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THE RELATIONSHIP BETWEEN LAND TENURE SYSTEMS AND DEVELOPMENT GOALS: A STUDY OF THE COLOMBIAN PALM OIL INDUSTRY

by

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ABSTRACT

In Colombia two strategies for development have been proposed; each calls for a different land tenure system. One strategy calls for a land tenure system of small-scale farms, the other for a tenure system of large-scale farms. This thesis intends to compare small-scale and large-scale farms for their impact on development.

In the thesis small-scale farms are assumed to be family farms, and large-scale farms are assumed to be plantations. A land tenure system of family farms is compared with a tenure system of plantations by a number of criteria. The thesis shows that a tenure system of family farms will not maximise all goals of development; nor will a tenure system of plantations. The thesis explicitly shows which development goals are maximised by family farms and which by plantations.

Initially the thesis demonstrates the functional relationship between land tenure systems and agricultural production techniques. Agricultural techniques are shown to be determined by the tenure systems and their objective functions; hence plantations will adopt different techniques than family farms. The model used to demonstrate the relationship assumes a neoclassical production function and two objective functions. The two objective functions are shown to result in higher capital-labour

ratios on plantations than on family farms. Plantations will tend to adopt mechanised techniques, whereas family farms will adopt non-mechanised techniques.

The thesis then examines the macro implications of the two land tenure systems. At the macro level the thesis assumes that Colombia has three principal development goals; they are maximising consumption over time, maximising current employment and maximising net foreign exchange saving. The rationale for concentrating on these three development goals is shown in the thesis.

Plantations with their higher capital labour ratios are shown to maximise consumption over time. Family farms are shown to maximise current employment and net foreign exchange saving. Neither land tenure system maximises all three development goals; hence a conflict arises when Colombia has more than one development goal and time horizon.

That a conflict exists is tested empirically by a cost-benefit analysis of family farms and plantations. With technical data on palm oil production in Colombia, the above conclusion is endorsed. The plantation is ranked above the family farm when the goal is maximum consumption over time, and the family farm above the plantation when the development goals are maximum current employment

and maximum net foreign exchange saving.

Finally the policy implications of the conflict are examined. Since neither tenure system maximises all three development goals the land tenure system will need to change with different development goals. The thesis examines how the land tenure system can be changed. The thesis concentrates on two policy variables, the cost of labour and the cost of capital. Adjustments in these two variables are shown to influence the relative importance of family farms and plantations.

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PART I: THEORETICAL ANALYSIS

CHAPTER ONE

INTRODUCTION

1. Objective and Approach

The purpose of economic development is to raise living standards. Improved methods of communication in developing countries have stimulated expectations of higher living standards.[1] However, all too often, the developing countries are constrained from fulfilling these expectations. The result may be growing frustration.

One of the principal constraints on development is the rapid population growth rate. As a group, the developing countries have experienced population growth rates of 2.2 per cent a year. In Latin America, the population has been growing even faster, at an average of 2.7 per cent a year and with at least four countries exceeding 3 per cent.[2] This is more than twice the rate of European countries in the nineteenth century.[3]

The growth rate of population can constrain higher living standards in two ways. Firstly, the population growth rate may absorb increases in national income. Hence, income <u>per head</u> will be prevented from rising. Secondly, the population growth rate may exceed the

economy's ability to absorb labour. The result will be growing unemployment.

Historically, the first way has been less constraining. The population growth rate has not absorbed income increases, and per capita incomes have increased. In Colombia, for example, the population has been growing at 3.2 per cent a year but output has been growing even faster. Average real per capita incomes have increased by 1.7 per cent a year.[4]

However, national income has not increased sufficiently to solve the second problem, labour absorption. Colombia's labour force is growing at 3.5 per cent a year and productivity at 2.9 per cent a year.[5] To absorb the growing labour force, national income must increase by 6.5 per cent a year. Since this rate has been achieved by Colombia only in isolated years, labour absorption has been insufficient. While the annual growth rate of labour is 3.5 per cent, the growth rate of employment is only 2.2 per cent. The difference is the growth rate of effective unemployment. If present trends continue over a third of the labour force is projected to be unemployed and underemployed by 1985.[6] In absolute numbers this is four million people.

Unemployment tends to produce considerable hardship in the developing countries. Theoretically, if average per capita incomes are rising, the employed can transfer income to the unemployed. If there is a potential Pareto improvement, aggregate living standards can be raised by income redistribution. However, income redistribution may be more a theoretical possibility than a reality. The fiscal machinery may

be inadequate to redistribute income or the government may not consider redistribution to be in the country's or its own interest. The unemployed will then be left with no alternative but to seek family support or to live in great hardship.

To ameliorate hardship caused by unemployment, the government can place first priority on labour absorption. Projects can be selected for their ability to maximise current employment. However, maximising current employment can involve a cost in that some other development goal may have to be sacrificed. If labour absorption is inconsistent with output growth, for example, maximising current employment will reduce the economy's ability to employ labour over time. The policy-makers will then face a decision whether to reduce current unemployment or unemployment over time.

The problem of conflicting goals will be illustrated in this thesis. The context will be Colombia's land tenure systems. With the level of unemployment perhaps at one-quarter of the labour force and the rate of unemployment growing at 1.3 per cent a year, Colombia has high and growing unemployment. The policy-makers face the decision whether to reduce current unemployment or unemployment over time. Land tenure systems will play a critical role in that decision since the land provides employment for almost half the labour force.

The principal objective of this thesis is to compare tenure systems for their impact on economic development. Economic development is defined as a broader concept than reducing unemployment. It is defined by an objective function which consists of three goals. Land tenure systems

will be compared for their effect on each of these goals. The three goals are consumption over time, current employment and net foreign exchange saving. Their relevance to Colombia is demonstrated.

The tenure systems are compared theoretically and empirically for their impact on the development goals. Since the thesis finds that a conflict theoretically may, and empirically does, exist between goals some important policy implications emerge. Any particular land tenure system will not maximise all three development goals. Maximisation of one may reduce another. The tenure system which is desirable, therefore, depends on which goal is the maximand. If a particular land tenure system fails to maximise the policy-maker's assumed goals, the tenure system will need to be changed. The thesis examines policy measures that can change the tenure system. The policy measures are adjustments of relative factor prices.

Factor price adjustments are the principal policy measures because they appear to be the most practical in the Colombian context. Other measures of changing land tenure systems are excluded as unfeasible. Hence land reform, however desirable it may be, is not analysed. The more feasible approach may be to change tenure systems indirectly.[7] This is the intention of factor price adjustments.

The point of departure in this thesis is a model which compares tenure systems at the micro level. Two tenure systems, plantations and family farms, are considered. They are defined by their maximising behaviour under competition. Plantations are assumed to maximise profits whereas family farms maximise total output subject to a leisure constraint.

Using neoclassical production functions, the model compares their production techniques. It shows that techniques on plantations tend to have higher capital-labour ratios than family farms.

The micro model allows the comparison of plantations and family farms at the macro level. The conclusion that plantations tend to have higher capital-labour ratios than family farms is used to compare the two tenure systems for their effect on development. Each regime is examined for its effect on the three development goals. Plantations are shown to maximise consumption over time because of their higher capital-labour ratio. Conversely, family farms tend to maximise current employment and net foreign saving.

The final theoretical section analyses the effect of factor price adjustments on plantations and family farms. It concentrates particularly on price adjustments of capital and labour. The objective is to show how tenure systems can be changed to coincide more with the government's development goals.

The theoretical conclusions of the thesis are empirically evaluated. Since there are three theoretical analyses there are three empirical sections.

The conclusion that the three goals are inconsistent is evaluated by a cost-benefit study. Plantations and family farms are ranked by their internal rates of return for the three development goals. The conclusion is supported. Plantations are ranked higher than family farms in maximising consumption over time, family farms in maximising current employment. For the goal of net foreign exchange saving, the ranking is less conclusive. Either plantations or family farms can maximise net foreign exchange saving: the ranking depends on the economy's dominant constraint.

The possibility of changing land tenure systems by factor price adjustments is examined within the Colombian agricultural sector. Only two factors are considered, capital and labour. The opportunities for changing tenure systems appear favourable. The factor markets are not perfectly competitive; hence, factor prices vary between plantations and family farms. Capital is cheaper and labour more expensive to plantations than to family farms. These distortions provide an opportunity for selective price adjustments.

Finally, three hypotheses of the micro model are evaluated. The hypotheses are conditions for the capital-labour ratio on plantations to exceed that on family farms. The model does not prove conclusively that the capital-labour ratio will differ, but the data support the hypotheses, and hence increase the likelihood that capital-labour ratios will diverge.

2. Organisation of the Study

2.1 The crop

To fulfil its objective, the thesis concentrates on a single crop. Plantations and family farms are assumed to grow the same crop. The rationale for this assumption is to exclude crop composition as an explanatory variable. Production techniques will differ from one crop to another; hence, inclusion of more than one crop would have distorted the anlaysis. The objective is to show the impact on development of two tenure systems which are identical except for their maximising behaviour.

The crop used as illustration is the African oil palm. In a number of respects it fulfils the requirements for a cross section study.

Of primary importance is the availability of data. Chapter Three briefly describes the introduction of the African oil palm into Colombia. Since this crop is not indigenous to Colombia, a number of studies were made to see if the agronomic conditions were suitable. Given the perennial nature of the crop with its long gestation period and large initial outlays, other studies were made to see if the financial aspects were favourable. These studies have continued over the years, and provide a good source of data.

Of equal importance is the diverse pattern of cultivation. In Colombia, oil palms are cultivated on units which range in size from less than five hectares to units of over 2,500 hectares. The diversity in size presents an ideal pattern of land tenure. Typical family farm regimes exist, as do units which have the characteristic features of a plantation regime. There are no landlord-tenant forms of landholding, only the two forms analysed in the thesis.

A third advantage of the oil palm crop is that substitutability exists betwen factors, particularly between capital and labour. Oil palms can be cultivated by production techniques that have high or low capital-labour ratios. The technique selected will depend on the objective function to be maximised and on relative factor costs.

In the fourth place, palm oil is a homogeneous crop. Quality can be scientifically determined and palm oil below standard is uncommercial. No problem of comparability of product between tenure regimes exists.

Finally, as Chapter Three shows, oil palms were introduced into Colombia with government support. Subsidies, credit facilities and trade advantages were offered to palm oil producers. The policy conclusions of

this thesis, therefore, are not without precedent in the history of the industry.

2.2 Organisation

Chapter Two provides the theoretical background of the thesis. It presents the micro model and its macro implications. The two tenure systems are compared for their impact on the three development goals, and the policy measures examined.

Chapter Three presents a description of the Colombian land tenure systems, two agricultural strategies and the palm oil industry.

Chapter Four evaluates the land tenure systems by cost-benefit analysis, and provides data to support the conclusions of the micro model.

Chapter Five examines policy implications and offers suggestions for further research.

3. Review of Literature

The importance of the land tenure system to developing countries is well documented. The land tenure system will affect the rate of capital accumulation.[8] It is the main source of rural wealth.[9] It also determines the rural distribution of income; if land is unequally divided among the population, income distribution will be skewed.[10] Hence, the tenure system is at the core of rural living standards: where the tenure system is onerous to the majority of people, as in Colombia, living standards suffer.[11]

The inequalities may result in social instability.[12]

In spite of their importance, land tenure systems have received only cursory social evaluation. There have been only a few studies comparing the effect of tenure systems on any one development goal; there have been no studies comparing their effect on several goals. The studies that exist have also tended to be empirical. In addition, there have been no studies examining the responsiveness of tenure systems to factor price adjustments. The thesis intends to repair these omissions. By postulating a complex objective function, it intends to compare tenure regimes by several goals. By adjusting two factor prices the thesis intends to show that tenure systems can be changed.

These two contributions will be dealt with consecutively in the review of literature. The review of literature will first cover studies which have compared land tenure systems. It will then review the brief literature on factor price adjustments as a potential policy measure. Finally, the literature on individual farms will be discussed.

The majority of studies which have compared land tenure systems have been empirical. They have also concentrated on economic efficiency as if that were the only goal of development. Two such studies have been made in Colombia. The earliest was the report by the Comité Interamericano de Desarrollo Agricola (CIDA) which divided farms into four sizes.[13] The report found that the average product of labour varied directly, and the average product of land inversely, with farm size. Studies in other Latin American countries, and later studies in Colombia, have confirmed its findings.[14] The implication of the report is that land utilisation is

inefficient. The report implies that output can be increased by redistributing land and labour.

CIDA did not disaggregate its data by crop. Therefore, the conclusion is less significant. Small farms maximise value per unit of land by growing crops with high yields, whereas large farms produce extensively. In Colombia, only 33 per cent of the land of large farms is under crop compared with 80 per cent of the land of small farms.[15] Hence, the likelihood is that the average product of land varies inversely with farm size.

The second major study similarly failed to disaggregate by crop. Berry used 1960 census data for his cross-section study.[16] Farms were evaluated according to the criterion of value added / social opportunity cost of input. The criterion is more sophisticated than that used by CIDA but the goal is still efficiency. The study concluded that small farms are more efficient than large farms.

An improvement over these two studies has been made by the Consortium for the Study of Nigerian Rural Development (CSNRD) in its analysis of tree crops. Efficiency is still retained as the development goal, but the CSNRD disaggregates by crop. In palm oil production, family farms are shown to be more efficient.[17] For other tree crops, the conclusion is the same.[18]

The only studies which have rejected economic efficiency as the development goal are those by Baldwin.[19] He incorporates pecuniary externalities that are excluded by economic efficiency.[20] Baldwin's studies

are also unique in being theoretical. As in this thesis, the theoretical analysis is based on differences in production techniques. Two land tenure systems are assumed, plantations and family farms, and each has its distinct production technique. In the analysis, the tenure system which has the most externalities maximises development.[21] Since family farms tend to have greater externalities than plantations in his model, the study concludes that family farms are more conducive to development than plantations.

The failure of Baldwin was to insufficiently specify the goal of development. For if development has more than one goal Baldwin's conclusions may not hold. His comparison of micro units with the macro social welfare function was an important contribution to the literature. Yet because he failed to specify the goals within the social welfare function there was no conflict between land tenure systems. This thesis will introduce a time horizon and show that conflicts between tenure systems must emerge.

The thesis also rejects Baldwin's reliance on externalities. He assumes externalities that cannot be quantified and have little operational value for project appraisal.[22] He did not attempt to test his conclusions empirically, and so was not concerned with practical limitations of data.[23] This thesis empirically evaluates its conclusions and therefore includes only quantifiable externalities.

The possibility of changing land tenure systems is discussed in the thesis. Baldwin's analysis is applicable only to newly-settled regions. It has no policy implications for regions which are already settled. It proposes no policy measures which can change existing tenure systems. This thesis will repair the omission by examining factor price adjustments as policy measures.

The literature is singularly devoid of much discussion on changing tenure systems by factor price adjustments. Yet the possibility of influencing production techniques is discussed. For example, the International Labour Office (ILO) examined possible price adjustments that will discourage mechanisation in Colombia.[24] Changes in depreciation allowances, subsidies, and interest rates are possible adjustments. Myint also mentions several price distortions that will reduce dualism among production techniques, but he does not analyse how these will affect the land tenure system.[25] The only exceptions are Griffin and Dorner.[26]

Griffin uses evidence that fertiliser prices are distorted in Colombia to argue that the government implicitly favours large farms. In coffee production he finds that small farmers are more efficient, yet they are obliged to pay more for fertiliser than large farms. His solution is to subsidise inputs on small farms and so improve their relative profitability. The analysis indicates that tenure systems can be changed by factor price adjustment. Dorner, in a less specific context, notes that factor prices have tended to benefit large farms. His solution is for contrived dualism to favour small farms. Credit and land would be made more accessible to small farms. Simultaneously, newly-settled land would be distributed on the basis of labour absorption which would also favour small farms.

This thesis develops the analysis of Griffin and Dorner to show how a variety of policy measures can change the land tenure system. Adjustments in the prices of capital and labour can be combined to alter

the production techniques used by the micro units.

At the level of individual farms, plantations have tended to be overlooked in favour of family farms or 'landlord-tenant relationships.'[27] The literature on plantations tends to be critical of them because of their negative externalities.[28] On the family farm, however, the literature has been plentiful and generally sympathetic. The pioneering work on the family farm was undertaken by Schultz.[29] His conclusion that peasant farmers act rationally has enabled farm models to use traditional economic premises.

Among the most recent, Nakajima's model initially demonstrates the subjective equilibrium of a family farm.[30] It is then subjected to exogenous changes of a number of variables. The family farm behaviour pattern assumed by Nakajima builds on earlier work by Nicholls and Sen.[31] The family farm maximises output subject to a leisure constraint. This behaviour pattern is incorporated into the micro model in the thesis. However, from the point of view of the oil palm industry, the model is deficient in not including capital as an input. Given the character of much of subsistence agriculture, it is a valid approximation of reality. Yet, because capital is a large share of total palm oil output, Nakajima's production function cannot be used.

The model in this thesis includes capital as a separate input. Its inclusion enables capital-labour ratios to be compared on land tenure systems. The capital-labour ratios are shown to diverge because of the behaviour pattern on the tenure systems.

4. Elements of the Model

4.1 Definitions

To clarify certain concepts used in this thesis, it seems appropriate that their definitions are provided.

Land tenure system: A form in which land is held that incorporates all rights created by man. Examples of tenure systems are plantations and family farms.

Agricultural strategy: A policy of the government or its agencies towards land tenure systems and agricultural production techniques.

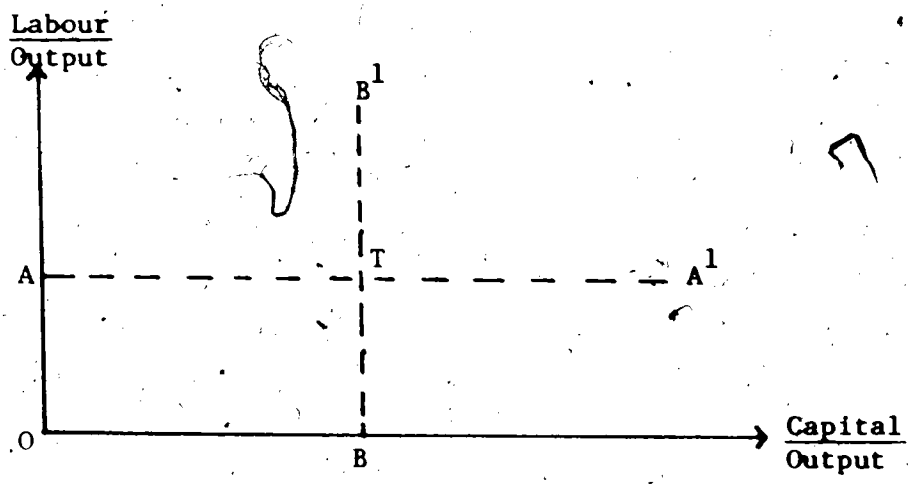
Land reform: An agricultural strategy which involves direct changes of land tenure systems through widespread expropriation and redistribution of land.

