THE SOCIO–ECONOMIC PROBLEMS OF THE'GREEN REVOLUTION': THE SOUTH–ASIAN EXPERIENCE *

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I. Introduction and Background

"Green Revolution" is a term now almost unanimously employed to define the agricultural phenomenen of highly increased foodgrain yields wich has occurred, since late 1961's in some low income countries and especially in the Indian subcontinent. More specifically, however, the term can be defined as the application of hydrological, bio-chemical and mechanical innovations in agriculture. (Fatemi, 1972; Gotsch, 1973, Ishikawa 1971). The history of Green Revolution as a package of the above innovations is fairly recent. The main breakthrough was made as a biological innovation, in the late 1940's, when Dr.Norman Borlaug and his associates succeeded in producing a new dwarf wheat variety.*** This in the early 1960's was followed by genetically improved rice varieties. But these new seeds alone have not been sufficient for the Green Revolution. Hydrological innovations in the from of tubewells and pumpsets; chemical innovations as fertilizers and pesticides and a host of mechanical innovations have formed the complementing components (Brown, 1970; Gotsch 1973). Genetically improved seed varieties obviously have the potentials for high yields, high incomes and for increased efficiency in agricultural productivity. These potentialities arise from the biological characteristics of the new seeds which in brief are:

i) greater fertilizer responsiveness,
ii) early maturity,
iii) capacity to double yields and hence multiple cropping,
iv) short, stiff stems,
v) slender erect leaves,

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* This paper is largely based on My M. Sc dissertation (Sezal, 1973).

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*** Dr. Borlaug's research was sponsored by the Rockefeller Foundation. The motive behind it was to soften the rising nationalism in Maxico which in 1939 had resulted in the expropriation of the Rockefeller Standard Oil interests. Cleaver Henry M. Monthly Review, June 1972.

vi) no photo-period (day-length) sensitivity in the case of rice and,
vii) adaptability to a wider range of soil and seasonal variations.
(Brown, 1970; Jayapnakash, 1973)

To understant the importance of these biological characteristics of the new seeds it is useful to make a comparison with the old traditional seed varieties. First of all, the old seeds do not have sufficient fertilizer responsiveness. So much so that when fertilizer is applied in a silghtly larger quantity they become " top heavy with grain" and fall over or "lodge" before the grain is ripe. Secondly, the old varieties have tall straws, which is in fact very necessary for survival against a range of attacks such as weeds, heavy rains and floods. But this very same trait makes them too weak to be able to endure the added grain load attainal le through high fertilizer usage.

The new seeds overcoming these weaknesses by their above mentioned characteristics are therefore highly superior to the old seeds. In order the potentialities of the now seeds (rising productivity in agriculture) to be realized however, o range of innovations have to be put into practice along with the new seeds. (Cepede, 1972; Jayaprakash, 1973). One of the most important associated innovations of the genetically improved seeds is that hydrological innovations; or to be more precise the application of hydrological innovations. Lack of propitious agroclimatic condi tions, vagarious of monsoons and a good irrigation management had always been crucial for successful crop productions, but never so critical until the introduction of the new high yielding varieties. For the success or failure of the new seeds very much depends on the existence or non-existence of a stringent irrigation management. This is not so difficult now thanks to various hydrological innovations that make artifical control of suffly of water possible. Among those, tubewells and electric pumps have been the most celebrated ones*. A fine small-scale irrigation system thus made available has at least two great advantages; Firstly, provided that purchasing power is there, farmers can easily buy and install a tubewall or electric pump in a short time rather than having to wait for years for a adam to be builty by public authorities. Secondly and perhaps more important than the first, farmers having got their own irrigation system can under their personal management control the precise timing and quantity of water supply which could not be possible under the public irrigation systems. (Nulty, 1972).

The importance of irrigation upon the crop-yields is clearly reflected in the figures showing agricultural foodgrain yields. In Pakistan, it has been found that in 1967-68 wheat yields or irrigated lands were 12.6 mounds (1 mound=82,2851 bs) as apposed to 5.6 maunds of Unirrigated land; and (clean) rice yields on irrigated lands were 11.2 maunds as against 6.2 maunds of unirrigated lands. (Nulty, 1972) The importance of irrigative innovations has been fully realized by the farmers. This can be clearly seen in the figures showing the installed tubewells. It was recorded that during the 1968 crop season alone 42,000 tubewells were installed by the Indian farmers. In Pakistan, on the other had, the number of tubewells rose from 41,370 in 1966 to 73,205 in 1969. A remerkable response on the part of the farmers. (Brown, 1970; Nulty 1972).

*Tubewells and electric pumps are essentially mechanical innovations. Since, however, they are directly and solely employed for artificial water control it is thought apt to treat them as hydrological innovations in this paper.

As a final word on the importance of hydrological innovations it must be abded that even if irrigation is not always necessary, as for instance in the rain-fed areas, a sound water management is essential if the maximum from the genetically improved seeds is to be botained. 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 the Indian subcontinent although the capacity for higher yields is as great as in the case of wheat. Higher yielding new rice varieties however, require a more sophisticated system of water control which has not yet been introduced in the Indian subcontinent to a sufficient degree. (cleaver, 1972).

