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PROBLEMS OF MECHANIZATION IN INDIAN AGRICULTURE

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Six months' research in South Asian countries (particularly India) and intensive study of all available publications do not enable any one to form an opinion; and the article should be read as personal remarks on the part of a student of Indian farming—written in full consciousness of the fact that his first contact with Indian problems does not enable him to grasp the problems in their complexity. The author cannot hope to give more than a modest contribution to the problems of technical progress in Indian agriculture—problems which are now being examined almost everywhere in India.

Forms of Mechanization

The agricultural statistics for 1961, show 34,297 tractors (Table I) ; these are largely concentrated in 3 States : Punjab—7,840, Uttar Pradesh 7,139 and Rajasthan 3,154,—*i.e.*, 56.8 per cent of the total for India. The number of tractors in these 3 States rose by 106, 22 and 148 per cent respectively between 1956-61. The overall increase for India was 64 per cent. The figure of 34,000 (39,000 by December 1962) is not very large for a country based largely on agriculture, as India is. But the start of the first pioneer techniques of modern farming in India is the right moment for analysing the problems. For, the tractor brings with itself deep changes in the economic and social structure, and a discussion of these changes may help in dissipating unjustified apprehensions.

Tractors are used on governmental farms (Suratgarh, Tarai), on farms attached to colleges (Ludhiana, Bichpuri, Deras) and in some of the Army's dairy farms. They are mostly utilized for ploughing and other heavy operations, rarely (*e.g.*, in Suratgarh and Tarai) for sowing, inter-cultivation, harvesting of cereals and transport; but even in these few cases hired labour is employed, for instance, in harvesting rape-seed, sugarcane, etc., hundreds of farm hands are brought in seasonally from neighbouring villages. Much the same system prevails in the large private farms in Uttar Pradesh (some of which have an acreage of up to 2,000 acres and more.) There, too, mechanization extends mostly to soil cultivation, the other operations being left to a large number of seasonal workers.

The techniques of the large (government or private) estates have had little impact on the neighbouring small peasants. This may be due to the social gap

* In connection with a research programme initiated and guided by Dr. Otto M. Schiller, Professor of Agricultural Economics and Rural Sociology at the South Asia Institute of Heidelberg University, the author has been sent to India and neighbouring South Asian countries. There, he worked during the winter season of 1962-63 on investigations for the following subject : "Socio-economic and structural implications of the first phase of mechanization of farming processes in South Asia." The author wants to acknowledge his debt to Dr. Schiller for the inspiring advice and assistance extended to him in the preparation and evaluation of this research work. Thanks are also extended to the professors and students of agricultural colleges and research institutes in India, officials in Central and State Departments of Agriculture and Co-operation, Registrars of Co-operative Societies all over India. They all showed untiring patience for the foreigner's inquisitive questions; they were always ready for frank discussion of the problems and for giving generous informations. Last, not least, the author and his wife, who joined him in all the visits to villages, owes deep gratitude to the many, who assisted him during his intensive tour covering 13 of the 15 Indian States. No one is named, but no one forgotten. They all have contributed to our deeper understanding of the problems facing modern India.

TABLE I—TRACTORS IN INDIA : 1956 AND 1961

State	1956	1961	Percentage Increase (+) or Decrease (—) in 1961 over 1956
Andhra Pradesh	1,626	1,762	+ 8.4
Assam	159	3,968	+ 2397(?)†
Bihar	1,227	1,520	+ 23.9
Gujarat	1,052	1,999	+ 90.0
Jammu and Kashmir	106	131	+ 23.6
Kerala	187	276	+ 47.6
Madhya Pradesh	1,311	2,025	+ 54.5
Madras	822	1,390	+ 69.1
Maharashtra	2,066	1,415	— 31.5
Mysore	807	934	+ 15.7
Orissa	95	194	+104.2
Punjab	3,809	7,840	+105.8
Rajasthan	1,274	3,154	+147.6
Uttar Pradesh	5,839	7,139	+ 22.3
West Bengal	450	328	— 27.1
Union Territories	150	222	+ 48.0
India Total	20,980	34,297	+ 63.5

†Figures for Assam are under re-examination by the Directorate of Economics and Statistics of Ministry of Food and Agriculture, Government of India, New Delhi.

