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Industrial Growth, Rural Income and the Sustainability of Agriculture in the Dual Economy

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by

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Abstract

A steady decline in per capita agricultural output in the low income countries of sub-Saharan Africa has prompted a reappraisal of the agricultural pricing policies associated with the dominant strategy of growth-through-industrialization. This paper considers the implications of the strategy for the utilization of agricultural resources, using a simple variant of the dual economy model. The model is characterized by a direct relation between industrial wages and average agricultural income, implying that intervention in agricultural prices which depresses average agricultural income raises industrial profits. The paper discusses the conditions in which price intervention will be associated with the overutilization of agricultural resources. It is argued that the liberalization of price policy with respect to tradeable inputs and outputs without corresponding revision of price policy with respect to non-tradeables may have just this effect, and so may threaten the sustainability of agriculture.

1. Introduction

One result of the chronic failure of the countries of sub-Saharan Africa to assure food security under a range of climatic conditions has been a reappraisal of the growth-through-industrialisation strategy that has dominated policy in those countries in the post-war period. Ever since Lewis published his seminal (1954) paper on growth in the dual economy, it has been an article of faith that development in countries of the sub-Saharan African type implies the expansion of the modern industrial sector using resources drawn from the traditional agricultural sector. But while the importance of industrialization to the development process is still not questioned, the implications of industrialization for the sustainability of agricultural performance are coming under increasingly close scrutiny. A succession of surveys in the mid-1980s showed that industrial growth had not only failed to stimulate agricultural growth in sub-Saharan Africa, it had been associated with a chronic decline in average agricultural output (FAO, 1985; UN,11986; World Bank, 1987; and IMF,1987). Since then the World Bank and the IMF have launched a direct attack on the interest rate and agricultural price policies associated with the industrialisation strategy

of those countries where industrial export revenue has been insufficient to service current debts. They have alleged a systematic bias against agriculture - citing the taxation of agricultural exports; procurement prices below the border prices for exports and import substitutes under monopsonistic marketing arrangements; and low interest rate structures that discourage agricultural savings. More importantly, they have made the removal of such a bias a condition of structural adjustment finance (Commander, 1989).

The World Bank and IMF initiatives are designed to stimulate agricultural output by providing appropriate microeconomic incentives to farmers. Given the results of earlier work on the supply responsiveness of farmers elsewhere (eg Berhman, 1968), the initiatives have assumed that improved producer prices will lead to the expansion of agricultural supply, and will provide both the incentives and resources to conserve the agricultural resource base (see, for example, Bond, 1983; Cleaver, 1985; and 1988; Barbier, 1988). To date, however, evidence on the impact of the iniatives has been very mixed. A number of countries have revised exchange rate policy, and have introduced the principle of export parity pricing for major cash crops - but there has been no continent-wide trend towards this objective (Moseley and Smith, 1989). Indeed, in most less developed economies agriculture continues to be 'penalized' by the protection of the industrial sector, either directly or through the overvaluation of the exchange rate (Barbier, 1989). Moreover, even where price regimes have been liberalized, the supply responsiveness of farmers in sub-Saharan Africa has been muted. The short run price elasticity of supply of individual cash crops has been shown to be positive and sometimes high, but long run aggregate supply elasticities are generally very low, and in some cases even negative (Green, 1989; Rao, 1989; Perrings, 1989a).

This evidence raises two sets of questions about the sustainability of agriculture in sub-Saharan Africa. The first relates to the microeconomic problem of individual supply responses, and the resource implications of the particular responses observed in sub-Saharan Africa. It is widely recognized that price responsiveness is more tightly constrained by institutional factors in sub-Saharan Africa than it is in, for example, south-east Asia (Delgado and Mellor, 1984; Lipton, 1987; Junankar, 1989). The fact that a substantial proportion of goods and services are not traded, and cannot be traded under existing institutions, is argued to limit the scope for

influencing farmers' production strategies solely through price adjustment (Ghai and Smith, 1987; Beynon, 1989). Additionally, constraints on the supply of basic natural resources limits the capacity of those who do participate in the market to respond to price incentives. As Addison and Demery (1989) point out, raising the return on productive assets will not help if people do not have access to those assets. Moreover, even where farmers do have access to productive assets, the lack of infrastructure - both real and financial - may limit their capacity to respond to the incentives offered by changing real returns on those assets (Beynon, 1989; Addison and Demery, 1989). As yet, however, very little attention has been paid to the short or long run environmental effects of changing incentives. Indeed, the nature of the linkages between producer prices, agricultural supply responses, and natural resource effects has yet to be identified - though there are good prima facie reasons to suppose that a positive supply response will be associated with significant environmental effects. In many parts of sub-Saharan Africa it has been argued that poorer farmers cannot increase productivity at the extensive margin simply because they do not have access to land (Feder and Norohna, 1987). But the evidence is that such expansion of agricultural output as has occurred has been at the extensive rather than the intensive margin. It has involved movement into increasingly marginal climatic, vegetational or topographical conditions, and the potentially adverse environmental implications of expansion of cultivation in forested, hilly or semi-arid conditions are well established (Mosely and Smith, 1989; Barbier, 1988; Pearce, Barbier and Markandya,1988).

The second set of questions raised by the evidence are logically prior to questions about farmer responses. They concern the linkages between the general strategy of growth-through-industrialization, and the prices which guide the allocative decisions made by farmers. These questions ask what the strategy means for agricultural incentives, and so for agricultural resource utilization. They are also concerned with the scope for, and nature of, agricultural price liberalization under the strategy. Unlike the issue of supply responsiveness, these questions have attracted very little attention at an empirical level, and almost no attention at a theoretical level. While the properties of the dual economy model of industrialization in an agrarian economy are the subject of a continuing literature, attention remains fixed

on the well researched issue of unemployment (see, for example, Feldman, 1989).

Given the increasing attention being paid to the sustainability of development strategies, and given also the consensus that appropriate incentives are crucial to the sustainable utilization of natural resources, both sets of questions are important. This paper is, however, mainly concerned with the broader issue of the linkages between agricultural incentives and the development strategies applied in dual economies. To explore these linkages, it considers the implications of a model of the dual economy for the utilization of resources in the agricultural sector. The model is a variant of the dual economy model originally due to Lewis (1954), but owing its current form to later contributions by, inter alia, Fei and Ranis (1964, 1978), Harris and Todaro (1970), Cordon and Findlay (1975) and Basu (1980).