The second important associated innovation to be applied along with the high yielding new varieties (HYV's) is the artifical fertilizers which has proven to be indispensable with when the new seeds are sown. Indeed the application of fertilizers is so absolutely necessary that in many circles the Green Revolution has been referred to as "seed fartilizer revolution". Although the term underestimates the importance of hydrological (irrigative) and mechanical innovations it nevertheless underlines the importance of fertilizers correctly, To cite just one example it is calculated that if a good yield to be obtained, for one hectare of IR-8 type rice 120-130 kg. (nitrogen) fertilizer must be provided (polmer, 1972) This is an amount which if applied to the old rice varieties would have only rotted the whole crop. The fertilizer resistance character of the new seeds along with the irrigative innovations hides a great potential for increases in physical yields and not income. Calculations show that there is a very strong interdepence between water and chemical fertilizer and between these both and genetically improved hing yielding seeds with respect to the volume of output and net income. (Nulty, 1972). This interdependence between the new inputs has been well realised by the farmers. India's fertilizer use increased from 765,00 nutrient tons in 1965-66 to a record of 2,2 million nutrient tons during 1970-1, The increase from 1969 to 1970-1 was over 10 per cent. The present Fourth—Five Year Plan has a fertilizer consumption target of 5,5 million nutrient tons (Jayaprakash 1973). The last series of innovations constituting the Green Revolution package has been that of mechanical innovations. As a whole it is the most complicated and controversial of all the Green Revolution innovations. Some items such as small power tillers, motors, fertilization and spraying equipments seem on the whole to be consistent with the factor endowments of the adopting countries and hep towards increasing productivity in the agricultural sector. But heavy mechanical innovations such as tractors, combines threshers etc., seem to be less obvious in having the same positive traits. Hence they have been seen to have created market divergences between net private and net social benefits and costs. Notwithstanding mechanisation both in India and Pakistan has been observed to go hand in hand with the other Green Revolution inputs, the full effect of wpich will be analysed in detail later (Gotsch, 1973)

Since 1966 the Green Revolution as a package of the above innovations has been vigorously applied in both India and Pakistan. According to the most recent estimates over half the irrigated wheat area in Pakistan and about 45.6 per cent of the total wheat area in 1969-1970 was planted with the new seeds. In absolute terms the area under the HYV's rose from 101,200 hectars in 1966067 to 2,832,900

hectares in 1969 - 70. In the case of rice the performance has been less spectacular although still considerable. In rice, the new HYV's constituted over one third of the total rice acreage, compared to a negligible figure in 1966-67.

The Indian experience too has been remerkable. From a mere 514,000 hectares in 1966-67 the area under the high yielding wheat varieties rose to a massive 6,111,000 hectares in 1969-70. Put differently, in 1969-70 36,8 per cent of the total wheat area in India was planted with the new seeds. The rice performance of India, on the other hand has been more successful than Pakistan's. In India, in 1966-67, only 514,000 hectares of the total rice area were under the new varieties. This amount in 1969-70 rose to 4,370,2000 hectares. This amount forms 12 percent of the total area planted with rice.

The real significance of these changes can best be understood by looking at the production figures. The Indian wheat production in 1966-67 was 10,424,000 tons. In 1969-70 i.e. in a period of three years, the figure had reached 18,652,000 tons. The rice production to rose tremendously from 45,657,000 tons in 1966-67, it reached to 60,645,000 tons in 1969-70.

In Pakistan, the wheat production in 1966-67 was 3,957,000 tons In 1969-70 it had reached 7,294,000 tons. In rice, the production increase for the corresponding years was from 16,410,000 to around 22,1000,000 tons.

II. The Socio-Economic Problems of the "Green-Revolution"

It is evident from the above analysis that the "Green Revolution" has benefited the Asian Countries - India and Pakistan in particular - to a considerable extent. It can be claimed that the 'Green Revolution" has opened the road to self-sufficiency, for both countries. But the Green Revolution has, besides it's benefits also generated and accelerated various socio - economic problems of crucial importance. These, stated briefly, are:

A) The problems of Employment Opportunities

B) The problem of Regional Disparities.

C) The problem of Income Inequalities.

It has been largely due to these potentially serious socio - economic problems that many have cast their doubts upon the "revolutionary nature of the Green Revolution". Indeed the Asian experience - India and Pakistan in our study - shows that the development contribution of the Green Revolution stands or falls on the size and negative impact of the above problems. It is with this contention that we now turn our full attention to these socio - economic problems.

II.A. The Green Revolution and Employment Opportunities:

As is the case in all other low income countries (LIC's), a large majority of the population and hence labour force in both India and Pakistan live on the tradional agricultural sector. With low productivity and land shortage in force the agricultural sector in these countries is evidently burdened with surplus labour. Moreover, the population growth rate is frighteningly high in both countries. This adds up in an ever - growing fashion, to the already wellswollen labour force.