Source : Provisional Number of Livestock, Poultry and Tractors in India (1961 Census), New Delhi, April, 1962. (stencilled).

in the villages, but the financial status of the small peasant also does not allow him to spend cash on any services which he (somehow or otherwise) could render himself.

The Central Tractor Organisation, established by the Government of India soon after Independence, was dissolved. In some States, e.g., Maharashtra and Mysore, State organisations hire out tractors to farmers, in some others (Madras, Kerala and West Bengal) a similar service is being installed. These are, in most cases, heavy chain tractors suited for land reclamation, bunding and other heavy operations. Of course, these are available for hire by individual farmers; in practice, however, they seem to be used in big projects rather than on small individual farms. West Bengal may be an exception : there, medium-size tractors are used. In Maharashtra, too, in co-operation with sugar factories such medium-size tractors are available for deep ploughing the land of the cane growers.

In a few isolated cases, private contractors are hiring out tractors. Escorts farm at Kashipur, U.P., just started such a tractor service, available to everyone. A tractor dealer in Gujarat started this line of business some years ago. Sometimes, farmers, who own a tractor, do ploughing within their village against payment. A landlord in the granary of Tanjore hires out his tractor to his share-croppers, if they desire (mostly those who do not own any draft animal). Parallel cases could be observed in West Pakistan : landlords hire out a tractor to their share-croppers, who are thus able to rent twice the usual acreage and in return pay 75 per cent of the crop (instead of 50 per cent, as usual).

The author found only very few co-operative farming societies, owning or using a tractor, even if their acreage was large enough for economic use

of a tractor. (Mention should be made particularly of the societies in Rasulabad and Gambhira, Gujarat).¹ The student of co-operative farming may wonder, what success could be expected of co-operative organisation, if members continue to apply their old methods and receive no impetus from new techniques.

Changes in Farm Management caused by the Tractor

As far as the author could ascertain, there has been no investigation in India of the effects of the tractor—as the first step of mechanization—on the farmer, on agricultural manpower or on the tenant-landlord relationship. It is possibly too early yet for such an assessment. Only in very few cases the draft animals have been disposed of. Mostly, part of these animals has been retained as insurance against mechanical failure, lack of spare parts or similar mishaps. But everywhere, the tractor has reduced the need for draft animals. According to a study, prepared in Lyallpur, West Pakistan, 47 tractors on 40 farms have replaced 6 bullocks each.² The FAO, in a recent study, concluded that 20 bullocks could be replaced by one tractor; a figure that supposes optimum use of the tractor through a hiring-out service rather than individual ownership by medium and large-size farms (as in the Lyallpur study). No change from fodder-growing to other crops could be expected: fodder-growing and systematic feeding of animals are still rather uncommon. But the number of milk cattle seems to rise slowly, wherever the tractor had come in regular use.

Whether the tractor permits the farmer to make better use of the seasonal cycle by timely ploughing and sowing, could only be ascertained by long-term observations. Where irrigation is available, it may be possible to obtain, by the use of tractors more than one annual crop. The tractor can do the heavy field work better and more quickly, because the tractor ploughs deeper than under-fed draft cattle, driven by under-fed bullock drivers.

It ought, of course, to be ascertained, whether deeper ploughing is advisable under the climatic and soil conditions of India. Experience in other countries leads us to the conclusion that there are some definite risks. But, it should be possible to avoid them, e.g., by bunding, contour ploughing, etc. Deeper ploughing requires the application of more fertilizers and farmyard manure. There is no risk of a lack of organic manure, when the tractor replaces the animals. At present, farmyard manure is used not for soil improvement, but for cooking and heating purposes.

