of HYV	—	6.6	—	24.8	42.5	53.8	49.8	75.5
HYV as % of area planted	—	5.8	—	20.0	3.5	36.0	4.1	50.0
Total production	2 007	147	2 217	159	2 322	216	—	—
Pakistan:								
Total area planted	10 480	5 210	11 309	5 417	11 297	6 061	11 300	6 060
Area of HYV	— [2]	101.2	71.2	957.1	462.4	2 387.7	765.1	2 832.9
HYV as % of area planted	—	2.0	0.6	18.0	4.0	38.0	6.7	46.0
Total production	16 410	3 957	19 005	4 393	20 065	6 477	—	—
Philippines:								
Total area planted	3 096	—	3 304	—	3 332	—	3 330	—
Area of HYV	82.6	—	701.5	—	1 011.8	—	1 354.0	—
HYV as % of area planted	2.6	—	21.0	—	30.0	—	40.0	—
Total production	4 094	—	4 789	—	4 445	—	—	—

[1] The area of HYV figures for 1969-70 are estimates taken from the UNRISD source. The total area planted figures are the 1968-69 figures rounded.
[2] Less than 1,000 hectares.

Sources: FAO: *Production Yearbook 1969*, op. cit.; United Nations Research Institute for Social Development: *Statistical appendix to the survey of literature and readings* (Geneva, 1971), document UNRISD/71/C.58 (mimeographed). Percentages calculated by the author.

Effects of HYV

Individual and regional disparities

Where HYV are being used there is an even closer relationship than otherwise between the availability of water and increased production. Field investigations in India, for example, have traced high growth rates to progress in irrigation and associated changes in cropping patterns. And HYV would not have spread to the same extent in East and West Punjab if a large number of tube-wells and irrigation canals had not been built during the years preceding their introduction there. Even if irrigation is not always necessary, as for instance in the rain-fed areas, sound water management is essential. Lack of proper water control and management is part of the reason for the limited success of the new seed varieties in the rice-growing regions of Asia, although the capacity for higher yields is as great as in the case of wheat. Higher-yielding rice varieties, however, require a more sophisticated system of controlled irrigation and drainage, which up to now has been extensively introduced only in a few countries.

Any discussion of the impact of the Green Revolution must therefore keep in mind the limitation imposed by the availability of irrigated land and land under proper water control and management and the fact that there is bound to be a disparity in the economic benefits derived from HYV as between farmers with and without irrigation facilities. While the availability of irrigated and potentially irrigable land can act as a brake to the expansion of the use of HYV, the introduction of these seed varieties has often acted as an incentive for investment in tube-wells, small water-works, etc. For example over the past few years the number of tube-wells constructed in West Pakistan on private initiative has exceeded 100,000. However, since there is a minimum command (irrigable) area below which the cost of water rises sharply, this means that, while large farmers can sink a tube-well of their own (the size of command areas varying from twenty-five to thirty acres), those owning less than the minimum have to band together if they want to take full advantage of cheap water.

Aside from regional variations related to the availability of water, the HYV programme, by its very nature, is likely to make greater progress in the more developed regions, where the necessary infrastructure has already been established. Infrastructural development in the context of HYV implies the existence of appropriate marketing and storage facilities, together with the means of transportation needed to carry the surplus grains produced on the farms to the markets and eventually to consumers. The cultivation of new and improved crop varieties, unaccompanied by organised marketing facilities for example, has often resulted in frustration among growers. In the absence of adequate marketing facilities, moreover, the introduction of HYV further aggravates

unbalanced growth between regions; it helps an already developed region to become further developed, without providing a corresponding stimulus for a hitherto backward region.

The introduction of HYV is directly related also to the spread and dissemination of improved techniques of production and farm management. The new seeds call for an entirely different set of husbandry practices, involving aspects such as timing of planting, depth of seeding, frequency of irrigation, application of fertilisers, etc., in which most farmers need to be trained. In practical terms this means that agricultural advancement based on HYV can only become widespread through a programme of training covering millions of small farm operators. Until such time as farmers' training programmes are implemented, the more literate farm operators and those coming in closer contact with market forces will have a very definite advantage over the others.

A further consideration is availability of capital and access to appropriate credit facilities. The use of HYV assumes substantial investment in farm buildings, especially store houses, fertilisers, pesticides and other inputs, in addition to water supply. From the point of view of the individual, this implies a sharp increase in capital requirements. A rough estimate for India, for example, shows a required increase in investment per farm " from around $9 at present to around $200 for rice production if the full-scale HYV programme for rice production is to be adopted by a farmer ".[1] The problem of organised credit supply is therefore of crucial importance, especially in respect of small farm operators, tenants and share-croppers, who have little or no collateral to offer.

So long as easy credit and inputs such as fertilisers are accessible only to those in the upper strata of the agricultural community, there is bound to be an imbalance in the enjoyment of the fruits of the Green Revolution. Field investigations in North-west Uttar Pradesh, for example, revealed that income inequalities had increased with the introduction of HYV, not only because of variations in the size of holdings but because of divergences in access to inputs, credit and technical know-how and in the timely availability of these elements.[2]

Large as opposed to small farmers

As stated above, an important characteristic of the new seed varieties is that essentially their value is not affected by the scale of operations. Thus, used in combination with fertilisers, water and other inputs, they can ensure higher yields for both small and large farmers.

[1] *Economic Bulletin for Asia and the Far East*, op. cit., p. 12, footnote.

[2] S. L. Shah and L. R. Singh: " Increasing income disparities due to the new technology of agriculture in North West U.P.", in *Indian Journal of Agricultural Economics*, op. cit., Conference number, July-Sep. 1970, p. 129.

In practice, however, as already indicated, small farmers find it difficult to mobilise capital for investment in land and water development (tube-wells, pumping sets, etc.), and such investment is essential for using HYV. Investigations indicate that in Asia they are generally slow to take to new techniques not because of conservatism but mainly because of financial considerations. Again, theoretically, the solution is obvious: the provision of joint services to small farmers, both as regards the supply of inputs and the sale of produce. The practical problems involved in the organisation of such joint ventures will be discussed at greater length in a later section.