The model has been adjusted in two ways. First, it includes a non-standard specification of labour costs in the agricultural sector. This is intended to capture the peculiar characteristics of Lewis's 'traditional sector' in respect of employment, productivity and the distribution of the product. That is, it is assumed that labour is not hired at a productivity-related wage, and that the product is distributed between all those available to work whether they are working or not. The standard specification of labour costs in later versions of the model fail to capture these characteristics. Second, the model allows for the link between increases in aggregate supply and land utilization observed by Pearce, Barbier and Markandya (1988) and Mosely and Smith (1989). That is, it relaxes the assumption that the area of arable or grazing land available is fixed, and allows for expansion at the extensive margin. The strict meaning of land scarcity in this context is that expansion at the extensive margin involves movement on to land of progressively inferior quality.

The paper is concerned only with the relation between certain key price and quantity variables in the dual economy at and away from equilibrium. It does not attempt to model the dynamic processes involved in agricultural or ecological change, nor does it attempt to model the growth path of the industrial sector. The question of the long run sustainability of resource utilization is therefore addressed only indirectly, through the link between

agricultural price policy and the utilization of labour in the agricultural sector. The paper shows the conditions in which agricultural resources will be exploited to the point where the marginal physical product of labour is zero or even negative. It is assumed that in such conditions, the probability that those resources will be degraded in the long run is increased.

The paper is in five sections. The following section offers a very brief review of the characteristics and development of the dual economy model which has underpinned the strategy of growth-through- industrialization in the post-war years. It also indicates which assumptions of the model have been adjusted during its development and why[1]. Section 3 describes the model under analysis in this paper. Section 4 discusses the implications of the model for the link between industrial wages, agricultural productivity and agricultural employment, and establishes the rationale for an anti-agricultural bias in dual economies pursuing a strategy of growth through industrialization. Section 5 then considers the implications of an anti-agricultural bias for the utilization of agricultural resources. A final section discusses the significance of different price regimes and farmer responses for the sustainability of the agricultural sector.

2 Characterizing the dual economy

The main characteristics of the idealised dual economy are well understood, and so may be listed with little elaboration. There are assumed to be two distinct sectors: a traditional agricultural sector on the one side, and a modern industrial sector on the other. Following convention, these will be referred to as the agricultural and industrial sectors, but it is important to emphasise that the key difference between the two lies in the terms 'traditional' and 'modern'. The term 'industrial' is in fact a catch-all for the whole of the non-traditional sector of the economy, and so covers various non-manufacturing resource-based activities including commercial agriculture. It is held to constitute an 'enclave' in the agricultural sector, implying that it is in some way insulated from the agricultural sector. More particularly, it is supposed that while labour and products flow freely between the sectors, capital does not. Thus, while there is a tendency for wages/average rural incomes and prices to equalize across the economy, the rate of profit in the two sectors will differ. The presumption here is that

[1]For a discussion of where the dual economy models are located in the evolution of the theory of agrarian economies see Rao (1986).

agricultural capital is relatively immobile, partly because of the nature of property rights in agricultural assets, and partly because of the absence of financial intermediaries. The fact that most land is subject to common or communal tenure, for example, means that it cannot be sold. Similarly, the fact that there are few financial institutions - indeed few financial assets - inhibits the mobilisation of rural savings.[1]

The agricultural sector in the dual economy is characterised by land scarcity and labour abundance, together with a stagnant technology that is inappropriate to the factor endowments of the sector. Since agricultural expansion in many land-scarce economies has taken place at the extensive margin, land scarcity in the dual economy is more Ricardian than is implied by the Fei-Ranis version of the model. Expansion of arable or range land brings ever more marginal land into use. Labour abundance implies the existence of a labour surplus. This is indicated by the fact that even though technology is labour intensive relative to that in the industrial sector, it still yields a zero or negative marginal physical product of labour at full employment.

The existence of a labour surplus creates a pool of labour which is available to the industrial sector at no cost, in terms of forgone output, to the agricultural sector. In the Lewis model of the labour market in a dual economy, industrial labour is supplied at a constant real wage greater than the average rural income (the opportunity cost of industrial labour). This is the constant institutional wage hypothesis. Employment in the industrial sector is held to expand up to the point at which marginal revenue product of industrial labour is equated with the marginal cost of that labour. The main inference of the model follows directly. Until such time as the labour surplus is exhausted, the expansion of the industrial sector leads to a rising profit share in national income, a rising savings ratio (since industrialists are assumed to save at higher rates than farmers), increasing levels of investment, and hence an accelerating rate of growth.

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[1] It should be noted that although Lewis and Fei and Ranis make little of this assumption, it is crucially important to their results. If capital were freely mobile between sectors there would be a smooth transfer of resources from the declining to the expanding sector up to the point at which the returns to capital were equated. This is, perhaps, why Lewis was at such pains to point out that he was not just concerned with an industrial/agricultural sector dichotomy, but with the distinction between a capitalist sector (i.e. one in which capital is freely mobile) and a non-capitalist sector (i.e. one in which it is not).

The most frequently questioned of these characteristics, has been the constant institutional wage hypothesis. The hypothesis was implicitly challenged in the Harris-Todaro (1970) two sector model, in which the supply of industrial labour was held to depend on the level of unemployment in the system. This has given rise to what is now referred to as the Harris-Todaro equilibrium condition for the labour market, in which the differential between the industrial and agricultural wages (industrial wages and average agricultural income in this paper) is a function of the relative size of the industrial and agricultural labour forces and the level of unemployment in the system.

The Harris-Todaro equilibrium condition challenges the assumption that the industrial wage is invariant with respect to changes in the level of agricultural employment and unemployment. The more general underlying assumption that the characteristics of the agricultural sector are independent of the characteristics of the industrial sector, has also been been challenged from a structuralist perspective.. It has been widely claimed that the dual economies observed by Lewis in the post-war years, particularly in sub-Saharan Africa, were each the product of a unique history in which the characteristics of both sectors had evolved together. The agricultural sector was itself the product of a development process, and did not reflect some sort of original state (see for example, Arrighi, 1970). More particularly, it has been argued that the characteristics and role of the agricultural sector in dual economies of the Lewis type have, historically, been the product of government intervention.

Lewis had certainly acknowledged the potentially damaging effects of intervention in the agricultural sector,[1] but he suggested that the failure of growth in the industrial sector to stimulate the agricultural sector was evidence of pathological conditions unique to the developing countries (1972, 1979). 'Whether in any particular country the developing enclave does more to enrich or impoverish the traditional sectors' he argued' probably depends most on whether the government coerces or helps the traditional sectors ... In the absence of coercion the peoples in the

[1] In his (1954) paper, for example, Lewis admitted that the history of agricultural development in the dual economies had in fact been dominated by policies designed to inhibit technological change, and to control product and labour markets alike.

traditional sectors will almost certainly respond creatively to the new challenges of the modernisation in their midst' (1972, p. 29).[1] Lewis's structuralists critics, like Myrdal before them, argued that far from being evidence of a pathological condition, agricultural decay was necessary in order to maintain the crucial labour supply and wage control functions of the agricultural sector.