Until recently it was widely accepted that to ease the burden on the agricultural labour force and increase productivity per man in that sector a transfer of labour from the agriculture in to the nonagricultural sectors would be one of the best policies to adopt. That was also regarded to be one of the main contributions of agricultural sector towards over - all development. The experience, however, has shown this recommendation to be wrongly conceived. The increase in non - agricultural employment opportunities has not been large enough to absorb the ever - growing labour surplus in agriculture. The case is best illustrated by Pakistan. In Pakistan non - agricultural employment oppurtunities increased at a rate of 4.3 per cent annually in the period 1951-61, which has been regarded as an extemely good performance (Bose and Clark 1969). With due respect, however, this figure has not been capable to assimilate all the rural surplus labour. On the contrary, it is estimated that with the same 4.3 per cent increase in non - agricultural employmant, the existing population grewth rate of 3 per cen will, in fact, cause an increase in the absolute number of agricultural labour force rather than reducing it. Accordingly it is estimated that from 7.48 million in 1961, the agricultural labour force in Pakistan will reach to 10.12 million un 1975 and 11.85 million in 1985 (Ahmed, 1972).

As to India, in 1969, the year which the Fourth plan started, the official plan estimates were that there was already a backlog of around 10 million unemployed abour three —fourths of whom were in the rural sector. On the other hand, the projections made in 1966, suggested that during the Fourth plan, i.e. 1964-74, there would be a net addition of 23 million to the labour force. It was when estimated that 14 million of these would be absorbed by the no— agricultural sectors and about 4.5 to 5 million in the agricultural sector. But even with these very optimistic estimations the employment backlong is actually going to be about 4 million greater at the end of the at the end of the Fourth plan than was at the beginning. (Frankel, 1971).

The failure of the non-agricultural sectors in creating ample employment oppurtunities has been substantiated also by too many examples from the other LICs. It is now almonst unanimously agreed that rather than relying on the other sectors, the agricultural sector itself must play a greater part to accommodate its growing labour force within itself. Here it is thought that the timely arrival of the Green Rovolution can contribute to this end tremendously. Thes optimistic view, however, so far has not been justified by the Green Revolution practice that has been observed in India and Pakistan.

The appropriate way to analyse the affects of Green Revolution on employment opportunities would be to take up the issue in two parts; for this is in fact, how the Green Revolution has worked out in these countries.

Firstly, it has been observed that Green Revolution creates some employment opportinities wherever it is applied. We call this "Labour-Absorbing Affects"; and secondly, Green Revolution has been seen to have caused a considerable amount of unemployment in its application. We call this "Labour-Displacing Affects".

1– Labour-Absorbing Affects Of Green Revolution

A full quantitative analysis of the labour-creating affects of Green Revolution with respect to the Indian subcontinent has not yet been produced. Various studies have so far treated the issue only in parts and very often in abstract. The labour-absorbing model emerging from these studies is that demand for labour is created through.

i) The biological and hydrological innovations,

ii) The new farming and cropping pattern,

iii) Non-food grain and non-agricultural employment.

i) A relatively good indicater showing the labour–absorbing affects of the new innovation package is expenditure per hectare for farm labour. It has been recorded that in India for instance, there had occurred a marked increase in expendituder per hectare for labour on farms that cultivated the new-seed s, as compared with those farms that did not. On the case of wheat, the new-seed farms had Rs. 191.5 per hectare labour cost in 1967-68, where as the old-seed farms had a cop-responding figure of only Rs. 41.0. As to the rice, the new-seed rice farms labour cost, in the same year was Rs. 367.4 per hectare as against Rs.140.5 of the old-seed rice farms (Staub and Blase, 1971).

The most obvious reason for such differences in labour employment, as between the new-seed farms and the old-seed farms, lies in the bio-chemical and hydrological innovations. Indeed the new genetically improved seeds, with their biological characteristics such as greater fertilizer responsiveness, early maturity, multiple cropping, etc., require more labour than the old-seeds, on the other hand hydrological innovations have constituted an important determinant of more labour utulization on the farms. The main reason for this is that irrigation determines the intensity of cropping and therefore demand for labour. It has been found that in the Bihar district of India, the average intensity of cropping for the irrigated farms is 1.61 as against 1.31 in the unirrigated farms (Singh, 1972). In the same study the labour use per acre was also found to be considerably higher on the irrigated land than that on the unirrigated land. For all farms in the district irrigated wheat farms recorded 49.5 man-days per acre whereas unirrigated farms showed a mere 31.2 on the case of rice the difference in man-days per acre was even more higher; 69.7 man days per acre in the irrigated farms as against 43.4 man days of unirrigated farms (Singh, 1972).