The case study of Lyallpur covered an acreage of 4,421 acres. It was found that some farmers dismissed their labourers; others have increased the number of workers employed. There was in the result no change in total employment. Whether more or less workers are needed, will probably not depend so much upon the tractor, but upon the intensity of farming. Where land was used intensively

1. Gwildis found the same in the Deccan: out of 16 societies only four owned a tractor. *Vide: Johannes H. Gwildis, Die genossenschaftliche Landwirtschaft im Staat Bombay unter besonderer Berücksichtigung der Landwirtschaftsgenossenschaften in vier Distrikten des Deccan.* ('Co-operative Farming in Bombay State'), *Westdeutscher Verlag, Köln u. Opladen*, 1963.

2. The author is grateful for the opportunity to discuss the problem with Prof. Barkat Ali Quraishi and two of his students, Mr. Anwarul Haq and Mr. Shaukat Ali Quraishi—both graduating on economics of mechanized farming. Some preliminary results are quoted here.

before the purchase of the tractor, labour might become redundant to some extent. Where, on the other hand, land was hitherto extensively cultivated (or was not cultivated at all), the tractor may produce more employment, and quickly.

Technical Difficulties

An important question is, which type of tractor is adapted to the special conditions of India. There is the basic question : can the more complicated types of tractor with their highly sensitive equipment be used in a country like India during the first stage of mechanization ? The tractors might not be sturdy enough for the difficulties they have to face. In Europe and the United States, the first types of tractors were simple and hardy; they paved the way for further mechanization. In highly industrialised countries skilled workers had to be educated—a process taking one generation or more. Europe needed 150 years for its industrialization; but Europe's agriculture had to push the process of training its labour through within only 30 years.

Another crucial problem : spare parts and service. There is no need here for lengthy discussion of the well-known facts. The author believes that the only practical solution is the domestic production of tractors, equipment and spares.

Human beings anywhere are able to acquire the skill, needed in the use of modern machinery; they are able to handle machinery carefully, once they have understood its value and its functions and have gathered the necessary practical experience. Where training, experience and repair facilities are available, the results are excellent. I quote only Suratgarh and Tarai. In other cases, however, unskilled and inexperienced people are supposed to drive costly tractors in regions, where speedy repair is not available. This is a waste of the nation's wealth; it should be prevented.

In other countries, no one may drive a tractor without a licence. Thus, in Western Germany farmers and farm workers are required to attend a basic four weeks' course in a special school for farm machinery, before they may sit for the licence test. The purchase of a tractor may possibly be subject to the condition that the owner must employ an experienced driver. Training facilities are available in India in relatively few places only; most of the institutions for village level workers (*gram sevaks*) have no workshop, where the use of the tractor could be taught. Perhaps the *khadi gramodyog* schools could be changed from teaching hand spinning to teaching the use of farm machinery. The short course, which tractor salesmen are giving to the buyer on delivery—mostly one or two days only, is quite inadequate.

Finally, the wages of tractor drivers are far too low, compared both to their responsibility and effort, and to the value of the equipment they handle. Adequate salaries and a suitable system of premiums for timely repair and service may stimulate the effort and the degree of care for the equipment.

Economic Problems

Another question has to be asked in a country with a permanent surplus of labour and a yet bigger surplus of animals : whether mechanization of farming would be desirable or necessary? But even if it is, can the national economy

afford the investment required and curb other important national schemes? The surplus of human labour and of draft animals is there—a real under-employment (see below). But it may be that both men and animals are unable to perform the necessary seasonal work in farming to satisfactory standards and in proper time: the reason is their physical status. The cycles of food availability, and of peak work demand, never coincide. Only after the harvest, man and animal are relatively well-fed; at that time, there is no heavy work. On the other hand, during the busy season of ploughing, cultivating and sowing, food supply is at its lowest. Again, important (and urgent) work cannot be put into execution because of physical inability of labour; reference may be made to road building, to the construction of village schools and irrigation channels, to land reclamation,—some examples, where the need is urgent and the effect of available labour would be felt very soon.