To see how such intervention may work requires a clear sense of the decision-making process within the agricultural sector, and here the characterization of the dual economy has typically been very weak. One important dimension to the contrast Lewis drew between the 'capitalist' relations of the modern sector and the pre-capitalist' relations of the traditional sector, is the differing rules governing employment and the distribution of the product in each sector. This dimension has, however, been lost in the later versions of the dual economy model. The kin-based production units of the traditional sector - the traditional family farm - are in fact much closer in spirit to the labour-managed firm, than to the standard profit maximizing firm assumed in the later versions of the dual economy model. But unlike the labour-managed firm, however, the number of claimants to the net product is, to all intents and purposes, independent of any employment decisions made by the traditional family farm. Labour is not hired. Nor is it paid a wage related to its marginal product. Moreover, since (by assumption) there exists a labour surplus, the opportunity cost of adding members of the labour pool to the agricultural labour force is zero. In its characterization of this aspect of the agricultural sector, this paper appeals to the now extensive anthropological literature on the organization of labour and the distribution of the product in pre-capitalist economies (reviewed in Perrings, 1985).

3 A model of industrial profits in an agrarian economy.

Whether government intervention in the agricultural sector of the dual economy is seen as a pathological condition or not, it is clear that intervention has been endemic in the economies of reference. Industrial

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[1] A very similar argument about the normal tendencies of dual economies is to be found in Fei and Ranis (1964), in which it was claimed that a "'successful" dualistic economy, dominated by its inherent "rules of growth", quite naturally moves toward a "turning point" at which it sheds its underdeveloped characteristics and, in fact, is graduated into the circle of mature economies' (1964, p. 5).

wages have not been determined exogenously - as the constant institutional wage hypothesis would have us believe - but have been jointly determined with the industrial rate of profit, and the level of agricultural income. Agricultural productivity has not been independent of the growth of the industrial sector: agricultural output, employment and the industrial wage have been endogenously, not exogenously, determined. What this suggests is that the utilization of the resource base in the agricultural sector is also a function of price policy developed in support of industrial growth. It becomes interesting to consider, therefore, both how the supply and the supply price of industrial labour are determined in these circumstances, and what the implications of variations of the supply price of industrial labour are for the use made of natural resources in the agricultural sector. It is still useful to think of the industrial wage as a function of the opportunity cost of industrial labour, average rural income, but there is no reason to believe that this will be constant. Nor is there any reason to believe that it will be independent of either agricultural price policy, or agricultural employment. The main features of a model that enables us to consider these problems are described below.

It is assumed that both sectors produce tradeables, although whether they are actually traded is a separate issue. The agricultural sector produces crops/livestock for sale and/or for direct consumption. The industrial sector produces competitive manufactured goods (a catch-all for the range of products of modern sector enterprises) for sale. Both sectors employ material inputs at the world price net of the combined effects of tariffs and the exchange rate. In addition, however, the agricultural sector employs non-tradeable natural resources collectively called 'land'. Capital is assumed to be immobile between the two sectors, and there is no tendency to the equalization of rates of return on the assets employed in each sector. The labour force in both sectors derives from the rural population, and labour is assumed to be freely mobile between the sectors. The industrial wage rate is related to average rural income, and is equal to average rural income when unemployment is equal to zero (the Harris-Todaro condition). Average rural income is given by total income in the agricultural sector averaged over the whole of the economically active and inactive rural population. For convenience, population is assumed to be stationary, though extension of the model to include population increase is trivial.

The general form of the production function assumed in the industrial sector is standard. The production function assumed in the agricultural sector is less so. Agricultural output is held to be a function of labour, capital and land, but the latter is regarded as a function of the level of agricultural employment. This is intended to capture the stylized fact that in conditions of labour surplus an increase in employment within the area over which a family farm has rights, means the expansion of farm activities on to more marginal land. The technology is assumed to be stationary. A fixed input-variable output, discrete-time, dynamic model of production in the open agrarian economy is described in Perrings (1989b). The present model is more general in terms of the technological assumptions made, but given the specific aims of the paper it is not dynamic.

The core of the model comprises two identities describing the income of each of the two classes of asset-holder, industrialist and farming kin-group; two behavioural equations describing production possibilities in the two sectors, the production functions; and an equilibrium condition relating the industrial wage and average agricultural income. The income of each of the two classes of asset holder are described by:

$$Y = px - rk - vz \quad (1)$$
$$\Pi = \pi\chi - \rho\kappa - \omega\lambda \quad (2)$$

in which

$$x = x(k, L, z(L)) \quad (3)$$
$$\chi = \chi(\kappa, \lambda) \quad (4)$$

define agricultural and industrial output respectively, and:

- Y = income of farmers
- Π = income of industrialists (profits)
- k = material inputs in the agricultural sector
- κ = material inputs in the industrial sector
- L = labour inputs in the agricultural sector
- λ = labour inputs in the industrial sector
- z = land inputs in the agricultural sector (a function of the level of agricultural employment)
- p = price of agricultural output
- π = price of industrial output
- r = price of material inputs in the agricultural sector

ρ = price of material inputs in the industrial sector
v = price of agricultural land
w = average rural income
ω = industrial wage
u = unemployment

Since it is assumed that labour is not hired in the agricultural sector, the costs in equation (1) exclude a wage bill component. It would be straightforward to extend the model to cover the case where an agricultural labour market has developed, accommodating individuals who have no rights of access to land or other assets. That is not, however, the case being considered in this paper.

The prices of tradeables in both sectors are net of taxes, tariffs or subsidies. Hence:

$$p = ep^*(1 - t_x)$$
$$r = er^*(1 + t_k)$$
$$\pi = e\pi^*(1 - t_\chi)$$
$$\rho = e\rho^*(1 - t_\kappa)$$

where

e = the exchange rate
p^* = the world price of agricultural output;
t_x = the net effect of the exchange rate and agricultural export taxes;
r^* = the world price of agricultural material inputs;
t_k = the net effect of the exchange rate and tariffs on imports.of agricultural material inputs;
π^* = the world price of industrial output;
t_χ = the net effect of the exchange rate and industrial export taxes;
ρ^* = the world price of industrial material inputs; and
t_κ = the net effect of the exchange rate and tariffs on imports.of industrial material inputs.