As regards large landowners, two distinct trends have become apparent: on the one hand, with the discovery of HYV, a new class of progressive farmers from non-agricultural sectors of the economy has emerged. Generally speaking, these technology-conscious large operators prefer to maintain their holdings intact, having them cultivated by wage-paid agricultural labourers instead of renting them in smaller parcels to tenants and share-croppers. On the other hand, there are still the traditional landlords, who get their holdings cultivated by tenants and share-croppers on the basis of crop-sharing arrangements. In the majority of cases, however, such tenancy arrangements provide little or no incentive for the tenants to introduce HYV, since this would involve them in performing a number of additional back-breaking tasks, while still being forced to share with their landlords the increased produce thus obtained.

Setting aside for the moment the more complicated issues of tenancy and crop-sharing arrangements, which will be more fully covered in the next section, the discussion here will be limited to the problem of small versus large operators as it arises in the context of the surplus labour situation in Asia. The experience of Japan in the period following the Second World War is relevant in this connection.[1] In the Japanese case a deliberate policy choice was made in favour of supporting and sustaining the small-scale operators, with the object of combating the problem of the outflow of labour to the urban areas, where employment opportunities were limited. Since a similar problem of chronic unemployment and underemployment now exists in many countries of Asia, it would appear that agricultural policies there should aim at absorbing labour to the fullest possible extent within the agricultural sector itself. As already stated, the discovery of HYV provides an excellent opportunity in this regard, since the technical innovations in farming methods resulting therefrom are essentially labour-intensive in nature. It is in the smallholdings that the maximum use is made of labour, mainly because smallholdings are generally cultivated by the owners or tenants themselves, with the help of members of the farm family, who do not have to be paid cash wages.

[1] See, for example, Takeo Misawa: " Agrarian reform, employment and rural incomes in Japan ", in *International Labour Review*, Vol. 103, No. 4, Apr. 1971, pp. 393-413.

The relationship between high-yielding strains, the intensive use of labour and the size of holdings was investigated in a sample study of a village in Aligarh, India.[1] Table II has been compiled on the basis of figures made available through this field investigation. The table shows that a small farmer using HYV works his holding more intensively, mostly with the labour of the members of his family; consequently, family labour income is higher for small farms than for farms of four hectares and above.

The size of the holdings should not be considered only in relation to the fuller utilisation of labour; there is the equally important question of level of efficiency. It has been known and accepted by farm management specialists for some years now, even before the emergence of HYV, that total input and output per unit of land area is frequently higher on small than on large holdings. This has been borne out by farm management surveys undertaken in India [2] and elsewhere [3], and the available data indicate that this is so despite the fact that credit is more readily available, at lower rates of interest, to larger farmers. Further confirmation is provided by a study undertaken by the United Nations Research Institute for Social Development (UNRISD), which compared yields per acre on farms of different sizes and showed that an inverse relationship prevailed between productivity and the size of holdings.[4] Unless his holding is seriously fragmented, a small farmer working it with the help of his family is in an advantageous position as regards various labour-intensive tasks, such as weeding, seed-bed preparation, application of fertilisers and pesticides, the cleaning and clearing of water courses, etc., and these are tasks which are of crucial importance to the successful implementation of an HYV programme. Thus in Maharashtra it was found that small farmers using HYV had achieved growth rates twice as high as those with more land.[5]

For the small farmer to achieve these maximum returns, however, a certain amount of organisation and joint action is necessary; for increased production, and in order to bring the larger output to the market, a variety of services is essential.

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[1] Cf. R. S. Dixit and P. P. Singh: " Impact of high-yielding varieties on human labour input ", in Government of India, Ministry of Food, Agriculture, Community Development and Co-operation: *Agricultural Situation in India* (New Delhi), Vol. XXIV, No. 12, Mar. 1970, pp. 1081-1089.

[2] Government of India, Ministry of Food, Agriculture, Community Development and Co-operation: *Studies in the economics of farm management* (New Delhi, 1957-62).

[3] FAO: *Report on the 1960 world census of agriculture*, Vol. I: *Census results by countries* (Rome, 1966 and 1967), Parts A and B.

[4] Ram Dayal and Charles Elliott: " Land tenure, land concentration and agricultural output ", in UNRISD: *Social and economic factors in economic development*, Report No. 5 (Geneva, Nov. 1966), pp. 95-123.

[5] D. K. Sohoni and R. D. Khandarkar: " Pattern of income distribution, savings and expenditure in rural areas ", in *Indian Journal of Agricultural Economics*, op. cit., Vol. XXV, No. 3, 1970, pp. 132-133.

TABLE II. LABOUR EMPLOYED AND FAMILY LABOUR INCOME BY SIZE OF HYV-USING HOLDINGS IN AN INDIAN VILLAGE

(Rupees per hectare)

Size of holding	Human labour used (in money terms)	Family labour income
Below two hectares	369.14	1 697.30
Two to four hectares	321.80	1 679.01
Four hectares and above . . .	301.14	1 644.40

Problems of land tenure and land reform

In many of the densely populated countries of Asia, land and other resources needed for farming are concentrated in the hands of a few persons, be they landlords, merchants or money-lenders. This trend towards increased land concentration existed even before the introduction of HYV. In the Punjab, for example, holdings ranging between 100 and 150 acres increased by 40 per cent between 1955-56 and 1967-68.[1] Despite land reform laws enacted in most Asian countries, land still remains in the possession of a minority of agriculturists, with 40 to 60 per cent of the farms being cultivated by part or full tenants [2]; changes instituted in land tenure laws have been found difficult to implement. The expectation that, with the enactment of land reform laws, tenants and share-croppers would achieve security of livelihood and there would be a more equitable distribution of resources has remained unfulfilled. Moreover, land concentration and the monopoly of other factors of production are closely interrelated: " . . . because of the lower level of monetisation of the small farm, coupled with the fact that the small farmers' economy is frequently a deficit economy, the distribution of ancillary resources arising out of farm surpluses convertible into cash—such as transport, credit, and bargaining power vis-à-vis the market—becomes even more skewed than the distribution of holdings." [3]

The introduction of HYV in Asia, however, has brought with it a further development already mentioned in passing—the emergence of a new type of landowner on the rural scene, the progressive farmer. He is, in fact, a model farmer, and no government which has been preoccupied for many years with the problem of food shortages is going to legislate

[1] A. Rudra, A. Majid and B. D. Talib: " Big farmers of Punjab—some preliminary findings of a sample survey ", in *Economic and Political Weekly* (Bombay), Vol. IV, No. 39, 27 Sep. 1969, Review of Agriculture.