The new-innovations package combined and applied together have also made multiple cropping a reality which is a great achievement in agricultural evolution. In addition to higher output and higher incomes that can be reached thus, the reality of second, third and even sometimes fourth cropping has also brought new employment opportunities within a reach. It has been estimated that as a result of multiple cropping, the growth in labour requirements may amount to nearly 60 per cent, especially over short periods, (i.e. during the mansoon months). (Ahmed, 1972). In view of the fact that at present manpower remains underutilised for considerable periods of the year in both India and Pakistan, the potentialities of fuller manpower utulization thus promised bay multiple cropping is thought to be quite significant for both countries. But one has to be cautious against the optimism that the above

figure may suggest; for the largest percentage of this will, in fact, be increased day--work per worker already employed. In other words, the same number of workers will now more working days spread a little more evenly through the year; but the jobs actually made possible for the unemployment will not be that large (Singh, 1972; Rudro, 1971).

ii) The new farming and cropping patterns that create new employment opportunities are almost directly related to the bio-chemical and hydrological innovations dealt with above. With the availability of fertilizers, pesdicides and irrigation facilities a different farm management that the old traditional one is required. If the full potentials of the new -seeds to be realised, it is indeed essential that seed beds are prepared more thoroughly fertilizers applied in greater quantity in time, pesticides and irrigations done timely and harvesting finished quickly, A new farming pattern full of these task in greater proportions naturally requires more labour.

With the new farm-management pattern there may also appear a new cropping pattern aspecially in the form of sowing more labour intensive crop varieties; and adopting of mixed cropping. So for the most successful performance in this respect has been experienced with the new-rice varieties and especially with the IR-8 variety, The IR-8 rice is very labour demanding at both the planting level and harvesting level. At he planting level they require, line tarnsplanting and more intensive applications of irrigation, fertilizer and pesticides. At the harvesting level, on the other hand, because they mature earlier they necessitate early harvesting so that to make possible early preparations of seed beds for the second, third or even sometimes for the fourth cropping.

iii) The Green Revolution in India and Pakistan has contributed towards creating new employment opportunities yet in another way. Namely, by providing non-food-grain and non-agricultural employment. Although this will be analysed in more detail later a brief mention here may prove useful.

It has been observed that with rising rural incomes a change in the rural diet pattern and hence consumption of more livestock and dairy products takes place. This in turn, necessitates more livestock and dairy products farming which, in turn, create a good deal of new job opportunities for the rural population[13].

More important, however, both in scope and size, is the non agricultural and in particular small-scale industries employment opportunities tha Green Revolution has brought about. Since the whole issue will be dealt with in some detail later, it suffices to say here that small scale industry in tubewells and related imploments in Pakistan has indeed been very countributery in creating a whole range of new employment opportunities.

2. Labour-Displacing Affects Of Green Revolution:

The labour-Displacing affects of Green Revolution stem mainly from three sources; first source giving rise to labour-displacing repercussions is the new land-tenure pattern that is emerging in the Green Revolution farms. The second, in many senses more serious than the first, is the mechanisation impact of Green Revolution which is spreading fast especially among the large landowing farmers and the third source is the new cropping patterns that are being adopted as the result of Green Revolution.

a. The New Land Tenure Patterns

Before the Green Revolution made its real impact felt, the most common land tenure system in the Indian subcontinent, besides the owner-cultivator, was that of share-tenancy pattern. Although this showed some variations between the countries and regions it basically meant that (i) the inputs being used in the farm were more or less evenly shared (ii) that the landowner paid the tax-if there was any, (iii) that the tenant supplied human and animal power and finanlly, (iv) that the gress output obtained from the farm was shared, in most often than not, in a 50/50 base (Gotsch, 1973).

The Green Revolution by opening the ways to higher incomes has disturbed this pattern tremendously. The landlord seeing where their own personal benefits lie have in many instance tried to evict the tenants and deal personally with the complete husbandry of their farms. In the case of the medium landowners such eviction has been done more thoroughly. Since tracter mechanisation can replace tenant--supplied labour and animal power in these farms rather easily, it is not felt that evicting the tenants may have any disadvantages. In very large farm holdings, however, -200 acreas plus-eviction of tenants has been carried out only patially. In these farms landlords have kept some of the tenants firstly. "As a hedge against the uncertainty of mechanical power and secondly, as a source of guaranteed labour". (Cotsch, 1973). But even then they have insisted on higher rentals leaving considerably little to the tenant cultivators, It has been reported that in some cases the gross output share has been increased from 50/50 to 70/30 and even to 80/20 in favour of the landowners (Frankel, 1971). Unfortunately, we do not have any detailed study showing the size of the evicted tenants. A study of the case of the evicted tenants and unemployment caused by this, would no doubt, have been very helpful in assessing the direct unemployment caused by this, would no doubt, have been very helpful in assessing the direct unemployment affects of changing tenancy system. Nevetheless, some broad outlines emerging from various studies suggest thet unless acted upon fast unemployment caused by changes in tenancy system will become frighteningly large in both countries.