Agriculture in the modern economy benefits from the equipment, which industry produces. Heavy input of outside energy—oil engines, tractors, electric motors or electric energy transformed to nitrogen fertilizers—multiplies the effect of human efforts; it replaces the draft animal, thus increasing the area available for human food. Mechanization increases production and productivity. Thus, in the second stage of economic development, when agriculture is the most important source of capital, capital accumulation can be accelerated and capital transferred from agriculture to other sectors of economy without disadvantage to the development of farming itself. In the later stages, when industrial capacity is high, agriculture becomes the most important “home market” for industrial products.

Indian agriculture is poor in energy; in fact, it sells energy outside—*e.g.*, fuel to town households and workshops. This outflow of energy must be reversed, if farming is to fulfil its economic task—that of providing capital for the speedy development of the national economy.

Of course, both import and (to a lesser degree) home production of tractors and farm equipment mean expenditure in foreign currency. The economic planners will have to assess priorities and to co-ordinate development in the different spheres of the economy. But immediate promotion in the field of agriculture, so as to enable it better to play its role in the national economy, seems to the author a task of high priority. In the long run, at least, economic development would strongly benefit from investment in agricultural mechanization. Costly equipment must be put to maximum use: given the average farm size in India, individual ownership (and use) of tractors would be an exception, at least in the first phase of mechanization. Even where a farmer could find the money to buy a tractor, individual use would not be in the national interest. Each tractor should be used by as many farmers as feasible.

The Magnitude of the Task

If the basic idea of mechanization is accepted—its social impact will be discussed below—a further question requires an answer: how many tractors are needed? The estimate given here should not be seen as a forecast of coming development, but rather as a hint concerning the magnitude of the problems involved. Many factors have been left aside, such as size of the tractors, irrigation facilities, average

farm size, size of plots, etc. According to the agricultural census,³ the weaknesses of which need no discussion here, India has 61,780,000 operational holdings. The holdings below 0.05 acres may be left out of consideration. But even of the remaining 55 million holdings only those over 20 acres, 3,642,000 holdings commanding 145,800,000 acres are taken into account. 51,370,000 holdings with an acreage of 189,900,000 acres are left out of consideration.

It is further assumed—for the sake of simple calculation—that holdings of 20—100 acres need one tractor, holdings from 100—250 acres two tractors, 250—500 acres three tractors, above 500 acres four tractors.

2,529,000 holdings	20 — 40 acres	2,529,000 tractors
990,000	40 — 100	990,000
112,000	100 — 250 (2 ×)	224,000
9,000	250 — 500 (3 ×)	27,000
2,000	over 500 (4 ×)	8,000
3,642,000 holdings	over 20 acres	3,778,000 tractors

If we were to include 5,368,000 holdings with 10—20 acres, applying the rate of West German tractor ownership,⁴ a further 3,221,000 tractors would be needed. This would mean about 7 million tractors, and even then only 65.7 per cent of the acreage would be mechanized to a degree comparable to that reached in Western Germany.

This estimate makes four points evident :

1. The task cannot be fulfilled in a short time; it will take many years from the date, a decision has been taken by Government on the course to follow. These years will be needed also by the farming community. It must adapt itself to the (unavoidable) consequences; it must acquire the technical know-how.
2. Full as against partial mechanization is in the first stage an academic question. Even in highly industrialized countries, full mechanization takes its own time. In the near future, total mechanization of agriculture (with its corollary of unemployment) is not practicable in India.
3. The entire production (and transport) capacity of the industrial producer countries could not provide 7 million tractors. Production in India is the only economic solution from any point of view, quite apart from its other advantages : employment for surplus farm labour, appropriate provision of spare parts and service, training of skilled workers, saving of foreign currency.
4. The use of tractors must be pooled; as many farmers as technically possible must be served by one tractor.

