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AGRICULTURAL SURPLUS, LABOUR SURPLUS AND ECONOMIC DEVELOPMENT—A THEORETICAL APPROACH

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This paper attempts to present a theoretical analysis of a densely populated agrarian economy in support of the proposition that what appears to be "surplus labour" is in essence a case of full employment equilibrium attained at (*a*) a low level of productivity, (*b*) at a low level of technology and (*c*) at a level of subsistence wage. An effective labour surplus emerges with the growth of agricultural surplus following advancement of the agricultural economy. Labour surplus is a consequence of agricultural surplus rather than causing it by emigration. This view is, as will be apparent later, somewhat different from the trend of thinking led by Lewis, Nurkse, Ranis and Fei and many others which recognizes presence of a large volume of redundant labour force and "disguised" unemployment but does not recognize "disguised" shortage of labour in the under-developed agrarian economy except in a later phase.

The theoretical framework will cover the analysis of possibilities as to whether any new investible surplus emerges as *a matter of course* on account of the transfer of so-called "surplus labour" to the industrial sector so that the very emigration of labour creates momentum for industrialization and such industrialization in turn supports alternative employment for labour released from the agricultural sector. This is a very important issue because such diversion of labour from agricultural production to industrial production would have facilitated economic growth at a moderate cost.

An attempt will be made to show that a reasonable rate of economic development coming through industrialization may not be possible without the introduction of labour-saving technology in the agricultural sector of the economy.

THE BASIC ASSUMPTIONS

The basic assumptions underlying the proposed theoretical framework may be described as follows :

1. In a densely populated under-developed economy the agricultural wage rate is forced down to the subsistence level under the pressure of growth of population. Any increase in wage rate beyond this level tending to materialize through improvement of productivity stimulates an increase in the rate of growth of population till the wage rate is reduced to subsistence. Earning of bare subsistence is the basic fact in most of the farm enterprises.

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2. The assumption of zero marginal productivity of labour at the level of full employment though not empirically valid will be used as a tool of analysis to indicate the "equilibrium output" and that productivity of some working members may be higher than their consumption and of others lower than their consumption.[1]

This assumption is, however, different from one of the existence of a larger number of redundant population having no or little productivity. Moreover, zero marginal productivity is supposed to have little effect toward bringing down the wage rate below subsistence or, speaking in a more sophisticated language, below the "real cost of labour given by the individual rate of indifferent substitution between income and labour."[2]

3. Coexistence of two sectors—agricultural and industrial is assumed, and economic development is conceived to be diversification of the national product in addition to its mere increase : This is achieved by progressive transfer of labour force from the agricultural sector to the industrial sector.

4. It is assumed that only appreciable material capital in traditional agriculture is land. Since land is something fixed in quantity, the only productive factor with whose variation output varies is supposed in the present discourse to be labour.

In industrial production, however, investment in capital equipment also is taken into account as an important variable and it is assumed that labour employment capacity of the industrial sector would considerably depend upon capital-stock of this sector.

5. The supply of and the demand for farm labour are determined by the following socio-economic entities comprising the agricultural sector :

   (*a*) Landless agricultural labourers getting subsistence income solely from wage employment on employer farms.

   (*b*) Sub-marginal family farms almost exclusively dependent on their own labour for their own cultivation—but earning part of their income from wage-employment on bigger farms—the total earning being just equivalent to subsistence.

   (*c*) Marginal family farms almost exclusively dependent on self-labour for their own cultivation and almost wholly engaged in own cultivation obtaining a subsistence income from farming.

   (*d*) Family farms partly dependent on self-labour and partly dependent on hired labour getting an income above subsistence.

   (*e*) Family farms almost exclusively dependent on hired labour, getting an income much above subsistence and accumulating capital.

1. The assumption of "equilibrium output" in traditional agriculture influences T. W. Schultz a great deal in his work Economic Crises in World Agriculture, University of Michigan Press, Ann Arbor, U.S.A., 1965.

2. A. K. Sen, "Peasants and Dualism With or Without Surplus Labour," *Journal of Political Economy*, Vol. 74, No. 5, October, 1966.

Special emphasis is laid on the assumption that self-employing small owner farmers constitute the major part of a farm economy of a country like India and self-labour is the major source of farm labour supply.

The above-noted assumptions are drawn as far as possible from empirical findings and a theory of surplus labour cannot do without taking sufficient cognizance of the fact of extensive self-employment in the farm economy of an underdeveloped country.

A NEW VERSION OF THE TWO SECTOR MODEL

Lewis by presenting a two sector model has indicated how surplus labour from the subsistence sector is in a gradual process transferred to the capitalist-industrial sector till the marginal productivity of labour in the former sector rises to equality with that in the latter sector.[3]

Ranis and Fei have presented a refined version of the two sector model by dividing the process of economic development into three phases:[4]

(a) *Phase I.* This is characterized by zero marginal productivity of labour—each worker getting an "institutional wage" equivalent to the average product of labour.