[2] *Economic Bulletin for Asia and the Far East*, op. cit.

[3] Ibid.

against him. Moreover, economic success enables him to gain political power, both at the local and national levels, so that he exercises sufficient control in the legislative bodies to ensure that no drastic measures are taken against his interests. The same thing is reported to be happening in parts of Latin America, including Bolivia, Mexico and Venezuela, where a new class of " aggressive peasants... forged ahead when opportunity knocked ".[1] In fact in many countries the drive towards land reform and the measures for its effective implementation have been considerably weakened as a result of the governments' preoccupation with the vision of surplus production created by the Green Revolution. Until quite recently it was believed that the Green Revolution would act as an equalising force, benefiting all sectors of the agricultural economy—large and small farmers, tenants and owners, employers and employees —eliminating the need for structural reforms.

A related consideration, which has probably worked against the interests of tenants and small subsistence farmers especially, is the rise in land values, leading to speculative buying and selling of agricultural land; this has occurred, for example, in the Punjab.[2] With the prospect of good profits from farming, the cost of agricultural land has risen. With increased land values, small farmers have been encouraged to sell their holdings to commercial enterprises. Consequently, more and more of them are driven to join the ranks of landless farm workers. The trend is thus in the direction of concentration of good quality, especially irrigated, land in the hands of farmers practising modern techniques of farming, while the subsistence farmers are left with poor quality and unirrigated land.

According to the results of field investigations, the spread of the use of HYV has, in a number of countries, meant a general deterioration in the situation of tenants and share-croppers, since landlords are even more reluctant than before to get into a position where their tenants might be given any rights in respect of land under the prevailing land reform laws. In certain countries it has encouraged landlords to evict their tenants and cultivate the land themselves. From the point of view of the owner this is a logical step. Recent technological developments in agriculture make it possible for them to earn higher profits, which they no longer wish to share with tenants; it is also easier for the more progressive landowners to make agricultural labourers working under their direct supervision try out new farming techniques. Thus in the Philippines the first noticeable effects of the Green Revolution in the irrigated areas of the central provinces of Luzon were rising land values, increased insecurity of tenants and share-croppers and, finally, a wave of evictions, since " . . . the high returns from the miracle rice create an incentive for the landlord to ease

[1] Solon Barraclough: " Alternate land tenure systems resulting from agrarian reform in Latin America ", in *Land Economics* (Madison (Wisconsin), The University of Wisconsin Press), Vol. XLVI, No. 3, Aug. 1970, p. 222.

[2] Srinivasan, op. cit., p. 348.

out his tenants and operate the farm himself with the help of hired workers ".[1] A survey of the Mayantoc municipality between 1965 and 1967 revealed that the number of tenant farms had decreased by 6 per cent.[1] Of course the relationship between tenants and landowners does not always deteriorate as a result of the prospects of higher earnings opened up by HYV. Where, as in other parts of the Philippines, it is customary for landlords and tenants to share the costs of inputs and to take joint farm management decisions, as well as to share in the output, there is an incentive for the landlords, particularly if they are absentee landlords, not to take over the land but to encourage the tenants to adopt the new varieties and to invest in the land.[2] But even where land continues to be cultivated by tenants and share-croppers, rentals have risen considerably in response to the rise in production levels, again leading to a deterioration of their economic situation.

According to Francine Franknel, an expert employed by the United States Agency for International Development (USAID) who recently surveyed the situation in India, the majority of farmers (possibly 75 to 80 per cent in the rice belt) have experienced a relative decline in their economic position with the introduction of HYV, in particular unprotected tenants cultivating under oral leases.[3] As regards the Philippines, also, it is reported that landlords, anxious to participate in the benefits of HYV, are reluctant to enter into leasehold contracts without being sure that rent adjustments can be made in the case of an increase in yields. For the same reason, share tenants are uninclined to adopt the new varieties before the leasehold contract is settled.[4]

With the introduction of HYV the landlord/tenant relationship has undergone a metamorphosis. There is an increasing tendency for owners of large tracts of land to be overwhelmingly concerned with the monetary returns from farming and consequently to disregard their traditional obligations towards tenants and labourers, particularly in terms of social services; the relationship between landlords and tenants as well as between owners and hired workers is in fact becoming increasingly impersonal. This is particularly the case in those areas where outsiders (ex-servicemen, civil servants, tradesmen, etc.) are taking up farming as a purely business proposition; such landowners do not even have to contend with the burden of traditional ties. With the increasing population pressure on the land, those on the lower rungs of the agricultural ladder are without any

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[1] H. Voelkner: *The Philippines rice revolution : a case study of Title IX implementation* (Dec. 1969) (mimeographed), p. 66.

[2] R. d'A. Shaw: *The employment implications of the Green Revolution* (Washington, DC, Overseas Development Council, 1970) (mimeographed).

[3] Pritam Singh: " Green Revolution unleashes new social tensions ", in *Economic Times*, 22 June 1970.

[4] FAO: *Introduction and effects of HYV of rice in the Philippines* (Rome, Feb. 1970) (mimeographed), p. 114.

sort of protection in the event of natural and other calamities, whereas under the old feudal system they at least had some hope of paternalistic assistance from their landlords. As a result of technological development and the increased monetisation of the economy these feudal relationships have been set aside, without being replaced by even rudimentary forms of social security.

This state of affairs, in conjunction with the increasing disparities in agricultural income levels, has resulted in growing social tensions, which could very easily develop into open conflict.

It is evident from the available literature that unless appropriate measures are taken to protect the poorer sections of the agricultural population—tenants, share-croppers and agricultural workers—the introduction of HYV and related improved farming techniques can only result in increasing the disparities in the incomes of those who have access to land and other resources and those who have not. At the same time it should be clearly recognised that measures aimed at rent control, security of tenure, etc., will remain unimplemented without the necessary organisation at the local level to protect the interests of the potential beneficiaries, the principal problem being that of forming peasants and agricultural workers into sufficiently strong groups or unions to withstand the existing economic and political power of large landowners.

