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IDS/DP 182

SOME ASPECTS OF THE POLITICAL ECONOMY  
OF AGRICULTURAL SOCIETIES

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DISCUSSION PAPER NO. 182

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OCTOBER, 1973

Views expressed in this paper are those of the author. They should not be interpreted as reflecting the views of the Institute for Development Studies or of the University of Nairobi.

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ABSTRACT

This paper is a study of the various social and political systems which have been imposed on traditional agricultural economies in the past. Traditional agriculture is characterised by underemployment of the labor force except during harvest periods, and this has serious implications not only for the wage rate but also for labor's social and political freedom. Maximization of rent in an economy in which both land and labor are scarce brings strong pressures to bind labor to the farm through the crop year. Such restrictions have often taken the social and political form of feudalism. In a land surplus economy agricultural slavery may be practised in order to create a surplus for the propertied class.

Modern agriculture differs from traditional agriculture in employing its labor force fully, or almost fully, throughout the year. This requires an increase in the productivity of harvest labor made possible by technological advance and an increase in the ratio of capital to labor in harvesting. In the end, agricultural labor becomes more prosperous, and the problems of the seasonal variation in employment are transferred from labor to capital.

## INTRODUCTIONS.

This paper is a study of traditional (crop) agriculture, and its implications for the social and political affairs of those who lived and died in it.

Traditional agriculture was generally characterized by a low output-labor ratio.<sup>1</sup> But it was even more strongly characterized by the frenzy of activity in the harvest season required from every man, woman and child who could work and the equally striking relaxed manner of work and underemployment in the nonharvest seasons.<sup>2,3</sup> Modernized agriculture in present-day industrial economies generally no longer has these properties in its demand for labor to any significant extent.<sup>4</sup> This aspect of traditional agricultural societies as against modern ones leads to the basic hypothesis of this paper: in traditional agriculture, labor possesses a harvest usage and a nonharvest usage in the production of the harvested crop and it is generally fully employed only at the harvest time.<sup>5,6</sup> Conversely, it is being assumed that, for most of the

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1. There were obviously exceptions to this statement, possibly in some types of slash and burn operations in early migratory settlements. See (2).

2. Schultz (29) defines traditional agriculture as: "Farming based wholly upon the kinds of factors of production that have been used by farmers for generations" (pp. 3-4). "For a long time nothing new has been learned from trial and error or from other sources. Consequently, the state of the arts is constant..." (p. 31). "As agriculture approaches the particular equilibrium of traditional agriculture, the marginal productivity of investment in additional agricultural factors continues to decline... (until) there is no longer any incentive to save for additional investment in these factors." (pp. 31-2.)

Our definition of traditional agriculture differs from that of Schultz in viewing traditional agriculture as characterized by this condition — leading to a production function of the type shown later in our equation (1) — rather than as a stationary state for agriculture with a production function of any type whatever.

3. Traditional agriculture need not imply a low per capita income under either our or Schultz's definition (29), although it often did so.

4. Agriculture may not be wholly able to overcome its seasonality of demand for labor even in advanced industrial countries and may rely upon part-time or full-time workers migrating in from industry, from educational institutions, or from other countries. For examples on Britain and United States, (see 4, p.114) and 3, p. 37).

The variation of the work to be done over the crop-year in modernized agriculture is, however, generally handled by a relatively higher mechanization of harvesting work compared with that of non-harvesting work.

5. Another period when it may be fully employed is the planting season. Our analysis is simplified but can be easily adapted for this possibility.

6. For estimates of such seasonal underemployment in various countries at various times, see (4, ch.7).

history of traditional agricultural societies, land was not the serious, inflexible barrier to output that is often implied. The barrier was the availability of labor itself at harvest-time.

It is already obvious that the postulated agricultural pattern applies only to the farming of crops — and within these, mainly to cereals — and not to pastoral agriculture. Economies of the latter type are, therefore, outside the scope of this paper. This still leaves a long span of human history in which agriculture was carried on under our assumptions. This was sometimes done under conditions where land and labor were both scarce, the case analyzed in section I below. It was sometimes done under conditions where only land was scarce, a topic of concern in modern development theory and analyzed in section II. But there do seem to have been some cases where only labor was scarce. This is analysed in section III.

The theories that are offered in these sections are long-run economic theories. They abstract from the myriad patterns that different crops or different social and political systems can impose on the economic scene. The abstractions are heroic and our theories are an extreme simplification of a reality spanning different lands over centuries. The analysis may then appeal only to a few, of the type usually classified as good growth theorists. Nevertheless, they shed a great deal of light on the economic practices of societies with traditional agriculture.

Section IV sets out some of the social and political implications of our economic analysis. Our motive in this section is to clarify and sharpen our understanding of the socio-political impact of the economic forces characteristic of traditional agriculture. Once these forces are recognised, it becomes possible to better understand and predict the political and social structures that will accompany such agriculture. Our jump from the economic to the social and political sphere is also a heroic one. It assumes, among other things, that the decisions, dominant in the long-run, made by labor and landowners concerning output and inputs in traditional agriculture, were economic decisions<sup>7</sup> — in the sense of being optimal for given objective functions and constraints — and that

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7. Schutz (29, ch.3) has cogently argued that traditional agriculture was highly efficient under its existing conditions so that even "competent farm managers...cannot show the farmers how to allocate better the existing factors of production" (29, p.52). Schultz based his conclusion on studies of Senapur, India, by Hopper (1957) and of Penajachel, Guatemala, by Tax (1953).

if the market system was curtailed, it was done so because it was in the economic interest of the dominant groups in the society. The institutional structure of the society is thus a variable in our (long-run) analysis and not a datum inconsistent with economizing actions.

#### I. AGRICULTURE WITH SCARCE LAND AND LABOR.

Economists generally classify all the possible factors of production into land, labor and capital. Capital per laborer or per acre of land was generally small in traditional agriculture and did not change appreciably over centuries. The role of capital can, therefore, be ignored. This leaves only two factors of production, labor and land, as relevant to agricultural production. Assume that each of these is homogeneous.

Labor has basically two differing kinds of uses on the land. One of these is in activities other than harvesting. These activities take varied forms through the crop-year, such as ploughing, weeding, digging ditches and irrigating, etc. Such activities do not generally absorb all the labor force so that there is a pool of seasonally-unemployed labor which varies with the kinds of tasks required. Simplify by assuming that such non-harvest activities collectively employ the same amount of labor throughout the crop-year excluding the harvest-season.<sup>8</sup> Designate the quantity of labor thus employed as  $N'$ . The other usage of labor in agriculture is in harvesting. The harvest season in traditional agriculture has almost always employed the whole of the available labor force, often with the physically-maximum number of work-hours per day.<sup>9</sup> Designate the quantity of labor employed at harvest time as  $N''$ . If the total available quantity of labor is designated as  $N$  and it is assumed that the labor force is fully employed at harvest-time,  $N''=N$ .<sup>10</sup>

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8. The analysis can be generalized to the case where each activity-- and the amount of labor employed by it -- is considered separately. However, our assumption is adequate for our purposes and highlights the results of the analysis.

9. Exceptions to this statement may occur and are cited by the modern literature on the existence of surplus labor in some underdeveloped economies today. For example, see 7, 19 and 30. This case is analysed in section II below.

10. The distinction between the number of laborers and the number of man-hours supplied is critical to the modern theory of development as, for example, in (30) and (35). However, our analysis is a long-run one and we have chosen to abstract from this distinction by assuming, say, a working day of a constant length. We do not believe that allowing the working day to vary is either relevant to or affects the implications that we have chosen to derive in this paper. Unemployment may, therefore, be interpreted as some laborers working less than the specified working day.

The general production function can then be written as

$$Y = F(N', N'', L) \quad (1)$$

where  $Y$  is the total agricultural output which is harvested and  $L$  is the quantity of land.  $N'$ ,  $N''$  and  $L$  are the quantities of the three distinct inputs in production though there are only two factors: labor and land.

(1) may be assumed to possess the properties of neoclassical production functions or have fixed coefficients. The former case is more plausible in a long-run spanning centuries. It is also easier to work with. Therefore, assume that the first and second-order partial derivatives of (1) exist and are continuous. Also assume that the marginal product of each input in production is diminishing. Constant returns to scale are assumed<sup>11</sup> in order to ensure that Euler's theorem holds. No other use is made of this assumption since this property is otherwise academic with the land being taken as exogenously given.