Besides this, there is also a sizeable unemployment problems generated by the emergence of a new landed class. With the high profits that the Green Revolution now promises there has now appeared a new landed class of "Gentlemen Farmers", mainly consisting of exservicemen, retired civil servants, urban-based businessman, and a host of others, who see the new venture as a good business proposition. Thus both in India and Pakistan land prices have shot up, thereby first making any purchase of land out of reach for small, low income farmers and secondly, making for the small farmers very difficult to keep their land holdings (Ahmed, 1972).

3. The Mechanisation Impact:

Mechanisation in agriculture is generally needed when there exists a real shortage of manpower and/or when there is a need to finish some farm operations within a limited period of time under acute labour shortage. Under such conditions, it is quite conceivable that the introduction of the Green Revolution will urge more heavy mechanisation. If so, mechanisation itself will become a prerequisite to the

other innovations package identified with the Green Revolution. In the labour surplus countries, however, this is not and cannot be the case, at least, theoretically; for both in India and Pakistan though not a prerequisite, hevy mechanisation has, unfortunately, become a part of the Green Revolution reality.

In addition to the heavy reserve-depletion burdens that such mechanisation has put upon the shoulders of both these countries, it has also created vast unemployment problems.

In both India and Pakistan the Green Revolution has, on the whole, been adopted by large landowners who tend to prefer mechanisation not for sound technical and economic reasons but even for such reasons as to avoid probable labour wage bargaining and breaking the labour union power*. These are, of course, not the sole reasons for such wide, spread, easy mechanisation that is being observed in the Indian subcontinent. Added, and much more important the others, are the Institutional conditions within the adopting countries, government economic policies and mechanisation promotion by foreign aid resources and multilateral agencies, not forgetting the domestic industrialists and politicians (Ahmad, 1972; Gotsch 1973).

As regards to the first of these, institutional conditions within the adopting country may strongly encourage mechanisation at the expense of the low income majority of the rural population who are either wagearners, share, tenants or small landowners. The distribution of land, the land tenure system and (built-in) biases of service organisations in favour of large land-owners are such institutional conditions which, in effect, encourage mechanisation precess. Both the Indian and Pakistan experience supports this.

In India — and Pakistan alike — , the land distribution and tenure system shows that the large landowners have a sizeable place within the rural society, Being so they have always been very influential in any initiative move in agriculture, the Green Revolution being no exception. In actual fact both these countries the Green Revolution has largely been adopted and introduced by the large and rich landowners, who more often than not do not cultivate themselves. As opposed to the low income small farmers who generally work the land themselves with the help of family labour, the large landowners, having got to hire labour, are highly cost-conscious especially during the peak periods when both demand and wage for labour rises. To overcome this private cost disadvantage they substitute machinenes for human and animal power. The widely substituted heavy machines in this respect have been tractors, threshers and reapers . The labour displacing affects of these machines are markedly high. For the Punjab, for example, it has been estimated that, by 1983-84

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* "Although the farmers outwardly claim that the introduction of mechanical devices is intended to increase efficiency, several of them told us that 'the only way to teach these arrogant labourers a lesson is to mechanize agriculture' or 'in order to liberate ourselves from the dictates of agricultural labourers we would resort to mechanisation".

Oommen, T.K., "Agrarian Tension in a Kerala District: An analysis. *Indian Journal of Industrial Relations* vol. 712, 1971, p. 261 .

labour displacement will be of the order of 146 million man-days with about 37 per cent of the total displacement being caused by threshers and reapers alone (Ahmad, 1972).

There is clearly no economic justification for such a rapid mechanisation in the Indian subcontinent where there are large pools of under and/or unemployed labour. There appears to be clear divergence between the personal interests of individuals concerned only with maximising their own profit margin and the interest of society as a whole, the profit seekers taking no account of... the social costs of exacerbating problems of underemployment and unemployment, which do not enter into their personal assesment of costs and returns (Ahmad, 1972). For this, how ever, perhaps a larger part of the blame lies with the government policies in the concerned countries. Government economic policies in the forms of subsidies, licensing procedures, and tax reductions are the very things which by suggesting private profitability in mechanisation have, in fact, resulted in that direction. In addition, the prices both of inputs such as wheat, maize and Sugar-cane are distorbed-by government policies-in such a way that they enhance the attractiveness of mechanising farming operations (Gotsch, 1973).

In Pakistan, for instance, the general thrust of government policy has been to promote mechanisation, As a result a range of incentives-prodiring an extremely favcurable climate for mechanisation has been created against the some cautioning of the Planning Department on "premature" mechanisation. As a part of such incentives, the Agricultural Development Bank (ABD) has subsidized tractor mechanisation very heavily. As against the common 12 to 15 per cent rate of commercial banks for medium term credit, the ABD has chosen highly concessionary rates of 7 to 8 per cent. Moreover, the foreigh exchange for tractor purchases and other mechanisation has been sold to farmers at the official rate, which is almost half the value of foreign exchange in this country.

Mechanisation has also been encouraged by the generally favourable income position of the farmers thanks to the government policy which pegged the prices of a number of crops at rates well above the world example the wheat prices were supported at approximately 50 per cent above the world wheat prices (Gotsch, 1973).