Family farm: A farm whose labour is primarily supplied from within the family. Its size is sufficient to provide work for two to four man-years and for palm oil production ranges from two to fifteen hectares.

Plantation: A farm which hires labour. It is characterised by cultivation of highly commercial crops. Its size will vary by crop and for palm oil ranges from fifty hectares upwards. In Chapter Three plantations are synonymous with efficient farms that employ labour.

Mechanised techniques: If only two factors are assumed, mechanisation can be defined from Figure 1.[32] Capital is defined as depreciable capital only for the definition. If T is a technique which

Figure 1.1 Mechanisation and Non-Mechanisation



uses OA labour and OB capital investment for the same output, the area inside the angle B^1TA^1 is excluded. Inside that area both capital and labour inputs are higher than with technique T. The area BTA is also excluded because that would imply that both inputs are fewer than at T. The only areas for rational choice are areas ATB^1 and BTA^1. Mechanised techniques are defined as a movement in the latter area. They will maximise labour productivity.

For agriculture, land is an additional input in the production function. Land is not included in Figure 1. but the range of mechanised techniques can still be illustrated. Using T as the reference technique, capital only may be increased. This is termed capital-intensive and is shown by a movement along TA^1. Alternatively, both capital and land may be increased. This is termed labour-saving and is shown by a movement along TB. Hence labour saving increases output per worker;

Non-mechanised techniques: These are within the area ATB^1. They will maximise land productivity and are characterised by inputs of fertiliser, pesticides and labour. They include labour-intensive techniques which are shown by movements along TB^1.

Degree of mechanisation: The ratio of stock of depreciable capital to labour.

Degree of capital intensity: The ratio of depreciable capital use to labour.

Capital: Capital includes working capital, depreciable capital, human capital and imported capital. It does not include the palm trees themselves although they are implicitly costed by the inputs of working capital, imported capital, and skilled capital.

4.2 Method of testing hypotheses

The hypothesis that the desirable land tenure system will vary with particular goals is evaluated by a cost-benefit analysis. Family farms are compared with plantations for their relative desirability. Both units produce palm oil.

The output, palm oil, is shadow priced at world prices. All imports except for the input of skilled labour, are shadow priced. Imported inputs are shadow priced at world prices, domestic capital at domestic prices net of taxes and unskilled labour at various concepts of labour's opportunity cost.

The opportunity cost of labour varies with particular development goals. The goal of consumption over time has a concept of labour's opportunity cost which includes labour's consumption expenditures. Hence, the opportunity cost is higher than if consumption were excluded. This means that the shadow wage is high. At the other extreme, the goal of current employment may put the opportunity cost of labour at zero. The shadow wage will then be zero. This thesis has a positive shadow wage based on labour's estimated social marginal product.

Adjustment of labour's shadow wage is shown to change the evaluation of land tenure systems. As the shadow wage is adjusted, the relative ranking of plantations and family farms is changed. The ranking uses the internal rate of return as its criterion.

1.3 Data sources

Data on Colombian agriculture is generally poor although it has been improving recently. Colombia does not have an official and continuous set of statistics. The main statistical agency, Departamento Administrativo Nacional de Estadistica (DANE), was able to obtain sample data of crops harvested and planted for the first time in 1967. Other organisations have independently obtained estimates of crop yields and the area harvested, but often there is considerable discrepancy among the estimates. Evaluation of these estimates has been made by the Banco de la Republica and by the Agricultural Ministry's Oficina de Planamiento del Sector Agropecuario (OPSA).

Data on edible oil products is available from a number of sources. Considerable discrepancies were found particularly over the amount of edible oil produced and imported. Where data conflicted the estimates of the Ministry of Agriculture (OPSA and Minagriculture) were used. The Ministry has the most recent data with which to correct past estimates.

A statistical appendix will be attached to the thesis. This will show the source of data used in the empirical section.

Chapter Notes

1. The problems created by rising expectations are reviewed by Lauchlin Currie, "Economics and Study of Wellbeing", Simon Fraser University Working Paper, March 30, 1971. (mimeo).

2. The four countries are Colombia, Ecuador, Mexico and Venezuela. International Bank for Reconstruction and Development, "Economic Position and Prospects of Colombia" (WH-211-a), 1972. (mimeo).

3. D. Healey, "Development Policy: New Thinking about an Interpretation", Journal of Economic Literature, Vol. 10 (September 1972), p. 768.

4. "The World Bank Atlas", Finance and Development, Vol. 10 (March 1973), pp. 25-27.

5. The labour force growth rate is given by International Bank for Reconstruction and Development, Economic Growth of Colombia: Problems and Prospects, Baltimore, Johns Hopkins University Press, 1972, p. 9. For the productivity growth rate see International Labour Office (ILO), Towards Full Employment, Geneva, 1970, p. 57.

6. ILO. ibid., p. 18. The unreliability of this data is acknowledged by the ILO.

7. "Given the political restraints on land redistribution the central issue may more likely be the distribution of other factors." A. Berry "Land Distribution, Income Distribution and the Productive Efficiency of Colombian Agriculture", Yale Growth Center Discussion Paper No. 108, Yale University, March 1971, p. 25. (mimeo).

8. P. Raup, "The Contribution of Land Reforms to Agricultural Development: an Analytical Framework", Economic Development and Cultural Change, Vol. 12 (October 1963), pp. 1-21.

9. "In underdeveloped countries land is the principal source of wealth. As a result the distribution of land property rights will be the major determinant of the extent to which agricultural labour has access to that wealth." Comité Interamericano de Desarrollo Agricola (CIDA), La tenencia de la tierra y desarrollo socio-economico del sector agricola en Colombia, Washington D.C., p.iii.

10. For Colombia see A. Berry, op. cit.

11. "There seems to be adequate justification for singling out the concentration of landownership . . . as the one factor that is most responsible for the host of social and economic ills which afflict the southern part of the Western Hemisphere. In no country are the deplorable effects of the maldistribution of landownership and control more evident than in Colombia." T. Lynn Smith, Colombia: Social Structure and the Process of Development, Gainseville, University of Florida Press, 1967, p. 8.

12. "Where the conditions of landownership are equitable and provide a viable living for the peasants revolution is unlikely. Where they are inequitable, and where the peasant lives in poverty and suffering, revolution is likely if not inevitable. H. P. Huntingdon, Political Order in Changing Societies, New Haven, Yale University Press, 1968, p. 375.

13. CIDA, op. cit.

14. This is true for at least Argentina, Brazil, Chile and Guatemala. M. Sternberg, "Agrarian Reform and Employment with special reference to Latin America", International Labour Review, Vol. 95 (January 1967), p. 12. For Colombia see P. Dorner and H. Felstehausen, "Agrarian Reform and Employment, the Colombian Case", International Labour Review, Vol. 102 (September 1970), pp. 221-241.

15. ILO, op. cit. p. 71.

16. A. Berry, op. cit.

17. C. K. Laurent, "Investment in Nigerian Tree Crops: Smallholder Production", Consortium for the Study of Nigerian Rural Development, (CSNRD), No. 18, 1968.

18. The other tree crops are cocoa and rubber. Ibid.

19. R. Baldwin, "Patterns of Development in Newly Settled Regions", Manchester School of Economics and Social Studies, Vol. 24 (May 1956), pp. 161-179; also R. Baldwin, "Export Technology and Development from Subsistence Level", Economic Journal, Vol. 73 (March 1963), pp. 90-92.

20. A. Prest and R. Turvey, "Cost-Benefit Analysis: a Survey", Surveys of Economic Theory, Vol. 3, London, Macmillan, 1968, pp. 155-207.

21. "Income transfers associated with purely pecuniary external effects . . . tend in an economy where resources are inefficiently allocated to produce changes that bring about additional growth", Baldwin, "Export Technology", op. cit., p. 80.

22. "There is a surprising discrepancy between the scientific effort devoted to the subject and its practical relevance for economic project appraisal. At least this is the case when one adopts a concept of externalities which is sufficiently precise to be of any operational value." A. Gutowski and W. Hammel, "An Aid Agency's Experience with the Little-Mirrlees Method," Bulletin of the Oxford Institute of Economics and Statistics, Vol. 34 (January 1973), p. 125-135.

23. This is not to deny their importance, nor the possibility that they can be noted. For evaluation, however, those externalities which cannot be quantified must be excluded. For the externalities of tenure systems see Smith, op. cit., Chapter 2.

24. ILO, op. cit., Chapter 12.

25. H. Myint, Economic Theory and the Underdeveloped Countries, London, Oxford University Press, 1971, Chapter 5.

26. K. Griffin, "Coffee and the Economic Development of Colombia", Oxford Bulletin of Economics and Statistics, Vol. 30 (May 1968), pp. 105-127. P. Dorner and L. Felstehausen, op. cit.

27. For two studies on the landlord-tenant relationship see S. Cheung, The Theory of Share Tenancy, Chicago University Press, 1969; and P. Bardham and T. Scrinivason, "Crop-sharing Tenancy in Agriculture", American Economic Review, Vol. 61 (March 1971), pp. 48-64.

28. Among the externalities are the economic vulnerability of plantation economics and the sociological rigidity of plantations, see United Nations, Land Reform: Defects in Agrarian Structures as Obstacles to Economic Development, Department of Economic Affairs, New York, 1951 p. 21, Also Food and Agriculture Organisation, Inter-relationship between Agrarian Reform and Agricultural Development, Land Tenure Study, Rome, 1953, p. 42.

29. T. Schultz. Transforming Traditional Agriculture; New Haven, Yale University Press, 1963.

30. C. Nakajima. "Subsistence and commerical family farms: some theoretical models of subjective equilibrium"; Subsistence Agriculture and Economic Development (ed.) Wharton C. Aldine; Chicago; pp. 165-185.

31. W. Nicholls, "An agricultural surplus as a Factor in Economic Development", Journal of Political Economy, Vol. 71 (February 1963) pp. 1-29; and A. Sen, "Peasants and Dualism with and without Surplus Labour" Journal of Political Economy, Vol. 74 (October 1966), pp. 525-550.

32. The diagram but not the definitions come from I. Sachs, "Selection of Techniques: Problems and Policies for Latin America", Economic Bulletin for Latin America, Vol. 15 (January - June 1970), p. 1.

CHAPTER TWO

THE MICRO MODEL AND ITS MACRO IMPLICATIONS

Introduction

This chapter compares theoretically the impact of two land tenure systems on development. The land tenure systems are plantations and family farms. Development is defined by three development goals; consumption over time, current employment and net foreign exchange saving.

The starting point is a micro model which relates production techniques to land tenure systems. The model shows that production techniques tend to differ between tenure systems which produce the same crop. Plantations tend to use more mechanised techniques than family farms. This is indicated by higher capital-labour ratios on plantations than on family farms.

A section then provides a rationale for the three development goals postulated in this thesis. It indicates the inter-temporal and intra-temporal choices that must be made with multiple goals.

Finally, the last two sections show the impact of tenure systems on development. The indication that capital-labour

ratios differ between tenure systems is used to evaluate the impact of plantations and family farms on each of the development goals. The analysis shows that neither of the tenure systems maximises all three goals. High capital-labour ratios and plantations maximise consumption over time. Low capital-labour ratios and family farms maximise current employment and net foreign exchange saving.

The fact that neither of the tenure systems maximises all three development goals suggests a conflict. The existing tenure system may not maximise the policy-makers' particular development goal. For example, if consumption over time is the goal, plantations are the desirable tenure systems; yet the existing tenure systems may be family farms. The policy-makers will therefore attempt to replace family farms with plantations. In this thesis the policy measures are factor prices. Adjustments in factor prices are analysed for their efficacy in changing land tenure systems. The policy conclusions are shown in matrix form at the end of the chapter.

1. The Model

Introduction

To deduce the hypothesis that land tenure systems and their maximisation goals functionally determine production techniques in agriculture, two land tenure systems are assumed - the plantation and the family farm. Each tenure system differs by the objective function it maximises.

1.1 The objective function

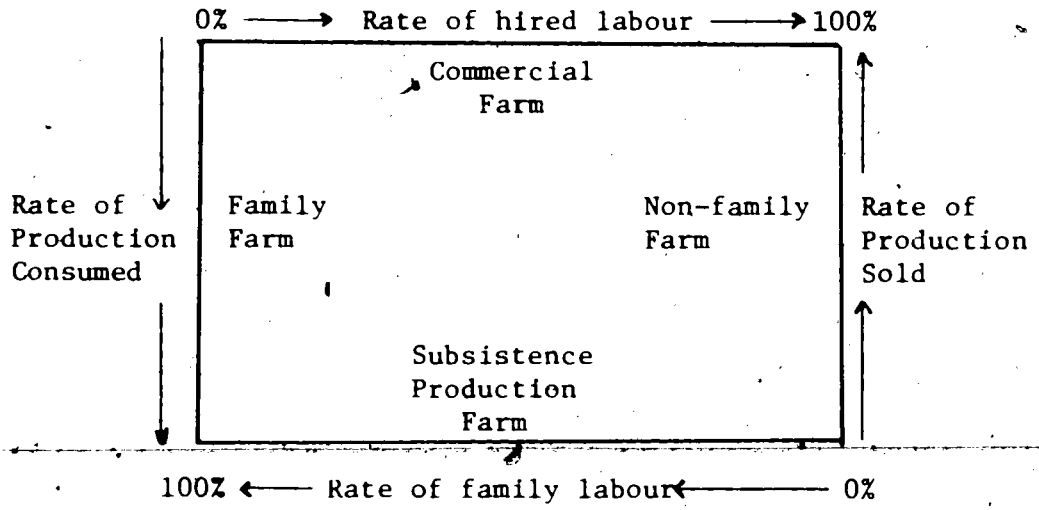
1.1.1 The plantation

The plantation is assumed to be a profit maximiser. The plantation is also assumed to be a price-taker in both input and output markets. This is a valid assumption for the majority of palm oil plantations in Colombia.[1] Accordingly, the plantation is assumed to pay factors the value of their marginal products.

1.1.2 The family farm

The essential characteristic of a family farm is that the farm employs no hired labour. All the labour is supplied by the family. The family farm can be illustrated by Figure 2.1 which comes from Nakajima.[2] The family farm occupies the left-half of Figure 2.1. As

Figure 2.1 Subsistence Farming



one moves to the left, the proportion of family labour increases

Whether the output is sold or is consumed on the farm is less important. With palm oil, the total output is sold. Hence, the palm oil unit is in the left-hand upward corner and can be designated as a commercial family farm.

The aim of the family farm is to maximise utility (U);

$$U = (X,L) \qquad (2.1)$$

where X is family income for the year and L is family labour.

The partials have the expected direction:

$$\frac{\partial U}{\partial X} > 0 \qquad (2.2)$$

$$\frac{\partial U}{\partial L} < 0 \qquad (2.3)$$

The objective function of the family farm is that of maximising total utility subject to a leisure constraint.

The utility function is constrained by a minimum income and the physiological maximum labour input, which may be the family size. The constraints can be expressed as:

$$X \geq \bar{X} > 0 \qquad (2.4)$$

$$0 \leq L \leq \bar{L} \qquad (2.5)$$

Where $\bar{X}$ refers to the level of subsistence income and $\bar{L}$ to the physiological maximum number of days labour supplied by the family.

1.2 The production function

About the production function the following assumptions are made for both tenure systems.

1. Three inputs are used; Land (N), Labour (L), and capital (K). The inclusion of capital as a separate input is contrary to usual practice particularly in family farm models. Capital is included here as a separate input in order to be able to demonstrate that the capital-labour ratio differs between the two tenure systems.

2. The production function assumes constant returns to scale with the properties; $L^{\alpha} K^{\beta} N^{\gamma}$ where $\alpha + \beta + \gamma = 1$, and the elasticity of factor substitution = 1.[3]

3. Land is fixed.

4. Capital is fixed. This assumption is relaxed later. The production function of the family farm is:

$$X_f = L_f^{\alpha} K_f^{\beta} N_f^{\gamma} \qquad (2.6)$$

where the subscript f refers to the family farm regime. The production function of the plantation is:

$$X_p = L_p^{\alpha} K_p^{\beta} N_p^{\gamma} \qquad (2.7)$$

where the subscript p refers to the plantation regime.

With the objective function which is to maximise total utility subject to a leisure constraint, the family farm will pay labour (the

family labour) the value of its AVERAGE physical product. The payment of average product to subsistence labour is an integral component of dual economy models.[4] The wage (w_f) on family farms is

$$w_f = \frac{L_f^{\alpha} K_f^{\beta} N_f^{\gamma}}{L_f} = APP_L \qquad (2.8)$$

which with land assumed fixed becomes:

$$w_f = \frac{L_f^{\alpha} K_f^{\beta}}{L_f / N_f^{\gamma}} = APP_L \qquad (2.9)$$

The plantation on the other hand is a profit-maximiser. As a price-taker, the plantation pays labour (hired labour) the value of its marginal product (MPP_L):

$$MPP_L = \frac{\partial X_p}{\partial L_p} = \alpha K_p^{\beta} L_p^{\alpha-1} N_p^{\gamma} \qquad (2.10)$$

$$= \alpha \frac{L_p^{\alpha} K_p^{\beta} N_p^{\gamma}}{L_p} \qquad (2.11)$$

The wage on plantations (w_p) therefore with land assumed fixed is:

$$w_p = \alpha \frac{L_p^{\alpha} K_p^{\beta}}{L_p / N_p^{\lambda}} \qquad (2.12)$$

The aim is to show that production techniques are determined by the objective functions of land tenure systems. The model will show that profit maximising plantations tend to have higher capital-labour (K/L) ratios than family farms who maximise total utility.

1.3 The capital-labour ratio

1.3.1 Initial wages are equal

To start the analysis two further assumptions are made both of which are relaxed later: The two assumptions are:

1. that labour costs on plantations are equal to labour costs on family farms. Hence, the MPP_L on plantations is equal to the APP_L on family farms. The labour transfer mechanism equalises factor returns.

2. that the capital constraint is not binding.