HYV and farm mechanisation

Mechanisation is by no means a prerequisite for the introduction of HYV; the Green Revolution has in fact been referred to as the Seed-Fertiliser Revolution for this very reason. It might have been assumed, therefore, that heavy machinery would be introduced only to a limited extent and in special situations where there was a real shortage of manpower or where there was a need to complete certain farm operations within a prescribed period of time as, for example, in the case of multiple cropping. In fact, however, the new seeds have been introduced mainly by large landowners who are inclined to favour heavy, imported machinery, not always for sound technical reasons but sometimes in order to avoid any confrontation with organised labour demanding their share of the increased produce or sometimes because, for them, farm machinery constitutes a status symbol.

Controversies have accordingly arisen as to the amount of mechanisation necessitated by the use of HYV and as to the extent of the consequent displacement of human and animal power. Very few studies are available permitting a valid assessment of the cause and effect relationship inherent in this situation. The trend towards mechanisation in agriculture generally associated with the use of HYV and the resulting displacement of labour need to be closely watched to ensure that the use of these seed varieties does not lead to a decrease in the demand for

workers in agriculture and a corresponding lowering of wages. The fuller utilisation of labour in Asia is an important objective of development policy, with 70 to 80 per cent of the labour force already dependent on agriculture and with agriculture having to provide employment for the increased workforce of the future.[1]

Since, as already stated, the Green Revolution is conducive to labour-intensive practices on the farm, it should theoretically result in increased employment in agriculture. This has happened in practice where the stability of the small family farm undertaking has been secured through the successful implementation of agrarian reform. In India and Pakistan, on the other hand, HYV have mainly been introduced by the larger and better-off farmers, who do not cultivate the land themselves. The use of hired labour by such farmers introduces the element of labour cost, which is a relatively minor consideration in the case of smallholders, who generally work the land themselves with the help of the family. In India and elsewhere the large farmers have tried to deal with this problem, especially during peak periods of demand for labour when labour costs are especially high, by substituting machines for human and animal power. As has been pointed out, " . . . farmers have responded to labour shortages and costs by substituting a more capital-intensive technology for critical activities where they are normally reliant upon non-family labour, or where the yield-increasing opportunities are dramatic ".[2]

Mechanical threshers are now being used extensively in India and Pakistan to separate the wheat (grain) from the straw [3], and for the Punjab, for example, it has been estimated that by 1983-84 labour displacement will be of the order of 17.4 per cent, or 146 million man-days,

[1] While it is assumed on the basis of historical evidence that agriculture's share of the labour force will diminish in the course of economic development, the absolute number of persons engaged in agriculture in Asia is so large that the number of those actually dependent on farming for their income and employment must continue to grow for some time to come. This has been clearly illustrated in respect of West Pakistan, where non-agricultural employment opportunities increased at a rate of 4.3 per cent annually in the period 1951-61; assuming a continued 3 per cent yearly increase in the total labour force in the future and a rate of growth of non-agricultural employment opportunities similar to that of the 1950s, agricultural labour force projections are as follows:

1961	7.48 million
1975	10.12 million
1985	11.85 million
2000	13.65 million

Clearly the number of people for whom employment opportunities will have to be created in the agricultural sector must continue to increase in the next ten to twenty years. (Cf. Hiromitsu Kaneda: " Economic implications of the ' Green Revolution ' and the strategy of agricultural development in West Pakistan ", in *Pakistan Development Review* (Karachi), Vol. IX, No. 2, summer 1969.)

[2] Martin H. Billings and Arjan Singh: " Mechanisation and rural employment, with some implications for rural income distribution ", in *Economic and Political Weekly* (Bombay), Vol. V, 27 June 1970, Review of Agriculture, p. A-63; see also Shah and Singh, op. cit., p. 129.

[3] USAID: *Spring review of the new cereal varieties—major physical inputs* (Washington, DC, May 1969) (mimeographed).

with about 55 per cent of the total displacement being caused by tractors and pump-sets and 37 per cent by threshers and reapers.[1] In the Philippines, also, large landowners are known to substitute capital for labour even when there are no economies of scale to be achieved, mainly because they resent and fear labour's increasing political consciousness and capacity to organise.[2]

There is obviously little economic justification for rapid mechanisation in Asia under the present conditions of population pressure on the land. There appears to be a clear divergence between the personal interests of individuals concerned only with maximising their own profit margin and the interests of society as a whole, the profit-seekers taking no account of " . . . the social costs of exacerbating problems of underemployment and unemployment "[3], which do not enter into their personal assessment of costs and returns.

An attempt to calculate roughly the direct and indirect costs and benefits of mechanisation in West Pakistan led to the conclusion that " . . . the indirect social costs, mainly arising from throwing large numbers of farm labourers out of employment, may be considered much greater than the possible indirect benefits ".[4] In the same study it was noted that, as a result of mechanisation, the labour force used per unit of land had already been reduced by about 50 per cent. The authors, basing themselves on an investigation covering sixty mechanised farms in the Punjab and Bahawalpur, reported that the amount of permanent labour on these farms had declined from 2,000 to only 340 persons, 100 of whom were employed on tractors.

It is not intended to imply that there should be no mechanisation of farm operations, especially since this may result in a considerable increase in production and the extension of the " agricultural frontier ". Limited and selective mechanisation is in fact necessary for the double and triple cropping of land [5], which requires quick harvesting and preparation of land, and this is often not possible with the slow, bullock-driven equipment traditionally used by the farmers. The introduction of tractors for land levelling and cultivation is similarly essential if available land resources are to be fully exploited. However, every opportunity for farm

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[1] Ruddar Datt: " Myth and reality about Green Revolution ", in *Economic Affairs*, op. cit., p. 356.

[2] UNRISD: *Regional development: experiences and prospects*, Vol. I: *South and Southeast Asia* (Geneva, 1970), Part I.

[3] Bruce F. Johnston and John Cownie: " The Seed-Fertilizer Revolution and labor force absorption ", in *American Economic Review* (Menasha (Wisconsin)), Vol. LIX, No. 4, Part I, Sep. 1969, p. 574.