Assume also that the economic unit in charge of production of crops -- denoted in this paper as the landowner -- maximizes profits. The information required for maximizing profits is, besides (1), the cost or price per unit of each of the inputs. A profit maximizing landowner would equate the marginal product of each input to its price in order to determine his demand for the inputs and his output.

The prices of the inputs would obviously vary over space and time. Some information on these can be generated under alternative sets of assumptions. We examine some of these plausible alternatives in the next few pages and then comment on their applicability.

Consider the price of land first. Land has already been assumed to be fixed in supply. Hence, the return to land, from a macroeconomic viewpoint, is a residual -- a rent -- after payment to other inputs. However, it is not a residual from the viewpoint of the individual farmer. Our focus is on the employment of labor rather than on the return to land and we proceed to consider at great length the labor costs facing a farmer.

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11. That is,  $\lambda Y = F(\lambda N', \lambda N'', \lambda L)$ .

The marginal product of labor is defined from (1) as

$$\frac{\partial Y}{\partial N} = \frac{\partial Y}{\partial N'} \frac{\partial N'}{\partial N} + \frac{\partial Y}{\partial N''} \frac{\partial N''}{\partial N} \quad (2)$$

$\partial Y/\partial N > 0$  in the neoclassical theory of a dual economy (17).

$\partial Y/\partial N = 0$  in the classical approach to the dual economy (21, 8).

It seems unlikely that pure agricultural economies could have sustained a labor force over long periods of time with its marginal product equal to zero. It seems likely that the normal case for most societies was that  $\partial Y/\partial N > 0$ .<sup>12</sup> We discuss this case in this section and postpone the treatment of the case  $\partial Y/\partial N = 0$  to the next section. Here we make an even stronger assumption that  $N''=N$  so that the total labor force was fully employed at least at harvest time. This seems perfectly consistent with the empirical evidence for most of the agricultural economies that we know of. That is, it is assumed, in addition to (1), that:

$$\partial Y/\partial N'' > 0 \text{ and } N''=N \quad (3)$$

(3) assures that  $\partial Y/\partial N > 0$  in (2).<sup>13</sup>

Land has already been assumed to be fixed in supply so that the marginal product of labor must be diminishing in an economy with a growing labor supply. Hence, the output per laborer would decline as the labor force grows.<sup>14</sup> Conversely, the output per acre of land would increase as the labor force grows.

$N' \leq N$ , with  $N$  as the labor force itself. Most agricultural economies had a surplus of labor at times other than the harvest so that  $N' < N$  seems to be the normal case for analysis. However, the possibility

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12. Boserup's study of essentially traditional agricultural societies strongly supports the conclusion "that in many cases the output from a given area of land responds far more generously to an additional input of labour than assumed by neo-Malthusian authors" (2, p.14). For example, increases in the frequency of cropping a given field have been an important means of increasing agricultural output from a given land area with an increasing population. Thus, cropping a plot once in a generation might give way to cropping every third year or so and finally to continuous cropping.

13. A number of other restrictions on (1) seem reasonable. Assumptions made so far imply that  $\partial^2 Y/\partial N^2 < 0$ . It is further likely that  $(\partial^2 F/\partial N' \partial N'') > 0$   $(N''/Y) (\partial F/\partial N'') > (N'/Y) (\partial F/\partial N')$ . These restrictions are discussed later though only to the extent that they enter our analysis.

14. For instance, see (12, pp. 778-79) for the declining output/labor ratio in the production of wheat and rye in 19th century Russia.

of  $N^* = N$  can emerge and is considered later in the analysis. It is, therefore, being assumed at this stage that  $N^* < N$  (4)

Suppose that a labor market exists and is initially competitive or roughly competitive. The period for which labor contracts will be made is rarely specified or analyzed in modern economic theory but assumes a critical role in an analysis of traditional agriculture. There are two basic possibilities. These are considered below.

One possibility is that the labor contracts -- in the sense of the required notice of the termination of employment -- are entered into for short periods, say for a week or a month, as in most present-day industrial economies. Separate contracts can then be negotiated for work in the nonharvest season and for work in the harvest or in one of the seasons only. Assuming profit-maximization by employers, labor will be paid its marginal product in the harvest season. But labor is never fully employed in the nonharvest season. If laborers were willing to work for any wage, no matter how low, the competitive labor market would drive the wage rate in the nonharvest season to zero (or some negligible amount). It is, however, unlikely that laborers would work for a zero wage. Their preferences between work and leisure would specify a supply function for labor for nonharvest work. Such a function may, and is likely to, show a zero supply of labor at a zero wage rate and even at some low wage rates. Hence the wage rate for nonharvest labor will have to be positive. The total wage per laborer for the crop-year will be the sum of the wage for harvest work and of the wage for nonharvest work.

The other possibility is that wages will be negotiated for the crop-year and not separately for harvest and nonharvest seasons or their subperiods. Such a crop-year or annual wage could be paid out in monthly --- or some other subperiod -- instalments of equal or unequal length. A variety of practices is possible here, as in the present-day academic

professions. It is, however, likely that the monthly installment will be higher in harvest time than in nonharvest times to reflect the relatively greater amount of work required in the harvest season.

Under crop-year contracts with a positive marginal product of harvest labor and with  $N^0 < N$ , the competitive labor market ensures that no wage needs in fact be paid for the work done during the nonharvest season.<sup>15</sup> Nonharvest labor would then be employed until its marginal product,  $\partial Y/\partial N'$ , becomes zero. That is,

$$\frac{\partial Y}{\partial N'} = 0 \quad (5)$$

Since  $\partial Y/\partial N'$  is likely to be a function of  $N', N''$  and  $L$ , (5) can be solved for  $N'$ , the quantity of labor employed in the nonharvest season, for a given labor force and a given supply of land.

The employment of labor would be larger in the nonharvest season if its marginal product were zero than if it were positive. Conversely, the marginal product of land would be higher if more rather than less nonharvest labor is employed. Employers of labor then have a strong economic interest in negotiating annual or crop-year contracts rather than monthly ones: their rents are higher for the former than for the latter. However, laborers have an interest in negotiating monthly contracts.

The economic interest of groups over the long run is supported by the social and political pressures that can be applied. Employers of labor in general can bring such pressures to a greater degree than laborers looking for work. The capacity of the latter to resist such pressures depends upon their organization, usually lacking in most agricultural societies, upon the existence of independent means of livelihood and upon various other factors. In most societies it is unlikely that the pressures could be resisted in the long run, so that most agricultural societies should show a pattern of crop-year rather than monthly contracts. This is all the more likely in unsettled societies in which the law cannot guarantee personal security or the security of one's property, so that protection has to be sought through association or subservience to others, usually among the landowners. However, other societies in which each person is economically

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15. Provided, of course, that the marginal product of labor in the harvest season ensures a wage rate at which laborers are willing to work. This marginal product can be quite high, as will be seen later in this section, while the minimum wage required by labor to induce it to work can be extremely low and at a bare subsistence level.

strong and sufficiently secure could function under monthly contracts. This variety is likely to be a minority, with a tendency towards a further decline in number. We analyse further the most likely case of crop-year contracts with nonharvest labor employed up to the point where its marginal product becomes zero.

Assuming (5),  $N^h/N$  would be constant if the production function is homothetic in  $N^h$  and  $N$ . One special form of such a function is, for illustration,

$$Y = \lambda^\alpha F(\lambda N^h, \lambda N, L) \quad -1 < \alpha < 0 \quad (6)$$

In this case, the isoquants between  $N^h$  and  $N$  are radially-parallel to one another, as shown by the curves  $Q_1$ ,  $Q_2$  and  $Q_3$  in figure (1a). The efficient expansion path with  $\partial Y/\partial N^h = 0$  is shown by the ray OA through the origin.

There does not seem any analytical necessity to assume that the production function has the form (6) nor does it seem likely that such a production function would have held for long periods for land of different qualities. The expansion path may then have any shape, passing, however, through each isoquant at the point at which it becomes perfectly vertical - i.e., at the point at which  $\partial Y/\partial N^h = 0$ . An a priori judgment cannot be made on the likelihood of the case that actually holds. However, the size of the harvest -- and the density of the crop -- determines employment in the harvest season, with the likelihood of a roughly constant crop/employment ratio. It is likely to be increasingly difficult to eke ever-increasing harvests out of a fixed quantity of land, so that the marginal productivity of  $N^h$  must not only be diminishing but increasingly so as  $N^h$  increases. Hence  $N^h/N$  is likely to increase as  $N$  increases, a case shown in figure (1b). That is, a greater proportion of the labor force becomes increasingly employed throughout the year. This is, however, not a blessing for labor so employed since there is no increase in total remuneration for such work. In fact, it represents a worsening of the overall standard of living (including leisure) for labor.