Given that:

$$APP_{L_f} = MPP_{L_p}$$

$$\text{i.e.} \quad \frac{L_f^{\alpha} K_f^{\beta}}{L_f/N_f^{\gamma}} = \alpha \frac{L_p^{\alpha} K_p^{\beta}}{L_p/N_p^{\gamma}} \qquad (2.13)$$

$$\frac{K_f^{\beta}}{L_f^{1-\alpha}/N_f^{\gamma}} = \alpha \frac{K_p}{L_p^{1-\alpha}/N_p^{\gamma}} \qquad (2.14)$$

The aim is to show that:

$$\left(\frac{K}{L}\right)_p > \left(\frac{K}{L}\right)_f$$

Since $1-\alpha = \beta + \gamma$ (by assumption 2)

$$\frac{K_f^{\beta} N_f^{\gamma}}{L_f^{\beta} L_f^{\gamma}} = \alpha \frac{K_p^{\beta} N_p^{\gamma}}{L_p^{\beta} L_p^{\gamma}} \qquad (2.15)$$

$$\left(\frac{K_f}{L_f}\right)^{\beta} = \alpha \left(\frac{N}{L_p}\right)^{\gamma} \left(\frac{L_f}{N_f}\right)^{\gamma} \left(\frac{K}{L_p}\right)^{\beta} \qquad (2.16)$$

$$\left(\frac{K_f}{L_f}\right)^{\beta} = \alpha \left(\frac{N}{L_p} \frac{L_f}{N_f}\right)^{\gamma} \left(\frac{K}{L_p}\right)^{\beta} \qquad (2.17)$$

$$\left(\frac{K_f}{L_f}\right) = \alpha^{\frac{1}{\beta}} \left(\frac{N}{N_f} \frac{L_f}{L_p}\right)^{\frac{\gamma}{\beta}} \left(\frac{K}{L_p}\right) \qquad (2.18)$$

Therefore;

$$\left(\frac{K}{L}\right)_p > \left(\frac{K}{L}\right)_f \quad \text{if} \quad \alpha^{\frac{1}{\beta}} \left(\frac{N}{L_p} \frac{L_f}{N_f}\right)^{\frac{\gamma}{\beta}} < 1$$

$$\text{or if} \quad \alpha \left(\frac{N}{L_p} \frac{L_f}{N_f}\right)^{\gamma} < 1$$

In order to forcefully bring out the difference in K/L ratios this condition can be stated as:

$$\left(\frac{K}{L}\right)_p > \left(\frac{K}{L}\right)_f \quad \text{if} \quad \alpha \left(\frac{N}{L_p} \frac{L_f}{N_f}\right)^{\gamma} < 1 \qquad (2.19)$$

$$\left(\frac{N}{L_p} \frac{L_f}{N_f}\right) < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}}$$

which simplified becomes:

$$\left(\frac{K}{L}\right)_p > \left(\frac{K}{L}\right)_f \quad \text{if} \quad \left(\frac{L}{N}\right)_f < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \left(\frac{L}{N}\right)_p \qquad (2.20)$$

Since α and γ are less than one and greater than zero; $\left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} > 1$

Equation (2.20) states that for the family farm to be more labour intensive

than the plantation, $\left(\frac{K}{L}\right)_f < \left(\frac{K}{L}\right)_p$ the labour per hectare on the family farm must be less than that on plantations by some multiple.

If the imputed rental value of land on plantations is lower than on family farms $\left(\frac{L}{N}\right)_p$ is likely to be less than $\left(\frac{L}{N}\right)_f$. The size of $\left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}}$ is therefore critical if the condition that $\left(\frac{L}{N}\right)_f < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \left(\frac{L}{N}\right)_p$ is to hold, given that $\left(\frac{L}{N}\right)_f > \left(\frac{L}{N}\right)_p$

Assume $\alpha = \beta = \gamma$ on both regimes = 0.33, then $\left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} = 27$. This means that for the plantation to be more capital intensive than family farm units, the number of men per hectare on family farms must be LESS THAN 27 TIMES the men per hectare on plantations. This condition is clearly likely to hold. Even with a Cobb-Douglas production function such substitutability between labour and land is not likely, given diminishing returns.

The smallest amount that $\left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}}$ could be is 4. This is when $\beta = 0$. Only if family farms employ four times as many, or more than four times as many, labourers per hectare than the plantation, will the condition not hold.

1.3.2. Labour costs on family farms are less than on plantations

The assumption that imputed labour costs on the family farm are less than on the plantation regime is more plausible than the earlier

assumption that they are equal. This is for two reasons:

1. Unions are strong and cohesive on plantations. They will force up labour cost on plantations.

2. It is plausible that the disutility of family farm labour is less than that of plantation labour. If $\left(\frac{\partial U}{\partial L}\right)_f > \left(\frac{\partial U}{\partial L}\right)_p$, family farm labour would be prepared to work for lower wages than the plantation worker.

Assume that wages on family farms are lower than plantation wages.

Assume that A.P.P.L. = θ M.P.P.L. where $0 < \theta < 1$

From equation 13 $$\frac{L_f^{\alpha}}{L_f} \Big/ \frac{K_f^{\beta}}{N_f^{\gamma}} = \alpha \frac{L_p^{\alpha}}{L_p} \Big/ \frac{K_p^{\beta}}{N_p^{\gamma}} \qquad (2.21)$$

$$\left(\frac{K}{L}\right)_f^{\beta} = \theta\,\alpha \left(\frac{N_p}{L_p}\frac{L_f}{N_f}\right)^{\gamma} \left(\frac{K}{L}\right)_p^{\beta}$$

$$\left(\frac{K}{L}\right)_f = (\theta\,\alpha)^{\frac{1}{\beta}} \left(\frac{N_p}{L_p}\frac{L_f}{N_f}\right)^{\frac{\gamma}{\beta}} \left(\frac{K}{L}\right)_p \qquad (2.22)$$

$\left(\frac{K}{L}\right)_f < \left(\frac{K}{L}\right)_p$ if $(\theta\,\alpha)^{\frac{1}{\beta}} \left(\frac{N_p}{L_p}\frac{L_f}{N_f}\right)^{\frac{\gamma}{\beta}} < 1$

$$\frac{N_p}{L_p}\frac{L_f}{N_f} < \left(\frac{1}{\theta\,\alpha}\right)^{\frac{1}{\gamma}}$$

$$\frac{L_f}{N_f} < \frac{L_p}{N_p}\left(\frac{1}{\theta\,\alpha}\right)^{\frac{1}{\gamma}}$$

Since $\theta < 1$ $$\left(\frac{1}{\theta\,\alpha}\right) > \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \qquad (2.23)$$

Equation (2.23) reinforces the earlier conclusion reached when the cost of labour was the same on the two tenure systems. The inequality shows that the family farm must have an even higher labour-land ratio relative to the plantation, (higher than the previous section) for the condition not to hold. If the inequality holds the hypothesis is validated, i.e. that $\left(\frac{K}{L}\right)_p > \left(\frac{K}{L}\right)_f$.

1.3.3 The capital constraint is binding

This section aims to answer the question whether the capital constraint could so restrict plantation regimes that they could not apply the more capital intensive production techniques. This is a possibility when the capital constraint is binding.

The capital constraint of the family farm regime is the credit that is available. This amount will be determined by the collateral which for the family farm is land.

$$K_f \leq \lambda N_f \quad \text{where} \quad 0 < \lambda < 1 \qquad (2.24)$$

The capital constraint at time t of the plantation regime is some proportion of the value not only of land but also of capital assets such as machinery.

$$\dot{K}_{pt} \leq \psi \left(\frac{\partial X}{\partial K_p} K_{p_{t-1}} + \frac{\partial X}{\partial N_p} N_p \right) \qquad (2.25)$$

Credit and investment at time t (K_{pt}) is a function of the capital stock and land. As the constraint is reached the maximum feasible investment

$(\dot{K}^*)$ becomes:

$$\dot{K}^* = K_{pt-1} = K_t$$

Then equation (2.25) can be re-written:

$$K_{pt} = \psi \left(\frac{\partial X}{\partial K_p^p} K_{pt} + \frac{\partial X}{\partial N_p^p} N_p \right) \qquad (2.26)$$

Since the capital constraint takes account of capital as well as land, the proportion of credit available to plantations will tend to exceed that available to family farms, i.e.

$$\psi > \lambda$$

Substitution of equation (2.28) into the production function yields

$$K_{pt} = \psi \left(\beta \frac{X}{K_p^p} K_{pt} + \gamma \frac{X}{N_p^p} N_p \right) \qquad (2.27)$$

which reduces to:

$$K_{pt} = \psi X_p (\beta + \gamma)$$

Assuming that $\frac{K_f}{L_f} < \frac{K}{L_p^p}$ then: $\frac{K_f}{K_p^f} < \frac{L_f}{L_p} \qquad (2.28)$

Since, from equation (2.20) it is true that

$$\frac{K_f}{L_f} < \frac{K}{L_p^p} \quad \text{if} \quad \frac{L_f}{N_f^f} < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \frac{L}{N_p^p}$$

Then

$$\frac{L_f}{L_p} < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \frac{N_f}{N_p}$$

Since $\frac{K_f}{K_p} < \frac{L_f}{L_p} < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \frac{N_f}{N_p}$ if the capital constraint is binding for both tenure systems equations (2.24) and (2.28) can be substituted into $\frac{K_f}{K_p}$ to yield:

$$\frac{\lambda N_f}{\psi X_p (\beta + \gamma)} < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \frac{N_f}{N_p}$$

Therefore

$$\frac{\lambda}{\psi} < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \frac{X}{N_p} (\beta + \gamma) \qquad (2.29)$$

Since $\left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}}$ is a large number and $\psi > \lambda$, it is likely that $\frac{\lambda}{\psi} < \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} \frac{X}{N_p} (\beta + \gamma)$. Hence, it is possible for $\left(\frac{K}{L}\right)_p > \left(\frac{K}{L}\right)_f$ with a capital constraint.

Conclusion

The model has shown using comparative static analysis that land tenure systems and their maximisation goals determine agricultural production techniques. For the same crop, plantations will tend to use higher capital-labour ratios than family farms. The reason lies in the objective functions. If family farms maximise total output they will pay labour according to its average product, whereas plantations, being profit maximisers, pay labour

their marginal product.

Chapter Five will indicate how distortions in the Colombian factor market can reinforce the higher capital-labour ratios on plantations.

2. Development Goals

Introduction

Plantations and family farms cannot be evaluated socially until the goals of the policy-makers are known. Only when these goals are known can criteria and shadow prices be determined.[5]

Traditionally, the development goal attributed to the policy-makers has been economic efficiency which is concerned with potential Pareto improvements.[6] An increase in economic efficiency occurs when redistribution of gains can more than compensate those who suffered a loss of economic welfare. The criterion is cost-benefit analysis.

One deficiency of economic efficiency and cost-benefit analysis is that redistribution is only assumed to occur. Cost-benefit analysis merely shows that with a positive sum costless redistribution can make everyone better off. It does not imply that such redistribution will actually take place.[7] The assumption that redistribution will occur in developing countries is perhaps unrealistic.[8] The unrealistic assumption detracts from the relevance of economic efficiency as a development goal.[9]

A second deficiency of economic efficiency as a development goal

is its static properties. This is linked with its failure to explicitly include distribution effects. Development is a dynamic process and may be retarded by maximising static goals.[10] Mechanisms which are disequilibrating can be important. Pecuniary externalities for example are excluded on theoretical grounds although these may be the very essence of development.[11]

To take account of these deficiencies, three alternative development goals are postulated. The three goals are consumption over time, current employment and net foreign exchange saving. The first two goals explicitly incorporate distribution effects. The rationale is that distribution effects directly determine development. The goal of net foreign exchange saving indirectly incorporates distribution through linkages.

The three goals will involve the policy-makers in a choice. The choice has at least two dimensions. Firstly, there is a choice of time horizon for maximising the same goal. Secondly, there is a choice between maximising two goals in the same time horizon. This is an intra-temporal choice. Both dimensions are illustrated by the three goals.

As noted in Chapter One, Colombia is constrained by a high population growth rate. The economy cannot absorb the labour force, so that "effective unemployment" is high and also growing. The high and growing level of unemployment presents a choice of time horizon; policy-makers must choose whether to adopt a short time horizon or a longer time horizon. The former is implied by maximising current employment, the latter by the goal of consumption over time. A choice is necessary if the two goals conflict.

Intra-temporal choice is incorporated by the goal of net foreign exchange saving. If either current employment or consumption over time conflict with net foreign exchange saving, there may be a choice of goals within the same time horizon.

This thesis will illustrate the choice of goals and time horizons by comparing production techniques and land tenure systems. It is recognized that changing the output-mix may ease conflicts between goals. This is Currie's partial solution for Colombia.[12] Yet if factor substitutability exists a choice between production techniques still is necessary.

2.1 The objective function[13]

2.1.1 Consumption over time

The purpose of economic development is to raise the standard of living. One indicator of the standard of living is per capita consumption. Per capita consumption may be maximised currently or at a distant point in time. The intertemporal distribution depends on the social discount rate. This can be seen in Figure 2.1.

Figure 2.1 The Conflict Between Maximising Present as Against Future Consumption

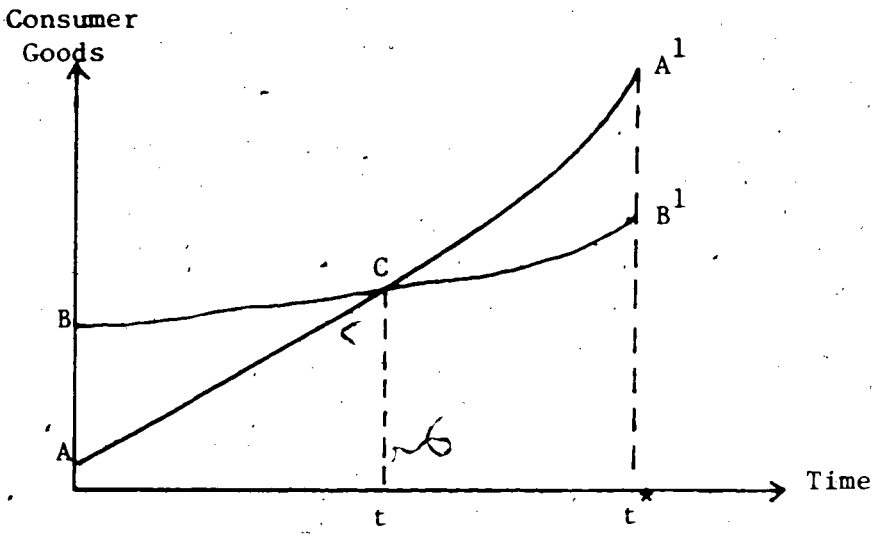


Figure 2.1 shows two production techniques (A and B) producing consumer goods over time. Both techniques involve the same outlay. Technique B has the larger immediate output of consumer goods, but a lower rate of growth of output, whereas technique A has a higher rate of growth, but smaller immediate output. When a conflict does exist, as in figure 2.1 the problem is whether to select technique A or B. B is superior until time t^* in Figure 2.1, when the net benefits of its larger immediate output (shown by the area ABC), are offset by the net benefits later of technique A (shown by the area A'B'C). If time preference and the social discount rate are higher than some breakeven point say ro, technique B will be selected. At discount rates below ro, technique A has the higher net present value, and hence technique A would be selected. What discount rate and production technique is selected depends on the development goal.

If consumption is to be maximised at a distant point in time the

social discount rate is low. Policy-makers may have a long time horizon because per capita consumption is not expected to increase in the future. If the elasticity of marginal utility is negative, the social rate of discount varies directly with the rate of growth of per capita consumption. Hence, an economy whose population growth prevents per capita consumption from increasing will have a low social discount rate.

Even with rising per capita consumption a low discount rate may be justified. A low discount rate is justified if the economy cannot employ the available labour force, and if the elasticity of marginal utility with respect to employment approaches zero.[14] If the concept of diminishing marginal utility is not applicable to employment, inability to employ the labour force may justify a low discount rate even with rising average per capita consumption. The absence of diminishing marginal utility with employment may require that a higher relative weight be given to future as against current employment than to future as against current per capita consumption.

2.1.2 Current employment

There are a number of reasons why employment would be a development goal.[15] One of the most important is that unemployment is a cause of poverty in developing countries.[16] Generating employment, particularly of unskilled labour, can be a policy to reduce poverty. Moreover, if fiscal measures cannot redistribute income, generating employment may be the only redistributive policy available. In developing countries, disillusionment with poverty has led to wider acceptance of employment as

a development goal.[17]

The emphasis on employment is on current rather than long-run employment, and on high rather than low discount rates. This suggests adoption of technique B in Figure 2.1. Maximising current employment and high social discount rates may be rational in developing countries.[18] Firstly, per capita consumption and employment may be rising rapidly. Secondly, time preference may be short because of uncertainties that deter long-term planning. Total utility decreases more by a project's failure than it increases by a project's success; hence, the cost of failure may justify long-term planning only when risks are known. Thirdly, uncertainties may make the contribution of present sacrifices insignificant. With, for example, the discovery of oil a country can grow wealthy independently of its present sacrifices. Finally, income inequalities and high unemployment may threaten political and social stability.[19] The policy-makers may be prepared to sacrifice a higher growth rate of output and employment if social unrest can be avoided.

2:1.3 Net foreign exchange saving

Import substitution policies have created problems in developing countries.[20] Yet they may be the only way of meeting the foreign exchange shortage faced by many developing countries. If export earnings cannot be increased import substitution policies may reduce foreign exchange needs.

The shortage of foreign exchange tends to arise because export

earnings cannot be increased and import needs remain unsatisfied.[21] In developing countries, the unsatisfied import need may result in higher unemployment. Initially, import substitution tends to concentrate on consumer goods because they already have a market. Yet to manufacture consumer goods, capital goods are necessary and the market may not be large enough to support their domestic production. So capital goods must be imported. Since the consumer goods sector is dependent on capital goods a certain minimum of imports is necessary. Without these imports, domestic resources in the consumer goods industry cannot be fully employed.

Net foreign exchange saving is included as a development goal for two reasons. Firstly, as shown above, a shortage of foreign exchange may impede full employment. Secondly, the palm oil industry in Colombia was established explicitly to save foreign exchange.[22]

2.2 The problem of weighting

An objective function with multiple goals poses the problem of weighting. This is a problem of specifying and quantifying the relative importance of the goals. The weights must be known before resources can be allocated.

To solve the problem of weighting a number of methods have been advocated.[23] One method would rank goals by lexicographic ordering with economic efficiency as the dominant goal. If economic efficiency is not relevant as a goal to underdeveloped countries this method is inapplicable.

Another would rely on explicit statements of polity-makers or would infer weights from analysing past choices. However, policy-makers are unlikely to state the weights they attach to different goals. Nor is it necessarily plausible to infer future weights from analysing past choices. Another method is to regard certain goals as constraints. The deficiency of this method lies in deciding which goals are constraints.

The method used in this thesis is to assume weights of either zero or unity for each of the development goals. Plantations and family farms will be evaluated by only one goal at a time; weights on the other goals will be zero.