The 'price' of land, v, is given by the institutional price, v_i, plus effective land taxes or subsidies, v_t. That is

$$v = v_i + v_t$$

So, for example, if agricultural land is held in common property ($v_i = 0$), and is subject to open access ($v_t = 0$), $v = 0$. On the other hand if agricultural

land is held in common property ($v_l = 0$), but access is regulated through user charges ($v_t > 0$), $v = v_t$.

The two sectors are linked through the labour market by the equilibrium (Harris-Todaro) condition:

$$\omega = \frac{Y(\lambda + u)}{\lambda(L + u)} \tag{5}$$

This defines the industrial wage as a function of agricultural income, unemployment, and the relative size of the industrial and agricultural labour forces. Since we are holding population fixed, we may normalize by setting the total population equal to unity, such that:

$$1 = L + \lambda + u \tag{6}$$

and since average agricultural income is defined by;

$$w = Y/(L + u) \tag{7}$$

equation (5) may be written in the form

$$\omega = w(1 - L)/\lambda \tag{8}$$

Equations (5) and (8) make the scope for anti-agricultural biases to serve the interests of industrial growth immediately clear. The industrial wage varies directly with average rural income, although the relation is mediated by the level of unemployment. Since industrial profits vary inversely with industrial wages, a strategy of development through industrialization implies an incentive to intervene in the production decisions of farmers in a way that redistributes income away from those assumed to save at a low rate and towards those assumed to save at a high rate - for the usual Kaldor-Pasinetti reasons.

The instruments commonly used to adjust the functional distribution of incomes are a set of taxes - formal or informal export taxes on output and import tariffs on inputs. Tax and tariff regimes are maintained that will confer benefits on the industrial sector through the effect on the wage rate. Indeed, the tax wedge in agricultural income provides a direct lever on the industrial wage: industrial wages being affected in very similar ways by

changes in either the taxation of agricultural outputs, or tariffs on agricultural inputs. Specifically, if we write equation (5) in the form

$$\omega = \frac{[ep^*(1 - t_x)x - er^*(1 + t_k) - (v_i + v_t)z](1 - L)}{\lambda(1 - \lambda)} \tag{9}$$

it is immediate that for agricultural exports,

$$d\omega/dt_x = -ep^*x(1 - L)/[\lambda(1 - \lambda)]; \tag{10}$$

for imported material inputs,

$$d\omega/dt_k = -er^*k(1 - L)/[\lambda(1 - \lambda)]; \tag{11}$$

and for land,

$$d\omega/dv_t = -z(1 - L)/[\lambda(1 - \lambda)]. \tag{12}$$

An increase in taxes on agricultural output and tariffs on agricultural inputs, or an increase in the user charges on land will, *ceteris paribus*, have the effect of driving industrial wages down, and so industrial profits up. The effective limits to the admissible level of taxes and tariffs are given by the 'no-trade' point: the point at which producers choose to opt out of the market, producing either for direct consumption or for parallel markets. Given the very high proportion of tradeable goods in sub-Saharan Africa that are transacted outside formal markets, there is reason to believe that tax and tariff regimes have been fully exploited in this regard.

It needs to be emphasised that the model discussed in this paper represents a high level of abstraction from the complexities of the real economies of sub-Saharan Africa. In reality, the agricultural sector comprises a range of institutional types, some much closer to fully commercialized farming firms than others; the effective dispossession of people in the rural areas has, in several cases, led to the creation of a rural labour market; a complex hierarchy of markets has emerged, some more formal than others; average rural income has been boosted by public and private transfers alike; and so on. What a very simple model of this sort can do in these circumstances, is to identify the key trade-offs between agricultural income, industrial profits and agricultural employment in an industrializing development

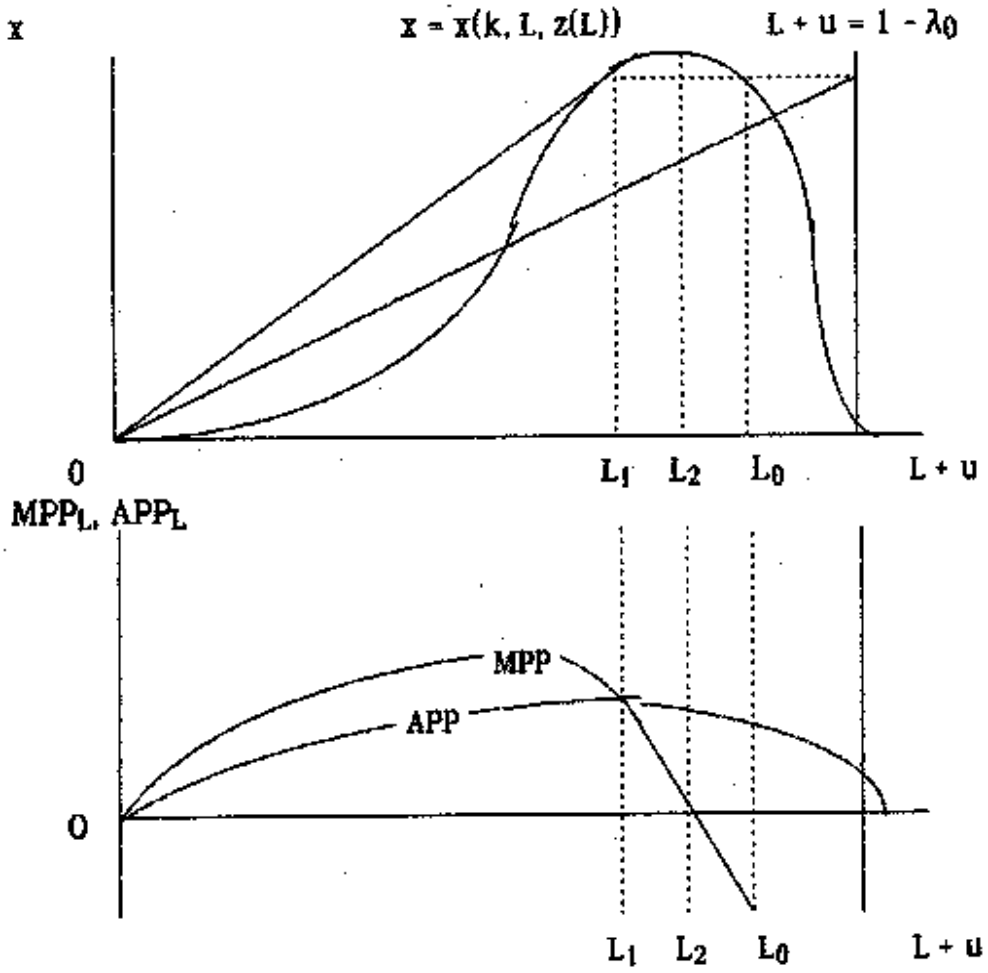
strategy. While it is clear that agricultural incentives have not been motiv ated by the need to ensure the sustainability of resource use, it is not as clear from a survey of the available literature what does motivate them. The model presented here provides one set of answers. To see what these are, however, we need to consider the properties of the general model in more detail.