(b) *Phase II.* This is characterized by rising marginal productivity of labour which, though rising through transfer of labour to the industrial sector, is not large enough to cover subsistence so that labour still gets an institutional wage (average product) exceeding its marginal productivity.

(c) *Phase III.* This is characterized by equality of wage rate with marginal productivity of labour heralding the commercialization of the agricultural sector.

According to the above analysis if in the first phase some workers whose marginal productivity is nil are transferred to the industrial sector with higher productivity, the agricultural surplus to the extent of excess of "institutional wage" over zero marginal productivity which is drawn from the family pool of product is available for supporting their employment in the industrial sector. With progressive migration of workers to the industrial sector the marginal productivity of labour improves eliminating the excess of wage over it. A situation arises when transfer of a worker means reduction of the product so that no surplus on his account is available to him when he is employed in the industrial sector.

The first difficulty in the theory of Ranis and Fei consists in the identifiability of workers making zero contribution to production or making contribution less than their consumption ("institutional wage"). The marginal productivity of labour can be conceived only in terms of labour units such as man-hours or

3. W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labour" in A. N. Agarwala and S. P. Singh (eds.): The Economics of Underdevelopment, Oxford University Press, Bombay, 1958.

4. G. Ranis and J. C. H. Fei, "A Theory of Economic Development," *The American Economic Review*, Vol. 51, No. 4, September, 1961.

man-days, not in terms of an integral worker. The obvious consequence is that the productive contribution of no worker unless he is observably absolutely idle can be conceived to be nil in its integrality. Emperical evidence does not unquestionably or unequivocably speak for zero marginal productivity of even a man-day far from zero marginal productivity of an integral worker in the farm economy of an under-developed and densely populated economy. Nor it is possible to convert labour units into an integral number of identifiable workers having zero marginal productivity even on the assumption that some labour units have no productivity.

Another difficulty of the theory arises from a static conception of the "institutional wage." Ranis and Fei say that upto the end of the second phase every worker gets an "institutional wage" equivalent to the average product of the workers even though his productive contribution is less than this amount. But in spite of an upward shift in production function the "institutional wage" has been conceived to be unchanging to give an inflated picture of the quantum of "agricultural surplus" accruing from the withdrawal of "redundant workers" from the farm sector.

It is quite possible that an upward shift in the production function might bring about an upward shift in the "institutional wage line" with the effect of commercialization of the agricultural sector being warranted earlier or the third phase being overlapped with the second one.

THE MECHANISM OF SELF-LABOUR EMPLOYMENT ON SMALL FARMS

It is not fully correct to suppose that labour units will be employed on own farm upto zero marginal productivity just because by doing so output can be maximized. This is true if there is no disutility of any part of the labour units which is not compensated by equivalent product. But if uncompensated disutility of labour exists employment of self-labour would not be extended up to the zero marginal point. If there is pressure of "surplus labour" within the family farm, employment of labour would at most be pushed up to the subsistence point which may be higher than the point of zero marginal productivity of labour. Thus the quality of subsistence wage and a positive marginal productivity may be maintained. If subsistence is earned before zero marginal productivity point, there would be no further exertion of labour upto zero marginal productivity. The position of zero marginal productivity would be reached if that is indispensable for ensuring subsistence wage. The situation of uncompensated disutility of labour can be avoided by taking the opportunity of employment on bigger farms, if employment on own farm is not enough for covering subsistence. Much depends upon the form of the marginal productivity function—particularly its height in relation to the origin.

The position may be considered with reference to Figure 1A and Figure 1B.

In Figures 1A and 1B the horizontal axis indicates the quantity of labour and the vertical axis indicates the marginal productivity of labour, M_1P_1 and M_2P_2 showing marginal productivities at different levels of employment. Marginal productivity curves in this and subsequent diagrams are taken as linear for the convenience of exposition. OP_1 is the quantity of availalbe family labour. The

marginal productivity curve of Figure 1B is higher than that of Figure 1A which reaches zero when OP_1 amount of labour is fully employed. OS is subsistence wage (the subsistence wage line SR_1T passing through R_1, the middle of M_1P_1),

