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BACKGROUND PAPERS FOR DISCUSSION
AT
THE INTERNATIONAL SEMINAR
ON
**“COMPARATIVE EXPERIENCE OF AGRICULTURAL
DEVELOPMENT IN DEVELOPING COUNTRIES
SINCE WORLD WAR II”**

NEW DELHI

25th, 26th, 27th and 28th OCTOBER. 1971

THE INDIAN SOCIETY OF AGRICULTURAL ECONOMICS
46-48, Esplanade Mansions, Mahatma Gandhi Road, Fort,
BOMBAY-I.

AGRICULTURAL MECHANIZATION IN SOUTH ASIA

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The last few years have witnessed a significant shift in the literature on economic development. It used to be that top priority in terms of output and employment was given to industry as the dynamic sector whose growth was to pull other sectors along. Most of the policies following from this viewpoint--low food prices, emphasis on heavy industry, import substitution, and protection against foreign manufacturers--had the direct or indirect consequence of subsidizing industry at the expense of agriculture. A number of factors have changed all this: one consequence of starving the agricultural sector has been the need to import increasing quantities of food; an upward revision has been necessary in estimates of the speed with which population and hence the labor force has been growing; and third, the labor-absorbing capacity of the industrial sector has proved less than had been hoped, certainly less than needed. Finally, the advent of the new seeds (HYV) and cultural practices have capped this intellectual transformation. Among other things, this technology raises the hope that a solution to unemployment may be found in the countryside rather than in already overcrowded urban areas. But despite its potential, two nagging questions about the new technology have arisen: will it lead to

* Development Digest, Vol. IX, No. 1, January 1971, pp. 108-113. (Adapted from a report on a conference "Employment and Unemployment in Near Eastern and South Asian Countries," sponsored by the Government of Nepal and U.S. AID, Kathmandu, Nepal, 6-9, July, 1970).

more rather than less inequality in income and wealth; and if so will it, abetted by factor price distortions, encourage a form of mechanization that is labor displacing rather than labor absorbing?

The discussion here will focus on the second question. We are concerned with agricultural mechanization from several standpoints: what is its overall impact on employment? What effects will it have on productivity? How may its probable costs and benefits be jointly assessed in a South Asian setting? Several recent studies on the subject, and some of the discussions at a July, 1970 conference in Nepal which dealt with employment problems in the region, may be summarized.

Professor Khairullah Dawlati, in a paper presented in this conference, "The Effects of Tractors on Farm Output, Income and Employment During the Initial Steps of Farm Mechanization in Afghanistan" (mimeographed, 1970), supplies data covering more than a decade in three regions of the country. Tractors were all used on very large farms, and their purchase was in part subsidized. Their use was in most cases associated over time with increases--varying by region and by crop--in irrigated area, output, marketable surplus and net farm income. The farm labor force was reduced in numbers by about 7 per cent (however, off-farm employment was no doubt increased by more than that). A more important change occurred in composition of the labor force; many renter-tenants were turned into share-croppers and full-time laborers, the landlord keeping more of the management functions (and possibly returns) to himself. We may note that many other changes

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were occurring simultaneously with the introduction of tractors, but the economic results of tractorization can nevertheless be regarded as favorable. Such a conclusion is plausible in a country with a man-land ratio lower than average for the region, and where new lands can still be brought into cultivation.

Nowhere in South Asia, however, has mechanization become widespread. In Afghanistan we are talking about the effects of no more than 500 tractors imported over the years 1954 to 1966. Even in the Indian Punjab, only 20,000 tractors were available in 1968/69 for a total cropped area of over 10 million hectares. Far more important is what may happen to agricultural employment in the future, which is the topic of the Billings-Singh paper. For the Punjab, the authors project an overall reduction of 17 per cent in the need for labor by 1983/84 as a result of the projected introduction of new seeds and mechanical innovations. For Maharashtra, while agricultural labor requirements are to increase because the positive effects of more intensive cultivation with new seeds will more than offset the substitution effects of a limited introduction of mechanical power, the agricultural labor force is nevertheless expected to increase considerably faster than the demand for its labor. Thus, unemployment and underemployment can be expected to rise in both cases, unless the surplus labor is absorbed in non-agricultural occupations--as appears to be occurring in the Punjab. The disparity in these results suggests that similar projections for other areas will have to be undertaken before any general pattern begins to emerge.