4 Agricultural employment, rural income, and industrial profits.

Consider, first, the link between agricultural productivity and agricultural employment. The agricultural production function, $x = x(k, L, z(L))$, is constructed on the assumption that there is no technological change. Material inputs and labour are both combined with land which has all the usual properties of a potentially exhaustible resource. If 'underexploited' the marginal physical product of agricultural labour will be positive and increasing, if 'overexploited' the marginal physical product of agricultural labour will be negative. The total physical product of agricultural labour, described in figure 1 below, reflects these properties. The assumption of 'surplus' labour is reflected in the location of the 'full employment' locus: $L + u = 1 - \lambda_0$. This is located to the right of the highest point on the total physical product curve to indicate the existence of what Fei and Ranis called a 'redundant population'. What it implies is that for a given level of industrial employment, and for a given set of land resources, the rural population sharing in the agricultural product is greater than the population which could be productively employed.

The 'average rural product' is given by the slope of a ray from the origin to the point on the full employment locus $L + u = 1 - \lambda_0$ associated with the level of output corresponding to the actual level of employment. Notice that for all except the maximum level of total physical product there exist two levels of employment corresponding to the same 'average rural product'. We can thus define two measures of excess human capacity in the system: open and disguised unemployment. Open unemployment characterises that section of the rural population who are not economically active. Disguised unemployment characterises those who are economically active, but who could be withdrawn without affecting average rural income. In figure 1, if current employment were L_0, open unemployment would be given by $u = 1 - \lambda_0 - L_0$, and underemployment by $L_0 - L_1$.

Figure 1



The objective of the agricultural sector derives from the assumption that total agricultural income is distributed between all members of the rural population. Accordingly, if the agricultural population is fixed, average rural income will be maximized at the point where total distributable income is greatest. This results in familiar first order conditions: the equalization of the marginal revenue product and marginal cost of labour. From (1) (3) and (6) the first order conditions for the maximization of w with respect to L require that:

$$p(x_L + x_z z_L) - v z_L = 0 \qquad (13)$$

where

$x_L = dx/dL$
$x_z = dx/dz$
$z_L = dz/dL$

$p(x_L + x_Z z_L)$, the marginal revenue product of labour, reflects both the direct effect on output of a change in employment and the indirect effect on output of a change in land utilization due to a change in employment. vz_L, the marginal cost of labour, reflects the cost of bringing additional land into use as agricultural employment increases. It is an indirect cost. By assumption there are no direct costs of labour. Note that these first order conditions suppose that the rural population is fixed, implying that an increase or reduction in agricultural employment results in an equivalent reduction or increase in open unemployment (ie. $du/dL = -1$). The first order conditions for the maximization of average rural income where this is not the case will be discussed momentarily. Equation (13) indicates that if there exists a labour surplus, and if land is held in common property with no user charges: i.e. $u > 0$ and $v_i + v_t = 0$, the optimal level of employment will be that at which the marginal physical product of agricultural labour is equal to zero - L_2 in figure 1.

To show the importance of the assumption that $du/dL = -1$, let us take two other cases: the first where $dw/du = 0$, implying that the unemployed do not share in the distribution of agricultural income (the labour-managed firm case); the second where $du/dL = 0$, implying that a fall in agricultural labour does not result in a rise in unemployment in the system. In both these cases the optimal level of employment will be that at which the average rural income is equated with the difference between the marginal revenue product and the marginal cost of agricultural labour - marginal agricultural income. Assuming $v_i + v_t = 0$ this would be at L_1 in figure 1. In these two cases, the first order conditions would require that

$$p(x_L + x_Z z_L) - vz_L - w = 0 \qquad (14)$$

These conditions look rather closer to the conditions one would expect under a standard specification of labour costs, and standard distributional assumptions. They help to underline the importance of the distributional assumptions of this paper. Under the assumption that the unemployed do share in the distribution of the net agricultural product, it is not possible for a traditional family farm to change the average income of its members by changing the number of people with some claim on the net income generated by the farm. It follows that the existence of a labour surplus in the dual economy influences both average rural income (7), and, since

average rural income is the opportunity cost of industrial labour, the industrial wage (8).

Taking open unemployment first, since $\omega\lambda = w(\lambda + u)$, it follows that $\omega \geq w$, and that $\omega = w$ if and only if $u = 0$. Under the assumption that migration is costless, industrial wages and average rural income will be equal if and only if there is no open unemployment in the system (the probability of finding industrial employment is equal to unity in a Harris-Todaro sense). Underemployment has a similar effect to unemployment, in that positive underemployment depresses average rural income, and so industrial wages. But the mechanism is different. Where open unemployment depresses average rural income by adding unproductive claimants to the total physical product, underemployment depresses average rural income directly by reducing the total physical product. This follows directly from the definition of underemployment as comprising that section of the agricultural work force which could be withdrawn with no effect on average rural income. The existence of underemployment implies that the marginal physical product of agricultural labour is negative - as at L_0 in figure 1[1].

The industrial wage rate accordingly varies with agricultural employment, underemployment and unemployment, as well as with the relative input and output prices which determine the value of the agricultural product. To approach the link between industrial wages, profits and agricultural employment, consider the general relation between income growth in the two sectors. Using (1) (3) and (5) to (8), and holding prices constant, the total differential of (5) is:

$$d\omega = [(1 - L)/(1 - \lambda)][(px_L + px_Zz_L - vz_L - w)dL - wdu] - \omega[1 - \lambda/(1 - \lambda)]d\lambda/\lambda + [(1 - L)/\lambda]dw \qquad (15)$$

in which the expression $[(px_L + px_Zz_L - vz_L - w)dL - wdu]$ will be equal to zero at the optimal level of agricultural employment. Depending on the

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[1] In the Fei-Ranis case, where the marginal physical product of labour is assumed to fall to zero and to be constant thereafter, underemployment would not reduce the total physical product. Moreover, the withdrawal of one underemployed person would have the same effect on average rural income (zero) as the withdrawal of all underemployed persons. In the case of this paper, the withdrawal of one underemployed person will not have the same effect as the withdrawl of all underemployed persons. Indeed, the withdrawal of successive underemployed persons will cause average rural incomes to rise up to the point at which the marginal physical product of agricultural labour is zero.

distributional rules either $du/dL = -1$ or $du/dL = 0$. In the first case conditions (13) apply. In the second case conditions (14) apply.

