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SOME BASIC ECONOMIC ASPECTS OF TECHNOLOGICAL PROGRESS IN THE TEA PLANTATION INDUSTRY*

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By technology is meant the combination of various productive factors and technological progress implies changing this input mix in such a way as to increase output per unit of resources and reduce production costs per unit of output.

Technological improvements in agriculture can be broadly classified into two types :

(1) The first involves the application of a technically more desirable amount of a particular variable factor of production to fixed factors meaning thereby a movement up the existing production function.

(2) The second implies the adoption of new methods of production or new inputs rendered possible by improved knowledge from agricultural research. These are known as innovations and their effect is to yield a new and higher production function for a given schedule of factor use or a lower cost function for a given schedule of output.

The innovations fall in two categories :

(*i*) Those which increase the marginal productivity of capital and labour in relation to land and can be described as "land saving." These innovations—described as biological innovations by E. O. Heady—again can be subdivided into two types :

(*a*) Those involving organizational improvements and use of new or superior types of non-fixed inputs. These changes open up the technical possibility of producing the whole range of a given output schedule at lower unit costs.

(*b*) Those involving the use of new indivisible factor units which can be taken advantage of only when output is above a certain level.

(*ii*) The second category of innovations can be described as "land using." A typical example is the substitution of machinery for labour. Its effect is to raise the marginal productivity of capital and land and increase the role of capital and land relatively to hired labour in production. Thus, this type of innovation would induce the producer to bring more land under cultivation in order to utilize a new machine fully.

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The effect of technological improvements on producer income is dependent on the price elasticity of output demand. If the demand is inelastic technological changes would reduce gross revenue of producers as a whole under competitive conditions unless the demand "shifts" sufficiently to absorb the additional output. And if the change increases the total cost at the new equilibrium output net income would also be reduced. The change in total cost would evidently depend on the volume of change in output following the particular technological change and the elasticity of the average cost function. However, the profits of individual producers who adopt the change earlier than others would always be increased and this would induce others to follow suit to avoid reductions in profits as product prices fall with expanding supplies in the market.

II

With these general observations on the various forms of technological change and their income effects an attempt is made here to examine their broad nature and economic implications for the Indian tea industry.

Tea is an important cash crop. An overwhelmingly large part of the crop is sold by producers and exports are a very important outlet. Several studies have confirmed that the demand for tea in the important tea importing countries of the world is price inelastic. However, as indicated earlier, under competitive conditions an individual tea producer who first adopts a well-tried technological innovation would benefit from the change unless tea prices are eventually reduced for absorbing the larger industry output. And with the favourable impact of sales promotion about which the industry is becoming increasingly conscious the demand curve for the commodity may be made to shift more rapidly than the supply curve so that prices would actually increase along with producer incomes. Thus, the Indian tea planters should be encouraged to continue to join in the race for technological advance that has been sweeping the export tea industry for maintaining and improving their export earnings from the commodity.

When there is an elastic supply of all productive resources it is easy to carry on production at the optimum intensity. But with shortages of inputs—fertilizer being a typical example—many tea estates have not found it possible to reach the technically optimum level of output on a given production function so that average overhead costs have been too large.

The first type of innovations as discussed earlier would, admittedly, constitute the main source of future increases in tea production. In this group may be included superior organization, supervision and co-ordination of various operations in the field and the factory, *e.g.*, proper pruning, proper supervision of plucking, proper handling of the green leaf, integration of the transport of leaf to the rolling machine, devising best team work from the plucking to the packing stage and improving the general layout of the factory. New types of fertilizers, chemical weed and insect sprays, soil conservation and superior tea strains along with the closer spacing of the bushes constitute other lines of improvement. This last factor, *i.e.* replantation with better jats such as has been carried out in North India since 1930 is of particular importance. Generally speaking, the yields of tea bushes over sixty years old fall rather sharply. And a programme of replanting involving the combination of younger bushes with better strains of the product

—a policy seemingly uneconomic to some producers owning old bushes that are still yielding—would not only reduce unit costs but would also serve the very important purpose of improving the quality of the product.

For tea production labour costs constitute a significantly large part of the total expenses of all estates although there are major inter-farm differences in production costs. As full details for labour costs including various amenities provided to labourers by employers are not available it is not possible to get a clear picture of the proportion of labour costs to total costs for Indian tea enterprises. On the basis of a sample enquiry the Plantation Inquiry Commission made the following estimate of labour costs for the year 1953 :

LABOUR COSTS IN TEA PLANTATIONS

	Percentage of total cost	
	North India	South India
Cost of wages	32.5	35.0
Cost of medical and other labour benefits	5.5	10.0
Total	38.0	45.0

Source : Report of the Plantation Inquiry Commission, Government of India, 1956, p. 99.