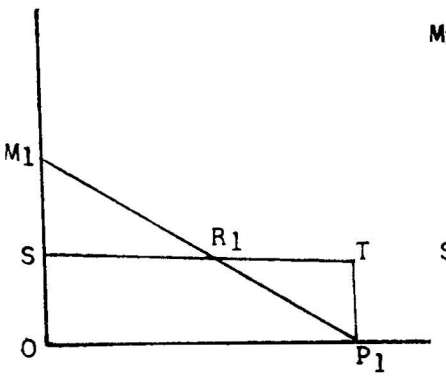

Figure 1A

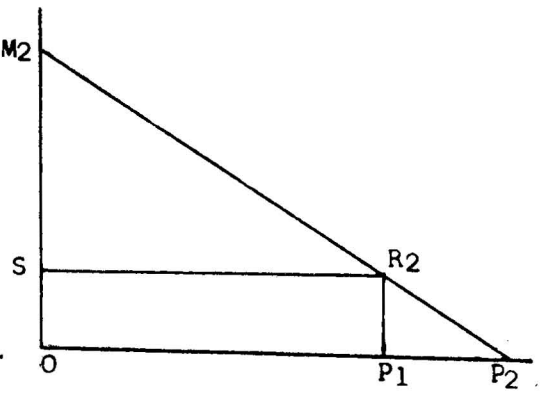

Figure 1B

which in Figure 1A is equivalent to $\frac{(M_1P_1O)}{OP_1}$, *i.e.*, in Figure 1A the subsistence wage is just equal to the average product of the worker and there is no surplus over consumption. In Figure IB as the marginal productivity curve is higher, full employment of OP_1 is attained without reducing marginal productivity to zero and there is a surplus over consumption M_2R_2S.

VARIABILITY OF CAPITAL-LABOUR RATIO

Starting with the assumption that there is abundance of surplus labour in the agricultural sector of the under-developed economy, it is possible to conceive that this surplus would wipe itself out through an appropriate adjustment of capital-labour ratio. (The concept of capital-labour ratio is introduced here to serve as an index of technology with its bearing upon economic growth). There is an equilibrium technology. If incremental capital requirement matching incremental labour force consequent upon the growth of population exceeds additional saving generated at a particular technological level, capital-output ratio will fall till the equilibrium technology is reached. Similarly, if the incremental capital requirement is less than saving generated as may be expected at a low level of technology, there will be a rise in capital-output ratio till again the equilibrium is reached. This is what is derived from Solow's growth model.[5] How far does this possibility of adjustment of capital-labour ratio work out in an under-developed economy which is presumably already at a low level of capital intensity? In all probability the economy here is in a region of static equilibrium at a low level of capital-labour ratio. An attempt at capital intensification beyond this region would simply fail reverting the economy to a lower level of capital intensity. Thus a high labour surplus economy will tend to be embedded in a low capital intensity technology. Thus every economy finds its own level of capital-labour ratio depending on the size of population. At its own level of capital intensity its surplus labour problem is

5. R. M. Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, Vol. 70, 1956.

not really a problem of surplus labour—but a problem of low productivity. Labour cannot be released appreciably within the present framework of technology for a higher rate of industrialization than what is in reality and the process of development of the entire economy is arrested. This situation demands looking for remedy in a low capital ratio technology with higher productivity—a sort of disembodied innovation of technology which improves productivity without capital investment. Assuming that disembodied innovation of technology has its limit—low capital intensity with low productivity tends to be perpetuated. Then it seems, as it were, that stagnation in an under-developed economy has no end. It is fed by 'surplus labour'—labour which is apparently redundant but in fact useful and indispensable at a low level of productivity and technology.

In case "surplus labour" in the agricultural sector becomes more productive through technological innovation of 'disembodied character,' indispensability of labour in this sector is increased so that no labour is released to step up industrialization in spite of increased availability of "agricultural surplus."

FURTHER WORKING OF THE MODEL

An attempt is now made in this section to formalize the working of the model described in the preceding section.

Let us first take up the case of a marginal farm which on the basis of self-labour is in a position to earn only a subsistence income. The case is represented in Figure 2.