Another possibility that could exist is one where the expansion path is as shown in figure (1c). This case is the one consistent with the increasing marginal productivity of  $N^h$  on a given amount of land, a possibility that may exist in newly opened and underpopulated lands.

Figure (1c) shows, therefore, a rather rare case compared with that shown by figure (1b) and we concentrate our attention on the latter case.

The argument for a zero marginal product of nonharvest labor can be better understood in the context of a special production function especially suited to land. Such a production function is

$$Y = F[G(N', L), N''] \quad (7)^{16}$$

(7) can be interpreted as: nonharvest labor and land combine to produce a crop standing in the fields, represented by the function  $G(N', L)$ . The crop in the fields ( $G$ ) and harvest labor ( $N''$ ) are, in turn, combined to produce the harvested output  $Y$ . The amount of harvest labor does not influence the rate of substitution between  $N'$  and  $L$  in producing the field-crop. The crop-year marginal productivity of labor for (7) is,

$$\frac{\partial Y}{\partial N} = \frac{\partial F}{\partial G} \frac{\partial G}{\partial N'} \frac{\partial N'}{\partial N} + \frac{\partial F}{\partial N''} \frac{\partial N''}{\partial N} \quad (8)$$

It was argued earlier that  $\frac{\partial Y}{\partial N'} = 0$ . That is,

$$\frac{\partial Y}{\partial N'} = \frac{\partial F}{\partial G} \frac{\partial G}{\partial N'} = 0 \quad (9)$$

The bottleneck in agriculture is harvest-labor, with the labor force employed to its full capacity. Given values of  $N'$  and  $L$  imply not only a certain field-crop but, with given  $L$ , also a certain density of crops per acre. The total crop that can be harvested is set by the size of the harvest labor-force so that any increase in the field-crop with a given  $N''$ , will not increase the harvested-crop. That is,  $\partial F/\partial G = 0$  in (9). It is unlikely that  $\partial G/\partial N' = 0$ . We may, therefore, assume that:

$$\frac{\partial F}{\partial G} = 0 \text{ and } \frac{\partial G}{\partial N'} > 0 \quad (10)$$

That is, the marginal productivity of nonharvest labor is not zero in the sense that any increase in it cannot increase the crop planted or maturing in the fields. It is zero only in the sense that any increase in  $N'$  cannot increase the crop harvested. This seems to be plausible for most agricultural economies: only that crop is planted which can be harvested by the available labor force.

In terms of the argument for a diminishing marginal product of labor, it seems likely that there would be roughly constant returns to scale

16. Note that our concern in specifying this function is with the long-run. From a short-run viewpoint,  $N''$  in any given year depends upon the crop ready to be harvested. This would depend upon the weather and upon  $N'$  and  $L$ .  $N''$  is then a function of  $N'$  and  $L$ . We have abstracted from the variations in weather conditions in different years so that our analysis generates the long-run path of  $N''$  but not its actual short-run values.

for proportionate increases in the field-crop and in harvest labor. However, as the nonharvest labor force increases on a given land, it becomes increasingly difficult to increase the field crop: planting has to be done more carefully, weeding more often, etc.. That is, there are significantly diminishing returns to nonharvest labor in terms of the field-crop. These arguments, suggest that (7) has the properties:

$$\lambda Y = F [ \lambda G(N', L), \lambda N'' ] \quad (11)$$

$$G(\lambda N', \lambda L) < \lambda G(N', L) \quad (12)$$

These implications invite comparison with the controversy on the existence or non-existence of surplus labor in the economy. The model shows a positive marginal productivity of labor on an annual basis and hence is in accord with the neoclassical theory of the dual economy as set out by Jorgensen (17). Labor could not thus be withdrawn from agriculture in such conditions without diminishing the total agricultural output. Further, the distinction drawn by Sen (30) between the number of labourers and the number of man-hours, with variation in the number of man-hours worked per laborer, does not arise here. Labor is fully employed at harvest time, with each laborer putting in the longest-possible working day, since the wage, not only during harvest time but throughout the year, is dependent on the work put in at harvest time.

The model presented here also uses the neoclassical assumption that the labor force in agriculture will be paid its marginal product. From the long-run point of view, a fair degree of competition would ensure that the annual wage rate tends to equal the crop-year marginal product of labor. The perspective here is one of decades and even centuries.

The requirement of work whose marginal productivity and hence wage is zero must lead to a considerable social pressure to avoid such work through land ownership and employment of others. The high and increasing marginal productivity of land as labor increases makes it increasingly easier to live off the proceeds of land and be a landlord only, without being a cultivator, if there was sufficient capital to purchase enough land. But the social pressure to own land must be intense even for those with a little capital since ownership of land provides for continuous year-round employment and freedom from social or political bondage implied in such a system.

Further, since  $N' < N$ , there exists a considerable degree of seasonal unemployment in such an economy. The permanence of such unemployment over time without a wage implies that social customs, which allow for the sharing of such work, arise. Such unemployment would then take the form of underemployment or disguised unemployment rather than of outright unemployment.

The marginal productivity of labor at nonharvest times is zero. Some of this labor could be withdrawn from agriculture without decreasing agricultural output. Such a phenomenon could occur and has occurred extensively in history under a putting-out system or a Gandhian-type village development. The putting-out system was a form of domestic industry employing very little capital per worker, organized and co-ordinated by travelling merchants bringing raw materials to the villagers and carrying away the finished product. Payment was usually by piece. This system existed throughout much of Europe during the seventeenth and eighteenth centuries, if not much earlier.

From the perspective of a development plan, the labor unemployed at nonharvest times could be used in community improvement schemes or any other work without detriment to agricultural output. The disadvantage of employing such labor is that it is seasonal, located in the countryside and primarily rural in skills and outlook. Its seasonality may rule out its use on capital-intensive projects in a country which is very short on capital. This implies the need for a sector or industries which do not require any significant amount of land or capital per laborer. Traditional village industries such as the spinning and weaving of cloth, as of carpets in many parts of Asia today, local construction, etc., are examples of such industries.

II. AGRICULTURE WITH SCARCE LAND AND SURPLUS LABOR.

As the labor force grows relative to a given supply of land, it may reach a point where its marginal product becomes zero. This implies, in terms of (8), that

$$\frac{\partial Y}{\partial N} = \frac{\partial F}{\partial G} \frac{\partial G}{\partial N'} \frac{\partial N'}{\partial N} + \frac{\partial F}{\partial N''} \frac{\partial N''}{\partial N} = 0 \quad (13)$$

While it is a mathematical possibility that this condition is met by either  $\partial F/\partial N'$  or  $\partial F/\partial N''$  being positive, with the other being negative, this does not seem to be a realistic possibility. The most likely case is one where an increase in nonharvest labor can not increase the field-crop, i.e.,  $\frac{\partial G}{\partial N'} = 0$ , so that, eventually, with a given field-crop, additions to the harvest labor force cannot increase the crop harvested, i.e.,  $\partial F/\partial N'' = 0$ .  $\partial Y/\partial N = 0$  implies that agricultural output is at its maximum for the given supply of land. Such a possibility exists and was posited by the classical economists such as Ricardo. It is basic to the models of (21) and (8). Its critical empirical test is the implication from  $\partial F/\partial N'' = 0$  that the labor force employed in the harvest season has reached its maximum so that unemployment exists even in the harvest season and grows as the labor force grows.

Most past agricultural societies have left graphic accounts of the frenzied activity in the harvest season with every man, woman and child fully occupied with some activity at harvesting times and working for the physically longest possible working day. Such societies did not satisfy the requirement that  $\partial F/\partial N'' = 0$ . However, some writers<sup>17</sup> have maintained that this possibility has occurred in some societies in recent decades, as, for example in India. If this has occurred with normal -- and not with unexpectedly poor -- harvests, it seems to have been a genuinely rare case in human history for several possible reasons, the most important of these being that labor cannot subsist, without declining, below certain minimum living standards.

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17. For example, see (19) for summaries of some of the studies reaching this conclusion.