A study of tractors in West Pakistan by S.R. Bose and E.H. Clark (The Pakistan Development Review, Vol. IX,

No. 3, Autumn 1969) concludes that the social benefit-cost comparison for tractors is negative, and that such machines are inappropriate to a labor-surplus economy. The authors analyze the economic effects of progressive tractorization of all suitable farm lands in West Pakistan at various annual rates, computing first the direct costs and benefits to farmers at current prices (including gains from lower labor cost and replacement of bullock fodder with other crops; output per acre increases as a time trend only). These turn up generally positive for the farmer. The social costs and benefits--to the national economy--are then obtained by adjusting the farmers' figures to eliminate effects of the subsidies and agricultural price supports (a dominant element) and the taxes involved. Here the results are strongly negative: at a 12 per cent annual growth in tractors, for example, the annual direct social costs by 1975 would be 330 million rupees compared to some 200 million in benefits. In short: tractors are profitable to farmers as individuals, but not to the nation as a whole. The authors also judge that indirect, non-measured, costs (re-settlement of displaced workers, loss of meat and milk supply, disadvantages of local tractor production compared to animal-implement production) clearly exceed the indirect benefits (increases in mechanical skills and agricultural savings).

These conclusions contrast sharply with Roger Lawrence's in his recent study "Some Economic Aspects of Farm Mechanization in Pakistan" (1970, mimeographed). 1) He first analyzes the effects of introducing a series of mechanical devices in six stages on a particular wheat-cum-cotton sequence of cultivation on irrigated land in

West Pakistan. Timeliness is a key factor because speed in harvesting winter wheat and planting spring cotton in a given field strongly affects cotton yields; it also affects the subsequent time of planting for wheat and whether the cycle can be completed within a year or must be interspersed with fallow and other crops (as is common). Costs are measured at current market values and also as "opportunity costs" based on scarcity values. The costs per unit of output measured in both ways were found to decrease continuously as mechanical devices were added, with an overall reduction of nearly 50 per cent as compared to traditional methods. The labor requirement per acre with mechanical devices used remains greater than or nearly equal to the labor required with traditional methods up to the final and most mechanized situation in which combines are introduced, where it falls to a somewhat lower level.

2) For wheat growing on rainfed soils, the use of tractors is even more favorable, largely because they make possible deeper plowing which, in certain soils, conserves the limited moisture available in much of West Pakistan; yields can be increased up to three times in some areas.

3) For rice lands in East Pakistan, on the other hand, power tillers can contribute neither strategic timeliness nor significant moisture retention. With labor and bullock inputs priced at market values, tillers can offer cost savings; but a comparison of opportunity costs (including labor and grass feed at zero) would put bullock cultivation under half the tiller cost per acre.

A few comments are in order. First, the effects of various innovations are treated separately in the Billings-Singh paper; the interactions among them which might make the sum of the parts greater than the whole

are not fully taken into account. In particular, by increasing the speed of agricultural operations, tractors permit an increase in intensity of cultivation. The authors assume some increase in cropping intensity over time, but the rates were estimated on the basis of historic trends rather than related to the rate of mechanization. Given a specified rate of increase in cropping intensity, the addition of tractors will then be labor-displacing, as they indicate; but it may not be if appreciable additions to multiple cropping are induced by the mechanization. Lawrence's paper focuses on just these possibilities, using cases where data were collected in sufficient detail to show the results of using particular machines. Bose and Clark, however, cite a survey showing inconclusive results of mechanization on the productivity of land, and argue that animal-powered implements may have as great a potential as tractors. The question of whether there are other ways than tractorization to increase cropping intensity is an intriguing one. On the face of it there would seem to be no agricultural processes that could not be speeded up merely by using more labor and bullocks. The difficulties in applying this solution in practice have been that labor-management problems on large farms can become severe and that shortages of labor and bullocks are likely to appear during peak harvest and planting seasons. More investigation of alternative means of increasing cropping intensity, and possible barriers to each, is obviously called for.