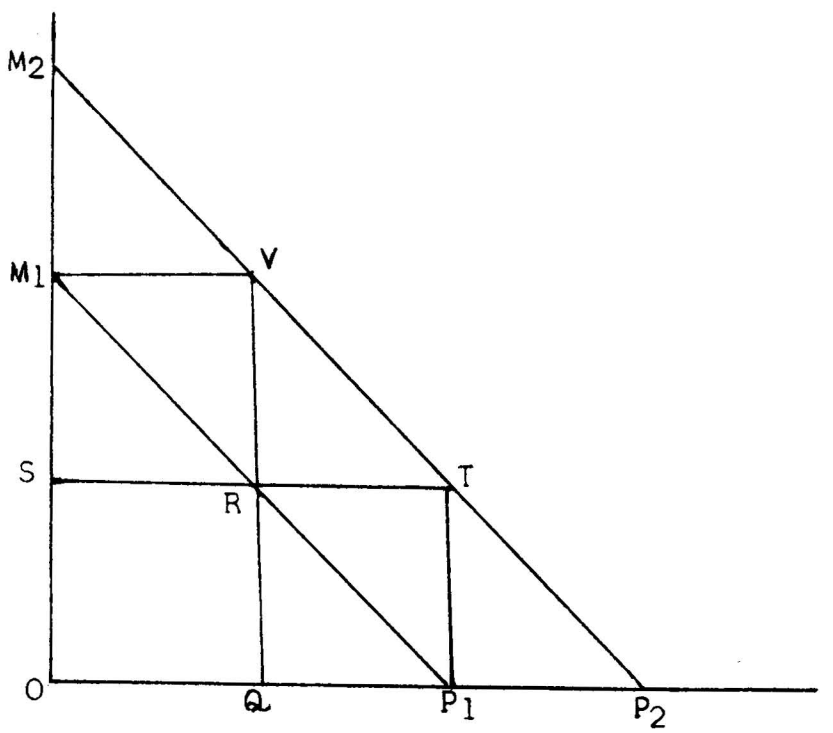

Figure 2

OP_1 is the quantity of self-labour available to a marginal farm earning only a subsistence income, *i.e.*, M_1P_1O, M_1P_1 is the curve of the marginal productivity of labour reaching zero at OP_1 level of employment within the framework of the existing technology. An "agricultural surplus" to the extent of RQP_1T is to be produced to support QP_1, amount of labour released for industrialization. But with the withdrawal of QP_1 labour from the farm the net surplus would only amount to M_1RS. Usually this surplus makes up the deficit P_1RT on account of QP_1 whose productivity is less than consumption. If QP_1 is transferred to the industrial sector there will be a shortage to the extent of P_1QR.

Now suppose there is an upward shift in the marginal productivity curve owing to a technical innovation which increases labour productivity without saving labour. Let us suppose that the marginal productivity curve shifts upward to a horizontal distance of RT and vertical distance of RV from all points of the original curve to take the new form M_2P_2 passing through T. T is the point at which the perpendicular line from P_1 upward intersects the extended subsistence line SR. Here emerges a net agricultural surplus of M_2ST no part of which is spent in supporting less productive labour QP_1. Now if QP_1 is removed there will be a loss of product to the extent of VQP_1T reducing the surplus M_2ST to M_2SRV which may not be or precariously higher than RQP_1T. If, again, a part of the increased production as is natural to an under-developed economy goes to raise the level of living, *i.e.*, OS is raised to a higher level, no surplus will be available to support release of QP_1 for industrialization.

To ensure an emergence of agricultural surplus necessary to support employment of QP_1 in the industrial sector the subsistence wage line must not be higher than the one passing through R, the mid-point of M_1P_1 parallel to OP_1; because under this condition $M_1SR = RP_1T = /= RQP_1 = M_1VR$, so that M_2SRV is higher than RQP_1T just by M_2M_1V. It is unusual that subsistence wage line will not rise beyond OS with the rise in the marginal productivity curve of labour. Thus the transformation of a subsistence farm into a surplus producing farm by itself is not helpful towards transfer of labour to the industrial sector.

But if labour force increases through the growth of population to OP_2 with the rise in the marginal productivity curve, the incremental labour force can be withdrawn in favour of the agricultural sector on the basis of the matching agricultural surplus to the extent of M_2ST. Thus in this case the expansion of employment in the industrial sector is limited to incremental labour force which may not be sufficient for a reasonable economic growth. It is, on the other hand, possible that this surplus is going into new investment in the farm sector itself sustaining employment of the incremental labour force in agriculture with little diversion to industry.

The output of farm may be elastic with respect to withdrawal of labour. This means that when a few labour units are withdrawn from the farm, the output is increased and maintained at the optimum level by intensification of *the remaining labour force.*[6] But such elasticity of output may also be accompanied by elasticity of consumption with respect to change in income and in the exertion of labour power. An increase in the exertion of labour power and income might bring about an appreciable increase in the consumption of food to wipe out any agricultural surplus which might accrue following emigration of labour. This is very likely

6. See discussion of the point in A. K. Sen, *op. cit.*

to happen in the case of subsistence farms. Thus elasticity of output has not much influence on the creation of surplus. The total quantity of original output, on the other hand, could be maintained by a labour-saving technical innovation with OQ labour working on the farm, QP_1 being released. Then a surplus $M_1SR + RQP_1$ could be available for the support of QP_1 employed in the industrial sector.

We may also consider another case where the marginal productivity curve rises to M_2P_2 partly through technical innovation rooted in plant-biological improvements and partly through labour-saving innovation so that the total output of M_2OP_2 could be obtained by OQ labour, QP_1 being released. In this case a substantial amount of surplus M_2SRQP_2 would emerge which is not only sufficient for supporting QP_1 labour employed in the industrial sector but also for supporting future growth of labour force.

Let us now consider the position of employer farms which conduct farming with hired labour—with reference to Figure 3.