4. The New Cropping Pattern

The Green Revolution and especially the genetic innovations side of it was initially limited to wheat. Indeed, as late as 1968-69 the area under the new wheat varieties in India were almost twice that of the new-rice varieties. To be exact in this year the area under the new wheat varieties was 12.0 million acres of rice (Jayaprakash, 1973). That was in fact an increase of 10.7 million acres in the new wheat area over the 1966-67 level 1.3 million. Such as massive switchover can, no doubt, be attributed only to one factor; the high income potentials of the new wheat varieties. Indeed this very factor has attracted many farmers into cropping wheat instead of the previonus crop varietties that they grow.

These changes in cropping patterns cause serious unemployment problems when the change is from a relatively labour, intensive crop to a relatively less-labour demanding crop. This case is clearly improved dwarf wheats, in labour-requirement

terms have a comparative advantage over cotton (which requires a good number of labour), the old cotton, fields have been turned into new wheat fields, thus giving rise to a considerable amount of unemployment.

Although the exact number of peaplo losing farming jobs as a dircet result of the switch-over is not known observations on changes in crop acreages may give some clue in this respect. For the whole of India, the cotton acreage and production has decreased tremendously since 1964-65. In 1970-71 crop season the cotton had already lost 755,000 hectares as compared with 1964-65 level, to other crop production. The resulting loss in production has been 1,121,000 tons. In Madhya Pratesh region alone an absolute acreage change of 213,000 hectares was recorde in 1970-71 against the 1964-65 level; with 56.5 per cent wall in the to cotton production although, the cotton yield during that period had risen by 8.0 per cent, Meanwhill the area under the wheat production in this same year recorded 170,000 hectares increase. A clear indication that a very large proportion of cotton fields had gone to wpeat production (Bansil, 1972).

Such changes in cropping patterns have also taken place in rice fields. In bihar for instance there was a recorded decline of 77,000 hectares in the area under rice which was, in fact, shifted to wheat production. In Orissa, the shift has been more substantial8 239,000 hectares previously under rice was transferred to other crop productions most notably to wheat. The loss in rice production due to this shift for the 1970-71 season was a massive 664,000 tons. Even West Bengal, a traditionally rice growing state increased its area under the wheat crop from practically nil to over lakhs hectares[30].

Although it is certain that the new cropping pattern has re-employed some of the old workers, the pattern of change suggest that the number left unemployed are much larger than the number of people being re-employed.

II.B The Green Revolution and Regional Disparities:

Among the socio-economic problems attributed to the Green Revolution, the question of regional disparities has been the least explored. Indeed, the lack of any quantitative study leaves most of the issue still in the dark. Notwithstanding most of the literature on the subject support the view that the Green Revolution has, in fact, caused both regional and intra-regional disparities in India and Pakistan (Cleaver, 1972; Folcon, 1970). One point, however, is worth to be made clear from the beginning; and this is that the Green Revolution in India and Pakistan rather than actually creating regional and intra-regional disparities; it has only reinforced already disparate structure prone to such effects. What is more, even with the built-in structural disparities the Green Revolution in these countries would not have had the negative affect of increasing the disparities at the present speed and degree if only in its application the government of the concerned countries could have taken somewhat more cautious policy measures.

In India, for instance, the regional and intra-regional disparities brought about by the Green Revolution have their roots in the so-called new plenning policy formulated by the Planning Commission in 1964. In it, two important recommendations were made to speed up the agricultural development.

Firstly, it was recommended that efforts should be concentrated in the 20 to 25 per cent of the cultivated area where supplies of assured water created "fair prospects of schieving rapid increases in production" (Frankel, 1971).

Secondly, it was recommended that within such areas all material and financial aids to increase production should be provided for the "progressive" cultivators who were very likely to make a good use of the provided facilities.

Based on these recommendations the new policy was put into practice on October 1965, when 114 district out of 325 were selected for an Intensive Agricultural Areas Program (I.A.A.P.). Around that time the importance of the new genetically improved seeds were just beginning to be realised, By November 1965, the Food Ministry took the steps for the application of the new seeds in the selected areas of I.A.A.P. With this "New Strategy", also came the notion of "package pratices" which emphasised the necessity of providing the cultivators with..... credits, modern inputs, prive incentives marketing facilities and technical advice (Frankel, 1971).

With the 'Intensive Areas' strategy it was inevitable that regional and intra-regional disparities would be accentuated. This is what has actually happened. While the selected areas have made marked progressess, the dry areas of the country which constitute one, third of the sown area, with poor irrigation rescurce and rainfall have fallen farther back. Even the selected areas have not shown the same levels of improvements (Rudra, A. (1971).