The Plantation Inquiry Commission further pointed out that generally, about two-thirds of the total number of labour days in plantations are utilized in plucking. According to C. R. Harler, in Assam over 1,000 workers are needed for field operations during the peak period in an estate of 1,000 acres, averaging 1,200 lbs. of tea per acre. Of these, about 200 will be engaged in weeding and the rest in plucking.[1] According to V. D. Wickizer's estimate picking costs constituted 24.7 per cent of total costs of tea production in 1948.[2]

What is more important, there has been a progressive rise in the wages of plantation labour along with increased requirements of housing, medical facilities and general amenities under post-war labour legislation mainly, the comprehensive Plantation Labour Act of 1954. Thus, while the prices of tea machinery have gone up as a part of the rise in the general price level, the prices of labour have gone up by a greater extent in many cases. This has given a powerful stimulus to the second group of innovations involving replacement of labour by machinery in the field and the factory. In physical terms or constant rupees, *i.e.*, adjusting for cost-price changes the industry has been using progressively more machinery and equipment with a steady rise in output per man-day.

Labour-saving mechanization has been fairly extensive in the processing factory mainly the larger units including rolling, cutting and drying which apart from cost reduction allows a greater control over quality. But the crux of the whole problem of mechanization is plucking which, as indicated earlier, demands a very large part of the total working force during the four to five peak months in tea production. It is true that tea plucking in India, as in Ceylon, is done largely

1. C. R. Harler: The Culture and Marketing of Tea, Second Edition, London, 1956, p. 64.
2. V.D. Wickizer: Tea, Coffee, Cocoa: An Economic and Political Analysis, Stanford, 1949, p. 467.

through casual labour in the peak season who are sometimes paid lower wages than regulars due to their weak bargaining power. But this cannot continue for long and under government pressure the tea producers will have to pay them wages comparable to those of permanent workers. Mechanical plucking through well-designed power equipment or even simple hand shears or clippers would substantially reduce the requirements of plucking labour and hence total plucking costs. Moreover this would help in the direction of performing the work by a relatively small regular labour force thereby disposing of the very high seasonal labour peak—after all, a none-too-desirable feature of tea production. By hand a woman labourer can pluck 40 to 60 lbs. of leaf a day while a good plucker in North India can pluck at the most 120 lbs. by hand in a day. But with shears a woman can pick 200—250 lbs. and a man 300 lbs. a day in Japan where plucking has been almost completely mechanized.[3] However, a highly debatable technical point about the mechanization of tea plucking is the depreciation in quality associated with mechanical pluckers for they preclude selective picking—the factor which slackened the pace of mechanization of the fruit crops in the United States as compared to field crops. In view of the pressing need for improving the quality of the product by all means for better marketability in the quality-conscious high-income tea importing countries of the world the pace of mechanized plucking will have to be carefully regulated. With some cash crops price differentiation on the basis of quality is not significant but for tea this has been found to be of particular importance. Weeding and pruning—the two other labour intensive operations in the field—are, however, much more amenable to mechanical treatment.

The various labour-saving mechanical innovations in the factory and the field, as indicated earlier, would induce tea producers to acquire more land so that the ultimate effect of these innovations would be less labour per unit of output and not only larger amounts of capital but also larger area of land per productive unit. Taking on a few more acres in contiguous blocks at a time is possible for those estates which now have some unutilized land suitable for tea cultivation. But the supply of new land being generally inelastic there would be a tendency toward more land per productive unit through amalgamation. During the last decade there was actually a tendency for the number of estates in Assam, West Bengal and Mysore to fall and for the average size of estates to rise.[4]

Finally, it may be pointed out that apart from mechanization and horizontal integration, substantial saving of costs may also result from vertical integration in the tea industry implying the combination of ownership of land holdings and factories in single hand. The reason is besides managerial economies, a more regular supply of raw materials, *i.e.*, standard leaf from the field to the factory. The leaf raised in small holdings is sold to factories which in turn have little control over the leaf they buy.