The conditions suggested above for the zero marginal product of labor are that:

$$\frac{\partial G}{\partial N'} = 0 \text{ and } \frac{\partial F}{\partial N''} = 0 \quad (14)$$

Note that neither of these conditions requires that  $\partial F/\partial G = 0$ , the condition suggested earlier as the reason for the existence of unemployment in the nonharvest season. In fact, it is likely that an increase in the field crop, if it can occur, can be harvested with an increased harvest-labor force, so that  $\partial F/\partial G > 0$  when (14) holds. The conditions for the existence of seasonal and full-year unemployment are, therefore, quite different, without either one implying the other. The literature on development has, unfortunately, often used one to imply the other, as in taking the existence of large scale nonharvest season unemployment to show the zero marginal product of labor and year-round unemployment (19). In fact, if the long-run expansion path was as shown by the curve OA in figure (1b), overpopulated economies satisfying (14) would show relatively little, if any, seasonal unemployment: they are likely to have attained the 45° path before the level of population was large enough to satisfy (14). This implies another test of the Classical surplus-labor assumption: the level of employment (or underemployment) would be fairly well constant over the harvest and the nonharvest seasons as compared with the likely form of the neoclassical case where the level of employment is much less in the nonharvest season as compared with that in the harvest season.

III. AGRICULTURE WITH SCARCE LABOR AND SURPLUS LAND.

Another case that is both realistic and analytically interesting is one where land is unlimited in supply relative to labor. Such a condition exists where unsettled land is almost as fertile as the existing land and can be claimed by anyone willing to clear it and farm it. Such a condition must have existed for thousands of years in human history. It existed as recently as the nineteenth century in much of the Americas and may be met even now in parts of Brazil.

Land which is relatively unlimited in supply cannot command a positive price so that its optimal usage requires that its marginal productivity must be zero. This implies, in the context of the discussion in section I, that only harvest labor can have a positive marginal product in any optimal usage of the factors of production.<sup>18</sup> Therefore, the total output must be payable only to labor.<sup>19</sup>

However, while nonharvest work has a marginal productivity of zero and, therefore, a wage of zero, this work is essential to production. Crop-year contracts or some other commitment to stay on the farm are still required. But another additional complication has been introduced: it does not pay to be a landowner since ownership of land has a zero economic return. Therefore, employment of labor which is paid its marginal product is hardly worthwhile even under crop-year contracts. Land ownership and employment of others is only economically profitable if the others work without a wage, as on the family farms or in slavery. In both these cases, labor need not be paid its marginal product. In neither case can more be spent per laborer than the marginal product of labor since labor is the only scarce factor of production.<sup>20</sup> The family is a social unit in which

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18. This section assumes the case suggested in section I as being dominant -- that is,  $N^1 < N$  leads to a zero rate of return to nonharvest labor and a zero marginal product for it.

19. Note that our analysis has not explicitly allowed for capital as an input. If some capital is used, part of the output will go as a return to capital.

20. Constant returns to scale in production were assumed earlier. Therefore, with surplus land and surplus nonharvest labor, Euler's theorem states that,  
$$Y = (\partial Y / \partial N) N$$
so that the average and the marginal products of harvest labor are equal.

allocation is not according to an economic criterion and the total output or earnings of its members is distributed among the members. Slavery, however, is an institution under which the slave- and land-owner captures for his own use that part of the marginal product of labor which he does not spend on slave-labor. Call this the 'slave-surplus-product'.

If land on which slave labor can be used is unlimited, as is total land, the slave-surplus-product attaches solely to the ownership of slaves and their capital value would reflect it. Land would still possess a zero price. If, however, land is relatively unlimited but the land on which slave labor is permitted or is profitable to use is relatively limited, such slave-using land would capture some of the slave-surplus-product and would command a positive value. Conversely, the abolition of slavery would eliminate the economic basis for the value of such land.

IV. SOME SOCIAL AND POLITICAL ASPECTS OF AGRICULTURAL ECONOMIES

This section departs from economic theory to speculate on the institutional practices which may be said to flow reasonably out of the implications derived above of our economic models. Two basic assumptions relate these economic implications to their social and political implications derived in this section. One of these assumptions is that a social and political institution cannot exist for long in a historical context if it is not in the economic interest of the dominant political group in the society. The other assumption is that if certain social and political practices are substantially to the economic benefit of such a group and that knowledge and moral acceptance of such practices exists, then such practices are likely to come into being. These seem to be reasonable over the long time span for which traditional agricultural patterns have dominated the life of settled communities in human history.

Economists are constantly aware of the disturbances that may upset the equilibrium values of the variables in their theories. Powerful disturbances that may upset the social and political implications of the preceding equilibrium analysis can come from the basic nature of man and his environment, defining these terms in their broadest sense. An ideological revolution such as the emergence of a religion or a communist revolution is one example of such a disturbance. Another example is foreign conquest and rule, imposing its own patterns upon the economy and polity. Such disturbances can clearly occur frequently and leave their impact for centuries. Our subsequent comments in this section obviously abstract from such disturbances and their impact.

IV.1 This subsection considers only the case where both land and labor are scarce, i.e., both have a positive marginal product. The major implication derived earlier and of interest here is that it is to the interest of landowners that labor contracts should be for the crop-year, with a crop-year wage equal to the marginal product of labor in the harvest season. There is no payment for nonharvest work and there would be no incentive to do such work in a system of monthly contracts. It is, however, in the interest of laborers to enter into monthly contracts so that they can earn a positive wage even for nonharvest work. A variety of practices are, therefore, likely to exist. The most dominant of these would be the one in the interest of landowners from whom the politically powerful classes generally come and would require crop-year contracts.

The tying-down of labor to a farm for the crop-year requires restrictions both on the mobility of labor and on its capability in bargaining for wages. Such restrictions can be met within the family unit, a co-operative, a kibbutz or some other form of free association of adults. But such free associations of adults have been relatively rare compared with the non-free associations.<sup>21</sup> The medieval feudal system<sup>22</sup> in Europe and Japan in its complex variations is a prime example of the social and political practices characteristic of such non-free associations.

Europe and Japan differ in many important respects, especially in terms of geographical location and cultures. They did not share a heritage of slavery or feudalistic traditions. Yet they both evolved feudalistic practices. The explanation for such evolution may be in the common economic patterns that they shared. Both have temperate climates so that generally only single-cropping per year was possible. Both practiced farming in a manner that conformed to the model set out in section I and, therefore, required the tying down of labor to the farm for almost ten months or more of the year.

This tying down of labor, or crop-year labor contracts as we have designated it earlier, cannot take a purely economic form where labor has an interest against such practices and where labor does not possess any capital which can be attached-- or taken as a lien-- for failure to abide by the contract. It must, therefore, take a social and political form. The family system achieves this purpose by tying down a wife and young children, though not necessarily mature children unless they are tempted by the possibility of the inheritance of the land. Labor may also be tied down by grants of small parcels of land, by giving minor grazing rights to laborers on the landlord's land, by allowing squatters to put up shanties, etc., always in exchange for services on the landlord's land. But such incentives are likely to be reinforced by customs or even laws against labor reneging on such services and moving away. This picture is very much that of feudalism.

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21. A family composed of a man, his wife and their young children is not really a free association. An extended family is a free association which can be fairly common.

22. We are concerned with economic and not with political feudalism. The former is basically characterised by "tenures more or less servile in character". Economic feudalism may exist independently or jointly with its political counterpart. Thus, in France "political feudalism, then, was dead (long before 1789); economic feudalism was living and vigorous", (15, p. xviii) as it had been for centuries. Serfdom had disappeared, the peasant was personally free but he still owed various forms of compulsory services to the seigneur and was restricted in his movement or freedom to farm his own land.

Marc Bloch described the characteristics of a feudal society as one with "a subject peasantry; widespread use of the service tenement (i.e., the fief) instead of salary, supremacy of a class of specialised warriors; ties of obedience and protection which bind man to man; fragmentation of authority; and, in the midst of all this, survival of other forms of association, family and State" (16, p. xix). Lenin, looking at feudalism from the economic viewpoint, emphasized the economic element in his definition of a "corvee economy" as

Firstly, the predominance of natural economy ...  
Secondly, such an economy required that the direct producer be allotted the means of production in general, and land in particular; moreover, that he be tied to the land, since otherwise the landlord was not assured of hands....  
Thirdly, a condition for such a system of economy was the personal dependence of the peasant on the landlord.... There was required "extra-economic" coercion as Marx calls it ... Fourthly, and finally, a condition and consequence of the system of economy described was the extremely low and stagnant condition of technique, for the conduct of husbandry was in the hands of small peasants, crushed by poverty and degraded by personal dependence and by ignorance. (20, pp. 191-2)

Feudalistic societies created the dependence of the peasant upon the landowner in a variety of ways. This dependence might be that of the landless serfs or villeins, forbidden to leave the farm on pain of personal punishment. It might be that of free yeomanry owning their own land but owing services to the landowner, often during the harvesting season. It might, in between, be the dependence of squatters using the landlord's land marginally in exchange for a few services.

