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Comments on farm mechanization in less developed countries

At last two policies are evident with regard to the question of agricultural mechanization in less developed countries.

On the one hand are government subsidization policies for larger tractors either for private purchase, hire service or for highly capital-intensive government schemes such as land settlements, state farms and irrigation projects. Generally, these have either been failures or have disregarded the larger issues of income distribution; replacement of labour and animal power; foreign exchange requirements for purchase, for fuels, spare parts and technical training of man power and administration (Eicher *et al.*, 1970, pp. 18-24). For example, these problems have been well documented for Africa (Kline *et al.*, 1966).

On the other hand is the approach that looks at the second generation problems arising from the above policies and tries to do something about them. This policy does look at the larger issues and stresses the need to design and adapt mechanical technology to suit local conditions (Thorbecke, 1970, pp. 26; Eicher *et al.*; Pearson Report; Greene). However, because the latter approach is a relatively recent phenomenon, the attitude that modernization and mechanization are synonymous seems to be more widely prevalent among policy makers.

The purpose of this paper is to discuss the above problems using a recent report by the government of Thailand and one by the UNIDO (1) in Lebanon as exhibits. It is very probable that similar reports are being made in many other less developed countries and particularly in the Middle East which by their omission of highly relevant arguments are likely to do more harm than good to the national economies of these countries. The arguments that are omitted are extremely relevant to the broader questions of economic, social, political and agricultural development policies.

Exhibit one : THAILAND

In 1967 there were 848 two-wheeled and 3 457 four-wheeled tractors imported into Thailand at a cost of 192 million Baht or about \$ 9,2 million (*Thailand Farm Mechanization etc.*, 1969, pp. 34,

38). Total two-wheeled and four-wheeled tractors in use in 1967 were estimated at 2 040 and 17 500 respectively. The trend toward importation of larger horsepower machines is seen in that 83 % of farm tractor imports as of 1969 had been for 50 to 69 horsepower tractors (*Thailand Farm Mechanization etc.*, 1969, pp. 57).

All tractors were imported for assembly in Thailand. The two-wheeled Japanese models were in inter-row vegetable cultivation while the larger models, primarily imported from the United Kingdom, were rented out by private owners for land preparation. Import costs for other implements was 21 million baht or about \$ 1 million (*Thailand Farm Mechanization etc.*, 1969, pp. 42-43).

While tractor plowing was also used with non-rice (or upland) crops, 56 % of the regional market for tractors was in the Central Plains geographic region

TABLE I
 Power Sources Used by Farmers in Rice Production, Thailand, 1967 (*)

Region	Power Source for Land Tilling	
	Hand Labour plus Animal Power %	Farm Tractors %
1. Metropolitan	20	80
2. Central Plain (Lower) . . .	31	69
3. West	68	32
4. East	33	67
5. Central Plain (Upper) . .	34	66
6. North . . .	88	12
7. North North-east.	62	38
8. Near North-east.	81	19
9. East North-east.	97	3
10. South . . .	44	56

(1) UNIDO refers to the United Nations Industrial Development Organization.

(*) Thailand, Government of, *Thailand Farm Machinery, etc.*, 1969, p. 102.



(*Thailand Farm Mechanization etc.*, 1969, pp. 4) where Paddy was the dominant crop. Tractors were used as a power source by over 50 % of the farmers sampled in five out of ten regions in 1967 (Table 1). Agricultural survey results in 1963, however, estimated that only 14,9 % of farm house-holds used mechanical power of any form (*Thailand, Census of Agriculture, 1963, Summary Volume*). Therefore mechanization appears to be taking place at a rapid pace.

This report was mainly concerned with the use of large, four-wheeled tractors. The trend towards larger horsepower tractors was shown and reasons for this trend were given as : « hard soils », the « scale of commercial operations in peak seasons » would require large machines, « less personal labour requirements and greater efficiency » (*Thailand Farm Machinery etc.*, 1969, p. 57). In this view, the two-wheeled tractor was a spearhead for the introduction of larger tractors.