The advantage of this method is that the costs and benefits of plantations and family farms can be explicitly demonstrated. If neither tenure regimes dominates by all three development goals adoption of either of the regimes involves a cost. By evaluating each tenure regime against each of the development goals this cost can be demonstrated.

Both current employment and net foreign exchange saving could have been placed as constraints on the objective function. The disadvantage of this method is that some weight would have to be assigned to the constraints. Implicit in specifying the constraint level is the marginal weight of the constraint to the other objectives. Until the constraint is satisfied, it has a high weight and after it is satisfied, the constraint has a weight which reflects the cost of achieving it.

The purpose of this thesis is not to assign weights; it is merely to show that certain tenure systems may be undesirable by some

development goals. Hence, any weighting would be superfluous as well as arbitrary. In addition, the weighting would fail to explicitly demonstrate the costs and benefits of plantations and family farms.

2.3 Intra-temporal conflict between goals

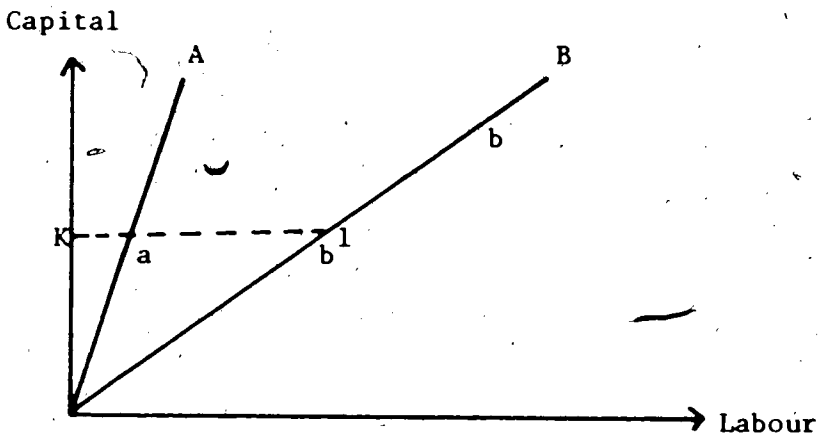
Development goals may not be mutually consistent at a point in time or over time. The problem of inter-temporal conflicts has been demonstrated with the social discount rate. This section aims to demonstrate how intra-temporal conflicts can occur.

2.3.1 Conflict between current output and current employment

A conflict between maximising current output and current employment may arise with L-shaped isoquants. Neoclassical assumptions of factor substitution obviate conflicts because of continuous convex isoquants. Relative factor prices can be adjusted to attain full employment and maximum output. As long as factor substitution exists both current employment and output can be maximised.[24]

A conflict may arise once coefficients are fixed. The conflict is illustrated in Figure 2.2, Two production techniques are shown. Technique A is mechanised farming, technique B is non-mechanised farming. With the two techniques output at a and b are the same. Output

Figure 2.2 The Conflict between Current Output and Employment



at b^1 is less than at b. If the economy is limited to a capital input of K, a conflict occurs. Output is maximised at a since a is greater than b^1. However, employment is maximised at b^1. Hence, output maximisation requires technique A whereas employment is maximised with technique B.

The conflict occurs with a divergence of capital-output and capital-labour ratios. It occurs when production techniques with low capital-labour ratios have high capital-output ratios. Its relevance has been confirmed by the empirical studies of production techniques.[25]

2.3.2 Conflict between net foreign exchange saving and consumption over time

A potential conflict exists between maximising net foreign exchange saving and consumption over time. The conflict may arise because production techniques which maximise consumption over time have high

import coefficients.

Projects with high import coefficients can still maximise net foreign exchange saving. High import coefficients may be more than offset by large savings of foreign exchange. If the capital-output ratio is low and the demand schedule elastic, large savings of foreign exchange can compensate for imported capital. The net foreign exchange saved may be large. However, unless revenues compensate, high import coefficients will tend to reduce net savings. The result would be a conflict between net foreign exchange and consumption over time.

3. Development Goals and Land Tenure Systems

Introduction

The micro model demonstrated that plantations tend to adopt production techniques which have higher capital-labour ratios than those used on family farms. The immediately preceding section presented a rationale for defining development in terms of consumption over time, current employment and net foreign exchange saving. This section intends to connect capital-labour ratios with the three development goals. The effect of different capital-labour ratios on the three goals will be examined. Indirectly, because of the relationship between capital-labour ratios and plantations and family farms the effect of the two tenure systems on development will be examined.

This section will also analyse how changes in relative factor

prices will influence capital-labour ratios and through them, land tenure systems. Policy-makers may be unable to redistribute land directly, but may be able to influence land tenure systems indirectly through factor price adjustments.

3.1 Consumption over time

The preceding section suggested some reasons why policy-makers would wish to maximise consumption over time and have low social discount rates. It is the intention now to show which land tenure regime is most efficacious in maximising this goal.

3.1.1 Capital-labour ratios

Among the earliest models to recognise the conflict between present and future consumption is that of Galenson and Leibenstein.[26] Their model aimed to maximise the rate of per capita consumption at some point in time (say To). Capital accumulation would be maximised until To with no regard to consumption before or after To. With this maximand and an assumed saving function that savings out of wages are zero and out of profits are unity, the model aimed to maximise the amount of surplus per unit of capital. Maximising the amount of surplus per unit of capital will result in maximising capital accumulation at time To, and hence consumption over time.[27]

In the model an increase in the share of income going to labour reduces the rate of capital accumulation and hence the level of per capita consumption at time To, because of the neo-classical saving function. To

generate the maximium rate of capital accumulation wage employment is therefore minimised. The result upon production techniques is to bias selection in favour of mechanised techniques (high capital-labour ratios) rather than non-mechanised techniques.

Even with a less extreme neo-classical saving function than the Galenson - Leibenstein saving function, maximising the amount of surplus is critical in maximising consumption over time. The amount of surplus will clearly depend upon the rate of saving.

If the level of employment (L) is used as a proxy for consumption, the growth rate of employment (and hence consumption over time) will be maximised with higher savings. Using K = capital and i for the capital-labour ratio.

$$L = \frac{L}{K} K = \frac{K}{i} \qquad (2.30)$$

$$dL = \frac{dL}{dK} dK = \frac{dK}{i'} \text{ where } i' = \frac{dK}{dL} \qquad (2.31)$$

The growth rate of employment (and consumption) is:

$$\frac{dL}{L} = \frac{dK}{K} / \frac{i'}{i} \quad \text{where} \quad \frac{i'}{i} = \frac{dK}{dL} / \frac{K}{L} \qquad (2.32)$$

Assuming a neo-classical saving function such that:

$0 \leq Sw < S\pi \leq 1$. where Sw is the propensity to save out of wages and $S\pi$ the propensity to save out of profits.

Capital accumulation is a function of savings where K is capital

and Y is income

$$dK = sY = \left(Sw + (S\pi - Sw) \frac{\pi}{Y} \right) Y \qquad (2.33)$$

and the rate of capital accumulation :

$$\frac{dK}{K} = \left(Sw + (S\pi - Sw) \frac{\pi}{Y} \right) \frac{Y}{K} \qquad (2.34)$$

Simplifying using the output-capital ratio $(1/V = \frac{Y}{K})$ equation (2.34) can be written:

$$\frac{dK}{K} = \frac{Sw}{V} + (S\pi - Sw) \frac{\pi}{K} \qquad (2.35)$$

Equation (2.35) can be substituted into equation (2.32) to yield:

$$\frac{dL}{L} = \left(\frac{Sw}{V} + (S\pi - Sw) \frac{\pi}{K} \right) / \frac{i'}{i} \qquad (2.36)$$

Equation (2.36) states that with higher capital-labour ratios the growth of employment and consumption over time is maximised when savings out of surplus are maximised. If the capital-output ratio is constant, the rate of capital accumulation is maximised by maximising savings out of surplus. Higher capital-labour ratios can lead to higher consumption over time even with rising capital-output ratios if there is a sufficient increase in savings.[28] This may occur for example with rising output-labour ratios.

Given the conclusions of the micro-model, plantations are the desirable tenure system when the development goal is consumption over time.

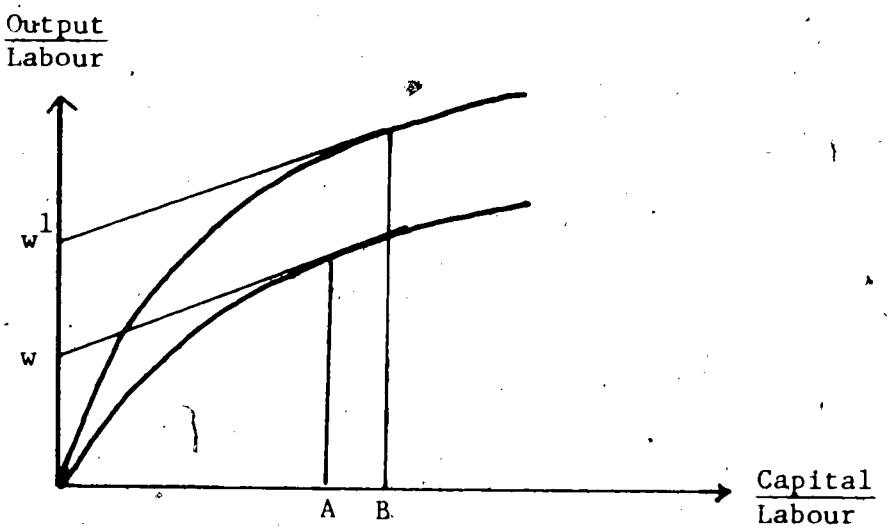
Plantations tend to have higher capital-labour ratio than family farms. If it is assumed that the propensity to save out of profits is higher than out of wages, plantations will maximise consumption over time.

3.1.2 Factor price adjustments

The capital-labour ratio is positively related to the wage-rental ratio (w/r), i.e. $K/L = R(w/r)$ where the partial derivative with respect to w/r, R^1 is > 0. To raise the capital-labour ratio either the cost of labour (w) may be raised or the cost of capital (r) reduced.

To raise the cost of labour either money wages or fringe benefits can increase. Capital will be substituted for labour and the capital-labour ratio will rise. The effect can be seen in Figure 2.3. Harrod neutral technical change is shown as wage rates rise from OW to OW^1. The increase in wage rates will produce higher capital-labour ratios as wages

Figure 2.3 The Effect of Raising the Cost of Labour on Production Techniques



rise from OW to OW^1. The increase in wage rates will produce higher capital-labour ratios from A to B as capital is substituted for labour. If savings rose, the effect would be an increase in the employment growth rate. The output-capital ratio has remained constant in equation (2.36) and yet savings have risen. Consumption over time would increase.

The effect of higher wages on agricultural production techniques will therefore be to raise capital-labour ratios. Mechanised techniques will be adopted to substitute for the money wage. The same effect would be felt if social legislation gave employees more generous fringe benefits. The cost of labour is increased and mechanised techniques become relatively more profitable.

In addition to stimulating mechanised techniques the government has a further objective when its development goal is consumption over time, the government also wants to encourage plantations rather than family farms. When consumption over time is the development goal, plantations are the desirable land tenure system since, as the micro model showed, plantations tend to have higher capital-labour ratios than family farms. Raising the cost of labour may, however, adversely affect plantations relative to family farms.

Plantations may be adversely affected if their cost of labour is raised relatively to the cost of labour on family farms. The cost of labour can be raised either by higher money wages or by increasing fringe benefits. As the micro model showed family farms pay labour according to its average product. Higher money wages will not cause the average product on family farms to increase. Higher money wages may,

therefore, only raise the cost of labour on plantations. Similarly, fringe benefits only apply to hired labour; hence, increasing fringe benefits will only raise plantation labour costs.

The result may be to increase unit costs on plantations as capital is substituted for labour. If the two tenure regimes are in equilibrium, family farms may gain a competitive advantage. The share of output which is generated from plantations may fall and the share generated from family farms rise. This is contrary to the government's land strategy when it wishes to maximise consumption over time.

An alternative and preferable policy measure to raise capital-labour ratios is a reduction in the cost of capital.[29] Lowering the cost of capital will clearly stimulate substitution of capital for labour and adoption of mechanised techniques. An additional policy measure is to make credit more readily available to purchase capital goods that displace labour.

Plantations as the desirable land tenure system could be favoured by selective credit controls. The cost of credit could be lower for plantations or for the purchase of tractors and farm machinery. If the lower cost of capital inputs were unavailable to family farms, plantations could gain a competitive advantage.

3.2 Current employment

To maximise current employment, low capital-labour ratios would be adopted. In agriculture this means that non-mechanised techniques are

desirable. In addition, family farms will be favoured. Family farms tend to use production techniques which have lower capital-labour ratios than the techniques on plantations. Policy measures will be designed, therefore, to support family farms rather than plantations and non-mechanised rather than mechanised techniques.

3.2.1 Factor price adjustments

To induce selection of non-mechanised rather than mechanised techniques either the cost of labour could be reduced or the cost of capital raised.

A reduction in the cost of labour would have the desirable effect of inducing non-mechanised techniques through the substitution of labour for capital. However, its effect on tenure systems may be less desirable. The principal beneficiaries may be plantations rather than family farms. The cost of labour can be reduced by providing subsidies or by legislating fewer fringe benefits. In both cases family farms will be unaffected. Family labour is outside the labour market. Subsidies and fringe benefits apply exclusively to hired labour. The result will be lower labour costs on plantations, but constant labour costs on family farms. If prior to the labour cost reduction, the two tenure systems were in equilibrium, the relatively lower cost on plantations will provide them with a competitive advantage. Yet plantations are not the desirable land tenure system.

An alternative is to decrease the wage-rental ratio by raising the cost of capital. Higher capital costs would produce lower capital-

labour ratios as non-mechanised techniques were adopted. It would have a neutral effect on tenure regimes. The relative position of family farms and plantations would remain unchanged. Only if selective controls were introduced would the relative position change. If, for example, credit were cheaper to family farms than to plantations, family farms would gain a competitive advantage. In equation (2.29) λ would be reduced less than ψ. If the constraint is binding it is possible that the inequality of the equation will not be met.

3.3 Net foreign exchange saving

Introduction

In an earlier section of this chapter, consumption over time was shown to be a function of domestic savings. Domestic savings generated output growth through capital accumulation. However, constraints may prevent savings from generating output growth, and one constraint is the foreign exchange shortage. An economy constrained by foreign exchange can increase domestic saving and yet not generate output growth. In such an economy additional savings may not increase consumption over time.

A foreign exchange model has been developed for Colombia by Vanek.[30] The model yields pessimistic conclusions for the growth potential of domestic savings. In Vanek's model generating additional saving will achieve little, if any, increase in the growth rate of output.

However, Vanek's model is deficient in two respects. Firstly,

the model does not allow for change in output-mix that will lower import coefficients.[31] Secondly, Vanek assumes fixed coefficients. The capital-output, capital-labour ratios are assumed fixed. Once substitutability is permitted a more optimistic view emerges. Domestic savings enable domestic goods to be substituted for imports, and wage-rental adjustments produce reductions in import coefficients. The result is a more positive view towards domestic savings, and a more constructive role for factor price adjustments.

3.3.1 Fixed coeffients

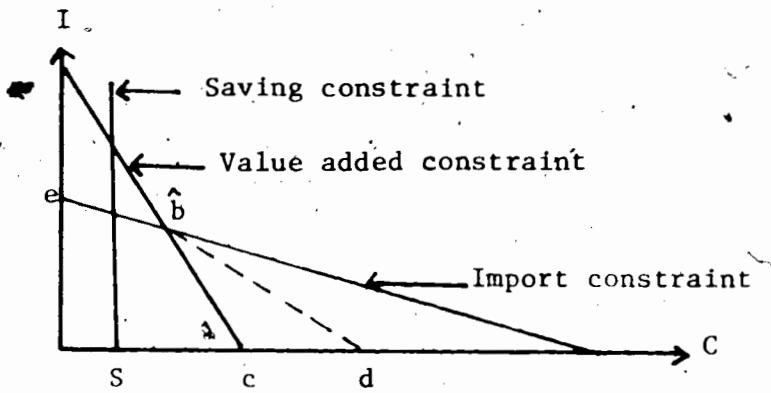
In Vanek's model there are four activities, and all four require imported inputs. The four activities are: domestic production of investment (I_D); direct imports of investment goods (I_M); domestic production of consumer goods (C_D); and direct imports of consumer goods (C_M). I and C refer to investment and consumption, and the subscripts D and M to domestic production and imports respectively. In matrix form this can be written:

		Activities			
		I_D	I_M	C_D	C_M
Output	I	1	1	0	0
	C	0	0	1	1
Input	M	a_1	1	a_2	1
	V	b_1	0	b_2	0

The column headings are the four activities. The first two rows are the output of investment goods; I and C. The last two rows stand for inputs of imports, M and of domestic inputs, V (for value-added).

Diagramatically, the consumption-investment opportunities are shown by Figure 2.4. The axes show investment, I and consumption, C.

Figure 2.4 The Three Constraints



The slopes are given by the following assumptions from the matrix above:

$$a_1 > a_2 > 0$$

$$b_2 > b_1 > 0$$

which states that investment goods production is more import intensive than than consumer goods production, and that the converse is the case for domestic inputs. Hence, for a given amount of foreign exchange, more consumer goods than investment goods could be produced which gives the slope of the import constraint function. Conversely, for a given volume

of domestic inputs more investment goods could be produced than consumer goods which gives the slope of the value added constraint.

The import and value added constraints can be written:

$$M \geq a_1 I_D + a_2 C_D + I_M + C_M \qquad (2.37)$$

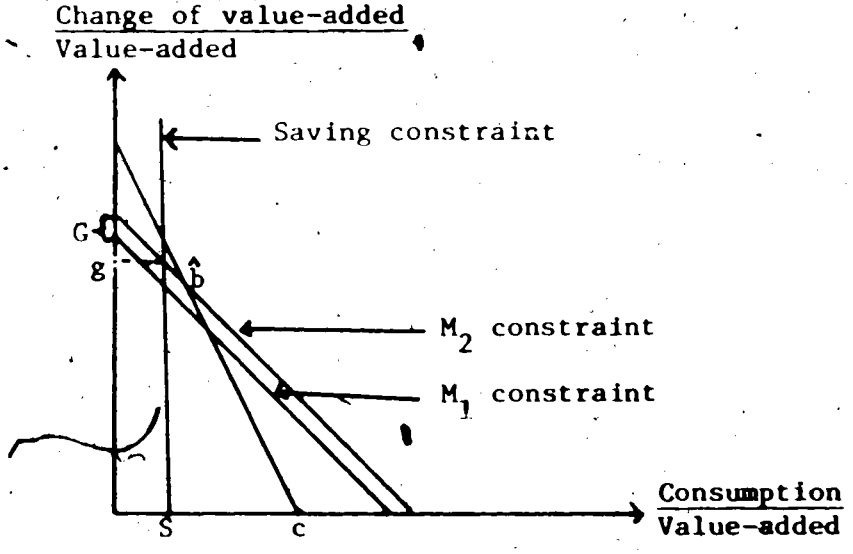
$$V \geq b_1 I_D + b_2 C_D \qquad (2.38)$$

The saving constraint shows the minimal level of consumption. Savings cannot be increased by shifting the saving schedule to the left.