The Further Use of Draft Animals

Highly developed farming communities—as a rule—do their work without draft animals. Their animals produce human food (milk, butter, cheese, meat,

3. Eighth Round of the National Sample Survey, Indian Agriculture in Brief, Fifth Edition, Delhi, 1960.

4. 66 per cent of holdings in the 5-10 ha. category owning a tractor.

eggs). The heavy work is done more cheaply by electric power and tractor. The change-over will take time; but it is inevitable, once the tractor is introduced. Assuming that one tractor replaces 6 bullocks—a very rough guess, not taking account of any special technical problems), then in the first phase of mechanization (with tractors used only in holdings above 20 acres) 22.6 million draft animals would become redundant. In the second phase, the figure would increase to 42 millions.

This problem is more complex for India, than in the industrialised countries such as Western Germany, France, Great Britain, United States or Soviet Russia. Even there, the farmers are devoted to their animals; but the question is not loaded with long established tradition, as it is in India. Religious belief, in this as in other respects, may prove a factor in social development. Mechanization of farm operations might become the starting point for a new assessment, a re-evaluation of the role of the animal in human society; priority must be given to human beings, but justice must be done to the animals by providing food and care for the animals which serve humanity.

Changes in Land Tenure

All State statutes on land reform exempt from their provisions concerning land ceilings (i) tea, coffee and rubber plantations, (ii) orchards, in so far as they constitute large compact areas, (iii) specialized farms, engaged in cattle-breeding, dairying, etc., (iv) sugarcane farms (operated by sugar factories), and (v) efficiently managed farms consisting of compact blocks, in which heavy investments or permanent structural improvements have been made and whose break-up is likely to lead to a fall in production.⁵ These exemptions and even more the resumption of former *sir*-lands⁶ for self-cultivation from the tenants have brought in their wake results, which the initiators of the land reform did not foresee. Tenants and share-croppers have been evicted; hired labour has replaced them. Part of the bullocks were replaced by tractors, necessitating less labour for the same operations—and thus encouraging more intensive cultivation.

Modern agriculture requires a certain number of big farms for experiments in new techniques and new machinery, for breeding purposes, etc. Progressive land owners must also be induced to invest in farming, making their farm a modern and paying proposition, rather than sharing crops with the tenants and consuming the surplus outside the village (in any case, outside agriculture).

Modern techniques offer the means to a change-over from share-cropping tenancy to modern large-scale farming, but only for people willing to invest money, which generally will earn less than the 50 per cent share in crops, hitherto earned without any investment. Large farms must become the pilots of technical progress. If they are owned by private farmers, they will add to the social, economic and political weight of this group in the farming community.

In contradiction to the intentions of land reform, the status—legal and economic—of the tenant has been weakened, leading to substantial unrest in the pea-

5. Cf. The Third Five-Year Plan, New Delhi, 1961.

6. Land owned and operated by zamindars.

santry. This unrest is clearly expressed in West Pakistan, where huge numbers—hitherto not statistically accounted for—of share-croppers were evicted. In India, the same development may have happened, but perhaps to a lesser degree. At any rate, these undesirable social developments do not stem from mechanization, but rather from the economic powers ruling legislation on land reform and the implementation of the statutes. Where the tractor is brought to the village by a private owner and hired out to small-holders or tenant-farmers, a new social power in the village may arise. Apart from the three chief people (landlord, moneylender, middleman), a fourth—the contractor of farm machinery—may appear and create additional forms of economic dependence. The tractor would in that case fail to stimulate production and to raise the standard of the small-holder. Private contractors, hiring out essential equipment, are socially undesirable, under the conditions of the Indian village of today. Other forms must be found, possibly the Government-owned tractor pool or co-operative ownership and use of the tractor.⁷

Problems of the "Tractor Pool"