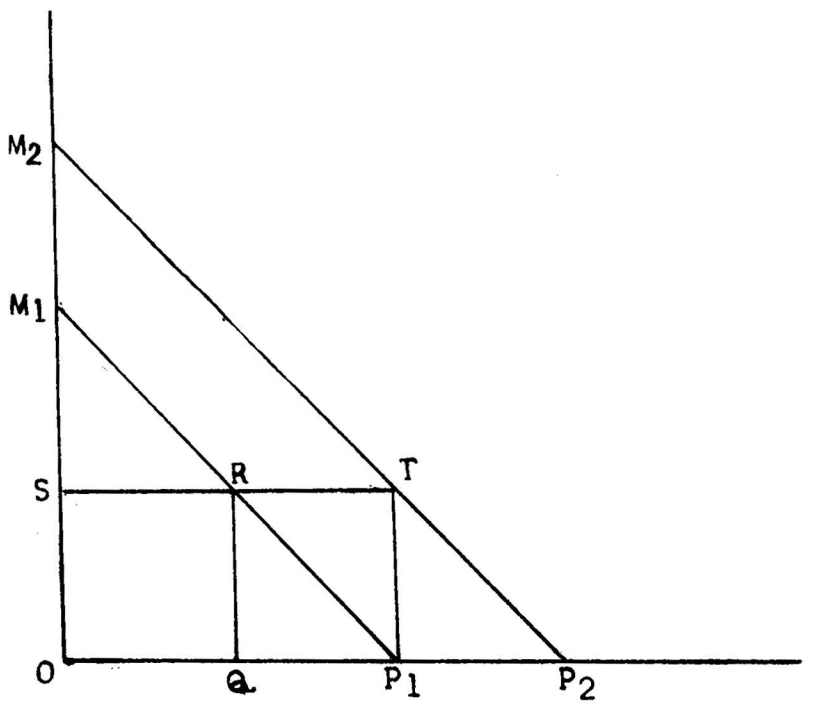

Figure 3

In Figure 3 the marginal productivity curve is M_1P_1. When the wage is OS labour will be employed up to OQ. When the marginal productivity curve is raised to M_2P_2 through technological innovation in the nature of plant-biological improvements, the demand for labour would increase from OQ to OP_1. Though the agricultural surplus would increase from M_1SR to M_2ST, the agricultural sector may not be in a position to release labour for the industrial sector. This is because technological innovation of biological type creates excess demand for labour

on employer farms. Thus the agricultural surplus is not matched by labour surplus to be employed in the industrial sector.

Probably the extra surplus M_1RTM_2 would tend to be wiped out in meeting excess wage demand following an excess demand for labour. To retain this surplus it would be necessary for the farm to adopt labour-saving devices. With the adoption of labour-saving devices it would be possible for the farm to have a substantial surplus by employing the original amount of labour to produce the original quantity of the product. Thus the investible surplus would be available for supporting employment of labour released from the farm-sector in favour of the industrial sector.

It may be noted here that in the foregoing analysis we have not given any consideration to the curve of supply of labour. We have proceeded on the assumption that irrespective of availability of labour wage rate is equivalent to subsistence. Agriculture in a developing economy does not altogether present a static picture. Productivity increases through intensification of use of at least the traditional methods,—but this increase in productivity is offset by an increase in the rate of growth of population—the resultant is a static subsistence equilibrium. This position can be depicted on a macro-economic scale with reference to Figure 4.