The findings of a recent study is, indeed, very revealing in this respect. First of all, it can be argued that the coming of the Green Revolution has above all benefitted those regions that have produced wheat and rice and not benefitted those regions that have carried on producing other farm varieties such as jowar, sugarcane, cotton, groundnuts, jute, etc., Over the six year period between 1964-65 and 1970-71 cotton production showed a 19.7 per cent decline, and jute 19.1; while rice production, over the same period showed an 8.0 per cent increase and wheat 89.7 (Bansil, 1972). But even the Green Revolution regions have not shared the benefits equally. The just quoted figures show a clear-cut wide difference between the rice and wheat regions. Thus while the wheat growing regions have reaped larger shares of benefits from the Green Revolution the rice growing regions have not been so lucky.

On the other hand, there has emerged large divergencies among the wheat growing regions. The Indian Punjab has benefited the most out of the Green Revolution practice. The wheat production in Punjab has increased fram 2,360,000 tons in 1964 - 65 to 4,873,000 tons in 1970 - 71. This is an increase of 1 - 6.5 per cent. In Maharashtra over the same period, the wheat production has increased from 408,000 tons to 451,000 tons. To make the difference between the two regions more apparent it must be added that against the 106.5 per cent productuon increase of Punjab, the increase in Maharasthra is only a 10.5 per cent (Bansil,1972)

In the case of rice, differences between the regions have been more severe. While some regions have made disparate gains, many others have, in fact, lost their previous gains. Thus while Tamil Natu has increased its rice production from 1964-

65 to 1970-71 by 31.4 per cent; the rice production in Orissa has, over the same period, declined by a massive 15.0 per cent.

The Indian case of regional disparities is very complex, and a comprehensive analysis of its deep-rooted causes (some of which were briefly mantioned in the openning section of this paper would require a massive study beyond the boundaries of this paper. It thus, however, appears that the major factor reinforcing the rigional and intra-regional disparities-as in Pakistan has been the availability or non-availability of a good irrigation system. The Pakistani experience illustrates this point only to well. Since tubewells constitute the basic implement for assured water supply, the regions with greater number of tubewells have benefited the most from the Green Revolution. The recent study by L.Nulty on Pakistan, shows that in tihs respect there are large differences between the regions. With respect to size and cilimatic conditions, there is an apparent inequality in the distribution of tubewells as between the regions. In Multan (Lahore) for instance, the number of tubewells was only 945 (Nulty 1972). But the inter-relationship between tubewells and production and resulting difference from this is best reflected in the case of Behawalpur and Khairpur. In the 1968-69 crop season Bahawalpur wheat acreage was 7 million acres and the production of wheat was 9 million tons. In contrast although Khairpur had a larger wheat acreage, 9 million acres, its wheat production was 1 million tons less than Bahawalpur's, i.e., 8 million tons. Granted that other factors were at force; the availability of water by tubewells seem to have affected the performances of the both regions, for while Khairpur had 295 tubewells in this crop season, Behawalpur had 1,845 (Nulty, 1972). Thus although the cultivators in Khairpur had cultivated a much larger area, their benefits from that cultivation was less than their counterparts in Bahawalpur who had cultivated a smaller area. On the whole it has been found the average yields on the rain-fed farms are 3- to 100 per cent less than the irrigated lands. With such differences in the average yields, it is almost inevitable that there will also emerge vast output and income differences.

In addition to the income differences that are generated by water-availability in the forms of tubewells the existence or non-existence of tubewells also affect considerably the employment oppurtunities of the regions. "According to the 1967 P.I.D.E. (Pakistan Institute of Development Economic) survey, tubewell farms employed more workers in absolute terms and in terms of the manland ratio'.[9]

The question of regional of regional and intra-regional disparities has also constituted one of the bases for income inequalities between the rural groups which we analyse next.

II.C. The Green Revolution and Income Inequalities:

One of the central questions in the Green Revolution discussion- as indeed in discussion of any major economic and social change- is who gains, who loses; by now much; are the gains relative or absolute and is anything being done to distribute the gains equally?

To answer such questions the income position of various size of farmers, tenants and labourers- those who are directly involved in the Green Revolution application- have to be examined.

To start with the farmers, the Green Revolution has generated varying income increases, the size of which has depended on the farmers' holdings, Consequently, the largest single group making the most out of the new-innovations package, in both India and Pakistan, has been the large farmers. Being the wealthiest and best educated, who are in close contact with the authorities, the finance institutions, and even the research bodies the large farmers are obviously better placed to make use of the new package and obtain the necessary resources for its usage (Ouaden, 1971). This, they have indeed done. By initiating the Green Revolution practice in the very beginning, the large farmers have increased their incomes mayfolds.The gains that these large farmers have made is subtantiated by empirical evidences from the Green Revolution areas. In a survey conducted among Bisauli farmers by the Uttar Pradesh Agricultural University in India it was found that grose crop returns for the new seed farms in 1967-68 was around Rs. 450 per acre, and for the olr-seed farms it was only Rs. 200 (Wills, 1972). Thus a farmer with even a mere 20 acre, by cultivating the new varieties, would have made an income many times larger than the small farmer of say 7.5 acre, who due to non-availability of the new innovations package, unwillingly cropped the old variety.