[4] Swadesh R. Bose and Edwin H. Clark II: " Some basic considerations on agricultural mechanisation in West Pakistan ", in *Pakistan Development Review* (Karachi), Vol. IX, No. 3, autumn 1969, p. 294.

[5] I. Inukai: " Farm mechanisation, output and labour input: a case study in Thailand ", in *International Labour Review*, Vol. 101, No. 5, May 1970, pp. 453-473.

mechanisation should be carefully reviewed and efforts made, wherever possible, to substitute locally produced equipment and machines for the imported variety. Experiments in producing cheap and efficient equipment in developing countries are being made at various research centres, including the International Rice Research Institute (IRRI) at Los Banos in the Philippines.[1]

Selective mechanisation along these lines offers a number of advantages: it makes it possible to increase production and exploit HYV to the maximum; it does not displace available manpower and may even function as a factor in the maximum utilisation of labour by removing bottlenecks in the timing of farm operations; simple machines of the type developed by the IRRI can be locally manufactured, thus resulting in a saving in foreign exchange while providing supplementary employment in non-farm occupations in the rural sector itself.

If it is finally decided after careful investigation to introduce heavy farm machinery, every effort should be made to do this through the intermediary of farmers' organisations, co-operatives or government tractor stations, so that small farmers may have the possibility of enjoying the benefits of mechanisation and there is less danger of large-scale displacement of farm workers.

It is evident that there is an urgent need for investigation of the problems involved in the joint use of machinery, particularly those currently faced by tractor co-operatives and other similar organisations.

Conditions of agricultural labour

There is an upward trend in the number of landless agricultural labourers in Asia, due to natural causes (the population increase) as well as the action of economic forces reducing the small landowners, tenants and share-croppers to the status of farm labourers. Simultaneously, where HYV are being introduced, there is an increase in the demand for labour per cultivated hectare. In the case of India this emerges clearly from table III.

To take just one district in Delhi State, it was discovered that the introduction of Mexican wheat varieties had doubled the amount of family labour used per acre and had also resulted in a small increase in the amount of hired labour.[2] Theoretically, therefore, it would appear that the use of HYV should afford an opportunity of considerably reducing unemployment and underemployment, particularly since multiple cropping provides the possibility of having two or even three harvests

[1] H. T. Oshima: " The time to change to labour-intensive policies is now ", in FAO: *Ceres* (Rome), Vol. 3, No. 6, Nov.-Dec. 1970, p. 34.

[2] Indian Agricultural Research Institute: *Five years of research on dwarf wheats* (New Delhi, 1968), p. 45.

TABLE III. ESTIMATED INCREASE IN HIRED MAN-DAYS AS A RESULT OF HYV CULTIVATION IN INDIA, 1968-69

Crop	Hired man-days per hectare		Increase per hectare (man-days)	Area under HYV (million hectares)	Total increase (million man-days)
	Pre-HYV	Post-HYV			
Paddy	75	161	86	2.6	223.6
Wheat	24	45	21	4.8	100.8

Note: The estimates are based on average labour utilisation in four states in the case of paddy and two in the case of wheat.

Source: R. K. Lahiri: " Impact of HYVP on rural labour market ", in *Economic and Political Weekly* (Bombay), Vol. V, No. 39, 26 Sep. 1970, Review of Agriculture, p. A-112.

a year. The situation as it has emerged in the different countries is, however, rather varied. With the introduction of HYV, a number of somewhat contradictory forces are set in motion: while there is undoubtedly an increase in the demand for workers in agriculture, especially at certain times of the year, there is also, as already mentioned, an increase in farm mechanisation, especially in the case of large and medium-sized holdings.

In the Punjab agricultural labourers would appear to be better off than before, mainly because the ratio of landless labourers to the total agricultural population there is low and the demand for their services has increased substantially. In Ludhiana (Punjab), for example, it is reported that the number of jobs has increased faster than the rate of growth of the population.[1] According to certain studies [2], however, the mechanisation of particular farm operations has increased the demand for seasonal labour, and it is no longer in the interests of landlords to engage workers on permanent contracts. This means that agricultural labourers find themselves overworked at certain times of the year but with little or no work during the rest of the year. To some extent this increase in seasonal farm employment is being balanced by the gradual growth of non-farm activities (i.e. activities complementary to agriculture) and the diversification of farming, which are among the broader effects of the introduction of HYV.

Other investigators believe that year-round employment in agriculture in the Punjab has increased, mainly as a result of intensive cropping

[1] Government of India, Ministry of Food, Agriculture, Community Development and Co-operation, Expert Committee on Assessment and Evaluation: *Modernising Indian agriculture—report on the Intensive Agricultural District Programme (1960-68)* (Nasik, Government of India Press, 1969), Vol. I.

[2] For example, M. H. Billings and A. Singh: " Labour and the Green Revolution—the experience in Punjab ", in *Economic and Political Weekly* (Bombay), Vol. IV, No. 52, Dec. 1969, Review of Agriculture.

and diversification of the cropping pattern. The difference of opinion appears to be due to the distinction between irrigated and rain-fed areas, there being a very definite increase in cropping intensity and multiple cropping with the expansion of the area irrigated.

The main determinant for increased employment in agriculture resulting from the introduction of HYV, therefore, appears to be the availability of water, to be ensured either by way of increased irrigation facilities or water control. But according to a survey by the Asian Development Bank covering Asia as a whole, land suitable for the double cropping of rice under existing development facilities amounts to less than 10 per cent of the total rice area of the region [1]; and the same is true for wheat.

Agricultural workers are naturally in a very advantageous position in areas where there has always been a chronic shortage of labour and where the workers are already organised in trade unions, as in Thanjavur, in South India. Here, for decades, it has been the practice to import labour from adjoining districts to perform such agricultural operations as harvesting and transplanting. The introduction of HYV and the resulting increase in intensity of farm operations augmented the bargaining power of the workers concerned so that they were able to obtain higher wages and improved conditions of work.

As regards the impact of the introduction of HYV on agricultural wages, the indications are that cash wages have generally risen, especially in the case of seasonal workers. However, the increase is by no means uniform.