No mention was made in this report of the long term possible problems of tractor mechanization policies. Nor were these problems mentioned in the development plan (Thailand, *The Second National Economic and Social Development Plan, 1967-1971*).

It is this omission which makes the above report of only marginal use to policy makers in my opinion.

Exhibit two : LEBANON

Recently, a report was published in Lebanon discussing in detail the actual and future aspects of agricultural mechanization in Lebanon (United Nations, UNIDO, 1971). A further purpose of the report was to study the possibilities of setting up a center for the adaptation of, construction of, and experimentation with agricultural machinery to Lebanese conditions. This objective is definitely worthwhile. However, the tone of this report is such as to avoid discussion of secondary problems that could arise from a mechanization policy.

The following points are made. There were about 3 500 tractors in use as of 1971 of which 70-75 % were four wheel tractors between 25 to 60 horsepower (U.N., UNIDO, p. 16, 50). Total imports of tractors and other machi-

nery amounted to 5-6 million Lebanese pounds per year (*Ibid*, p. 20). Local construction of machinery was valued at less than 1,5 million Lebanese pounds (*Ibid*, p. 20) and this was primarily by four small shops (*Ibid*, p. 23). In fact, there is very little detailed information on the state of mechanization in Lebanon and the first statement in this report acknowledges the uncertainty of statistical facts (*Ibid*, p. 16, section 3.1.1.). There are not more than 5 tables concerned with machinery in this whole report.

However, this has not prevented the report from making recommendations. By 1986-87, Lebanon should have some 9 to 10 000 tractors of which 70 % would be four wheeled, 25 % two-wheeled and 5 % crawler. The required machinery for tillage and other operations is listed (*Ibid*, Table 9, p. 51) and small crawler tractors of 15-25 horsepower are recommended for terraces and sloping lands (*Ibid*, p. 53). Local construction of tractors is not foreseen but only of certain implements (*Ibid*, p. 62).

Even though recognizing the importance of small holdings under 5 ha in size (*Ibid*, p. 22), there is no mention of any possible secondary problems such as : income distribution, unemployment, increased rural-urban migration. It is these omissions which, in my opinion, make this report of limited use to policy makers.

DISCUSSION

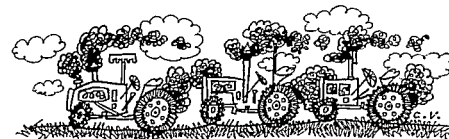
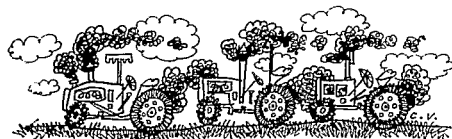
It can be seen from the above reports that the possible long term problems of agricultural mechanization have been omitted. But there are other reports that also fail to mention these problems. For example, the 1963 conference on the agricultural engineering aspects of rice production did not mention then (Johnson, 1963, pp. 22-24). More recently was the FAO and Massey-Ferguson Export Ltd. London conference to support the international rice year in 1966 (FAO, 1966). In the latter report, the disadvantage of small farm size when it comes to mechanization were stressed and the social, economic and political problems that may result from mechanization were avoided. Again, large machinery was considered a necessity in the Muda River project in

Malaysia (Bean, 1969). Finally, in the same manner, statements have been made which fail to consider the broader questions of income distribution, unemployment and rural-urban migration. For example : « It is only by larger output per man that farm incomes can be increased » (Stout, p. 13); or, « No-one wants to worsen the unemployment problems, however... overall economic development and increased standards of living (for whom ?) depend on increased productivity of labour » (Stout, p. 20). The overall tone one of the latter report by Stout put out by the FAO is to convince policy makers who know little about the complexity of the subject that mechanization and modernization or even agricultural development are synonymous.