Let us now define the proportional growth of the industrial and agricultural labour forces to be,

$$\underline{L} = -\eta \underline{w} \tag{16}$$

$$\underline{\lambda} = -\epsilon \underline{\omega} \tag{17}$$

where
$\underline{L} = dL/L$
$\underline{\lambda} = d\lambda/\lambda$
$\underline{w} = dw/w$
$\underline{\omega} = d\omega/\omega$

and where $-\eta$ and $-\epsilon$ are the demand elasticities for agricultural and industrial labour respectively. Using (8) (16) and (17), (15) may be written in the form

$$\underline{\omega} = \underline{w}\frac{1 - \eta(L/\lambda)(\Omega/w)}{1 - \epsilon[1 - \lambda/(1 - \lambda)]} \tag{18}$$

where

$$\Omega = [(1 - L)/(1 - \lambda)][(px_L + px_Z z_L - vz_L - w)dL - wdu/dL]$$

Equation (18) is analogous to the Cordon-Findlay equation (Cordon and Findlay,1975; Feldman,1989), in that it defines the relation between the growth of industrial wages and the growth of rural income in dual economies. Unlike the Cordon-Findlay equation, however, the algebraic sign of (18) does not turn on the elasticity of demand for industrial labour alone. The expression $[1 - \lambda/(1 - \lambda)]$ may be positive or negative depending on the size of the industrial labour force relative to the rural population. More particularly, $[1 - \lambda/(1 - \lambda)] < 0$ if $2\lambda > (1 - \lambda)$. The smaller the industrial labour force as a proportion of the total population, the higher the elasticity of demand required to switch the sign of the equation from positive to

Certainly, the higher the elasticity of demand for industrial labour, and the higher the level of industrial unemployment, the greater will be the probability that growth in industrial wages will vary inversely with growth in average rural income. In general, however, evidence on both

employment levels and demand elasticities suggests that industrial wages in dual economies may be expected to vary directly with average rural income. Indeed, this turns out to be the main source of difficulty in the liberalization of agricultural price regimes.

In addition, while $\Omega = 0$ at equilibrium levels of agricultural employment - ensuring that the numerator is positive, disequilibrium in the agricultural labour market opens up the possibility of other results.

To see the link between industrial profits and agricultural employment more directly, consider the derivative of (5) with respect to L:

$$d\omega/dL = \frac{\Omega}{\lambda\{1 - e[1 - \lambda/(1 - \lambda)]\}} \tag{19}$$

It is clear that industrial profits will respond positively to changes in the level of agricultural employment away from equilibrium. As with (18) the sign of this derivative depends on the elasticity of demand for industrial labour and the size of the industrial labour force relative to the total population. But it also depends on Ω. At the optimal level of agricultural employment $\Omega = 0$, indicating a plateau in the industrial wage function. Moreover, since $d^2\omega_b/d\lambda^2$ is of the same sign as d^2w/dL^2, and since $d^2w/dL^2 < 0$ at the critical value of L, the industrial wage is maximized at the level of agricultural employment at which average rural income is maximized. By the same reasoning, industrial profits are minimized at that level of agricultural employment. Specifically, the first derivative

$$d\Pi/dL = -\frac{\Omega}{[1 - e[1 - \lambda/(1 - \lambda)]} \tag{20}$$

is equal to zero at the critical value of L, while the second derivative is of the opposite sign to d^2w/dL^2 at that value. More generally, a change in the economically active proportion of the rural population is by itself sufficient to change the industrial rate of profit (by changing the industrial wage rate) irrespective of what is happening to relative prices in either the industrial or agricultural markets.

An associated set of effects worth identifying are the feedback effects of a change in the level of industrial employment. Since industrial labour is drawn from the rural population it follows that a change in the level of industrial employment will have a direct impact on average rural income, whether or not it is associated with change in agricultural productivity. But the strength of this impact will depend on whether industrial labour is drawn from the economically active or inactive populations. There are two cases to consider.

In the first case, if industrial workers are drawn from the economically active rural population ($du/d\lambda = 0$), then

$$d\Pi/d\lambda = \pi\chi_\lambda - \omega\{[\lambda/(1 - \lambda)] - \Omega/\omega\} \qquad (21)$$

where $\pi\chi_\lambda$ denotes the value of the marginal physical product of industrial labour. (21) will be maximized where the value of the marginal physical product of industrial labour is equal to the direct and indirect marginal cost of employing an additional unit of industrial labour. The marginal cost of industrial labour comprises both the direct wage costs and the indirect effect (positive or negative) on industrial wages of a change in the level of agricultural employment. If the difference between the value of the marginal physical product and marginal cost of agricultural labour is greater than average rural income, an increase in industrial employment will be associated with falling wage rates, and vice versa.

In the second case, if industrial workers are drawn from the economically inactive rural population ($dL/d\lambda = 0$), there are two indirect effects on industrial profits. The first is the effect on industrial wages of a change in the size of the economically inactive rural population sharing in an agricultural product of fixed amount. If unemployment falls as industrial employment rises, average rural income and so industrial wages rise, causing industrial profits to fall. The second is the effect of a change in open unemployment on the differential between industrial wages and average rural income. In this case, if unemployment falls the differential will narrow so increasing the industrial profits associated with a given level of average rural income. The two effects accordingly work in opposite directions. From the derivative

$$d\Pi/d\lambda = \pi\chi_\lambda - \omega\{[\lambda/(1 - \lambda)] - w/\omega[1 - (1 - L)/(1 - \lambda)]\} \qquad (22)$$

we can see that the relative strength of the two effects depends on the relative importance of industrial and agricultural employment. If $L > \lambda$, then $[1 - (1 - L)/(1 - \lambda)] > 0$, and the net indirect effect on industrial profits will be negative. On the other hand, if $L < \lambda$ the net indirect effect on industrial profits will be positive. For a given level of agricultural employment greater than the level of industrial employment, rising industrial employment (falling unemployment) will cause industrial profits to rise. For a level of agricultural employment less than or equal to the level of industrial employment, rising industrial employment will have the opposite effect.

Since Ω includes the expression $w[(1 - L)/(1 - \lambda)]dL/du$, (22) differs from (21) only in the absence of a term capturing the effect of a change in the value of the marginal physical product of agricultural labour. Accordingly, whether the marginal costs of industrial labour are raised or lowered by drawing additional labour from the rural population depends in the first case ($du/d\lambda = 0$) on the effect of a change in agricultural employment on the marginal physical productivity of agricultural labour, and in the second case ($dL/d\lambda = 0$) on the relative size of the two sectors.