For a village co-operative (—not necessarily a joint farming society—) to acquire one tractor would be the maximum investment compatible with the financial means of its members. There is always the risk of technical mishaps, of lack of repair service or of spare parts, particularly in the busiest season. If there is one tractor only, the cultivator would be compelled to retain a safety margin of draft animals; thus part of the possible advantage would be given away. Pooling up to an optimum of 10 or 15 tractors might obviate this difficulty. The risk would be spread equally : some way can be found, so as to serve in case of breakdown 15 villages with 14 tractors, pending repairs. A larger pool, comprising a number of villages or basic groups, would be worthwhile, even though contact and mutual influence would be better exploited in a co-operative based upon one village only.

Co-ordination between neighbours is an essential pre-requisite, in view of the small size of fields and holdings; without it, economic use of the costly tractor, where every mile of transport has to be paid for, cannot be assured. Co-ordinated use of the tractors would not face insurmountable obstacles.

The problem of pooling the land for joint or collective farming need not be discussed here. (The author strongly believes, though, that poor and physically weak people will have to pool their resources; by common effort they can reach goals, which none of them could hope to attain on his own.) But to deny joint farming societies the tractor and similar mechanical equipment—as is sometimes hinted—would be unjustifiable, a sign of bias against co-operative efforts. If the land, pooled in a society or otherwise under its control, warrants economic employment for a tractor, the society should have the chance of modern farming and high efficiency.

7. It is sufficient to quote P. N. Mathur and K. William Kapp : "Privately owned tractors or tractor stations would encourage and strengthen the position of the moneylender and would create new powerful vested interests in the rural economy with all the social and political disadvantages and none of the advantages of the co-operative way." *Vide*, "The Transition from a Bullock to a Tractor Economy in India : Some Indirect Effects and Benefits," *Weltwirtschaftliches Archiv* (Hamburg), Vol. 87, No. 2, 1961, pp. 333-350.

One of the difficulties the small farmer faces is the need for cash payment. The Government organisations in Maharashtra and Mysore (and, it is assumed, also in other States) demand cash in advance for their tractor services. That makes the service virtually prohibitive for the average cultivator in India. Credit for the cost of the tractor service should be allowed until the harvest, when payment in kind could be obtained from even the smallest farmer. This would allow to reach several goals : better cultivation, reduction of indebtedness (to contractors hiring out tractors or draft animals), lessened control for the middleman, higher influence of co-operative (or governmental) institutions in the marketing of farm surpluses. The idea of supervised production credit could thus be extended to a new field.

Regarding the rates to be charged for the use of a tractor, different points are to be taken into account. Priority should be given to the small-holders—they have hitherto been Government's step children, when subsidies were distributed. But they have only very small fields; priority for them would be incompatible with the economic use of tractor pools—tractors would waste time and fuel moving between the small plots. Reduced rates for compact blocks of land (with cultivation co-ordinated and serviced jointly) would be a step in the right direction—small-holders would obtain the services of the tractor at low rates by co-ordinating their activities. A new starting point for effective extension service would be created incidentally. The difficulty of even the best extension service in poor countries is that the small-holder has no economic "breathing space" and therefore cannot change his method of production. Good advice has little effect—it cannot be followed. But if the official or semi-official organisation could offer better technical equipment and advice, receptiveness would increase, because the small-holder would be able to follow the organisation's advice.

The tractor pool—governmental or government-assisted co-operative—could thus solve several problems at once. All these problems are, in reality, interdependent : better farming, more intensive use of the land, effective extension, marketing of more produce at better rates, decreasing influence of moneylender and middleman.