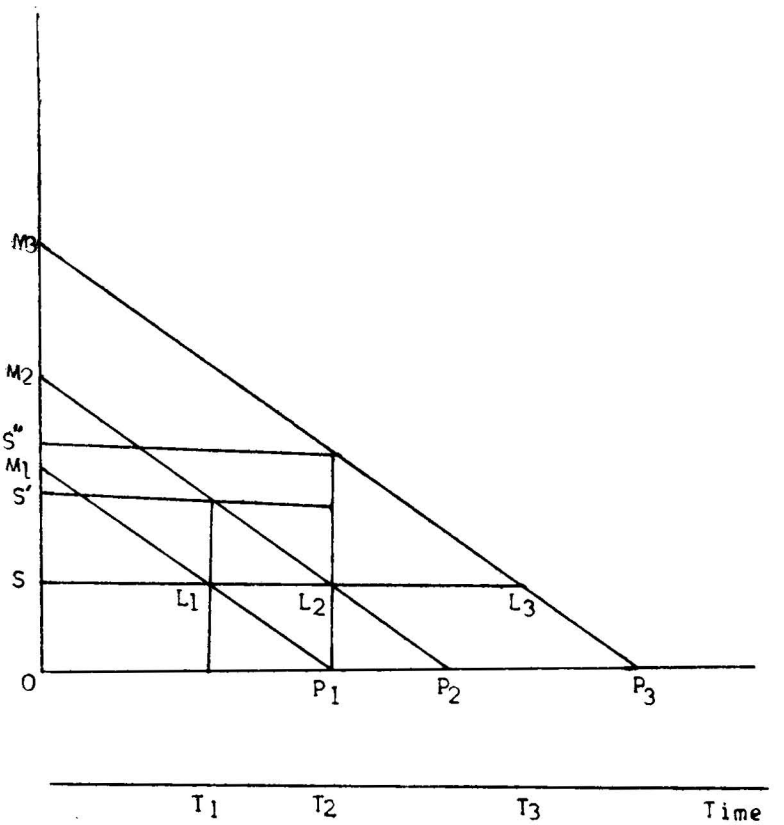

Figure 4

Figure 4 presents an aggregative picture of the total agricultural economy. MP is the marginal productivity curve of labour shifting from M_1P_1 to M_2P_2 and from M_2P_2 to M_3P_3 over time. The aggregate labour force increases from SL_1 to SL_2 and from SL_2 to SL_3 over time. OS is the subsistence wage. While the marginal productivity of labour is increasing through technological innovation, the labour force is also increasing through growth of population—thus the equilibrium wage rate is maintained at the subsistence level OS. The mode of operation is like this : When the wage rate is OS and labour force is SL_1, there is an upward shift of the marginal productivity curve M_2P_2 raising the wage rate to OS′, but now the labour force increases to SL_2 so that the wage rate reverts to OS. When the marginal productivity curve further rises to M_3P_3, the wage rate rises to OS″ only to revert again to OS as labour force increases to OL_3. The subsistence wage in this way, tends to be almost perpetuated.

Increasing pressure of population forces intensification of use of the available capital resources and the technical potential with the result of a balance on the point of a low capital-labour ratio subsistence income. Parodoxically enough, such an economy is not in a position to release the so-called "surplus labour" for industrialization as a matter of course.

One should, however, be warned against over-simplification of the subsistence wage to which Figure 4 is committed. Subsistence wage should not be taken as a rigid magnitude. If the rate of technological progress is higher than the rate of growth of population, it is possible that the subsistence wage line will itself be undergoing a rise. Instead of taking subsistence as a fixed quantum there is greater analytical convenience in taking consumption of the farm family as equivalent to its subsistence. And when we say that under the pressure of growth of population the wage rate is lowered to subsistence, we mean evaporation of the investible surplus over consumption of the farm family. Objection has been raised to computation of profits in "Studies in the Economics of Farm Management" (sponsored by the Ministry of Food and Agriculture, Government of India) by imputing to family labour the market wage rate as shadow labour cost which "fictitiously" shows predominance of "losses" in Indian agriculture.[7] The present writer, however, would have preferred taking actual consumption of the farm family as its wage cost to imputing value to its own labour at the market wage rate or simply neglecting the family labour cost. Valuing farm family labour at its consumption cost would have led to an estimation of profit that might be defined as "investible surplus." This would be better than ruling out of consideration the value of family labour as an element in cost.

A MATHEMATICAL NOTE

Let us now attempt an elaboration of this proposition in terms of a mathematical formulation. It is directed towards analysis of agricultural surplus with its bearing on industrialization and, for that matter, economic development without inviting the concept of "surplus labour" which has been found to be ambiguous in the earlier sections.

7. A. K. Sen, *op. cit.*

Let us suppose that in the initial stage the consumption of the agricultural sector consists only of agricultural products. Only when a surplus emerges an appreciable part of the surplus is spent on industrial goods creating demand for these goods. The production of industrial goods in addition to the level already attained is supported by the portion of agricultural surplus going into consumption of these goods.

It is assumed that the labour force is employed in the farm sector up to the point of optimum output or zero marginal productivity.

It will now be seen how far it is possible for a farm economy reaching optimum (equilibrium) can release labour for the industrial sector.

Let consumption of agricultural products by the agricultural sector be determined by the function

$$C = 1 + mY + nP \quad .. \quad .. \quad .. \quad .. \quad (1),$$

where C = consumption,

Y = total agricultural product,

P = total agricultural population,

l, m and n = constants.

If S denotes surplus of the agricultural product over consumption, then it is $(Y - C)$

$$\text{or } S = Y - 1 - mY - nP$$

$$= (1 - m)Y - (1 + nP) \quad .. \quad .. \quad .. \quad (2)$$

Suppose this surplus S is exchangeable into $S\delta$ amount of industrial goods, δ being the terms of exchange of agricultural goods for industrial goods.

Let us now turn to agricultural production which is supposed to be governed by the relationship

$$Y = a + bL - cL^2 \quad .. \quad .. \quad .. \quad .. \quad (3),$$

where Y = total product,

L = quantity of labour employed,

a, b and c = constants.

Supposing that the labour force is employed up to the point of maximum production (employment beyond this point being ruled out as absurd), we have :

$$\frac{dy}{dL} = O = b - 2CL$$

$$\text{or } 2CL = b$$

or $L = \frac{b}{2C}$ which means that labour force at the point of maximum production is equivalent to $\frac{b}{2C}$ when we put this value of L in the above equation we have :

$$Y = a + \frac{b^2}{2C} - \frac{b^2}{4C}$$

$$= a + \frac{b^2}{4C} \quad .. \quad .. \quad .. \quad .. \quad (4)$$

Putting this value of Y in (2), we have $S = (1—m)\ (a + \frac{b^2}{4C})—(1 + nP)$.