In Punjab, the new innovations package, were largely utulised by the cultivators with large land holdings of 20 acres and above; a number which accounted for 37 per cent of the total cultivators in the area. Inevitably, the gains were largely accrued to these large landowners and soon a serious income disparity rapidly emerged, between them and the majority of other farmers with holdings smaller than 20 acres (Frankel, 1971) The size of income gaps thus created between the large farmers and the small were alarlingly high, as the following finding in Ludhiana depicts.

In 1966-67, in Luthiana the average yield of old-seeds was found to be 2,108 pound per acre, or a little less than 10 quintals. On the other hand, the average yield of the new seeds, in the same crop year, was 4,235 pounds per acre, or 20 quintals. In that crop year the procurement price for the new varieties was Rs. 76 per quintal, whereas for the local variety the price thanks to the consumer preference was Rs. 80 per quintal, i.e., a little higher than the new varieties. Accordingly a farmer who cropped and sold the new varieties grossed approximately Rs. 1,520 per acre. Allowing for the input costs of around Rs. 260 per acre, the net return to him was still somewhere around Rs. 1,260. The farmer growing the old varieties with Rs. 80 per quintal grossed only Rs. 800 per acre, subtracting the input costs of around Rs. 100, the net income per acre left was only around Rs. 760 on average therefore, the farmers who did take up the new innovations package doubled their output and increased their net income by more than 70 per cent (Frankel, 1971).

With the demonstration effect and deliberate government policies of providing services it was hoped that the Green Revolution practice would soon spread amongst the small farmers and thus benefit all the farming groups equally. However, three years later, various discussions with the extension workers the economists at the Punjab Agricultural University and more important the farmers themselves, have revealed that while all the farming groups participating in the new innovations package have made some gains, proportionately a much greater share has continued to go to the large farmers with holdings of 20 to 30 acres or more.

The reasons for the failure on the part of the small farmers to utilize the innovations package fully and share the resulting income gains can be identified as thus: The prospects of attaining maximum results from the application of the new seeds depend mainly on the availability of sound water supply management. This means that in order to attain sufficient water supply some irrigation works have to be carried out either by pumsets, tubewells and/or percelation wells. This with the other innovation units, such as fertilisers, pesticides, seeds etc., requires large capital investments. To take just one example the cost of installation of the smallest tubewell, which could provide water supply for a field of 20 to 25 acres was, in the immediate years of the Green Revolution, approximately Rs. 4000 to Rs. 6,000. With such large costs only the big farmers could finance the irrigation works either from their own personal wealth or from credit loans. The small farmers, on the other hand, could do neither; especially so in the initial years of the revolution. Until mid-1967, only farmers with 20 acres and above were eligible for minor irrigation loans. Although in 1967 the limit was lowered the 15 acres and above. This limitation still left out a large section of the farmers from participating in the new seed cultivation. Only in 1969 did farmers with holdings as small as 5 acres become eligible for government loans for tubewells and other Green Revolution inputs (Frankel, 1971).

There are two more reasons why the gains to the small farmers are less than to the large farmers. Firstly, because of the high costs of the fertilizers, the small farmers are almost forced to apply them in smaller doses, thereby failing to attain the full yield potential of the new seeds. This is confirmed by the fall in average wheat yields from 20 quintals per acre in 1966-67 to 14 quintals in 1968-69 (when the number of small farmers participating in the Green Revolution had considerably increased and when one would have expected a much better performance). Secondly, because of the high increases in input costs, the returns to investments in them have been declining (Frankel, 1971; Sharma, 1972).

With all these forces at play, the income gains achieved by the small farmers have only been marginal, whereas the large farmers with holdings of 50 acres and above have experienced a qualitative change in their standard of life.

III. How To Solve The Problems: Some Policy Implications Of The Green Revolution:

The Green Revolution - as it has been analysed in some dept in the previous pages - represents a significant advance in the agricultural technology of the adopting countries. It has a genuine potential for economic development. But there is the danger that if the appropriate measures are not taken soon, this potential may never be realized. The past experience of both countries show countries show that such policy measures have repeatedly been ignored and as a result a host of problems has sprung with serious social and political repercussions. There is now an urgent need for a set of policies. With respect to the Green Revolution practices these policies are the policies are the policies related to the production problems of the Green Revolution, and to the distributive (Welfare) problems of the Green Revolution.

Can the Green Revolution only as a package application produce the maximum results expected from it. From the experiences of the both countries it is now clear that no single innovation application can create a substantial improvement in foodgrain production. Moreover, the technological innovations like high yielding seed varieties, irrigative implements, chemicals and fertilizers are inadequate, if economic factors such as credits, input supplies, price incentives, adequate transport and marketing systems and agricultural training are not available. The problem of providing all these modern inputs and supporting services is very considerable. Green Revolution requires the setting up of an organizational framework which will be able to provide these inputs and services not only to a few rich and able farmers but also to the small farmers, and tenants who form the bulk of the rural population and yet cannot find an access to these Green Revolution packages. For a real agricultural revolution has to affect the mass of rural people.

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