The economy is limited to operate to the right of the savings constraint and to below the two input constraints; to the frontier e- $\hat{b}$- d. The economy is able to operate along $\hat{b}$ - d rather than along $\hat{b}$ - c, because of the direct imports of consumer and investment goods, C_M and I_M.

Since Vanek's model assumes a constant capital-output ratio, hence the increase in value added will be proportional to investment. Dividing through by value added gives the axes of Figure 2.5. The value

Figure 2.5 The Exchange Gap



added constraint becomes a constant. The two remaining constraints, the saving and the foreign exchange constraints, are the two constraints of concern to Vanek.

Vanek assume that the saving constraint is to the left of b. Because of this the model obtains pessimistic conclusions about the efficacy of domestic savings in accelerating the rate of growth of output. To the left of $\hat{b}$, an increase in saving by shifting the saving constraint to the left, has less of an impact in accelerating the growth rate of output (Δ V/V) than if the saving constraint were to the right of $\hat{b}$. This can be seen from the slopes of the value added and import constraint schedules. Hence, attempts to generate savings by high capital-labour ratios and by encouraging plantations, will increase the growth rate, but only at a high cost in current consumption. Generating savings and increasing the investment rate can only occur at the expense of current consumption, and with the assumption that $a_1 > a_2$ additional investment will bring a proportionately larger fall in consumption expenditures. A position to the left of $\hat{b}$ presents a pessimistic view of attempts to increase consumption <u>over time</u> by raising capital-labour ratios.

The same conflict can be expressed in terms of employment. Vanek's model has a conflict between maximising current employment and maximising the growth rate of employment. Because of the condition that $a_1 > a_2$ investment goods production is less domestic labour-intensive than consumer goods production. An increase in investment, and hence ultimately an increase in the growth rate of employment, will mean that not all labour displaced in consumer goods production will be re-employed

in investment goods production. Unemployment must rise.

Vanek attempts to estimate the Colombian foreign exchange gap. The gap is the increase in imports necessary to achieve a given growth rate. The constraints are similar to those shown in Figure 2.5 with the savings constraint to the left of $\hat{b}$. If g represents the target growth of output and the original import constraint were M_1, an increase in foreign exchange of G would be necessary to meet the exchange "gap". As can be seen from the diagram, a large leftward shift in the savings constraint would be necessary (if indeed it is possible given that a subsistence level of consumption exists) to achieve g. In the Vanek model, if the savings constraint is to the left of $\hat{b}$, an increase in import capacity (as through foreign assistance) is more efficacious than an increase in domestic savings in generating growth of output.

Because the Vanek model assumes zero substitutability among inputs the model offers little scope for domestic "bootstrap" strategies of development. From the perspective of this thesis, the assumption of zero substitutability precludes the possibility of altering production techniques and land tenure systems by adjusting factor prices. Accordingly, the following section will modify the exchange gap model by allowing greater substitutability, and arrive at less discouraging conclusions.

3.3.2 Variable coefficients

The following simplifying assumptions are made:

1. A Cobb Douglas production function is assumed with all

marginal products positive.

2. The capital-labour ratio is the same in both consumer and investment activities.

3. There are two domestic inputs, labour (L) and capital (K), and imports (M).

4. Using the earlier notation $a_1 > a_2 > 0$.

From these assumptions, a number of relationships can be derived, with factor prices as the independent variables. Their inclusion in the Nelson model enables governments to adjust factor prices and hence the foreign exchange gap.[32]

The capital-labour ratio is a positive function of the ratio of money wages to exchange rate and a negative function of the equilibrium rate of return on capital (r).[33]

$$\frac{K}{L} = C\left(\frac{w}{E}, r\right) \quad \text{where} \quad \frac{w'}{E} > 0 \qquad r' < 0 \qquad (2.39)$$

If the exchange rate is assumed fixed, the relationship merely states that the capital-labour ratio is positively related to the wage-rental ratio.

The import constraint equations can be shown as

$$\frac{M}{I} = a_1 (w/E, r) \quad \text{where} \quad w/E' > 0, \; r' > 0 \qquad (2.40)$$

$$\frac{M}{C} = a_2 (w/E, r) \quad \text{where} \quad w/E' > 0, \; r' > 0 \qquad (2.41)$$

and where $a_1 > a_2$ from assumption four. Equations (2.40) and (2.41) state that import intensity in consumer and investment activities is positively related to w and r, and negatively related to E. Both r and w will affect the price of capital goods produced at home, and therefore the cost of substituting domestic inputs for imports.

Both Vanek's model, and Nelson's model, show that if Colombia is constrained by foreign exchange, techniques which require fewer imports are preferable. In turn the constraint implies that techniques which have low capital-labour ratios are preferred. By the assumption $a_1 > a_2$, M/I > M/C so that capital goods have a higher import coefficient than consumer goods.

The implications are that the land tenure system with the higher capital-labour ratio will be less favoured in a foreign exchange constrained economy. When the capital-labour ratio is high, as on plantations rather than family farms, capital may either be directly imported (Im) or produced domestically with high import coefficients (aI_D). On plantations the higher capital-labour ratio is the result of mechanical techniques. When the techniques are produced domestically M/I is high, or when directly imported (Im), the constraint moves to the left. Family farms on the other hand have lower capital-labour ratios. Not only are direct imports fewer but the import coefficient is less. With the lower capital-labour ratio the demand for consumer goods will increase and M/C < M/I.

Unlike Vanek's model, Nelson's neo-classical model enables the government to adjust factor prices in order to change capital-labour ratios and land tenure systems. The increase in factor substitutability modifies the pessimistic conclusion of Vanek. The foreign exchange

constraint can be shifted out by a decrease in w/E or in r. The capital constraint can be shifted out by a decrease in w/E or an increase in r. Factor substitutability gives a greater scope to domestic savings and to domestic bootstrap strategies.

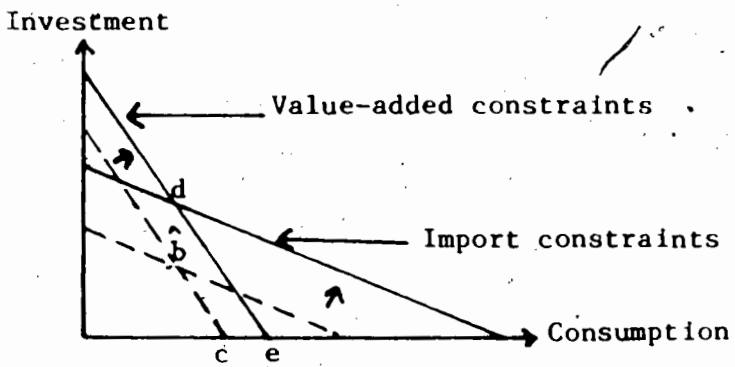
3.3.3 Factor price adjustments

In Nelson's model the three policy variable are 1) the cost of labour (w), 2) the exchange rate (E), and 3) the cost of capital (r). Adjustments of the factor prices can influence capital-labour ratios and hence the land tenure arrangements.

Decreases in both w and r and an increase in E will reduce import coefficients (from equations 2.40 and 2.41) and therefore shift out the import constraint. To shift out the capital constraint either w must fall or r must rise. The effect will be a fall in the capital-labour ratio, and an improvement in the competitive position of family farms.

The effect of a fall in the cost of labour (w) can be analysed using Figure 2.6 below. Assume an initial equilibrium at b. A fall in the

Figure 2.6 Effects of a Fall of Money Wages



money wages will encourage substitution of labour for capital and decrease the capital-labour ratio. The capital constraint will similarly shift out. The result is that both the capital-labour ratio, and the import intensity of domestic production, are reduced. The new equilibrium will be at d. A lowering of money wages will therefore produce higher employment and more consumption and growth. Once substitutability is allowed among factors, the pessimistic conclusions of Vanek are modified. On the one hand, there is less conflict between maximisation of current employment and output growth. On the other hand, the growth rate of output rises purely through domestic forces. There has been no increase in foreign assistance and yet output growth has risen.

Vanek's model is similarly modified when r falls. Vanek's model was pessimistic about increasing growth rates by generating savings. A fall in r, as equations (2.39) - (2.41) show, results in a higher capital-labour ratio and a fall in import intensity. If the initial equilibrium were at $\hat{b}$ in Figure 26 the capital constraint would shift leftward while the import constraint would shift to the right. The new equilibrium would result in higher savings, higher investment rates and faster growth.

A government attempting to lower capital-labour ratios in agriculture could raise E instead of lowering w. The effect on the import constraint would be the same. From equations (2.39) - (2.41) the import constraint would shift out as M/I and M/C fell. Raising E, however, may be less effective than a fall in w in lowering capital-labour ratios. Not all capital is imported or has high import coefficients.[34] The wage-rental ratio may not fall by as much as a direct adjustment of w, and so the capital-labour ratios may not fall by as much. Hence, to obtain a fall in

capital-labour ratios in a foreign exchange constrained economy, a fall in the cost of labour is perhaps preferable to an increase in the exchange rate. An increase in the cost of capital (r) would lower capital-labour ratios. However, an increase in r would shift the import constraint to the left.

To raise capital-labour ratios E would be lowered. The effect would be identical to a decrease in r in raising the capital-labour ratio and shifting the capital constraint to the left. However, unlike a decrease in r, a fall in E would increase M/I and M/C, and shift the import constraint to the left. Hence, raising capital-labour ratios by lowering E would have an adverse effect upon the foreign exchange constraint.

Conclusions

Once foreign exchange is introduced as a constraint, certain of the policy conclusions in earlier sections will be modified. In those sections capital was the only constraint.

The section on maximising consumption over time showed that higher capital-labour ratios and plantations were desirable. To obtain higher capital-labour ratios either the cost of labour could be increased or the cost of capital reduced. Of the two price adjustments, increasing the cost of labour was shown to be undesirable because the relative profitability of plantations would be harmed. Reducing the cost of capital was shown to be the preferable price adjustment. Introducing the foreign

exchange constraint does not modify the conclusion. Increasing the cost of labour would cause the import constraint to shift to the left and therefore be undesirable. Similarly, a reduction in the exchange rate would have the effect of increasing M/I and M/C and shifting the import constraint to the left.

The section on maximising current employment similarly opted for r as the policy variable. Maximising current employment requires low capital-labour ratios, and family farming as the tenure system. Both lowering w and raising r would produce the desired effect on capital-labour ratios. Yet lowering w would only affect plantations. Lower wages (and labour costs) would benefit plantations vis a vis family farms (the desired land tenure regime). Accordingly raising r was considered a more efficient policy instrument. The introduction of a foreign exchange constraint, however, reduces the efficiency of r as a policy instrument once current employment is the maximand. An increase in r will have the desired effect of reducing the capital-labour ratio, but an increase in r will raise the import intensity of investment and consumption activities. Accordingly, the import constraint will shift to the left. An alternative policy variable is the exchange rate. To obtain a fall in capital-labour ratios, E would be raised. Both capital and import constraints would move outwards. Hence, from equations (2.40) and (2.41) the desirable policy measure may be a fall in w and in E.

The policy variable, r, w and E can be incorporated into a matrix. The direction of the factor price adjustments will be compared for each of the development goals.

Development Goals	Constraints	
	Capital Only	Capital and Foreign Exchange
Consumption over time	r down	r down
Current employment	r up	w down, E up
Net saving of foreign exchange	-	r down, w down, E up

Chapter Notes

1. The assumption may be less valid for the three largest palm oil producers, particularly in the labour and output markets.

2. C. Nakajima, "Subsistence and Commercial Family Farms: some Theoretical Models of Subjective Equilibrium", in Subsistence Agriculture and Economic Development, Ed. by C. Wharton. Chicago, Aldine Publishing Co., 1969, pp. 165-185.

3. It should be noted that the coefficients are assumed the same in both tenure systems. This is an artificial assumption and may be empirically incorrect as Table 4.II on page 121 suggests. Yet a lower labour share on plantations reinforces the conclusions of the model since the lower is α the more likely is equation (2.20) to hold.

4. J. Fei and G. Ranis. Development of Labour Surplus Economy. Illinois, Irwin Inc., 1964, Chapter IV.

5. "What elements are to be considered as costs and what are to be considered as benefits and how they are to be evaluated are questions which can only be answered by a specific social welfare function." S. K. Nath, "Welfare Economics, Economic Growth and the Choice of Techniques," Journal of Development Studies, vol. 4 (January 1968), p. 240.

6. "Much of the economist's traditional emphasis on efficiency has had the effect of giving it a very high weight relative to growth or distribution". P.O. Steiner, Public Expenditure Budgeting, Washington D.C., Brookings Institute, p. 44.

7. "Cost-benefit analysis. . . is founded on a single criterion, a Pareto improvement. One wishes to remain neutral on the question of distribution in cost-benefit analysis." E. J. Mishan, "Cost-Benefit Rules for Poorer Countries", Canadian Journal of Economics, Vol. 4 (February, 1971), p. 86.

8. "To assume fiscal policies will redistribute gains is to show a misguided faith in the fiscal systems of developing countries and a fairly naive understanding of the interplay of economic and political institutions." M. Haq, "Employment in the 70's: a New Perspective", International Development Review, vol. 4 (1971), p. 11.

9. "Unfortunately some economists base policy recommendations on conclusions drawn from abstract models, neglecting the differences

between the models and the environment of actual decisions. This environment makes the single-minded pursuit of efficiency an inadequate surrogate for maximising national welfare." S. Marglin, Public Investment Criteria, Cambridge, M.I.T. Press, 1967, p. 38.

10. "Benefit cost analysis is . . . less relevant to public investment decisions in developing countries where the promotion of economic development is likely to be considered a major national objective. In the first place it has tended to emphasise the achievement of a Pareto Optimum. The analysis is normally cast in the framework of a fully employed market economy where the objective of economic policy is the achievement of a statically efficient allocation of resources." T. King, "Development Strategy and Investment Criteria: Complementary or Competitive", Quarterly Journal of Economics, vol. 80 (February 1966), p. 117.

11. "The quest for a unique ranking device probably accounts for the hostility of economists towards side effects and secondary benefits . . . secondary benefits may in fact be essential inputs." A. O. Hirschman, Development Projects Observed, Washington D. C., Brookings Institute, pp. 170-179.

12. L. Currie, "The Exchange Constraint on Development - a Partial Solution to the Problem", Economic Journal, vol. 81 (December 1971), pp. 886-904.

13. To avoid definitional controversy, the objective function of the policy makers is not referred to as a social welfare function: see S. K. Nath, A Reappraisal of Welfare Economics, Englewood Cliffs, N. J., Prentice-Hall, 1969.

14. This point is expanded by F. Steward and P. Streeten, "Conflicts between Output and Employment in Developing Countries", Oxford Economic Papers, vol. 23 (July 1971), pp. 145 - 169.

15. Among some of the reasons are the demoralising effects of unemployment, the impact on output of unemployment, the idea that work is good, the political dangers of large numbers of unemployed. See Stewart and Streeten, loc. cit.

16. "The real significance of chronic unemployment is that it is a cause of poverty." International Labour Office (ILO), Towards Full Employment, Geneva, 1970, p. 49. Although it should be noted that if unemployment itself is a development the inefficient use of labour may be justified and poverty grow more acute.

17. "The lack of well-being has created a reaction against growth as the principal objective of development, and has led to a demand to pay more attention to unemployment and income distribution." Robert McNamara, "Report to the Committee of Governors", International Bank for Reconstruction and Development, Washington D.C., September 27, 1971, p. 14. (mimeographed).

18. Further reasons for a short time horizon in underdeveloped countries are presented by A. K. Sen, Choice of Techniques, New York, Kelley, 1968, Chapter 8.

19. "It is obvious that the political and social unrest likely to accompany heavy unemployment . . . is a threat to the stability of the growing economy. D. Turnham, The Employment Problem in Less Developed Countries, O.E.C.D. Development Centre Studies, Employment Series No. 1, Paris, 1971, p. 11.

20. The problems created by import substitution policies are reviewed by I. Little, T. Scitovsky and M. Scott, Industry and Trade in Some Developing Countries, London, Oxford University Press, 1970.

21. Means of closing the gap by appropriate selection of production techniques are shown later in the chapter. The "gap" is analysed by S. B. Linder, Trade and Trade Policy for Development, New York, Praeger, 1967.

22. Indirect imports induced by projects are not deducted. This is due to insufficient input-output data.

23. A survey of the methods used and a criticism of each of these methods are presented by P. Steiner, Public Expenditure Budgeting, Washington D.C., The Brookings Institute, 1969, pp. 44-48.

24. This can be demonstrated by a convex isoquant. Both this point and the figure following are demonstrated by Stewart and Streeten, op. cit. pp. 148-152.

25. A. S. Bhalla, "Investment Allocation and Technological Choice - a Case of Cotton Spinning Techniques", The Economic Journal, (September 1964), and "Choosing Techniques: Hand Pounding v. Machine-Milling of Rice: An Indian Case", Oxford Economic Papers, (March 1965).

26. W. Galenson and H. Leibenstein, "Investment Criteria, Productivity and Economic Development", Quarterly Journal of Economics, vol. 69 (August 1955), pp. 346-370.

27. If $S = S_{\pi}\Pi + S_{w}W$ where $S_{\pi} = 1$ and $S_{w} = 0$, and W and Π refer to wages and profits respectively:

$$dK = I = S_{\pi}\Pi$$

$dK/K = \pi/K$ where π/K is the amount of surplus per unit of capital.

28. The model is modified from one found in Stewart and Streeten, op. cit.

29. Chapter Five outlines in more detail possible means of adjusting the cost of capital.

30. J. Vanek, Estimating Foreign Exchange Resource Needs for Economic Development, New York, MacGraw Hill Book Co., 1967. An excellent summary which has been incorporated in this section is in R. Nelson, T. Schultz and R. Slighton, Structural Change in a Developing Economy, Princeton, Princeton University Press, 1971.

31. See Currie's solution to Colombia's foreign exchange shortage. Currie, op. cit.

32. R. Nelson, T. Schultz and R. Slighton, op. cit.

33. E is the domestic cost of imported goods. It is defined as the number of pesos per dollar.

34. The variation in import intensity is illustrated by data that show the import intensity in investment goods activities to be two and a half that in consumer goods activities.