5. Anti-agricultural biases and agricultural resource utilization

Consider, now, the implications of the anti-agricultural biases observed in sub-Saharan Africa for the utilization of real resources in the agricultural sector. It should be recalled that wage restraint in this model of the dual economy is secured by restricting average agricultural income. Industrial wages are assumed not to be determined on a cost-of-living basis, but by reference to the opportunity cost of industrial labour. The presumption here is that even if the cost of living is formally a part of wage calculations under an incomes policy, average agricultural income remains a de facto point of reference in wage determination. Food price controls, for instance, operate through their effect on agricultural income, rather than on the urban cost-of-living.

This suggests a very particular interpretation of the term 'agricultural bias'. Specifically, agricultural prices are said to be biased if they reduce average agricultural income below the level that would obtain under the same

distribution of the agricultural product at socially efficient prices - export and import parity prices in the case of tradeables, and prices equal to marginal social cost in the case of non-tradeables. In other words, an anti-agricultural bias implies non-neutral intervention in respect of both input and output prices. The existence of monopsonistic purchasing prices below export parity prices, for example, may or may not indicate the existence of an anti-agricultural bias, depending on the pricing of agricultural inputs. If tradeable inputs are subsidized, and non-tradeable inputs are priced below marginal social cost, monopsonistic pricing may be associated with higher agricultural incomes and industrial wages than would obtain under socially efficient prices.

The anti-agricultural biases alleged to exist in sub-Saharan Africa relate almost exclusively to distortions in the cost of tradeable inputs and outputs due to the monopsonistic pricing of outputs, monopolistic pricing of inputs, and the income-depressing effects of taxes and tariffs. Throughout the literature virtually nothing is said about the cost of non-tradeables - range and arable land in particular. Yet this is the source of the uncertainty that leads Pearce, Barbier and Markandya (1988) to question the environmental effects of changes in producer prices. From the first order conditions for the maximization of average rural income where income is distributed to all members of the rural population, (13), agricultural employment will increase up to the point where the marginal cost and marginal revenue product of labour are equal. The marginal revenue product of labour is simply the value of the (tradeable) direct and indirect marginal physical product of labour, $p(x_L + x_Z z_L)$. The marginal cost of labour comprises the indirect costs of bringing additional (non-tradeable) land into use, vz_L. Under the structure of property rights obtaining in much of sub-Saharan Africa, land held in communal ownership is zero-priced, implying that $vz_L = 0$, and therefore that the optimal use of agricultural resources will be that at which the marginal physical product of labour is equal to zero. This is not affected by the level of the output price, p. Nor, more importantly, is it affected by the deregulation of the price of traded agricultural inputs and outputs. If agricultural output prices are raised to export parity levels, average agricultural income and so industrial wages will both be raised, but optimal resource use will remain unchanged.

The limited scope for output price liberalization to stimulate an expansion in agricultural output in these circumstances is obvious. So too are the adverse effects of output price liberalization on industrial profits. From (1) it is immediate that average rural income will remain constant in the face of a change in revenue, only if there is an exactly compensating change in costs. If output prices are decontrolled, while input prices are fixed, average agricultural incomes and hence industrial wages will rise (providing that equation (18) is positive in sign). This, in turn, will mean a reduction in the competitiveness of the industrial sector. While it is possible to seek compensating increases in the cost of tradeable inputs - interest rates, fuels, fertilizers and the like - the experience of the countries of reference here suggests both that the level of employment of such inputs is low, and that their elasticity of demand is high. Price liberalization that is not associated with the introduction of user charges on non-tradeables in common property will tend to reduce industrial profits.

There are two important qualifications to this, however, and it is these qualifications which have perhaps the most significance for agricultural resource utilization. The first derives from the fact that industrial wages (and so industrial profits) are also sensitive to the relative magnitudes of the industrial labour force and the economically active agricultural population. Equations (21) and (22) show this for the case where change in the level of unemployment is due to the growth of the industrial labour force. But industrial wages also respond to change in unemployment caused by change in the economically active proportion of the rural population. Specifically

$$d\omega/du = (w/\lambda)\{1 - [(1 - L)/(1 - \lambda)]\} - (\Omega/\lambda). \qquad (23)$$

Equation (23) indicates that industrial wages will fall with a fall in unemployment providing that the economically active rural population is greater than the industrial labour force. What this means is that policies which reduce open unemployment by stimulating the expansion of agricultural employment will cause industrial profits to rise. The implications of this will be considered momentarily. The second qualification derives from the fact that agricultural productivity, too, is sensitive to changes in the economically active proportion of the rural population, and is affected differently by changes in the level of productive

employment and underemployment. Specifically, the expansion of underemployment - indicated by a negative marginal physical product of labour - implies a direct reduction in both agricultural output (and so agricultural revenue), and open unemployment. From (13), positive underemployment in the agricultural sector will exist if and only if the marginal cost of labour is negative. From the assumption that $z_L > 0$, the marginal cost of labour, $(x_L + x_z z_L)$, will be negative if and only if $v < 0$. In the case where arable and pastoral land is held in common property, suggesting that $v_i = 0$, $v < 0$ implies that $v_t < 0$: user charges for land are negative. Negative user charges imply the existence of subsidies which make it privately profitable for individual farmers to work land even where the marginal physical product of labour is negative. There are, in fact, a wide range of examples of subsidies that are readily interpretable as negative user charges in the agricultural sector in sub-Saharan Africa; ploughing and land clearance grants being perhaps the most obvious examples. In terms of the model of the dual economy discussed here, the lower the level of open unemployment in an economy with a relatively small industrial sector, and the higher the level of underemployment, the lower will be the industrial wage rate.

Price intervention which lowers input prices relative to output prices does not necessarily affect industrial profits adversely (a) if it is associated with change in any of the real variables influencing the relation between industrial wages and average rural income (agricultural employment and unemployment) or (b) if it results in the direct reduction of agricultural output (underemployment). The second effect is particularly important. Underemployment implies that x_L, x_z, and v are all negative. If a subsidy on land use, vz_L, exceeds the output losses associated with that use, $(px_L + px_z z_L)$, expansion of the economically active proportion of the agricultural population will actually increase industrial profits.