Unfortunately, statistics on current wage rates are not readily available for Asian countries. In India, for which some data exist, there is considerable variation as between the different states. In table IV an attempt has been made to compare the level of cash and real wages in ten states of India between 1959-60 and 1968-69.

It is evident from the table that real wages in certain parts of India have actually decreased in recent years, following the introduction of HYV, probably because of the substitution of machines for men. Even where there has been an over-all increase, as in the Indian Punjab, the real wages of labourers engaged in ploughing and sowing, for example, have remained practically static, the general rise being mainly accounted for by increases at harvesting time. According to a recent World Bank report, the real wages of agricultural labourers in Asia as a whole have probably remained stationary and may even have declined in recent years.[2]

It is significant, on the other hand, that there has been a clear rise in the wages of village craftsmen. The demand for skilled labour, especially

[1] Asian Development Bank: *Asian agricultural survey* (Manila, 1968), Vol. II, p. 65.

[2] J. W. Mellor: *Report on technological advance in Indian agriculture as it relates to the distribution of income* (Washington, IBRD, Dec. 1969) (mimeographed), as quoted by Shaw, op. cit., Ch. 3, p. 23.

TABLE IV. CHANGES IN WAGE LEVELS IN TEN INDIAN STATES BETWEEN 1959-60 AND 1968-69

State	Index of wage levels in 1968-69 (1959-60 = 100)	Percentage change in real wages, after adjusting for changes in the consumer price index
Punjab	213	10
Maharashtra	174	− 5
Mysore	199	6
West Bengal	189	−22
Gujarat	158	− 1
Tamil Nadu (Madras)	219	27
Kerala	218	26
Assam	176	−19
Andhra Pradesh	212	32
Bihar	297	19

Source: Lahiri, op. cit., p. A-114, on the basis of statistics of the Ministry of Food, Agriculture, Community Development and Co-operation. Some distortions have crept in due to the different periods for which figures on wage levels and consumer prices happened to be available. It is believed that these distortions are of a minor nature.

blacksmiths and carpenters (who in any case are in short supply because of the time needed for training in these crafts), depends largely on the intensity of agricultural operations, which has substantially increased as a result of the Green Revolution. Moreover, this has also led to an increase in construction work in rural areas, mainly in connection with the development of the infrastructure.

From this cursory analysis of the employment situation resulting from the increased use of HYV, certain very general conclusions may be drawn. Obviously, where the number of labourers is small in relation to the total agricultural population, the introduction of HYV has brought about a marked improvement in their conditions of work and level of wages. The position, however, is quite different in areas where agricultural labourers constitute a substantial proportion of the rural population and where alternative employment opportunities are limited. Apart from this very general statement, it could be said that the elements which have a direct bearing on the employment situation in any particular area are *(a)* the extent of mechanisation and the processes which have in fact been mechanised; and *(b)* the extent of irrigation and the area potentially available for irrigation and water control. The intensity of cultivation, including greater utilisation of labour in multiple cropping, appears, as stated above, to depend primarily on the availability of water, which puts a definite limit to the employment impact of the Green Revolution.

Strategy for future developments

A résumé of developments

From the evidence now available in the form of field studies, surveys, etc., it is clear that the benefits of recent technological developments in agriculture are mostly being enjoyed by a minority of large commercial farmers, the majority of small farm operators remaining practically unaffected by the new discoveries. Since agricultural income tax is extremely difficult to administer, this cannot provide a solution to the distorted distribution of incomes within agriculture. Superimposed on this trend towards increasing disparities in income levels as between commercial and subsistence farmers is the trend towards growing regional disparities between the more developed, irrigated areas and the backward areas or communities which suffer not only from a lack of adequate irrigation facilities but also from poor communications and inadequate marketing and credit facilities. It is in these backward areas that the vast majority of farmers or peasants live. The implications of these regional disparities are obvious, especially where "... the bulk of added public investment is concentrated in the irrigated regions and, at the same time, there is no adequate fiscal machinery for distributing some of the increased incomes in these to other regions ".[1]

In addition there is the growing tendency for the larger commercial farmers to substitute machinery for farm labour, causing increased unemployment and underemployment. Employment problems need to be viewed in relation to the prevailing rate of population growth, the existence of limited non-farm employment opportunities, and the drive towards mechanisation associated with the introduction of HYV. The displacement of labour in agriculture as a result of mechanisation has been aggravated by the large-scale eviction of tenants and share-croppers and their reduction to the status of landless agricultural labourers, which has meant that the land tenure situation has in many instances worsened with the introduction of HYV. There is thus a polarisation of agricultural society, with a few farmers becoming richer and more prosperous, while the majority lose even the small stake they once had in the land. Moreover, while the Green Revolution has increased the supply of cereals through raising yields, the growth in total available food supply has not in fact resolved the problem of malnutrition, because so long as cash income remains concentrated in a few hands, there will be no effective increase in demand. In fact the problem of accumulation of surpluses and their disposal is coming to the forefront in many countries, with worsening bottlenecks in transportation, as well as a dearth of storage and processing facilities, both in villages and in marketing centres.

[1] Montague Yudelman: "The Green Revolution", in *OECD Observer* (Paris), No. 52, June 1971, p. 29.

The problems and difficulties outlined above obviously emanate from the growing concentration of purchasing power in the hands of a minority of large and medium-sized farmers who have been the principal beneficiaries of the Green Revolution. Although in theory the advantages of the new seeds and fertilisers are not affected by the scale of operations, in practice this is not so. If the mass of small farm operators are to benefit from HYV, neutrality in respect of the scale of operations would also have to be practised by the supporting institutions, including those that supply credit, fertilisers and water as well as those concerned with the marketing of the additional produce. Otherwise, unless there are special institutional arrangements, small-scale farmers cannot gain access to necessary inputs. For example, it is uneconomic for small farmers to construct tube-wells on an individual basis, so they must pool their resources for this purpose. Similarly, small farmers, especially tenants, are not individually credit-worthy and the terms of credit offered are too high, so again they need to group together to obtain credit on reasonable terms. Most important of all, the small farmer is generally not in favour of or is indeed against taking the risks involved in making innovations, so that special efforts are required to encourage him to introduce new seeds and related farming techniques.