PART II: EMPIRICAL EVALUATION

CHAPTER THREE

COLOMBIAN AGRICULTURAL STRATEGIES AND THE PALM OIL INDUSTRY

Introduction

The previous chapter presented the theoretical model of two land tenure systems and their relationship to three development goals. This chapter intends to provide a descriptive background of Colombian land tenure systems. It will also illustrate the three development goals.

The goals of consumption over time and current employment are illustrated within the context of two agricultural strategies. Both strategies have been proposed for Colombia. This chapter will briefly describe the tenure systems of the two strategies. One agricultural strategy would tend to result in large-scale mechanised holdings such as plantations, the other in small-scale non-mechanised family farms. It is suggested that the strategies advocate different tenure systems partly because of their different development goals.

In addition the goal of net foreign exchange saving is illustrated by the palm oil industry. The palm oil industry is described with particular emphasis on its role as an import substitute.

1. Agricultural Strategies

1.1 Land Tenure Systems

As in the rest of Latin America, the distribution of agricultural land is very skewed in Colombia. The skewed distribution is shown in Table 3.1. The table shows that the smallest 50 per cent of farms have only

Table 3.1 The Degree of Land Concentration and of Rural Income Distribution, Colombia, 1960.

Farm Size (hectares)	Cumulative Percentage No. of Farms	Cumulative Percentage of Area	Cumulative Percentage of Population	Cumulative Percentage of Income*
0-3	50.2	2.5	61.0	21.0
3-10	76.6	8.8	86.0	40.0
10-20	86.0	14.6	99.0	70.0
20-50	93.2	24.2		
50-500	99.5	69.6	100.0	100.0
>500	100.0	100.0		

Sources: Censo Agropecuario 1960, Botota: 1964 Second Part p. 39. Also A. Berry. "Land Distribution, Income Distribution and the Productive Efficiency of Colombian Agriculture", Yale Growth Center Discussion Paper No. 108, Yale University, March 1971. (mimeo).

* Income refers to income generated in agriculture, not to the income of people involved in agriculture. The data on land does not disaggregate by crop, soil or location. Hence the data may overstate the skewness of land distribution.

2.5 per cent of the agricultural land. Three-quarters of the farms have less than 10 per cent of the land. At the other extreme the largest 10 per cent of farms have three-quarters of the agricultural land. The largest 0.5 per cent have 30 per cent.

In addition to the land distribution, the distribution of rural income is also skewed. This is due to the dependence of rural income on land.[1] Table 3.I shows the income distribution. The poorest 61 per cent of the agricultural population receive a mere 21 per cent of total rural income. The 1 per cent of the population with farms over twenty hectares enjoy 30 per cent of the total rural income. Income distribution can be shown by a Lorenz curve. The Lorenz curve for rural income distribution in Colombia has a Gini coefficient of 0.57. This is very high and indicates considerable skewness. It is the highest Gini coefficient among the six Latin American countries for which data are available.[2]

Although the distribution of agricultural land is very skewed and the distribution of rural income is very unequal, these are not positive economic arguments for land reform. There may be equity considerations but skewed distributions can maximise certain economic goals.[3] However, the skewed distributions may also coincide with mis-allocation of factors. This appears to be the case in Colombia.

This mis-allocation of factors can be seen in Table 3.II. The table disaggregates by farm size but not by output. The table indicates that there is a mis-allocation of factors. There is too much labour and too little land on small farms and too much land and too little labour on

Table 3.II Relative Value of Output per Hectare of Agricultural Land and of Agricultural Labour

	Farm Size Categories				
	Sub-family[2]	Family[3]	Medium[4]	Large[5]	Total
Relative value of output:[1]					
per worker	100	418	753	995	281
per hectare	100	90	84	80	90
Percent of total:					
Agricultural labour force	58	31	7	4	100
Agricultural land	6	23	21	50	100
Value of production	21	45	19	15	100

Sources: M. Sternberg, "Agrarian Reform and Employment with Special Reference to Latin America", International Labour Review, vol. 95 (January 1967), p. 24, and H. Felstehausen, "Agrarian Reform and Development in Colombia", Land Reform in Chile, Colombia and Venezuela, Agency for International Development, vol. Spring Review of Land Reform, vol. 5 (June 1970), p. 9.

1. Gross value of output.

2. Sub-family farms are defined as insufficient to provide full employment of more than two man-years of labour.

3. Family farms are defined as those which can employ two to four man-years of labour.

4. Medium farms are defined as those which can employ four to twelve man-years of labour.

5. Large farms are defined as those which employ more than twelve man-years of labour.

large farms.

An improvement in the allocation of labour might produce an output-mix which could increase employment, output and land utilisation.

The labour-land ratio indicates that employment could be increased by a different output-mix. Table 3.II shows that the labour-land ratio varies with farm size. A similar relationship has been found for other Latin American countries.[4] It means that land fragmentation would result in a different output-mix and more intensive use of land. One report estimates for Chile that more intensive use of agricultural land could increase "effective employment" by 75 per cent.

Similarly, the output-land ratio indicates a potential increase in output. The output land ratio varies inversely with farm size. Sub-family and family farms shared less than one-third of the agricultural land. Yet they accounted for two-thirds of the value of output. Conversely large farms had half the agricultural land but produced only 15 per cent of the value of output.

More intensive use of land might also increase the proportion of land under cultivation. In the 1960 census year, only twenty-seven million hectares were used for agricultural purposes; this is less than a quarter of Colombia's land surface. Of this only 13 per cent was arable land. It

should be noted that much of Colombia's land is unsuited for agriculture. Hence figures showing theoretical land availability may overstate land underutilisation. Yet the proportion of land cultivated is very low. Arable land and land for intensive cattle grazing accounted for a mere 5 per cent of Colombia's total land surface.[5]

The possibility of improving the allocation of factors has prompted legislation aimed at land redistribution. However, the success of the legislation is doubtful. One economist has termed the Colombian legislation "reformmongering".[6] Another has suggested that "reformmongering" has done nothing to raise rural living standards.[7]

The latest piece of "reformmongering" was the Law of 1961. The Law established the procedures for expropriating property, for granting credit and for titling land. The Law established the Colombian Land Reform Agency (INCORA) to administer the procedures. INCORA has been moderately successful in its credit and titling activities.[8] In expropriating property INCORA has been less successful.[9]

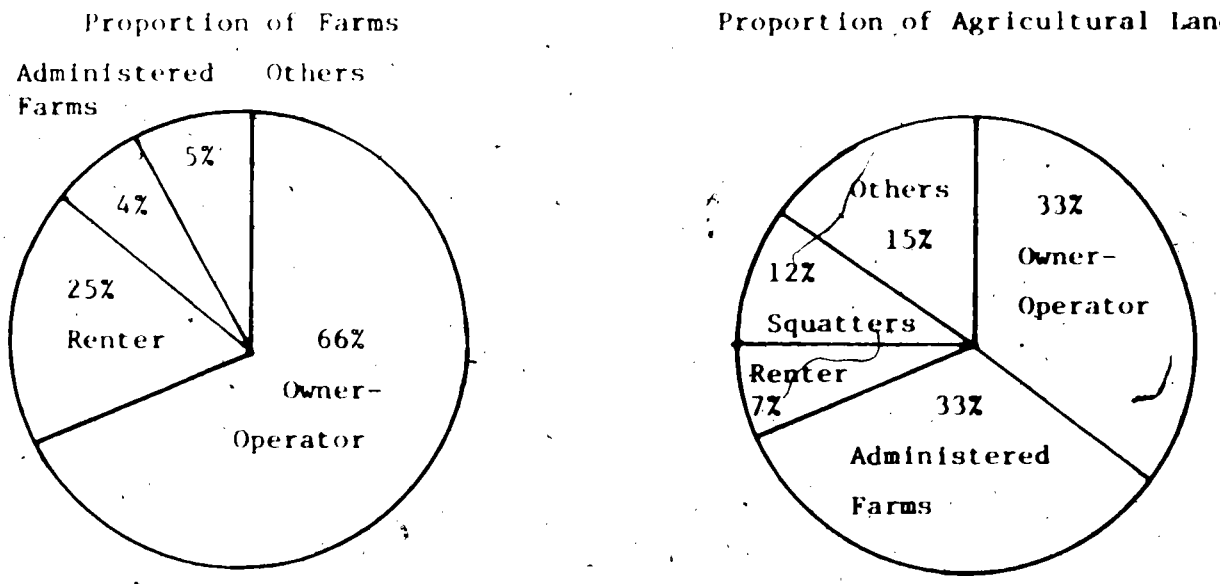
The Law of 1961 was not envisaged as a policy to fragment land into family farms. Expropriation was not permitted of any farm, however large, if that farm were operated efficiently.[10] The only justification for expropriation was underutilisation of land, and to demonstrate underutilisation has proven costly and time consuming.[11] The result has been a failure to redistribute land. By 1969 INCORA had expropriated only 124,000 hectares.[12] This compares poorly with Chile where three million hectares of private land were acquired in four years.[13] However, since 1969, INCORA has acquired further land for redistribution.[14]

The success of the Law of 1961 can be judged only by reference to its goal. Its purpose was not to fragment land-holdings. Its purpose has been to improve the economic efficiency of land use. The Law has not attempted to maximise other goals.[15] Expropriation is only permitted if it can increase output: it is not a means of fragmenting land-holdings to absorb labour.[16]

The limits to land fragmentation suggest that the present land tenure arrangement in Colombia will continue. Large farms can continue if they are efficient, and land fragmentation into family farms is not the goal of reform legislation.

The predominant tenure system is the owner-operator. Figure 3.1

Figure 3.1 The Land Tenure System in Colombia: 1960



Source: T. Lynn-Smith. Colombia: Social Structure and Process of Development, Gainseville, University of Florida Press, 1967.

presents the approximate proportions of the different tenure systems. The owner-operator clearly predominates. They account for two thirds of the number of farms. They represent sub-family, family and medium farms. In spite of their predominance owner-operators have only one-third of the agricultural land.

The largest farms are the administered farms. On these farms, managers are hired. Administered farms may be plantations or they may be landholdings for extensive cattle grazing. They constitute 4 per cent of the total number of farms. They also have one-third of the agricultural land.

1.2 Two alternative agricultural strategies

Large-scale farming, such as plantations, can be very efficient technically. It is partly for this reason that one agricultural strategy advocates large farms in Colombia. This is the Currie strategy.[17] In addition, the Currie strategy intends to raise labour productivity in agriculture, and as Table 3.11 shows labour productivity is maximised on large farms. This is an additional argument for large-scale farming.

The Currie strategy emphasises the low demand elasticity for agricultural goods. The low elasticity would tend to reduce agricultural incomes as output expanded. To alleviate the problem of falling agricultural incomes, the strategy calls for accelerated urban migration. An urban construction programme is proposed that would "pull" labour into the urban centres.[18] The agricultural labour force would be reduced absolutely.[19] If there is a reduction in the absolute labour force, agricultural output

can be increased only by raising labour productivity. Output cannot be increased by employing additional labour. Hence, the strategy calls for large-scale farming.[20]

The development goal behind the Currie agricultural strategy appears to be consumption over time. That the strategy has a long time horizon is indicated by its emphasis on labour productivity. Rather than merely maximising current employment, the strategy is concerned to improve labour utilisation.[21] The long time horizon is also indicated by this thesis. Chapter Two has shown that a long time horizon implies large-scale farming rather than family farming.

An alternative agricultural strategy is proposed by the International Labour Office (ILO).[22] It proposes that family farms should be the dominant tenure system and that large land-holdings should be fragmented into family farms.[23] The ILO projects for 1980 an absolute increase in the agricultural labour force of just under one million. To absorb this additional labour, the ILO calls for family farming. As Table 3.II shows, labour absorption per unit of land is higher on family farms than on large farms. Hence, the strategy proposes a tenure system of family farms.

The development goal behind the ILO strategy is current employment. Its dominance indicates a short time horizon. All other goals such as consumption over time are subordinate to current employment.[24] The ILO is even prepared to accept lower output in return for higher employment.[25]

The ILO's rationale for maximising current employment is poverty.[26]

It contends that output growth has produced high unemployment and skewed income distribution.[27] To ameliorate the poverty, the ILO would concentrate on labour absorption, and this implies for agriculture a tenure system of family farms.

From the evidence, Colombia appears to have adopted the Currie rather than the ILO strategy. Firstly, as noted earlier, Colombian land legislation has not attempted to fragment land-holdings. Large land-holdings can continue if they are efficient. Secondly, large-scale farming has grown increasingly important in Colombian agriculture. This is shown by the growing proportion of output coming from large farms. While total agricultural output has increased by an average of 3.3 per cent a year, the output of crops grown on large-scale farms has increased faster.[28] A group consisting of the vegetable oil crops increased production by an average of 11.7 per cent a year. Produced on large farms, their production is efficient even by world standards.[29] Of the five crops which grew, the fastest in tonnage (cotton, rice, sesame, millet and soybean), all but millet in 1960 had at least a third of their area cultivated on farms of over fifty-hectares.[30] Since 1960 the evidence suggests that the proportion of agricultural output grown on large farms has increased.[31]

1.3 Production techniques

Similarly, Colombia appears to have adopted the Currie strategy rather than the ILO strategy towards production techniques. Currie advocates mechanised techniques: the ILO, on the other hand, favours non-mechanised techniques.[32]

The adoption of Currie's strategy can be seen by the growing predominance of crops which are mechanised. Of the five crops which grew the fastest in tonnage, all the area planted with soybean and sugar was mechanised in 1960, while for the other crops, the proportion of the area mechanised fell from 80 per cent for cotton to 20 per cent for sesame.[33]

The adoption of Currie's strategy is also indicated by the increasing use of tractors. Between 1953 and 1967, the number of tractors more than doubled.[34] Since 1968, tractor imports have been allowed to enter free of any restriction and the real value of tractors and farm machinery in use has doubled again.[35] The beneficiaries of the rapid mechanisation have been the larger farms. No tractor suitable for small-scale agriculture has yet been developed for Colombia.[36] As a result, more than two-thirds of all tractors in 1960 were on units of over fifty hectares.[37]

Mechanisation primarily raises productivity per man rather than per hectare. Yet Table 3.III shows that large scale agriculture can produce very high yields per hectare. The table shows an overall correlation between farm size and yield per hectare.[38] The correlation exists even among crops such as potatoes which is a crop predominantly cultivated on small farms.

Table 3.III Crop Yield in Kilos per hectare by Farm Size and for INCORA Projects

Crop	Farm Size (hectares)						
	0-2	2-10	10-20	20-50	50-500	500-2500	INCORA
Barley	806	891	778	837	1,625	1,996	1,802
Grain millet	758	1,017	1,674	1.889	1,728	2,194	2,875
Potatoes	4,090	4,519	6,904	4.780	6,928	11,421	15,550
Wheat	704	630	694	642	1,442	1,858	1,592
Rice	1,635	1.642	1.693	1.595	1,840	2,367	2,847
Yuca	7,371	6,366	5,955	6.693	9,429	9,953	8,274
Lima Beans	322	309	347	344	411	965	1,158
Tobacco	957	1,013	907	964	864	1,523	1,762

Sources: International Bank for Reconstruction and Development (IBRD), Economic Growth of Colombia: Problems and Prospects, Baltimore, Johns Hopkins University Press, 1972, p. 237. It should be noted that INCORA's data are for 1968, while the data on farm size is for 1966. The IBRD recognizes that the two sets of data, are not fully comparable, but states that they are suggestive.

The correlation between farm size and land productivity exists partly because large farms have taken advantage of techniques which are essentially neutral to scale. Large farms have benefited from such inputs as improved seeds and fertiliser.

Over half the area of barley, cotton, rice, millet, soybean, tobacco

and wheat are planted with improved seed.[39] Of these, all but tobacco are predominantly large farm crops. Improved seeds of family farm crops have either not been adopted or have not been developed.[40] In the use of fertiliser, large farms have also benefited. Griffin has shown that large rather than small farms gained from the fertiliser subsidy.[41]

It should, however, be noted that small farms can also be efficient. With inputs of fertilisers and improved seeds, family farms can produce very high yields per hectare. The last column in Table 3.3 shows the yield per hectare obtained on the research farms of Colombia's Land Reform Agency (INCORA). The research farms are small and equivalent in size to a family farm. In all cases, the output-land ratio is high. Yields on the INCORA research farms even exceed those obtained on the largest farms. The high yields are due to non-mechanised rather than mechanised techniques.

Yet INCORA has available all the inputs including skilled personnel. The potential for increasing output on family farms may therefore be overstated. The use of fertiliser in Colombia suggest that new techniques are adopted by family farms.[42] However, their adoption takes time and requires scarce technical personnel. For the potential increase in output to be realised, the personnel would have to be available. Moreover, even if the output were realised, the net effects might not be beneficial. Low elasticity of demand could cause agricultural incomes to decline.

2. The Palm Oil Industry

2.1 Background

2.1.1 The vegetable oil programme

Traditionally Colombia has been a net importer of edible oils. Throughout the 1960's, Colombia was importing some fifty million tons of edible oil a year and the imports were costing US $12 - US $15 million a year in foreign exchange. It was to reduce and eventually to eliminate imports of edible oil that the government established the Vegetable Oil Programme by Discreto No. 290 in 1957.

The programme was part of Colombia's strategy of import substitution. The programme aimed to expand domestic sources of vegetable oils by tax exemptions and subsidies. The success of the programme can be seen in Graph 1. In 1960, total consumption of edible oil (imports plus domestic production minus stocks) was 70.000 tons of which over half (41.000) tons was imported. By 1971, imports remained at approximately the same absolute level but represented less than a third of the total (144.000 tons) consumed. Domestic production of edible oils between 1960 and 1971 had almost tripled.