In countries where the rate of growth of population is high and the rate of absorption of labour into the small industrializing sector is low (2), the relationship between agricultural development policies and overall economic development must be considered. This relationship is most evident with regard to the problem of labour unemployment (Frank, 1968 ; Baer and Herve, 1966). The key questions in any mechanization program should be the short and long term effects of mechanization on rural and urban economic problems, alternative methods of mechanization and the social and political implications.

Looking again at the FAO — Massey-Ferguson conference on rice mechanization as an example, one can see that the experiences of Japan, Taiwan, and a growing number of African and other countries which have developed technology to suit the mechanization problems of small farms under the heading of intermediate technology were ignored. One participant to this conference confused the issue by suggesting that modernization and the use of large tractors on large farms are synonymous in one sentence and then retracting this by saying that where populations are dense

(2) The rate of growth of population was estimated at 2,5 to 2,8 % for Lebanon (U.N., UNESOB, p. 221) and over 3 % for Thailand (Thailand, Gov't of, 1968, p. 54). Industrial growth is very slow in Middle Eastern countries (Chatelus, 1971) and in Thailand, only 3 % of a total of 43 506 factories established and registered by the end of 1967 employed more than 50 workers (Rojvithi, 1968) even though the manufacturing sector grew at a rate of 10,5 %/year up to 1966 (Thailand, Gov't of, 1968, p. 17).



and off-farm labour absorption slow the problem of mechanization becomes insoluble (Beckett, 1966, pp. 31). The argument is used to show the weakness of small scale rice farming in terms of increasing their productivity through mechanization. But no reasons are given why other countries could not imitate the Japanese experience prior to developing large scale mechanization. Another participant dismissed the problem of unemployment due to mechanization by saying that « ways and means of profitability using the man-hours now available should be sought » (Coleman, 1969, pp. 33-34). Only one participant suggested that the type and size of machinery introduced should vary with « prevailing conditions » such as wet or dry rice cultivation, labour supply, etc. (Lonnemark, 1969, pp. 39). In general, the social problems that result from mechanization of the wrong sort were not mentioned.

Some factors encouraging and discouraging a move from buffalo to tractor power were discussed by Mathur and Kapp. Their main argument stresses the need for assessing the long term changes resulting from tractor mechanization and suggests that cooperative tractor service centers could act as an « inducement mechanism for the introduction of new forms of organization, new ways of doing things, new skills, new disciplines and precision... it can lead to a variety of desirable socio-cultural changes... that are prerequisites of the quantitative increases of output and yields ... » (Mathur and Kapp, 1961, p. 335). But the problem is likely to be displacement of agricultural labour (Grist, 1959, pp. 181), initial increase in seasonal unskilled labour requirements followed by a drop off in rural population (Day, 1967, pp. 427-449) not to mention high costs of cooperative schemes. Premature tractor mechanization could lead to forces that « liquidate the small cultivator or prevent him from participating in the varietal and chemical revolution underway » (Nair, 1969, p. 226) which in turn, given the fact that most of the increasing population must be absorbed in rural areas (Mellor, 1969), could lead to social and political instabilities with much wider economic implications (Frankel, 1969; and Oloko, 1964).

Most of these arguments would apply to Lebanon or Thailand, as well as

other countries of the Middle East and Far East where population pressures are becoming intensified through rural-urban migration. The need to absorb labour on the land makes it a necessity for policy makers to study the long term effects of a mechanization program. The absolute size of population may not be the problem. Rather, the problem may be policies that encourage ever greater concentrations of people into poorly managed urban areas.

Will tractor mechanization increase yields per acre? The usual answer is no (Grist, p. 183; Kaneda; Sen) but to determine this requires local experimentation under local conditions. Johnston and Cownie suggest that a « labor-saving, capital-saving type of approach to agricultural development » like that used in Japan and Taiwan might be relevant to areas with rapidly increasing populations. They point out that it was through the use of improved implements for buffalo power that multiple cropping in Taiwan led to greater production and labour absorption (Johnston and Cownie, 1969, p. 572). The existence of under-employment is not « itself sufficient reason for rejecting mechanization » because selective mechanization could be followed such that few people would be deprived of employment (Fisk, 1961, p. 60). This supports the Japanese-Taiwanese approach of encouraging mechanization suitable for small holder farms (Kato, 1965, pp. 38-58). The same view was expressed by Grist : « ... perhaps insufficient attention has been directed to the adoption of mechanization to the particular needs of the small holder » (Grist, 1959, p. 154). These questions are as relevant to Lebanon as they are in Thailand.