III

While it is true that the scope for technological advance in the tea industry is considerable it must be emphasized that much more investigation remains to be done than has been conducted so far in the way of ascertaining the exact requirements of technologically efficient tea production. The large disparities between

3. C. R. Harler : *Op. cit.*
4. Tea-Trends and Prospects, Commodity Bulletin Series No. 30, F.A.O, Rome, 1960, p. 53.

the productive efficiencies of different estates have been statistically verified but very little fruitful work has been done about pinpointing the factors accounting for this inter-farm differences in productivity. It is not difficult to find faults with the sizes and layouts of existing estates and factories but much more so to prescribe with certainty the sizes and layouts of optimum productive units under changing techniques and to assess the impact of other factors affecting input efficiency. Some investigations were carried out by the Tea Board, the Cachar Plantation Enquiry Committee (1951) and the Plantation Inquiry Commission (1956) in this sphere but the need for further research can hardly be overstressed. The basic lacuna is in the paucity of empirical data—especially, information about costs of production. Systematic cost accounting is still little known or practised by a large number of tea producers and costing methods are thus far from standardised. This makes inter-estate as well as intra-estate cost comparisons extremely difficult and unrewarding. Speaking about the coffee industry Le Compte wrote in 1895, "It is practically impossible to find model states where all expenses are carefully entered and it is more or less impossible where the ledgers do exist, to obtain access to them."[5] This statement is almost equally applicable to the Indian tea industry of the present day although it is one of the most highly organized plantation industries.

While economic investigations on technological advances in the tea industry are admittedly complicated the problems of diffusion are somewhat less than for many agricultural industries. Leaving aside sociological and demographical problems the difficulties in the way of the diffusion of innovations are technical, psychological and economic. The first are less pronounced for the commercial tea industry which is basically a large scale, corporate, plantation enterprise consisting of a generally more enlightened and managerially adaptable group of producers than purely peasant enterprises. The vigorous research work on the various agronomical aspects of tea production done through the support of private entrepreneurs, especially in Tocklai and Devarshola, is an evidence of the strong producer interest in technological advance. The main difficulties are, admittedly, economic and are due to the fact that in many cases the initial capital expenditure is beyond the financial means of most estates although in some of the larger tea plantations there is a built-in capacity for adopting technological improvements. To cite one example, replantation with better plant varieties is highly expensive and this has mainly restricted it to a very small percentage of the existing acreage annually. And for small estates and peasant producers most of the technological measures are clearly impracticable under existing conditions. The position is worsened by import restrictions on machinery and high fuel taxes. The following general measures are suggested for mitigating the economic difficulties of adoption:

(1) Amalgamation of small estates. Although as indicated earlier, a trend toward increase in the sizes of estates is discernible much more remains to be done through government initiative and incentives to remodel the size of existing estates to conform to the needs of the changing pace and type of technological advance especially, mechanization.

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5. Quoted in The World's Coffee, International Institute of Agriculture and Bureau of F. A. O. in Rome, Rome, 1947, p. 350.

(2) Provision of suitably small replicas of larger machines to smaller estates and encouraging co-operative ownership and use of full-sized machines as far as practicable. A convenient list of the machines and equipments that are suitable for use to good advantage by small individual and co-operative factories is contained in the F. A. O. publication entitled "Equipment for the Processing of Tea."

(3) Exemption of highly useful tea machineries from import duties and other taxes and exploring the possibility of reducing fuel prices through selective subsidies.

(4) Provision of adequate machine servicing facilities and social overheads, especially transport facilities in tea growing regions by the State.

(5) Provision of credit facilities to tea producers by the Government and the commercial banks on a scale much larger than at present.

(6) Last but not least, revival of an export price stabilization scheme for tea through international collaboration as during the thirties and intensification of efforts for "demand creation" in overseas markets for which there is considerable scope.

MECHANIZATION AS A TECHNOLOGICAL CHANGE

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INTRODUCTION

Application of mechanical power to agriculture is one of the technical changes that took place in the Western countries and in Japan especially after the post-World War II period. One of the consequences of this development has been that the efficiency of the agricultural industry has gone high with a considerable reduction in the requirement of human and animal labour. If the number of tractors is taken as an index to measure the degree of mechanization in various countries, India's position is found to be the lowest. India had 0.08 tractors per 1,000 acres of cultivated land (1961) against 104.33 tractors[1] per 1,000 acres in Japan, 33 in West Germany, 17.5 in Denmark, 9.56 in France, 9.37 in the United Kingdom and 4.59 in the U.S.A. (1962).[2]

The factors such as small size of holdings, meagre financial resources, etc., which stand as deterrents to the introduction of mechanization in India are well known. But if the efficiency of Indian agriculture is to be boosted up, application of modern technology, such as introduction of mechanical power, is said to be one of the essential requirements.

1. More than 95 per cent of them are small tractors of 3—3 5 H.P.
2. *Source :* Production Year Book, 1964, Food and Agriculture Organization of the United Nations, Rome, 1964.