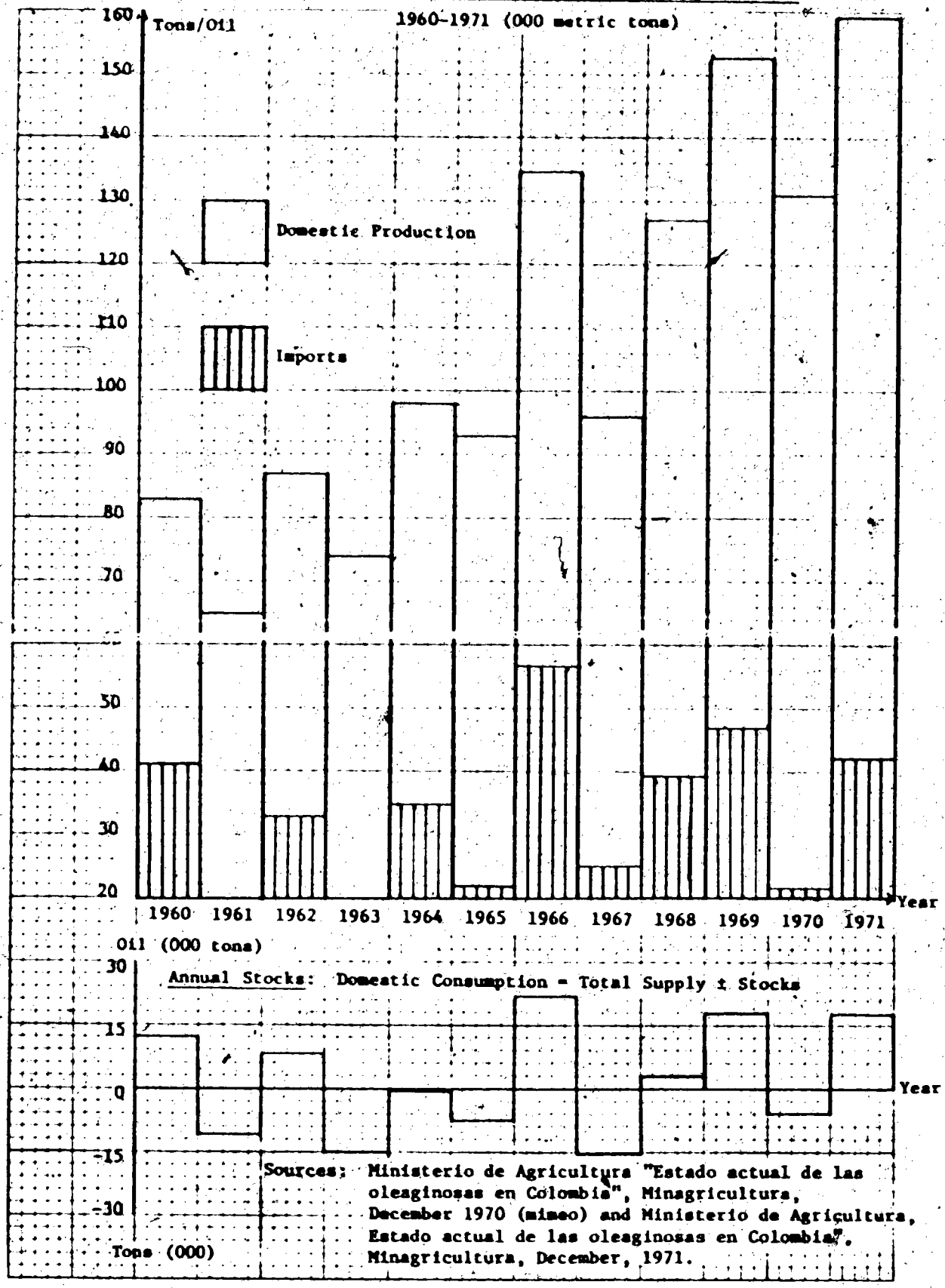
The principal source in the expansion of edible oil production was vegetable oil and particularly palm oil. As Graph II demonstrates, vegetable oil production has expanded dramatically. Over the period 1960-1971 vegetable oil production grew at an annual rate of 21 per cent and by 1971 accounted for 85 per cent of the edible oil produced. Animal

oils and fats on the other hand grew by only 4 per cent a year. Of the vegetable oils, palm oil production has shown the most dramatic expansion. Production of palm oil rose between 1960 and 1971 from 170 tons to 36,177 tons. From being an insignificant source of vegetable oil in 1960 (less than 1 per cent of the total), by 1971 palm oil had become the main source of a much greater total. In 1971, palm oil accounted for 36 per cent of the total vegetable oil produced.

Palm oil expansion occurred in Colombia primarily because of government support. The government offered tax exemptions and subsidies.[43] By the Vegetable Oil Programme, producers of palm oil were exempted from payment of taxes on patrimony, income and excess profits for ten years. With direct taxes on profits rising to 36 per cent and excess profits tax payable on net profits of a further 32 per cent, the exemptions were generous. Moreover, stockholders of palm oil units were themselves exempted from a proportion of patrimony and income taxes. In the area of research, the government has subsidised the Instituto Colombiano Agropecuario (ICA) which germinates palm seeds and advises (free of charge) family farms. In 1971, ICA spent $250,000 on palm oil and copra alone, and by 1973 ICA will have sixty-four agronomists and auxiliaries specialised in oil palms.[44] In the area of credit, the government has enabled palm oil producers to obtain credit cheaply and on a longterm basis.[45] The total credit authorised between 1963 and 1971 on palm oil amounted to 165 million pesos, and has expanded faster than for any other crop.[46]

Government support for palm oil expansion was necessary for two reasons. In the first place, the African oil palm is a perennial crop

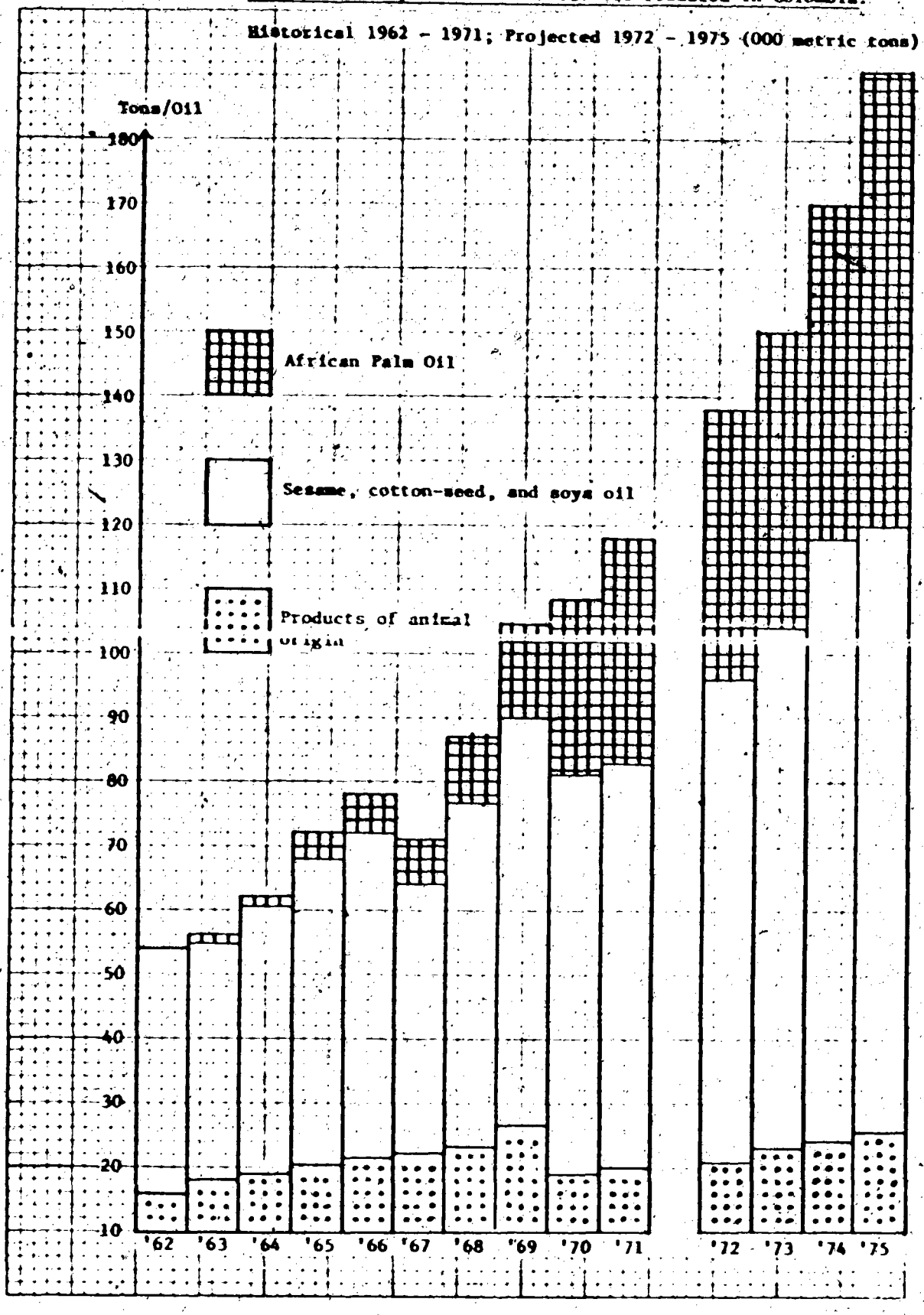
Graph 1: Composition of Total Supply of Edible Oils, Colombia



Sources: Ministerio de Agricultura "Estado actual de las oleaginosas en Colombia", Minagricultura, December 1970 (mimeo) and Ministerio de Agricultura, Estado actual de las oleaginosas en Colombia", Minagricultura, December, 1971.

Graph II: Volume and Composition of Edible Oil Produced in Colombia:

Historical 1962 - 1971; Projected 1972 - 1975 (000 metric tons)



with a four year gestation period. For the early years, the net returns are negative, and to induce outlays some form of government intervention was necessary. In the second place, African oil palms are not indigenous to Latin America and little was known about them. Knowledge had to be imported from abroad. Agricultural products which are new face greater supply undertainties than new manufacturing products, and to compensate for the undertainties the industry needed subsidies.

The result of government support was the rapid expansion in the production of palm oil. Throughout the 1960's, output of palm oil grew at an annual rate of 30 per cent a year. From 800 hectares planted in 1960, the area under oil palms grew to 19,000 hectares by 1967, and is forecast to reach 23,500 hectares by 1975.[47]

2.1.2 Distribution of holdings by size

Palm oil in Colombia is produced on both plantations and family farms. The majority of producers are family farms, but plantations produce the majority of palm oil. Over three-quarters of the oil is produced on the four largest plantations. The largest plantation has an area of 5,000 hectares and is the largest producer of palm oil in Latin America. Two others are over 2,000 hectares. The other plantations range in size from fifty hectares upwards.

While family farms form the majority of producers, they supply less than one-quarter of the palm oil. Family farming is financially feasible, but since the programme began many family farms have ceased

production of palm oil.[48] Of the 149 family farms established in the province of Caquetá, the majority by 1971 had been abandoned. Either credit, or the necessary patience, was absent.[49] Now family farms are only established on a cooperative basis as perimiter plantings to nucleus plantations. The plantation provides the expertise and the extracting facility; in return, the family farms sells the palm oil fruit to the plantation at a prearranged price.[50]

2.2.1 Net foreign exchange saving

The main goal of the Vegetable Oil Programme was import substitution. As an import substitute, palm oil has had mixed success. Palm oil has successfully replaced vegetable oil imports. The main vegetable oil import, copra, accounted for almost half (49 per cent) of total edible oil imports and had been as high as 90 per cent (1956). By 1970, copra had been reduced to 1 per cent of total edible oil imports. On the other hand, palm oil has not substituted for fish oil imports. From less than 1 per cent of total edible oil imports in 1960, fish oil imports had soared to 97 per cent by 1970.[51] (Graph III). In 1971, the Andean Pact allowed unrestricted entry of fish oil imports. In the first seven month of 1971, fish oil imports reached almost three quarters (73 per cent) of the total imported in 1970.[52] For the first time, 1971 saw a domestic surplus of palm oil.

The reason for the influx of fish oil into Colombia is its relatively low price. Fish oil at US $182 per ton c.i.f. is almost half the price of palm oil produced domestically. As an input fish oil is a

near perfect substitute for palm oil.

Palm oil and palm kernel oil is principally used as an input in the production of margarine, of soap and of shortening. Demand for these products in Colombia is forecast to rise and this will increase demand for the inputs. Soap production has been growing by 6 per cent a year, and the production of shortening is projected to rise by approximately 2 per cent a year.[53] However, in the production of margarine and shortening, fish oil substitutes for palm oil. Fish oil now accounts for over half the ingredients in margarine production in certain countries, and owing to its relatively low price the proportion has been increasing.[54] Similarly, fish oil is used in shortening. In 1970, (before the Andean Pact allowed unrestricted entry of fish oil), the Colombian refineries used fish oil for over half their input in shortening. Palm oil accounted for the residual. No data are available, but since 1970 the proportion of fish oil has probably risen.

Only in soap production are palm products free of competition from fish oil. Lauric acids make up some 20 per cent of the ingredients of soap, and the only lauric acid available in Colombia is palm kernel oil. However, by itself soap production would not provide an adequate market for palm oil products.

The substitution of fish oil imports for vegetable oil imports has had a beneficial impact on net foreign exchange expenditures. As Graph I shows, the volume of edible oil imports has not fallen appreciably, yet the value of the edible oil imports has declined. In 1960, the

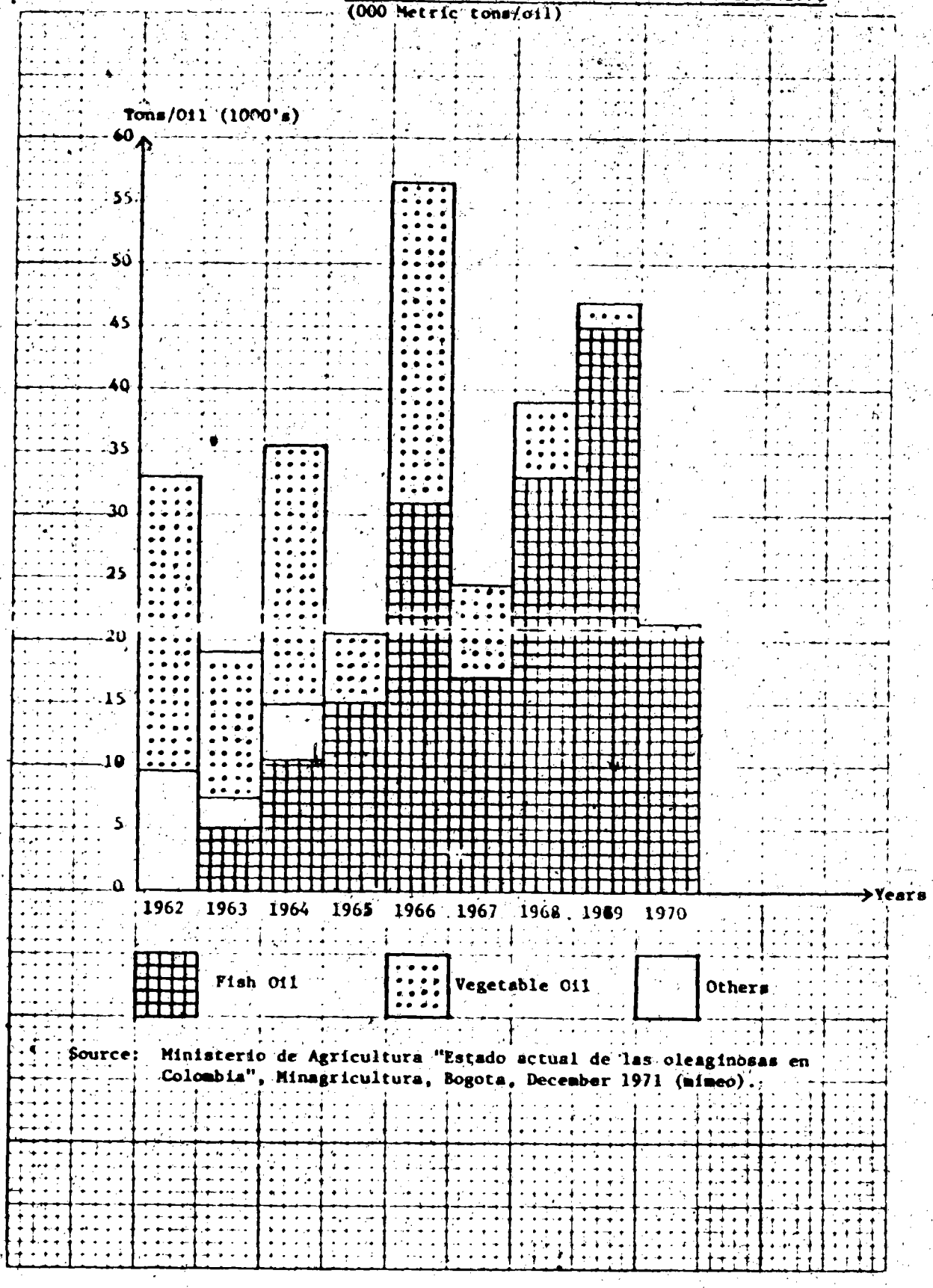
average price of edible oil imports had been US $402 per ton, by 1969, the average price had declined to US $114 per ton. Imports of edible oil in 1960 cost three times as much as the much larger volume imported in 1969.[55]

The decline in the value of imports enables Colombia to save foreign exchange by exporting the relatively more expensive palm oil. Exports would also supplement the shrinking domestic market for palm oil.

In the external market, Colombia has not the potential to export palm oil and palm kernel oil to Western Europe which absorbs three quarters of world palm oil imports and four-fifths of world palm kernel imports. Colombia's price is not competitive. The price of Colombian palm oil is US $325 per ton f.o.b, and the price of palm kernel oil US $403 per ton f.o.b. This is not competitive with international c.i.f. prices in Western Europe of US $262 and US $372 respectively.

In the external market Colombian producers have an opportunity of supplementing their shrinking market within Colombia by exporting to the Andean Group countries. Against palm oil imports, Chile now maintains a nominal tariff of 53 per cent against member countries and a nominal tariff of 246 per cent against third countries. Palm oil's domestic price in Colombia of US $325 gives an import price of US $497 a ton into Chile. This compares favourably with the prices of third countries. Even at the low international price of US $262, the tariff of 246 per cent will make an import price of US $907. Only Ecuador can offer competition, and Colombia has the advantage. The palm oil industry in Ecuador is less efficient, moreover the total area to be planted under oil palms is only 8,000 hectares.[56] Moreover, per capita consumption of vegetable oil is low

Graph III: Imports of Edible Oil into Colombia: 1962-1970
(000 Metric tons/oil)



Source: Ministerio de Agricultura "Estado actual de las oleaginosas en Colombia", Minagricultura, Bogota, December 1971 (mimeo).

and income elasticity is high among the Andean Group, so that the market will expand.[57] With competitive prices, Colombian producers have the opportunity of dominating the market.

Conclusion

This chapter has described Colombia's land tenure system and the palm oil industry. The tenure systems were illustrated within the context of two agricultural strategies proposed for Colombia. While the evidence is not conclusive, it indicates that Currie's strategy has been adopted. Large-scale mechanised agriculture has been supported rather than family farming and non-mechanised techniques. From Chapter Two, the reason may be a desire to maximise consumption over time rather than current employment.

The palm oil industry was established as an import substitute and its success appears doubtful. This chapter showed that while palm oil has replaced vegetable oil imports it has not replaced fish oil imports. The next chapter will establish whether the industry saved foreign exchange.

Chapter Notes

1. The importance of land as the determinant of income distribution is shown by A. Berry, "Land Distribution, Income Distribution and the Productive Efficiency of Colombian Agriculture", Yale Growth Center Discussion Paper No. 108, Yale University, March 1971. (mimeo).