6 The sustainability of resource use

To conclude, let us return to the question that has motivated this paper: the sustainability of agricultural resource utilization under a strategy of growth-through-industrialization. Using a simple equilibrium model of the dual economy that is well adapted to the identification of trade-offs in the economy, (but which lays no claim to capturing the essential features of

dynamic processes), the paper has considered what the implications of industrial growth are for the performance of the agricultural sector. Since average rural income is the opportunity cost of industrial labour in such an economy, the conflict of interest between the industrial and agricultural sectors is quite intuitive. The systematic bias against agriculture observed by the World Bank and the IMF may then be interpreted as the other side of a strategy of development through industrialization. Rural poverty may be interpreted as the outcome of policies suggested by the strategy. The question is whether the distributional implications of the strategy have any clearly identifiable significance for the sustainability of the agricultural sector.

The context within which this question is posed is the IMF/World Bank adjustment programme for low income, highly indebted, dual economies. The programmes are implicitly critical of most of the agricultural policies associated with the industrializing growth strategy. They are explicitly critical of the policy of depressing the prices paid to producers by monopsonistic marketing boards, and the liberalization of agricultural pricing policy is a major part of the programme. There is a certain irony in the fact that having driven down agricultural incomes through the manipulation of agricultural input and output prices in the interests of containing industrial wages, successive governments in many low income countries have watched the emergence of a tenuous, makeshift, competitive local industrial sector in which the implicit subsidy on wages is not the source of extraordinary investment funds for the expansion of the sector, but the sole reason for its existence. To the extent that increases in average agricultural income feed through into industrial wages, higher producer prices will tend to be seen as threatening to such an industrial sector. Indeed, this remains one of the strongest reasons for the unwillingness of many governments to allow producer prices to rise to world levels. It is also one of the strongest reasons for considering alternative forms of wage restraint once producer prices have risen.

Agricultural bias, in the sense of this paper, may be said to exist whenever input and/or output prices are modified in such a way as to reduce the average agricultural income stream below the level that would hold under a marginal social cost pricing rule. In the case of tradeables, the appropriate prices under this rule are 'border' prices. In the case of non-tradeables, the

appropriate prices are given by the marginal social cost of the resource, where the marginal social cost reflects the sum of the direct, external, and user costs. The marginal social cost of a natural resource such as grazing land, for example, includes not just the direct costs to the user of bringing that land into use, but also any uncompensated costs visited on others using the same resource, together with the future opportunities forgone by committing the resource to a particular use now.

Anti-agricultural bias in respect of tradeables is typically associated with output prices below export parity prices, and input prices above import parity prices. In respect of non-tradeables the position is a little more complicated. A particular feature of the price structure of agriculture in much of sub-Saharan Africa has been the implicit subsidy on agricultural land offered by traditional (common or communal) land tenure systems. Land has been almost universally priced below its marginal social cost, and in most cases has been 'free'. One result of this is that the resource has been overutilized in an economic sense. Indeed, we have seen that where land is zero priced under such land tenure systems, the optimal level of agricultural employment will be that at which the marginal physical product of labour is zero. This is certainly what was assumed in earlier versions of the dual economy model (eg Fei and Ranis, 1964). In this paper, the price of agricultural land is defined as the sum of an 'institutional' price - equal to zero for common property regimes - and a user charge. The term 'user charge' covers the sum of all direct charges, such as grazing or water fees, and all subsidies associated with the use of land. Where subsidies exceed any direct charges, the user charge is negative. Because of the effect that negative user charges have on privately optimal employment (and productivity) levels, we have the paradoxical result that cash grants to farmers can reflect an anti-agricultural bias.

This follows from the fact that bias is judged in terms of an income stream. It is important to consider the effect of the agricultural price regime on the long run performance of the sector. The question of the sustainability of resource use (and hence the sustainability of an income stream) under common property regimes turns on the user charge. User charges that are less than the marginal social cost of land, imply the resource will be overutilized in an economic sense. This does not, of course, necessarily imply that it will be overutilized in an ecological sense (Barrett, 1989). For

all renewable natural resources there exist levels of exploitation that are sustainable. If the level of exploitation lies outside this range, however, the resource will be depleted or degraded - due to the exhaustion of soil nutrients, erosion, devegetation or the like. Ecological overutilization supposes the depletion or degradation of renewable resources. Nevertheless, if a resource is appropriately priced, economic and ecological overutilization should be highly correlated. An anti-agricultural bias that rests on incentives to overutilize agricultural resources in an economic sense will tend to be ecologically unsustainable.

For this reason it is worth paying special attention to the impact of land-use subsidies on the industrial wage. Overutilization of land through underemployment of agricultural labour depresses industrial wages by reducing real output, open unemployment - and so the differential between rural income and industrial wages. Wherever industrial profits are under pressure (whether through the effect of agricultural ouput price liberalization or not) and wherever industrial profits are privileged under the general development strategy, there is an incentive to intervene in the agricultural sector to restrain average agricultural incomes. If intervention encourages the overutilization of natural resources, it increases the probability of the degradation of those resources.

Positive user charges for agricultural resources are still unpopular - partly on grounds of administrative efficiency and partly on the grounds of their alleged regressivity (see, for example, Green, 1989). Leaving the administrative difficulties to one side, if we are concerned with the long run distribution of income in economies of this type, it is difficult to see how the continuation of zero or negative user charges for resources used in the agricultural sector can promote equality in the distribution of income. The underemployment of agricultural labour, the overutilization of agricultural resources, and the consequent depression of the average agricultural income stream in many the low income countries can be traced directly to the implicit or explicit subsidization of non-tradeable agricultural inputs in the interests of industrial wage restraint. There is now general acceptance of the importance of pricing tradeable inputs and output prices at import and export parity respectively. If the sustainability of agricultural resource use is given due priority, it is hard to argue against user charges fixed by reference to the marginal social cost of the resources in question.

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The authors attempt to give some structure to the concept of sustainable development and to illustrate ways in which environmental economics can be applied to the developing world. Beginning with an overview of the sustainable development concept, the authors indicate its implications for discounting and economic appraisal. Core studies on natural resource management are drawn from Indonesia, Sudan, Botswana, Nepal and the Amazon.

David W Pearce, Anil Markandya and Edward B Barbier,
Blueprint for a Green Economy, Earthscan, September 1989, £6.95

This book by the London Environmental Economics Centre was prepared as a report for the Department of Environment, as a follow up to the UK government's response to the Brundtland Report. Here it stated that: '...the UK fully intends to continue building on this approach (environmental improvement) and further to develop policies consistent with the concept of sustainable development.'
The book attempts to assist that process.

Copies of the above publications are available from:

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- Research into environmental problems of less developed countries from an economic standpoint;
- Dissemination of research and state of the art environmental economics through publication, public and professional address and specialist conferences;
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