The fundamental characteristic in these, as in other descriptions of feudalism, is that of a "subject peasantry" with a "limited and conditional service". Such a characteristic is, as argued earlier, the major implication of our model for societies in which land was relatively limited.

In Europe economic feudalism was less severe whenever the bargaining power of laborers increased through a decline in population, or through the existence of new areas being settled or because of proximity to a town. If one looks at Latin America, where economic feudalism has existed without its political counterpart, several important points should be made. Labor was not necessarily immobile initially but was rendered immobile in the interest of landowners. Political forces were not required to bring economic feudalism into being; in fact, the latter came into being and existed in spite of the opposition of the national authority. Further, the lack, or existence, of an outside market for the estate's produce was not generally relevant for the creation or existence of peonage. The economic forces implied by our earlier analysis can thus have an impact upon the economic, social and political institutions even in the absence of significant labor mobility and of significant markets for produce. These factors have been claimed, we believe erroneously, by some writers to imply

institutional<sup>23</sup> rather than economic behaviour and thus the inapplicability of our economic analysis-- or of economizing actions-- to studies of feudalism and of other non-market economies (e.g., see 28, pp. 239-42).

Compare the feudalistic societies pictured above with others existing earlier in time and with relatively unlimited land. Greece in the pre-Christian era is a prime example of such societies. The wealth of documentation on Greece attests to the presence of slaves in farming as well as to the absence of a subject peasantry in it. Egypt, before the rise of Athenian Greece, attests to the same phenomenon. The American South in the nineteenth century is another example, and a modern-day one at that, of the applicability of our models to the existence of feudalism: the American South knew and practiced slavery but not feudalism. Latin America practiced both slavery and feudalism in the eighteenth and nineteenth centuries, with slavery being practiced in areas which had a smaller native population. For another comparison, predominantly pastoral economies as in Africa to the present day never seem to have had feudalistic relations: pastoral agriculture has a production function which does not create seasonal unemployment of the kind derived for crop-farming in this paper and can allow for labor force mobility.

One society which had scarce land as well as a traditional pattern of crop-farming and which, nevertheless, escaped a virulent form of feudalism is India. One possible explanation for such contrasting development of social and political institutions between the old settled lands of Europe and Japan and those of India seems to lie in the differences in climate which permit a double-cropping pattern over much of India. Double-cropping in traditional farming allows for seasonal unemployment but such unemployment is much less significant than in a single-cropping economy: there are two harvest seasons in the former and the nonharvest work for

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23. Thus Pirenne contends that in medieval Europe,

The whole idea of profit, and indeed the possibility of profit, was incompatible with the position occupied by the great medieval landowner. Unable to produce for sale owing to the want of a market... and as he was forced to consume his own produce, he was content to limit it to his needs. (27, p. 63).

We disagree. The possibility of a monetary profit was undoubtedly limited but not so the possibility of achieving higher levels of a good life or supporting a bigger retinue of armed servants to enhance the lord's power and prestige. Pirenne's views contrast with those of Pearse (25) and Miskimin (22) with his emphasis on continuing economic adjustments in labor services between the landlord and peasant throughout the medieval period and down to the eighteenth century.

each has to be compressed into the few remaining months, with the possibility that there may at most be only a few weeks, perhaps spread out over the non-harvest seasons, in which labor is not fully employed. There does not, therefore, exist the same intensity in the economic interest of landowners to tie labor down to the farm by feudalistic forms. Indian agriculture remained, therefore, remarkably free of feudalistic institutions. It could not, of course, completely escape some mild forms of feudalism, mainly in the form of customary services, some of them embedded in the caste system<sup>24</sup> and some in the Zamindari system.<sup>25</sup>

Another society that had traditional agriculture with scarce land but evaded feudalism was China.<sup>26</sup> Southern China, like India, also had

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24. Land in many parts of pre-British India

was regarded as being part of an aggregate, rather than belonging to a single person... (thus) different people—notably the cultivator, the Brahman, and the King—all had rights in the land which it would be impossible for anyone else to alienate. These rights were inherent in the functions that each performed.... (Thus) Brahmans could not sell lands...to anyone except another Brahman (6, pp. 45-46).

25. Thus in the Mughal period,

The zamindars, other than the peasant proprietors, generally gave their lands in hereditary lease to their tenants, who enjoyed security of tenure in terms of the patta granted to them, on condition that they paid their land revenue regularly. Even in cases of nonpayment the tenant was not usually deprived of his landholding rights, but the arrears were realized by other means. Considering the fact that there was not much pressure on land, the rights of the landholdings tenants were generally respected. At the same time, in view of the shortage of cultivators, the zamindars enjoyed the right to restrain the tenants from leaving their lands and to compel them to cultivate all arable land held by them. (14, p. 28.) Also see (6, p.47).

26. However, the early stages of Chinese society prior to its first unification under the Ch'in during the third century B.C. have often been described as feudal in character.

There had been a constant struggle between the government and a semi-feudal aristocracy which attempted to build up large estates prior to the southern Sung dynasty (1127-1179). By the twelfth century, this struggle had been lost by the feudal aristocrats who were gradually becoming landowners, claiming only a share of the harvest from their tenants. (26, ch.5.)

China "possesses no landed aristocracy...manorial estates worked by corvees, if they ever existed, have left few traces....landlord and tenant are parties to a business contract, not members of different classes based on privilege and subordination." (33, p. 63.)

The tenant in China, even if only a tenant at the landowner's will, pays rent, normally a percentage of the crop and rarely owes any labor-services. The rents may reach as high as 50 to 66% of the crop. (Ibid., pp. 65-66.)

a double-cropping system over most of its densely populated regions and its economic and political dominance over northern China, which had a single-cropping pattern, may have contributed to the absence of feudalism in the latter. While China, like India, escaped any virulent form of feudalism, it did evolve some tying of labor to the village and the landlords.

And now a final comment on the social and political structure of lands with traditional agriculture, scarce land and single-cropping. Our model does not specify a feudalistic structure for all such societies but dominantly so. Communities with free farmers owning their own lands could exist, as they undoubtedly did in a few places in feudalistic Europe and Japan. Conversely, peasant farming would be relatively more common where the economic interests of landlords towards forms of feudalism were weaker, as they were historically in India and China.

IV. 2 Section II considered the case where land is scarce but there is a surplus of both harvest and nonharvest labor. The marginal product of labor is, therefore, zero throughout the year. This case does not seem realistic to us for purely agricultural economies. As the marginal productivity falls and with it the wage rate and average productivity, the latter must eventually fall below the physical subsistence level. This is likely to happen even before the marginal productivity of labor declines to zero. As living standards fall, the Malthusian spectres of war, starvation and disease must check population growth. The long-run relationship between population and land is, therefore, endogenous and is likely to prevent a zero marginal productivity of labor in pure agricultural societies. The phenomenon could, however, occur in dual economies, with the industrial sector supporting the agricultural population above subsistence even with its zero marginal productivity in agriculture. But societies which have a developed industrial sector do not seem to have experienced such a phenomenon.

The possibility of its existence does seem to occur in pure agricultural economies whose population has grown to a point where the Malthusian restraints would occur but are prevented from occurring by foreign assistance or rigorous rationing. These are temporary expedients in a historical context. These conditions may have applied in India and China, as in some other countries, in recent decades.<sup>27</sup> The occurrence of the seed-based

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27. See (19) for evaluation of several studies on the subject.

Green Revolution in such countries points to their speedy elimination anyway. The increasing industrialisation of these countries is another reason, though a slower one, for such elimination.

IV. 3 Section III considered the case where land is relatively unlimited in supply. Such a case was shown to be a condition favorable to the long-run existence of slavery.<sup>28</sup> A few examples of this case are given below, though our limited knowledge of societies with slave-using agriculture makes us add a note of caution here.