Supposing that

$1 = 0$

$P = \frac{b}{r_{2C}}$ (quantity of labour force engaged to produce maximum output, r being labour units supplied by a man)

the expression is converted into

$$S = \left[(1 - m)\ (a + \frac{b^2}{4C}) - \frac{n}{r}\ \frac{b}{2C} \right] \quad .. \quad .. \quad .. \quad (5)$$

When $(1 - m)\ (a + \frac{b^2}{4C}) = \frac{n}{r}\ \frac{b}{2C}$

there is no surplus.

In other words, so long as $\frac{n}{r}\ \frac{b}{2C} < (1 - m) \left(\frac{4ac + b^2}{2b} \right)$ there emerges any surplus to support employment of labour in excess of $\frac{b}{2C}$.

Now if $a = 0$

$m = 0$

and $b = \frac{2n}{r}$

then there is no surplus to support employment in excess of the present equilibrium employment in the farm economy.

Let us suppose R amount of labour can be withdrawn even from within a farm economy which is at the optimum (equilibrium) level of output. We have to find out the net surplus that would remain after the withdrawal of R.

That is, we have to consider the difference between the output of reduced labour force $\left(\frac{b}{2c} - R \right)$ and consumption of the reduced labour force. From equation (3) we have total output of reduced labour

$$= \frac{b^2}{4c} - bR + cR^2 \text{ (when a is taken to be zero)} \quad .. \quad .. \quad (6)$$

From equation (1) and (2) we have total consumption of the original labour force $= m\frac{b^2}{4c}+\frac{n}{r}\frac{b}{2c}$ (by neglecting a and b and taking r as labour units supplied by a man) .. .. (7)

We have per capita consumption as

$$\left[m\frac{b^2}{4c}+\frac{n}{r}\frac{b}{2c}\right].\ \frac{2cr}{b}$$

or $\frac{mb^2r}{2b}+n$

or $\frac{mbr}{2}.+n$ .. .. (7)

Therefore, total consumption of reduced labour force

$$=\left(\frac{b}{2c}-R\right)\left[\frac{mbr}{2}+n\right].\ \frac{1}{r}$$

$$=\frac{mb^2}{4c}-\frac{mRb}{2}+\frac{nb}{2cr}-\frac{Rn}{r} \quad .. \quad .. \quad .. \quad .. \quad (8)$$

Subtracting (8) from (6), we have

$$S \text{ (the surplus)} = \frac{b^2}{4c}-bR+cR^2-\frac{mb^2r}{4c}+\frac{mRb}{2}-\frac{nb}{2cr}+\frac{Rn}{r} \quad (9)$$

Now consumption of R, *i.e.*, $\left(\frac{mRb}{2}+\frac{Rn}{r}\right)$ is equated to

$$\left(\frac{b^2}{4c}-bR+cR^2-\frac{mb^2}{4c}+\frac{mRb}{2}-\frac{nb}{2cr}+\frac{Rn}{r}\right)$$

from which solving for R, we get $R=\frac{b+\sqrt{(mb^2r+2nb)\frac{1}{r}}}{2c}$.

If m = 0, we have $R=\frac{1}{2c}\left[b+\sqrt{\frac{2nb}{r}}\right]$ .. .. .. (10)

Thus from a farm economy, labour force equivalent to $\frac{1}{2c}\left[b+\sqrt{\frac{2nb}{r}}\right]$ can be withdrawn for employment in the industrial sector.

Thus both the amount of agricultural surplus and withdrawable labour force of the agricultural sector (labour surplus) are determined by the parameters b, n and c.

Let industrial production be governed by the function $O=\lambda N^k I^\mu$

where N = quantity of labour,

I = capital investment,

O = product,

λ, k and μ = constants.

From the above function we have $I = \left(\frac{O}{\lambda}N^{-k}\right)^{\frac{1}{\mu}}$ .. .. (11)

which is investment in capital equipment required to produce (O), with employment of 'N'.

By putting the value of R from (10) and S from (9)[8] for N and O respectively in (11), we estimate the investment in capital equipment to employ labour withdrawn from the agricultural sector as :

$$I = \left[2^{K-2}\left(\frac{\delta}{\lambda}\right)\left\{b+\sqrt{\frac{2nb}{r}}\right\}^{-K} C^{K-1}\ (b-2cR)\ \left(b-2cR-\frac{2n}{r}\right)\right]^{\frac{1}{\mu}}$$

$$= \left[2^{K-1}\left(\frac{\delta}{\lambda}\right)\frac{n}{r}C^{K-1}\left\{b+\sqrt{\frac{2nb}{r}}\right\}^{1-K}\right]^{\frac{1}{\mu}}$$

subject to the condition that the amount of labour employed is within the range of possible combination with the prescribed amount of investment.

Now let us see what happens if growth of population is brought to the scene. It is assumed that the growth of labour force is proportional to the growth of population and tending to bring down the wage rate and the marginal productivity of labour to the subsistence level.