Another neglected interaction which could be important for employment is shifts in crops as a consequence of mechanization. Some shifts were allowed for by Billings and Singh, but in the main these were based

mainly on historic trends which may be invalidated by the mechanization. Thus if mechanization does in fact allow for an increase in multiple cropping, some land devoted to foodgrains could be freed for more labor-intensive crops. In addition, displacement of draft animals will release a certain amount of acreage under fodder (as Bose and Clark note) which could be used for more labor-intensive crops.

Many of the indirect effects on labor demand and supply were not assessed in these studies. An increase in farm income in general, and mechanization in particular, will lead to an increase in the demand for labor on two fronts: first, to produce, repair, transport and service an expanded range and quantity of inputs into agriculture, and second, to supply a wide variety of consumer goods and services. Within a local area some displacement of craftsmen may take place as demand shifts from traditional commodities to factory-made substitutes; this could be serious during a transition period that may last some time. But offsetting this will be an increase in demand for higher quality foods--fruits, vegetables and dairy products--all of which require more labor per acre to produce than do foodgrains. In addition, the increased income may actually reduce the labor force participation rate for women, thereby further easing the employment problem. Finally, the increased supplies of foodgrains resulting from mechanization will have a favorable, differential impact on the relative price of this important set of wage-goods, and make it possible to employ more labor generally throughout the economy with less inflationary consequences.

On the other hand, the increased use of capital for mechanized agriculture could mean less capital available

for other employment-generating activities. If the same increase in cropping intensity could be obtained using more labor-intensive techniques, it may be better to use the capital elsewhere. But labor-intensive methods are not always the most economical methods; and in any event substantial institutional and political changes may be required to bring about comparable results. Furthermore, since the incremental capital-labor ratio in agriculture is still low relative to that of most other sectors, and since the availability of new techniques and machines for agriculture could induce an increase in the propensity to save among farmers, it is unlikely that such lost opportunities will negate the positive effects.

A final consideration is that all of these studies were made under the assumption that institutional conditions will not change in pertinent ways. But there are other possibilities: for example, a trend toward larger landholdings and larger-scale farm operations, noted by some observers in east and west Punjab as well as by Dawlati in Afghanistan, could accelerate. On the other hand, anti-landlord pressures might gain strength, forcing new land reform moves or stricter enforcement of existing laws. Another possibility is that seasonal labor shortages in particular areas might be met by short term recruitment of workers brought in from labor surplus areas rather than by mechanization. Still another relevant change would be a rapid activation of programs which give small farmers a greater access to new seeds and related inputs. The first change would presumably decrease labor intensity, whereas the latter three should bring about increases in the labor intensity of farm operations. Still another possibility

is the development of customized machine services which should help maintain the viability of small farms.

In sum, three broad categories of conclusions emerge from these studies. 1) Most forms of mechanization will displace some labor and bullocks applied to particular operations; but, because they can increase crop intensity and help conserve moisture in some circumstances, there are some offsetting positive effects on employment as well as contributing to output. The extent to which the positive employment effects offset the negative ones depends strongly on the particular mechanical device being considered (e.g., tube wells vs. combines) and the particular soils and cropping patterns to which it is applied. 2) There are a number of indirect employment effects on other sectors, most of which should be positive. Since the studies at hand do not measure these effects, the outlook for agricultural labor is likely to be somewhat more favorable than they indicate. 3) But the overall net effect will be strongly influenced by the prices and the institutional arrangements that prevail. If, for example, market prices were to be brought into line with true opportunity costs, if land ownership ceilings could be enforced, or if additional migration of labor during harvest time could be encouraged, forms of mechanization particularly detrimental to labor would be discouraged.

Beyond this little of a general nature can be said. The situation is so complex, and the possibilities so varied, that no overall verdict on mechanization is possible. Particular devices, used for particular crops in specified areas, must be considered on their merits

in the light of the relevant institutional conditions and national objectives. Where so little is firm, a general policy approach worth considering is to correct price distortions and let the chips fall where they may, that is, to provide market signals reflecting true scarcities and let individual decision-makers choose whatever forms and amounts of mechanization they find to be in their best interest. This approach is not without its own set of difficulties, but at a minimum raising capital costs relative to labor costs so as to better reflect relative scarcities should help to deflect trends in useful directions where agricultural labor is plentiful and underemployment is a general problem.