There seems to be a strong religious and/or moral rule against large-scale enslavement of people of one's own race. Slavery has thus existed over long periods only where there was more than one race and, of course, only if one of the races was militarily weaker than the other. Further, people cannot be enslaved long, and at a profit, when others of the same race are free and in close geographical proximity: escapes would be common and it would be difficult or impossible to recapture the escaped slave. The use of African slaves in the Americas in the eighteenth and nineteenth centuries, rather than of European or Indian ones-- though the latter was widely attempted -- is an example of these points.

European societies before the birth of Christ clearly practised slavery on the farm. Greece did so and so did Rome in this period. Land in such societies was fairly plentiful, with large unsettled tracts. As population and settlements grew, the relative scarcity of land came into being. Slavery seems to have vanished from European agriculture long before the tenth century, although it was religiously, socially and morally permissible. It had given way to feudalism, a characteristic designated by us as one of societies with scarcity of land.

The revival of slavery in the seventeenth and eighteenth centuries in the Americas is an illustrative episode for our purposes. The slave-owners came from a European society which accepted the institution of slavery but never used it on the farm. The remarkable revival slavery in agricultural work after it had disappeared from Europe for a

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28. Slaves differ from serfs and vassals in a feudalistic society in that the former do not possess any cultivation rights, be they rights of ownership of land or shared usage of land, while the latter do possess such rights, encumbered, though, by obligations of labor and other services.

thousand years could be explained by the almost unlimited supply of land relative to free labor in the Americas.<sup>29</sup> In the American context, the institution of slavery spread and strengthened in the southern United States precisely when the Mid-West and West were being opened up.<sup>30</sup>

V. THE MODERNISATION OF AGRICULTURE.

V.1. 1 The models outlined so far and their implications are not applicable to modernised agriculture. Modernised agriculture differs from traditional agriculture outlined so far in terms of the techniques employed, whether such techniques are the result of the greater availability of capital or of technical change or of both. The impact of these two factors can take a variety of forms. Our concern here is very much narrower than the full variety of ways in which technical change and the greater availability of capital can change the pattern of agriculture. We focus only on the most fundamental change between traditional and modernised agriculture: the disappearance of seasonally-unemployed labor from agriculture.<sup>31</sup>

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29. " 'Free' land disappears already before the agricultural stage is reached. Tribes of food collectors and hunters consider that they have exclusive rights to collect food and to hunt in a particular area...". (2, p. 79.) The existence of 'free' land in the Americas from the seventeenth to the nineteenth centuries was through acts of continuing legal or illegal expropriations from the Indians who had originally claimed the land. Land was thus free to the Europeans only. It was not free to the Indians, and, in fact, the Indians did not practice slavery to any large extent before the European conquest.

30. For an excellent empirical study of the dependence of the price of slaves on their productivity, on their cost of maintenance, on the prices of output and on their supply, see (5).

Extensive, rather than intensive, agriculture was generally common to all North American colonial agriculture until the twentieth century. In so far as slave labor is cheaper, its efficient usage would require a larger usage of slave labor rather than of free labor per acre. Therefore, areas in the Americas in which slavery was permitted tended to develop cotton and sugar cane plantations, compared with areas using semi-free or free labor and growing cereals. Slave labor, at the same time, seemed inefficient compared with free labor since its marginal productivity would be lower.

31. See footnote 4 above.

The most critical bottleneck in traditional agriculture is the fact that there is a close limit to the size of the crop that can be harvested by the available labor force with its given productivity. This limit is such that the entire labor force cannot be employed at nonharvest time: its marginal product becomes zero at  $N' < N$ . The elimination of such a limit requires either an increase in the productivity of harvest-labor or an increase in the availability of capital per harvest-laborer, relative to nonharvest labor. We investigate the implications of such a change.

Assume that the average productivity of harvest-labor has risen, either through technical change or increased capital or both, sufficiently to employ all of the labor force at nonharvest time. The expansion path along the  $45^\circ$  line in figure 2 implies employment of the entire labor force both at harvest and nonharvest time. We assume such an expansion path for modernised agriculture.

It would be an unlikely coincidence if the marginal productivity of nonharvest labor along the  $45^\circ$  expansion path were zero for any  $N$ , rather than a positive amount. Figure 2, therefore, assumes a positive marginal product of nonharvest labor, as well as of harvest labor. The wage rate for nonharvest work is now positive.

The increase in the average productivity of harvest labor implies that if the entire labor force is to be employed, the overall scale of the harvest must increase correspondingly. Agriculture as a whole, therefore, must be more prosperous than under the traditional conditions. Labor is also likely to be more prosperous since there is now a positive wage for nonharvest as well as for harvest work. Landlords may also be better off in the sense of getting higher rents per acre of land. The relative distribution of income between land and labor may change either way.

With the nonharvest labor fully employed, the existence of seasonal unemployment or underemployment disappears from agriculture. The peculiar social and political conditions which necessitate making labor committed to work on a particular farm for the whole crop-year are no longer needed. They may disappear, being no longer in the interest of landlords or laborers, leaving free men working for monthly or weekly or daily contracts rather than for annual ones. In short, feudalism disappears.<sup>32</sup>

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32. This is too optimistic. The institutional inertia in a feudal society may lead to a long lag between the disappearance of its economic base and the actual elimination of feudal practices. This lag will be even longer where economic feudalism was supported by the political conditions for feudalism .

V.1.2 It would indeed be surprising if pure technical change, without any change in the capital per laborer, could take the economy to the 45<sup>o</sup> expansion path and maintain it there. Technical change does not seem to be that endogenous; otherwise the traditional agricultural production functions need never have existed for as long as they did. The increasing availability of capital per laborer must then be an important element in the change. The ratio of the capital per harvest-laborer to the capital per nonharvest laborer can be one possible endogenous variable maintaining the economy at the 45<sup>o</sup> expansion path. It is further likely that the increased relative productivity of harvest-labor comes through a relative increase in the capital per harvest-laborer, relative, that is, to the capital per non-harvest worker.

Conversely, the existence of traditional agriculture over centuries and in many societies, both poor and rich, is evidence that the mere availability of capital and induced technological change is not adequate for the disappearance of such agriculture.<sup>33</sup> Exogenous technological change, as in the knowledge of construction of harvest equipment, is also essential. It did not occur to a sufficient degree until the eighteenth century in Europe. However, once the basic knowledge, essentially of an industrial nature in the manufacture and use of equipment, becomes available, the relative shortage of labor at harvest-time and its relatively high wage rate imply that the earliest agricultural machines would be designed to be useful mainly in harvesting, though they may also be used for other work through the year. That is, induced technical change replaces-- or saves more on-- harvest labor than it replaces nonharvest labor. Modernized agriculture emerges under such conditions.

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33. In China from the fourteenth to the middle of the twentieth century, population had risen seven to nine times. Per capita grain consumption, on a secular basis, either remained constant or may have even risen slightly. About half of the rise in grain output was due to migration to hitherto uncultivated land; the land area cultivated quadrupled over the period. There was increasingly adoption of double-cropping but there was little capital deepening; the number of implements and draft animals appear to have kept pace with the population. (26, pp. 185-89.) There were very few institutional changes over the period and agriculture did not change its production function sufficiently to eliminate seasonal unemployment.

These arguments can be illustrated in the context of the production function presented in (7). The key to the full employment of the labor force is either to raise the marginal productivity of harvest labor, keeping capital constant, or to use capital. If both of these occur, a simple functional form of the production function which can be used for illustration is

$$Y = F[ G(N', L), H(vN'', K'') ] \quad (15)$$

where  $v$  ( $v > 1$ ) represents the increased efficiency of harvest-labor and  $K''$  is the amount of harvest-capital, that is, capital equipment used only at harvest time. The marginal product of nonharvest labor may or may not increase in terms of the field-crop but would have to increase in terms of the harvested crop in the context of our earlier discussion in Section I.

(15) highlights the fact that an increase in the supply of land through the opening up of virgin lands, or an increase in its efficiency through the use of capital, as with better ploughs, irrigation, fertilisers, etc -- termed as 'landesque' capital by Sen (30) -- does not lead to the elimination of the seasonal unemployment of labor. These changes could, in fact, intensify such unemployment.

Another way in which agriculture could switch from a traditional pattern of labor productivity over the crop-year to a modern one is by switching from farming to horticulture or cattle-raising. However, the demand for the products of such agricultural activities is generally limited and absorbs only a small part of the agricultural labor force. Such a switch did occur extensively in transitional economies such as those in nineteenth century Europe and especially on family farms which could not meet the capital or technological requirements required by modernised farming.