Social Aspects of Mechanization

One special aspect is reflected in the views on mechanization, held in India : the heavy unemployment. Will mechanization increase unemployment ? Srinivasan⁸ reports fears on this score; but he feels, that the children must be freed from farm work so as to be free to go to school. Shafi Niaz and Martin⁹ on the other hand, would not, as a rule, welcome tractors; Khusro¹⁰ believes that modern industry is not labour-intensive and develops slowly, so that urban population growth can provide the manpower required for the new factories. Rural workers becoming redundant in consequence of agricultural mechanization,

8. M. Srinivasan, "Pattern of Employment of Hired Labour in Agriculture in Certain Villages of Coimbatore Taluk of Madras State," *Indian Journal of Agricultural Economics*, Vol. XII, No. 2, April-June, 1957.

9. M. Shafi Niaz and Lee R. Martin: *Mechanization of Agriculture*, Karachi, 1955.

10. A. M. Khusro: *Economic Development with no Population Transfers*, Bombay, New Delhi, 1962.

could not, he believes, find industrial employment. Black¹¹ is of the same opinion. Anticipating increased unemployment from mechanization, he suggests, that it be deferred until technological progress, industrialisation and a definite fall of the population growth rate justify the transfer of rural workers to urban employment. Jacoby¹² believes, mechanization should be controlled and combined with a progressive diversification of the economy; then it could be a stepping-stone to a sound social and economic development. The Government Enquiry Commission of Pakistan¹³ advocates mechanization, but stresses the need to be extremely careful in its pace. Robinson¹⁴ has analysed the influence of tractors on village social life in Turkey. He has come to the conclusion, that the first phase of mechanization did not increase unemployment, but rather led to unequal distribution of existing under-employment. Planck¹⁵ is doubtful about mechanization in Iran, restricted there to the large estates and not followed by creation of jobs in industry. Nevertheless, he feels, that the present primitive methods of work cannot continue to be applied.

The Working Group on Co-operative Farming¹⁶ suggests, that the co-operative farming societies themselves must decide, whether or not to mechanize. Societies on existing cultivated holdings might usually adopt labour intensive methods and avoid the tractor. Societies reclaiming waste lands would, however, have to resort to mechanization.

Some authors take a positive view on mechanization. Mathur and Kapp¹⁷ believe in modern equipment as a catalyst. Mechanization could become the prime mover in the introduction of new forms of organisation. Tractors would produce more jobs and better wages. "Mechanization of Indian agriculture must be viewed as a major socio-cultural reform." Service co-operatives—they suggest—should hire out the tractors, "which could ultimately serve as modernization centres in rural India." Mandal¹⁸ too, believes, that even partial mechanization would make farming more efficient. Schiller¹⁹ discusses the basic problems of new techniques and their positive impact in developing countries. In the hand of private contractors, he believes, the tractor may become dangerous; it would destroy the social balance in the village and might cause further unemployment. In the hand of a public organisation or a local co-operative, however, mechanization implies no social dangers. Fisk²⁰ proposes selective mechani-

11. John D. Black: Land Tenure Adjustments in Pakistan, Dacca, 1962.

12. E. H. Jacoby: Agrarian Unrest in South-East Asia, Bombay, 1961.

13. Report of the Food and Agriculture Commission, Karachi, 1960.

14. Richard D. Robinson, "Tractors in the Village—a Study in Turkey," *Journal of Farm Economics*, Vol. XXXIV, No. 4, November, 1952, Wisconsin.

15. Ulrich Planck, *Die sozialen und ökonomischen Verhältnisse in einem iranischen Dorf*. ('The Socio-Economic Conditions of a Village in Iran'), *Westdeutscher Verlag, Köln und Opladen*, 1962.

16. Report of the Working Group on Co-operative Farming, New Delhi, 1959.

17. *Op. cit.*

18. G. C. Mandal, "Technological Change in Agriculture and Economic Growth," *AICC Economic Review*, 4th January, 1962, New Delhi.

19. Otto Schiller, *Die Bedeutung der Landtechnik für den Fortschritt unentwickelter Agrarländer*, "Landtechnik." ('The Impact of Mechanization on the Progress of Developing Agricultural Economies'), München, 1953, 23/24. See also O. Schiller and others, Report of the German Agricultural Delegation to India on Co-operative Farming, Farm Machinery, Land Consolidation and Dairy Processing, New Delhi, 1960.