The product of the initial year is given by

$$Y = a + bL_o - cL^2_o$$

where Y = the product, L_o = volume of labour in the initial year, a, b and c are constants.

$$\frac{dy}{dL} = b - 2cL_o.$$

At the end of t years the labour force rises to L_oe^{qt} where q is the rate of growth of labour force.

The product at the end of the 't' th year is given by

$$Z = ae^{pt} + bL_oe^{qt} - cL_o^2e^{2qt},$$

where e^{pt} is the technical progress factor

$$\frac{dz}{dL} = bc^{qt} - 2cL_oe^{2qt}.$$

The rate of growth of population is such that $be^{qt} - 2cL_oe^{2qt} = b - 2cL_o$ from which solving for qt we have

$$qt = \log_e \frac{b}{2cL_o} - 1,\ b > 2cL_o.$$

Therefore $q = \text{Log}_e\left[\frac{b}{2cL_o} - 1\right].\ \frac{1}{t},\ b > 2cL_o.$

The growth of labour force in an under-developed agrarian economy is as given above which keeps down the marginal productivity of labour and the wage rate constantly to the level of subsistence.

8. $S\delta$ = agricultural surplus converted into industrial product and m = 0.

CONCLUSION

If any surplus labour is to exist in the agricultural sector there must be 'surplus consumable' to support its existence. The maximum amount of such 'surplus labour' cannot exceed excess of maximum output of a particular time (in the state of a particular technology) over consumption of labour force required to produce this output—divided by per capita amount of consumption. Speaking disaggregatively, a subsistence farm cannot release labour for non-farm sectors, while a surplus-making farm can release labour for non-farm sectors.

Economic theories concerning the two sectors are centred on the possibility of reduction of farm output in the event of withdrawal of a part of agricultural labour force. The more important and relevant issue is the adequacy of agricultural surplus to support transfer of a certain amount of labour force from the agricultural to the industrial sector. Thus labour surplus is posed here to be a relative concept linked to agricultural surplus—rather than productivity, which would be changing with changing productivity and consumption. Co-existence of agricultural surplus and labour surplus is a pre-condition of economic development.

In an under-developed agricultural economy a tendency is at work towards equalization of the marginal productivity of labour on employing farms with the level of subsistence earned on the subsistence or near subsistence farms with the result that surplus labour for the industrial sector can be released only through some sort of labour-saving devices. This situation is perpetuated by growth of productivity through whatever technical change is introduced in the course of time accompanied by a particular type of growth of population.

REFERENCES

W. A. Lewis, "Economic Development with Unlimited Supplies of Labour" in A. N. Agarwala and S. P. Singh (eds.) : The Economics of Underdevelopment, Oxford University Press, 1958.

G. Ranis and J. C. H. Fei, "A Theory of Economic Development," *The American Economic Review*, Vol. 51, No. 4, September, 1961.

D. W. Jorgenson, "The Development of a Dual Economy," *The Economic Journal*, Vol. 71, No. 282, June, 1961.

G. O. Gutman, "A Note on Economic Development with Subsistence Agriculture," *Oxford Economic Papers*, Vol. 9, No. 3, October, 1957.

A. K. Sen, "Peasants and Dualism With or Without Surplus Labour," *Journal of Political Economy*, Vol. 74, No. 5, October, 1966.

T. Haavelmo: A Study in the Theory of Economic Evolution, North Holland, Amsterdam, 1954.

R. M. Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, Vol. 70, 1956.

R. M. Solow : Capital Theory and the Rate of Return, Amsterdam, 1963.

H. Leibenstein : Economic Backwardness and Economic Growth, John Wiley & Sons, Inc., New York, 1957.

G. C. Mandal, "The Concept of Disguised Unemployment with reference to the Productivity of Farm Family Labour," *Indian Journal of Agricultural Economics*, Vol. XXI, No. 1, January-March, 1966.

G. C. Mandal, "An Aspect of Inflation in India," *Bulletin of the International Statistical Institute*, Vol. XXXIII, Part III, 1951.

T. W. Schultz : Economic Crises in World Agriculture, University of Michigan Press, Ann Arbor, U.S.A., 1965.

M. L. Dantwala and W. B. Donde, "The Uneconomic Cultivator," Indian Journal of Agricultural Economics—Selected Readings, Bombay, 1965.

R. Nurkse : Problems of Capital Formation in Underdeveloped Countries, Oxford, 1953.

P. R. Brahmananda, "The Theory of Underdevelopment and Agricultural Backwardness," *Indian Journal of Agricultural Economics*, Vol. IX, No. 2, August, 1954.

Government of India: Growth Rates in Agriculture, Ministry of Food and Agriculture, 1964.

V. M. Dandekar, "Transforming Traditional Agriculture," *Economic and Political Weekly*, Vol. I, No. 1, August 20, 1966.