An interesting case emerges in the case of dual economies in which there is free mobility of labor between the two sectors, agricultural and industrial, and the industrial sector is sufficiently large relative to the agricultural sector. The industrial sector has the peculiarity relative to the agricultural sector that the productivity of labor is not generally affected by seasonal factors and is, therefore, generally identical for each month, or week, of the year. Labor can, therefore, be paid the same wage rate for every month or week and yet retain its mobility through weekly or monthly employment contracts. This pattern cannot in general come about independently in agriculture since the productivity of labor varies over the crop-year. But if the industrial sector is relatively large, the industrial wage-pattern will be imposed on agriculture so that

the marginal productivity of labor would have to conform to such a pattern. That is, the wage rate and the wage pattern with an unchanging monthly wage for every month of the year is exogenously given to the agricultural sector and labor productivity must conform to the exogenous wage and the exogenous wage pattern. Such conformity may be partly achieved through induced technical change and partly through a changing labor-capital ratio over the crop-year. The latter implies that more capital is used per laborer at certain times than others: the capital intensity is likely to be the highest at harvest-time.

Assuming the same basic level of technology for harvest and non-harvest technology, the production function relevant to modernised agriculture would generally possess the form,

$$Y = F(K', K'', N', N'', L) \quad (16)$$

where  $K'$  is nonharvest capital and  $K''$  is harvest capital. The dominant industrial sector specifies the same monthly wage rate irrespective of the season so that the marginal productivity of  $N'$  and  $N''$  must be identical. Further, the condition for full year-round employment of labor in agriculture specifies that  $N'=N''$ . The preceding production function can then be rewritten as,

$$Y = F(K', K'', N, L) \quad (17)$$

with  $N'=N''=N$  and with  $N$  defined as the agricultural labor force. The dominant industrial sector is also similarly likely to specify the same unchanging cost and marginal productivity of capital over the year in agriculture. It is unlikely that this condition is met by the same capital-labor ratio in harvest as in nonharvest time so that it is likely that  $K'$  will differ from  $K''$ . It is further likely that  $K''/N$  is higher than  $K'/N$ .

Modern agriculture, therefore, differs from traditional agriculture in that differing amounts of capital, rather than of labor, are utilised over the crop-year. However, the unemployment of any given capital equipment for part of the year does not raise the type of serious social and political implications that traditional agriculture faced for labor: no social or political inalienable rights adhere to capital per se and are violated by its ownership. As far as labor is concerned, its constant marginal product over the year, through a varying capital-labor ratio, allows for short-term contracts and labor mobility: the economic base for feudal control over human beings disappears. This is, in our context, the major social and political implication of the pattern of production and productivity over the year of industry and of the dominance of industry over agriculture.

V.2 A few comments on the transitional stage between the dominant traditional agricultural economy and the dominant industrial economy seem to be in order. The former was dominated by the fact that the marginal productivity of labor varied over the year. As the industrial sector grows it tends to absorb labor from the agricultural sector. In this transitional stage, the annual wage rate in industry is somewhat higher than the annual wage rate in agriculture to induce the gradual transfer of labor to industry. However, the time-pattern of the marginal productivity of labor in agriculture throughout the year has not fully adjusted and remains higher in the harvest season than at other times. Labor's productivity and wages in agriculture are, therefore, lower than those in industry in the nonharvest seasons so that the migration of labor to industry mainly occurs in such seasons. However, agricultural productivity and wages are likely to be higher in the harvest season as compared with those in industry, so that some reverse-migration to agriculture occurs in this season.<sup>34</sup> The stability of the work-force in industry is thus threatened at harvest-times and the firms in industry may resort to annual contracts or measures to tie down the labor to the firm at harvest times. These may take the form of extra bonuses, some part of the pay withheld through the year and payable at the end of the year, etc., or a mild form of feudalistic practices. Such responses are similar to those of traditional agriculture, though they are likely to be much milder since the problem of labor shortage to industry in harvest times is relatively minor and relatively short in duration, e.g., a month or two at most each year.

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34. This may occur even in advanced industrial economies for certain crops in certain areas. Certain forms of fruit harvesting pose difficulties in mechanization and may adhere to the traditional pattern long after other forms of agriculture have adapted out of it. See(4, p. 144) and(3, p. 37).

CONCLUSION AND SUMMARY.

Georgescu-Roegen in the Richard T. Ely lecture in 1969, considered the fundamental nature of the production processes and argued that

in any elementary process every agent is idle over some definite periods that depend not on our choice of whim but on the state of the arts... we can nonetheless eliminate this kind of idleness completely and ... there is only one way to achieve this: to arrange the elementary processes in a factory system...

to operate an arrangement of elementary processes in line it is absolutely necessary that we have the freedom to start a process at any time of the day, of the week, and of the year. Unfortunately, we do not always have this freedom. Seasonal variations-- which result from the position of our planet relative to our main source of free energy, the sun-- prevent us from adapting the factory system to a series of important productive activities. The most important instance is husbandry. For the overwhelming majority of localities, there is a very short and definite period of the year during which a corn plant, for instance, can be grown in the open space from seed. This is why farmers have to work their fields in parallel; that is, in a system of production that yields practically no economy of time...

The association between agriculture and the idleness of all agents involved is by now a commonplace. Still, not much is known or even suspected about the importance of the related loss. (11, p.8)

This paper has set out a simplified model of agriculture-- or husbandry in Georgescu-Roegen's terminology-- which is consistent with his ideas of the production processes. It showed the waste or loss involved in traditional agriculture as one of labor and derived the implications of that loss for the economic, social and political system. Modernized agriculture, of a nonfactory kind,<sup>35</sup> has also its wastage, though mainly in terms of idle capital rather than of labor. But capital has no moral or ethical rights to any kind of freedom and its slavery poses no socio-political problems.

Crop agriculture is a single production process from the preparation of the land for the planting of the seeds to harvesting. This paper has suggested the hypothesis that this agricultural process has a