Examples of smallholders' development schemes

The problem of small farmers and tenants and the need for special programmes to integrate them into the development process have been recognised by several governments, and schemes, mostly of a pilot nature, have been initiated on their behalf. It seems appropriate, in this connection, to outline briefly the Puebla project in Mexico, in which attempts have been made actively to involve small farmers in the modernisation of agricultural operations, through the introduction of HYV.[1] The Puebla project is relevant not only because it is already in its fifth year of operation, but also because it has been carefully and objectively evaluated on a more or less continual basis; it may, therefore, be considered as a model for initiating special programmes in this connection.

The project is located in the Central Plateau area, which is characterised by heavy population pressure, the small size of holdings, poor infrastructural development, especially communications, low levels of income and limited non-farm employment opportunities. Here land is traditionally cultivated by small operators using primitive farm equipment and farming methods. The development strategy adopted in the formulation of the project may be outlined as follows:

[1] Cf. in this connection International Maize and Wheat Improvement Centre: *Strategies for increasing agricultural production on small holdings*, proceedings of two international conferences held at Puebla, Mexico, in August 1970 (Mexico, 1970); and idem: *The Puebla project, 1967-69—progress report of a program to rapidly increase corn yields on small holdings* (Mexico, 1970).

— establishing a team of technicians to engage in truly co-ordinated work with small farm operators;
— introducing HYV on small farms under actual field conditions, instead of merely on demonstration farms in experimental stations, so that all the farmers can see for themselves the impact of the introduction of HYV;
— directly involving local leaders and farmers in development programmes and acquainting them with new techniques of farming;
— establishing closer links between small operators and all existing agricultural service institutions, at the federal, state and local levels;
— providing credit, agricultural inputs, crop insurance and other necessary resources on reasonable terms; and
— organising convenient markets, with a guaranteed price which is stable and attractive for producers.

It is reported that the response of small, even illiterate and previously backward farmers to HYV has been beyond all expectations. The success of the project is due, at least in part, to the close co-ordination of the activities of all government and non-government agencies aimed at raising living standards in rural areas.

In implementing the project it soon became evident, in view of the growing number of producers covered, that the small farmers would have to be organised into groups or associations for ease of contact. Various devices were tried out for this purpose so that each team of farm advisers could work with a number of groups. Besides maintaining contact with the groups thus created, the development teams hold meetings in each community to stimulate the farmers to organise themselves for specific objectives, such as management of a tube-well, placing group orders for particular kinds of fertilisers, the grading and sale of produce in specific markets, etc. This has involved identifying the local power structure and those with authority within this structure, and working through them to contact the smaller and more backward elements in the community. Once the groups are formed, they elect representatives to work closely with the farm advisers on all phases of the project. The process of institutionalisation in this compartmental form has proved to be a great success, whereas the formation of groups without specific objectives had previously been found impossible in areas where little social organisation exists amongst farmers. Generally speaking, it has been discovered that farmers are willing to work together for a well-defined objective. No attempt whatever has been made to give a name to the groups thus formed, or to designate them as " societies "or " co-operatives ". Rather, the actual form has been left to evolve gradually, as the smallholders themselves begin to identify the functions which they require their groups to perform.

Similar small farmer development schemes have been instituted in India, Pakistan and the Philippines. In India, for example, under the

Fourth Five-Year Plan, high priority is attached to measures specifically designed to enable weaker sections of the farm population to benefit from general economic growth and development, including the introduction of HYV. With this in mind, the Government has accepted the recommendations of the All-India Rural Credit Review Committee to set up specific projects for assisting small but potentially viable farmers; provision has been made for the implementation by the Small Farmers Development Agency (SFDA) of forty-six pilot projects, each covering approximately 50,000 farm families, in selected districts.[1] From the experience gathered in these pilot projects it is hoped to develop comprehensive policy measures for wider regional and national application. Like the Puebla project, each of the SFDA projects is supervised by a team of experts, in this case reporting to the District Commissioner, who has under him a project officer and assistant project officers. After identifying potentially viable small farmers [2], the team then proceeds to formulate individual and group production programmes using HYV, with the object of organising small farmers for the purpose of obtaining adequate and timely supplies of inputs from existing and new sources as well as building up an adequate infrastructure for improving the marketing, storage and processing facilities in the project area. The main reason for selecting the Commissioner as head of the team is to ensure proper co-ordination with existing district development departments, local authorities and voluntary agencies operating in the project area. Work on the pilot projects, as regards the identification of participants, the preparation of production programmes and the financing of the development activities generally, has already begun.

In Pakistan action to promote technological innovations in agriculture, including the use of HYV, with a view to improving the income levels and employment opportunities of small and marginal farmers, has been taken through the Pakistan Academy for Rural Development (PARD) at Comilla. In undertaking its pilot schemes, the Academy based itself on the hypotheses that the use of improved implements, machines and practices can best be achieved through co-operative or group action and that small, even subsistence, farmers will save and invest in farming once they are convinced of the prospect of immediate gain as a result of adopting modern agricultural techniques.[3] As regards water use, for instance, a cusec pump jointly used for irrigation can make sufficient water available for sixty to eighty acres of land if the holdings are in one or two compact blocks, whereas the individual use of such a pump by an

[1] Government of India, Ministry of Food, Agriculture, Community Development and Co-operation: *Small Farmers Development Agency—Central Sector Scheme* (New Delhi, Mar. 1971).

[2] No uniform criteria have been established for defining a potentially viable small farmer; each team has been left to work out the norm in terms of prevailing local conditions.

[3] PARD: *A new rural co-operative system for Comilla Thana—a rural co-operative experiment*, first annual report, 1960 (Comilla, 1960), p. 12.

average farmer is impossible, uneconomic and wasteful.[1] Similarly, the isolated use of insecticides does not work, since individual fields cannot be fenced off from insects.