20. E. K. Fisk, "The Mechanization of Agricultural Small Holdings in Underdeveloped Areas," *The Malayan Economic Review*, October, 1961.

zation for small holdings in developing countries, raising intensity of cultivation, but not causing unemployment. He stresses that, by modern techniques, double crops might become feasible, thus raising the demand for manpower per acre.

If opinions differ thus sharply, the views expressed by Government officials are (almost necessarily) guarded. Moreover, different views seem to be entertained at different levels. The Planning Commission in New Delhi proposes production of 10,000 tractors per year. Other departments propose improved implements drawn by men (without animal or motor power). Training programmes for *gram sevaks* and young farmers exclude technical training in basic operation and maintenance of tractors. India—it is argued—is a country, whose economy is based on the bullock; and the situation, it is assured, will not change in the foreseeable future—a very static approach. Hesitation and even ambiguity in official policies are natural; it might very well be too early yet for a clear-cut decision.

To the outside observer, the special economic and social problems seem tremendous. A large part of the farming population—cultivators not less than landless labourers—are under-employed : there is full work only for a few weeks per year. During the peak season, their manpower is not sufficient; the most urgent work cannot be done in good time.²¹ Part of the work done has no economic effect, according to modern economic standards : sometimes it is mere occupation. Work done by children, on the other hand, is an obstacle to education. But, the problem of under-employment is already there; tractors would not worsen the state of affairs, but merely render it visible.

Economic policies, anyhow, must strive to employ manpower efficiently, producing maximum output; mere employment is hardly an economic aim, unless it produces economic results. In the poor developing countries people mostly are under-fed. The tractor (particularly if used together with irrigation) will be a factor for intensive cultivation of the land; cultivable waste land can be brought under cultivation by the tractor, creating additional employment in harvesting, processing, transport and marketing.

The apprehensions that technical changes might be too rapid, is sometimes voiced in the slogan : Mechanization yes, but no motorization. Mechanization, it is demanded, must not render man obsolete.²²

These views seem to overlook two points :

1. The problem of agricultural production in developing countries lies just in this fact: no external energy is added ; fuel produced on the farm is used for other branches of economic activity. Energy, added directly or transformed (*e.g.*, nitrogenous fertilizer, modern equipment) increases production. Man and animal are, as it were, physically too weak for

21. M. Srinivasan found in 7 villages in Madras State villagers unemployed on 53 to 81 per cent of the potential working days. *Op. cit.*

22. A German report puts it that way: *Die Mechanisierung der indischen Landwirtschaft, Marktinformationsdienst der Bundesstelle für Außenhandelsinformation, Köln, February, 1963* ('Mechanization of Farming in India,' edited by Office for export information), stencilled.

the necessary increased efforts; they cannot draw the improved plough and turn the soil deeper,—they must use mechanical help.

2. The industrial nations could progress only through higher human productivity, made possible by the use of steam, electric or other forms of mechanical power. Labour was set free by mechanical help.

Mechanization of farming can be seen only as part of deep economic changes in the whole of society. The counterpart of this change is industrialisation; it creates new skilled jobs in factories (producing machinery), in service stations and repair shops, in technical training schools and in the extension service.

The tremendous difficulties, accompanying the early stages of this great change cannot be overlooked. All processes must be synchronized by farsighted economic planning, so that socially undesirable effects are avoided. Human energy, liberated by mechanization will have to be directed to the urgent tasks which India, possibly more than any other developing country, is faced with : irrigation, land reclamation, electric supply, road and school building, water supply, sewerage system, housing—to quote only a few. Human energy has hitherto been applied to secure subsistence near starvation level with primitive equipment and high waste of energy. The energy left over was insufficient for the needs of private or public investment. Mechanization should help to set free energy for the big common tasks, speeding up progress of the farming community and thereby of the whole of India.