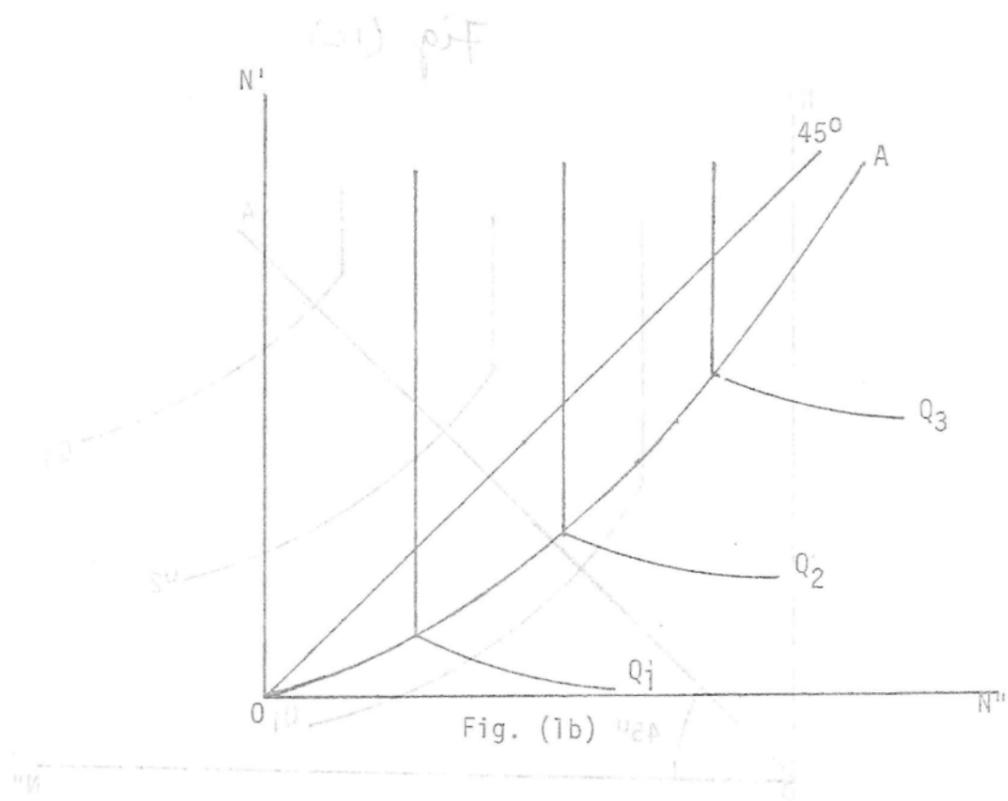
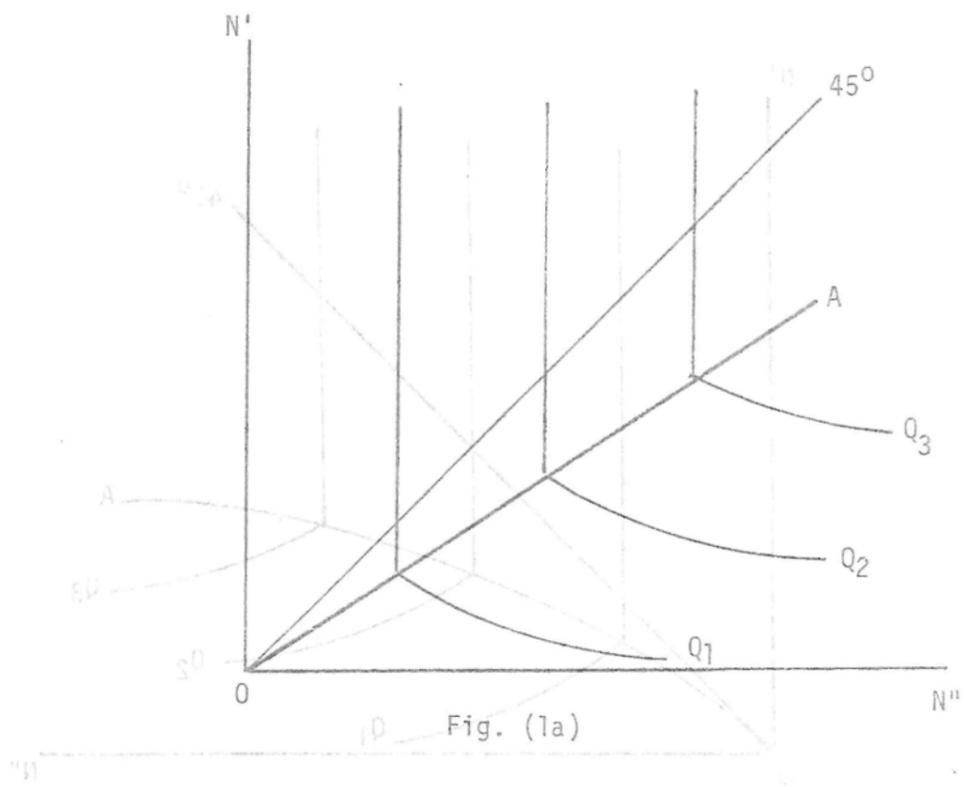
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35. Agriculture of a factory kind eliminates the loss due to the idleness of some input or other. Such agriculture is to be increasingly found in meat-production, such as in chicken-farming, and, to a limited extent, in the hydroponic growing of crops such as tomatoes.

production function characterized, in traditional agriculture by the full employment of the labor force only in the harvest season. The limitation of the labor force in the harvest season limits the crop that can be harvested and, therefore, limits the crop that it will be optimal to plant. However, in general, the crop that can be actually grown on the land can be increased beyond such a limit by employing a higher proportion of the labor force in the nonharvest season.

The underemployment of the labor force has serious implications not only for the wage rate but also for labor's social and political freedom. Maximisation of rent in an economy in which both land and labor are scarce implies strong pressures to bind labor to the farm through the crop year. Such restrictions often take the political and social form of a subject peasantry or vassalage. Variations in the intensity of such economic interest between societies and times would cause variations in the degree of vassalage from serfdom to a relatively free yeomanry. A land surplus economy may even go so far as to practice slavery in farming in order to create a surplus for the propertied classes.

Modern agriculture differs from traditional agriculture in employing its labor force fully, or almost fully, throughout the year. This requires an increase in the relative productivity of harvest labor compared with that of nonharvest labor. We have argued that such a change requires both technological change and an increase in the ratio of capital to labor in harvesting. The end result is to ensure a greater prosperity for agricultural labor while transferring the problems of the seasonal variation in employment from labor to capital. Capital, however, is by nature always a slave good. Its varying usage over the years does not lead to any interesting social and political practices that can characterise a society, as traditional agriculture did for labor through feudalism or slave-farming.



(a) pit

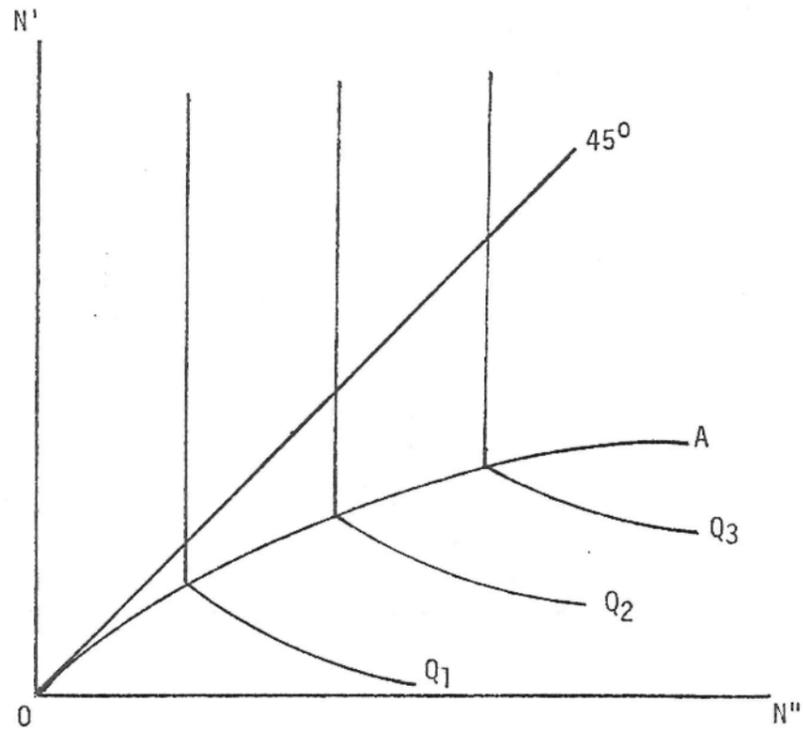


Fig (1c)

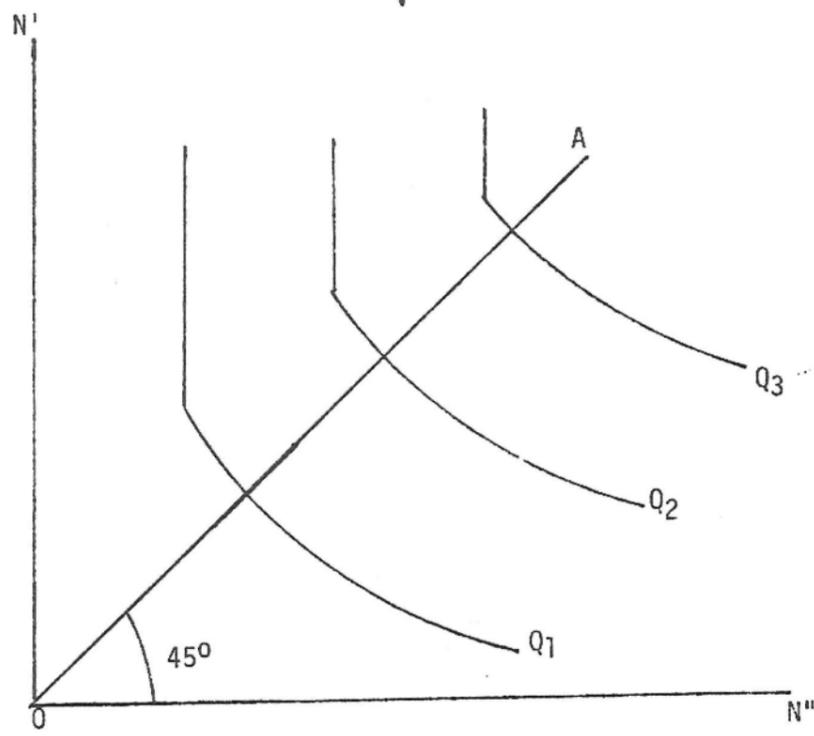


Fig (2)

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