A tendency exists to underestimate the costs of introducing tractor mechanization and to overestimate machine performance. Thus, while a great deal of labour hours are saved, successful mechanization requires proper levelling of the land and better irrigation facilities (Grist, 1959, p. 155), expenditure of limited foreign exchange reserves for import purpose (3), and high repair and maintenance costs. A negative net benefit to Indian society from tractor mechanization was estimated in a situation of labour surplus (Bose and Clark,

(3) In this case, Lebanon is an exception since she has an excess of foreign exchange reserves.



1969, pp. 273-308). Private profits diverged from social profits assisted by government and local conditions that favored larger farmers and the use of larger tractor (Johnson and Kilby, 1970). Such policies as no duties on imported tractors, low interest government loans which undervalue the cost of capital goods in relation to labour as well as undervaluing foreign exchange, subsidize trend. « The inconclusiveness and some of the inconsistencies of many estimates of costs have not infrequently been the result of lack of appreciation of the influence of local social conditions » (Grist, 1959, p. 181). In Thailand, declining export and domestic markets for rice, for example, and increasing yields may lead to surplus rice, lower prices, and the need for government subsidization of domestic prices. This is already happening in Thailand (Anonymous, 1971, p. 40). This will benefit the large commercial farmer, squeezing the small farmer out between declining rice prices and rising production costs as it did in the United States (Owen, 1966, pp. 43-70). In addition, the adoption of new practices in well irrigated areas before... poorer areas may lead to widening of regional differences in levels of income and growth (Griliches, 1960, p. 280).

It appears that tractor mechanization under some conditions can turn out to be a sizeable problem. Alternative means of raising production and of introducing modern technology have been suggested and practiced by many. It has been suggested that « biological-chemical » technology (4) is neutral to size of farm, raises yields per acre, absorbs labor per acre, and retards the formation of dualism in the economy (Kaneda, 1969, p. 112). In Taiwan, intensive methods of rice production were followed primarily using buffalo power. As a result, yields were increased by an average of 34 % using local Japonica rice varieties (Chang-Hwa, 1967; Kung, 1969). This contradicts such statements as « the hope of the future is seen to depend upon the use of herbicides and of herbicide application equipment » (Johnson, 1963, p. 23). Selective mechanization using two-wheeled tractors, or small four-wheeled tractors, improved buffalo, oxen-drawn implements or hand implements such as the

Japanese weeder are other alternatives. Some of these alternatives are already under study by the Thai Ministry of Agriculture and by the Lebanese Ministry of Agriculture. Overhead costs would be minimized; import requirements diminished as local small shops would be encouraged to build and maintain such equipments; and local skills and local participation in an intermediate technology would be encouraged. Such a policy would shift dependency attitudes common among traditional farmers (Marriot, 1952) towards greater self-reliance (Gray, 1970; Nyerere, 1967) and have ramifications for maintaining village social structure as well as political stability.

CONCLUSION

It cannot be over emphasized that policy makers should adopt a policy of agricultural mechanization suited to their local requirements. This presupposes an understanding of the interrelationships that exist between any such policies and overall national problems such as urban and industrial development, labour employment, rural development, social and political stability. The policy of selective mechanization or of intermediate technology should be studied to see whether or not it would be suitable for the agriculture development of one or more regions in the countries of the Middle East. This is particularly the case if we assume the value premise that we wish to have progress for the majority and not only a minority of the rural population.



(4) Naturally, one would need to keep in mind the problem of environmental pollution.