Because technological change in agriculture consists mainly of the development of mechanical irrigation to overcome the constraints to winter crop cultivation, together with the switch from traditional varieties of seeds planted to HYV, increased inputs of fertilisers and insecticides and increased use of improved implements, PARD has concentrated its efforts, since 1965-66 especially, on achieving a considerable expansion of mechanically irrigated areas in Comilla. The small farmers have been serviced through the tractors provided by the Kotbari Thana Central Co-operative Association, which is a federated body of the village co-operatives organised mainly by the small farmers themselves. Although ploughing on co-operative lines has not been without its problems, the co-operative societies have nevertheless gone ahead and organised machinery pools. According to the annual report of PARD for 1968-69 [2], co-operatives pooled 872 rotary weeders, 188 hand sprayers, 27 power sprayers and 252 pedal threshers, and all among farmers with holdings of between 0.5 and 5 acres in size. Physical capital formation has in fact been taking place extensively among small farmers in Comilla, and their response to the introduction of HYV has been similarly impressive.[3] The rising trend of per acre yields of boro crops after the 1966-67 season particularly reflects the rising proportion of HYV grown.[3] In the four years 1966-67 to 1969-70 multiple cropping almost doubled, while mechanical methods are reported to have virtually replaced traditional methods of irrigation. (There would, incidentally, appear to be a close correlation between the use of HYV, careful transplantation in lines and the spread of mechanical irrigation.[4]) In Comilla it has thus been proved in practice that group action is conducive to increased production.

A related objective of the Comilla scheme has been to correlate mechanical irrigation and the use of HYV with the fuller utilisation of rural labour in the rural sector itself, and this has been achieved through the considerable increase in winter crop cultivation, transforming the traditionally slack months of agricultural activity into the busiest months of the year.[5] Moreover, since 1962-63 there has been an extensive rural works programme, carried out mainly during the winter months, for infrastructural development, i.e. the construction of roads, embankments

[1] PARD: *Evaluation of the Thana Irrigation Programme in East Pakistan (1968-69)* (Comilla, Samabaya Press, 1970), p. 49.

[2] Idem: *Tenth Annual Report, 1968-1969* (Comilla, 1970), p. 43.

[3] Ibid., p. 33.

[4] I. Inukai: *Technological changes and labour utilisation in agriculture—a case study in Comilla, East Pakistan*, paper prepared for the Institute for Development Research (Copenhagen, 2 June 1971) (mimeographed), p. 16.

[5] Ibid., p. 19.

and irrigation facilities. In recent years (i.e. since 1967), however, the small farmers have lost interest in working for the rural works programme during the winter months, since they earn much better incomes from winter crop cultivation.[1]

Conclusions

The achievements of the Green Revolution are unquestionable; it is indeed a " revolution " in that it has, for the first time in recent history, brought a glimmer of hope to the large mass of rural people in developing countries all over the world. There is now the possibility of attaining an improved population/food balance in developing countries in the near future. During 1966-69, for example, the Green Revolution is estimated to have provided enough additional protein to supply 60 grams of protein a day for 30 million people on the Indian subcontinent.[2] However, it has also led to the emergence of new problems, essentially of a social and economic nature. The main problem is to ensure that the benefits resulting from the use of HYV are disseminated amongst all classes of agricultural and rural workers—smallholders, tenants, share-croppers and permanent and seasonal agricultural labourers. It would be the greatest tragedy of the twentieth century if the great technological advances embodied in the Green Revolution were allowed to widen regional and income disparities as well as to increase unemployment and underemployment in rural areas. As pointed out by one observer [3], the Green Revolution should not be considered solely as a means of increasing output but also as a force for development in the widest sense.

In the preceding pages schemes aimed primarily at helping small farmers to use HYV have been described. Most of these, except for the Mexican experiment, are of fairly recent origin, so that no firm conclusions can be drawn from the results obtained. However, there is enough evidence to conclude that, once supporting institutions are made available, small farmers are as interested in introducing HYV as those working larger holdings.

A continuous search for viable institutional forms is needed to ensure that the benefits of the Green Revolution reach the widest possible number of agricultural workers and especially those on the lower rungs of the agricultural ladder. This is especially indicated because developed countries " . . . have few institutional forms to export that can come to grips with the income distribution and employment questions that now plague Asia ".[4]

[1] Inukai: *Technological changes...*, op. cit., p. 22.

[2] Yudelman, op. cit., p. 30.

[3] Ibid.

[4] Falcon, op. cit., p. 705.

Finally, it must be recognised that the Green Revolution will not solve all the problems in the rural sector in Asia. Governments will simultaneously need to develop programmes directed mainly towards the achievement of the following basic objectives: an equitable land tenure structure, combined with the provision of suitable production and service institutions; increased employment opportunities, both seasonal and of a more permanent nature, together with a more equitable distribution of the income earned; greater participation by the large mass of peasants and labourers in the development process as well as in the resulting benefits. To attain these objectives, various two-way measures will have to be taken, like raising import taxes on farm machinery so as to create a disincentive for large farm operators to substitute machines for labour. Similarly, laws safeguarding the rights of tenants will have to be enacted and means found to enforce them. The establishment of tenants' organisations would undoubtedly assist this exhortatory process, offering "... a shield behind which tenants can gather, and a banner which provides them with the courage to demand collectively what they are too weak to demand individually ".[1] Also, appropriate forms of vertical integration could play a crucial role in enabling smallholders, tenants and share-croppers to benefit from economies of scale; successful examples in this respect exist in both developed and developing countries and more attention needs to be paid to them. In the case of agricultural wage earners, even more imaginative solutions need to be worked out and new tenure forms devised, including for example, the establishment of centrally managed units on the basis of an agreed pattern of operations which would give these wage earners a stake in the land while developing their managerial ability. For those who must continue to make a living from wage employment, laws must be enacted guaranteeing minimum wages and decent living and working conditions. Moreover, there is a need for a dynamic policy aimed at the expansion of service and supply industries in small towns and market centres which could absorb those redundant in agriculture. Such a policy, together with a large-scale rural works programme, could be expected to provide gainful employment for agricultural workers during periods of slack in agriculture, while at the same time assisting in the building up of the rural infrastructure. These and other employment promotion policies, together with continued population control measures, should ensure that technological development is geared to social justice and the raising of living standards for all sectors of the rural population.

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[1] United Nations, Department of Economic and Social Affairs: *Progress in land reforms—fourth report* (document E/4020/Rev. 1; ST/SOA/61), prepared jointly by the secretariats of the United Nations, the FAO and the ILO (New York, 1966), p. 39.