2. The Gini coefficients are derived in W. Cline, Potential Effects of Income Redistribution on Economic Growth, New York, Praeger, 1972, p. 113. The countries are Argentina, Brazil, Chile, Colombia, Mexico and Venezuela.

3. For example, a skewed income distribution may maximise consumption over time as Chapter Two showed.

4. M. Sternberg, "Agrarian Reform and Employment with special reference to Latin America", International Labour Review, vol 95 (January 1967), pp. 1-26.

5. The proportion of arable land per agricultural labourer is low compared with other Latin American countries. Ibid.

6. "Reformmongering" refers to legislative reform. A. Hirschman, Journeys Towards Progress, New York, The Twentieth Century Fund, 1963.

7. "The main effect of "reformmongering" has been to unify and strengthen the national political machinery, but not necessarily to broaden the distribution of economic benefit to workers and peasants." H. Felstehausen, "Agrarian Reform and Development in Colombia", in Land Reform in Chile, Colombia and Venezuela, Agency for International Development, (AID), Spring Review of Land Reform, vol. V, June 1970, p. 2.

8. In its function as a titling agency INCORA has granted 90,000 titles, in 1969 was issuing credit to 30,000 families and has settled 20,000 families on public land. Yet 95 per cent of the titles were on private land. In its lending function INCORA tends to substitute for other lending agencies, so if the 30,000 families not all represent a net credit increase. Finally, in its settlement policy INCORA has tended to perpetuate Colombia's unequal distribution of land. Ibid.

9. The failure is partly due to financial constraints. Only 9 per cent of INCORA's budget is spent on expropriation and land purchases. International Bank for Reconstruction and Development (IBRD), Economic Growth of Colombia: Problems and Prospects, Baltimore, Johns Hopkins University Press, 1972, p. 239.

10. "This may be seen as Colombia's chosen solution for the problem of land reform . . . not disturbing economically efficient holdings". United Nations, Progress in Land Reform, Department of Economic and Social Affairs, New York, 1966, p. 19,

11. IBRD, Economic Growth of Colombia: Problems and Prospects, op. cit., p. 238.

12. Felstehausen, op. cit., p. 20.

13. W. Thiesenhusen, "Current Status of Agrarian Reform in Chile", in Land Reform in Chile, Colombia and Venezuela, op. cit. pp. 1-49.

14. For example INCORA has recently acquired 7,000 hectares. (Personal correspondence with Lauclin Currie).

15. The existing balance of political power in Colombia is such that only the prospect of an immediate increase in production can be reasonably accepted as a reason for land reform." United Nations, Progress in Land Reform. op. cit., p. 21.

16. "We are carrying through a land reform whose primary objective is not so much to change the number of land owners as to increase national production". The President of the Republic. El Tiempo. 8 October 1964.

17. L. Currie. Accelerating Development: the Necessity and the Means. MacGraw Hill Book Co., 1966. Also L. Currie, "The Exchange Constraint on Development - Partial Solution to the Problem", Economic Journal, vol. 81 (December 1971), p. 886-904.

18. The techniques in construction would be labour-intensive and have low import coefficients.

19. At present over 1,1000 new agricultural families are formed a week. Comité Interamericano de la Alianza para el Progreso, "El esfuerzo

interno y las necessidades de financiamento externo para el desarrollo economico de Colombia, Bogota, 1966, p. 22. This may fall to 500 familes a week: see IBRD, Economic Growth of Colombia: Problems and Prospects, op. cit., p. 301.

20. "Throughout the world technology is daily enlarging the optimum size of farming units. It is to be hoped that in our group of developing countries contrary policies will not be advocated and carried out." Currie, Accelerating Development, p. 105.

21. "The diagnosis of underdevelopment ought to be as much concerned with solving the problem of inefficient employment, as with total employment". Plan de Deasarrollo, "Guias para una neuva estrategia de desarrollo", Primera Parte (written by L. Currie), Bogota, 1971, p. 78. (mimeo).

22. International Labour Office (ILO), Towards Full Employment, Geneva, 1970.

23. "We believe that a very different form of strategy is demanded, a strategy which can give far more people in the rural areas an opportunity for participating in commercial production for export and domestic markets from family-sized farms." ibid., p. 80.

24. "So employment becomes the target and over-all gowth the by-product." ibid., p. 49.

25. If the scale of reform is big and consequent disruption will cause some loss of output and the bigger the population shift the greater the loss. But this is in the initial period . . . the long-run potential effect of a large programme of land reform could be considerable, not only for employment but also for output." ibid. p. 71.

26. "Poverty, therefore emerges as the most compelling aspect of the whole employment problem in Colombia." ibid. p. 21.

27. "The root of the discontent with economic growth as a supreme objective has been the dawning realisation that even when it is rapid it has generally, as in Colombia itself, been accompanied by rising unemployment and widening gaps between the rich and the poor." ibid., p. 48.

28. L. Atkinson. "Changes in Agricultural Production and Technology in Colombia". United States Dept. of Agricultural Economic Research Service, June 1969. The data on the growth rates of output came from this source.

29. For a comparison of yields per hectare throughout the world see Currie, Accelerating Development, op. cit., p. 172.

30. Palm oil grew the fastest but this is excluded because the growth rate is due to the growing maturity of the palms. See IBRD, Economic Growth of Colombia, op. cit., p. 226.

31. For data which suggest that the large farms are becoming more important see Berry, op. cit., p. 37.

32. "The main policy rule could therefore be to emphasise those elements in modern technology which do not displace labour - seeds, fertiliser and pesticides - and those forms of capital formation which use a great deal of manpower." ILO, op. cit., p. 167.

33. Data comes from L. Currie, Accelerating Development, op. cit., p. 174. Currie recognises the problem of defining mechanisation but considers that his estimates are reasonable.

34. The number of tractors increased from 9,000 to 23,000 between 1953 and 1967. L. Atkinson, op. cit., p. 18.

35. The real value of sales rose from 1.286 (index of 100 in 1952) to 2834 in 1970. Banco de la Republica, Series estadisticas y graficos, Departamento de Investigaciones Economicas, December, 1970, table F.3.

36. Although a 12 h.p. tractor may be available shortly. IBRD Economic Growth of Colombia, op. cit., p. 243.

37. DANE, op. cit., p. 53. It should be noted from Table 3.1 that farms of this size constitute less than 7 per cent of the farms in Colombia.

38. The correlation between farm size and the average product of land is for the same crop. Table 3.II which showed an inverse relationship between farm size and the average product of land did not disaggregate by crop. The large farms are often for extensive cattle grazing which

yield low loutput-land ratios; hence Table 3.2 is evidence more of the underutilisation of land than of the relative efficiency of farms when the same crop is produced.

39. The proportions are 100 per cent tobacco, 60-100 per cent for soybean and millet, 94 per cent for cotton, 72 per cent for barley, 54 per cent for rice and 45 per cent for wheat. Departamento Nacional de Planeacion, "Informe sobre la produccion y consumo de semillas mejoradas en Colombia", Bogota, 1969.

40. For the subsistence crops and problems with their adoption see L. Atkinson, "Traditional and Changing Agriculture", United States Dept. of Economic Research Service, 1970.

41. K. Griffin, "Coffee and the Economic Development of Colombia", Oxford Belletin of Economics and Statistics, vol. 30 (May 1968), pp. 105-127.

42. Potatoes and tobacco are family farm crops in Colombia. Yet over 90 per cent of the planted area of potatoes is fertilised and 50 per cent of the planted area of tobacco. See IBRD, Economic Growth of Colombia, op. cit., pp. 246-247.

43. Resolucion 197. No. 30556. Diario Nacional, Bogota, July 7, 1961.

44. Total expenditure was 5.5 million pesos of which 3 million were for personnel. ICA. "Programma de acturidades: programa nacional de oleaginosas perennes", Cali, Februrary 1970 (unpublished document).

45. Interest charged rises from 12.5 per cent during the first 6 years to 14.5 per cent the later years. The maximum length of a loan is 10 years with a moritorium of 6 years.

46. Between 1966 and 1970 the value of loans increased by nine times their original value. Ministerio de Agricultura, "Informe 1969-1970". Bogota, 1970, Table 7, p. 45 (mimeo).

47. The proposal is for another 4,250 hectares in Narino alone. ICA Proyecto para aumentar la produccion y mejorar la productividad de la palmo africana en el litoral pacifico, Document No. DP-T-07, Tibaitata, April 1971.

48. The financial feasibility of family farms was shown in ICA. Proyecto para aumentar la produccion y mejorar la productividad de la palma africana en el littoral pacifico, op. cit. Also Ministerio de Agricultura, "Estado actuel de oleaginosas comestibles en Colombia", Bogota, 1970. (mimeo)

49. "The majority of these crops (African palm and rubber) have been abandoned, owing to the peasants' lack of knowledge about them, and the fact that they are long gestation crops". ICA, Estado y processo de desarollo agropecuario en cuatro zonas de colonizacion en Coqueta, Depto. de Economico Agricola, Tibaitata, April 1970, p. 80.

50. The difficulties and advantages of cooperative tenure arrangements for palm oil production are described in T. Phillips, "The Possibilities of Nucleus Plantations" in The Oil Palm, Tropical Products Institute, London, May 1965.

51. The data comes from Ministerio de Agricultura, "Estadisticas de los principales productos agricolas 1960-1970", OPSA, 057, September 1971.

52. Departamento Nacional de Planeacion. "Observaciones al estudio de fenalco sobre importaciones de productos agropecuarios y de industrias alimenticas". October 1971 (mimeo).

53. Vegetable Oils and Oilseeds. Commonwealth Secretariat, London 1971, p. 178. Also Ministerio de Agricultura, Estado actuel de las oleaginosas comestibles en Colombia, Bogota, December 1971.

54. The U.K. for example, cf. ibid. Vegetable Oils and Oilseeds.

55. Ministerio de Agricultura. Estado actuel de las oleaginosas comestibles en Colombia, op. cit., 1970.

56. F. Corrado. "La culture du palmier a huile en Equateur", Oleagineux, vol. 4 (April 1970), pp. 197-203.

57. In Bolivia and Ecuador consumption per capita per year of vegetable oils in 1967 was 0.7 and 2.7 kilos respectively (although the nutritional minimum is 9 kilos). Their respective income elasticities are 1.0 and 1.2. FAO, Agricultural Commodities - Projections for 1975 and 1985. Rome 1967, p. 82-84.

CHAPTER FOUR

AN EVALUATION OF LAND TENURE SYSTEMS AND AN EMPIRICAL EXAMINATION OF THE MICRO-MODEL

Introduction

Chapter Two compared theoretically plantations and family farms for their effect on different development goals. It showed that plantations maximise consumption over time and family farms maximise current employment and net foreign exchange saving. Here the two tenure systems are compared empirically for their effect on the three goals.

In addition three hypotheses of the micro model are evaluated with the available data on palm oil production. The objective is to establish empirically that plantations will tend to be more mechanised than family farms when they are producing the same crop.

1. An Evaluation of Land Tenure Systems

Introduction

The objective is to compare plantations and family farms empirically. This will provide an evaluation of Chapter Two's theoretical conclu-

sions.

A cost-benefit study is made of plantations and family farms which produce palm oil. Palm oil was selected partly because excellent palm oil data exist for physical inputs and outputs. Compiled by agronomists of the Instituto Colombiano Agropecuario (ICA), data are available for units of ten hectares and 500 hectares.[1] Data for the ten hectare unit are used for family farm evaluation. A ten hectare unit fits the definition of a family farm. It is sufficiently small that all labour can be supplied by the family. Yet, it is sufficiently large to support a family.[2] Similarly, the 500 hectare unit conforms to the definition of a plantation. Labour is hired, the objective is profit maximisation and cultivation is intensive.[3] From the data compiled by ICA, the two tenure systems can be compared.

The data will be used to estimate costs and benefits of the tenure systems. Since the comparison is by economic rather than financial criteria the costs and benefits are shadow, rather than market priced. This is particularly important for unskilled labour whose shadow price is adjusted for each of the development goals.

1.1 The Model

The tenure regimes will be ranked by the internal rate of return criterion. The theoretical deficiencies of the internal rate of return, while not undisputed have been widely acknowledged in the literature.[4] Yet in practice the internal rate of return is commonly used.[5] Its principal

advantage is that the discount rate is internally determined. For the purpose of comparing tenure systems a criterion that obviates discount rate problems is superior to criteria that require estimates of the social discount rate.

The internal rate of return will be used to compare each of the tenure systems for each of the three development goals. The tenure system with the higher rate of return will be the desirable tenure system for maximising that particular development goal. The model will be used for all the development goals.

For each tenure system total costs are the sum of the costs of unskilled labour, skilled labour, domestic capital inputs, and imported capital inputs.[6] For any year (t) total cost can be given by:

$$Ct^{*} = CLt^{*} + CSt + CDt^{*} + CMt^{*} \qquad (4.1)$$

where Ct^{*} refers to total costs, CLt^{*} to unskilled labour costs, CSt to skilled labour costs, CDt^{*} to domestic capital inputs, CMt^{*} to imported capital inputs and * to those values which are shadow-priced.

Total revenue in year t (Zt) is the product of palm oil output (Xt) and the shadow price of output (P^{*})

$$Z^{*}t = Xt\ P^{*} \qquad (4.2)$$

Output of palm oil in year t (Xt) is the product of the extraction rate (e) the area planted (Lt) and the yield per hectare (Yt). Yield per hectare will rise until the oil palms are mature.

$$Xt = e\ Lt\ Yt \quad (4.3)$$

Oil palm planting is staggered on plantations (100 hectares in the first year and 200 hectares in each of the subsequent years). Output of palm oil in year t on plantations will be.[7]

$$Xt = e\left[Lt\ Yt + Lt-1\ Yt-1 + Lt-2\ Yt-2\right] \quad (4.4)$$

Annual gross revenues (Zt^*) minus annual total costs (Ct^*) will be discounted over the economic lifetime of a palm oil unit (years t-1 to years t + 30) so that net benefits reduce to zero.

$$\sum_{t=1}^{t=30} \frac{Zt^* - Ct^*}{(1+i)^{31}} = 0 \quad (4.5)$$

The discount rate (i) is the internal rate of return and the higher the rate of return the higher is the tenure system evaluated.

1.2 Development goals and the shadow wage

Economic rather than financial evaluation requires that shadow prices are used when market prices do not reflect social opportunity costs. Shadow prices are particularly important in developing countries where structural rigidities frequently distort factor and commodity prices.

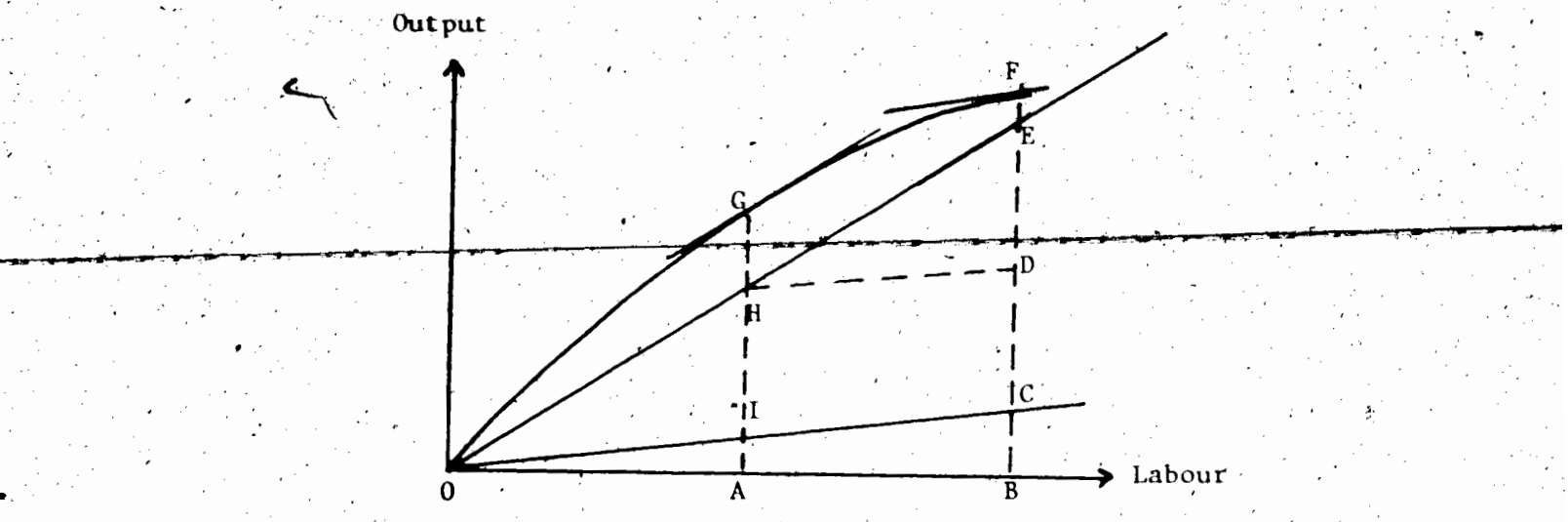
Technically, shadow prices are the Lagrangian multipliers of the constrained objective function in a programming problem. In practice

they are any prices other than market prices. They are used whenever distortions or rapidity of change prevent the market mechanism from setting prices that measure social costs and benefits. For example taxes or subsidies cause prices to diverge from social opportunity costs, and their distorting effect must be taken into account when an economic evaluation is made. Similarly, only part of the effects of a project may be associated with money exchange yet for evaluation such externalities must be shadow-priced. In underdeveloped countries, where inelasticities and administrative policies may create a wide divergence between market prices and opportunity costs, the selection of shadow prices becomes both necessary and more difficult.

Of particular importance is the shadow price of unskilled labour. The social opportunity cost of unskilled labour can be very low because of high unemployment. This may not be reflected in the market wage. Frequently the market wage exceeds labour's opportunity cost owing to distortions in the labour market. If this is the case, labour must be priced below its market wage. The shadow price imputed will depend on the particular concept of opportunity cost. The concept of opportunity cost, in turn, depends on the development goal.

The relationship between the shadow wage and development goals can be illustrated by the following diagram from Sen.[8] The axes refer to output and labour in the modern subsector. The slope of the rays OE and OC are the market wage rate and the shadow wage rate respectively. At output G consumption over time is maximised because the market wage is equated to

Figure 4.1 Goals and the Shadow Wage



labour's marginal product. At output F on the other hand current employment is maximised (consistent with labour's shadow wage). Consumption EB is greater than HA, and employment OB exceeds OA. However, at output F the surplus EF is less than HG so that the growth rate is reduced. Employment over time will fall.

Thus an economy which aims to maximise consumption and employment over time will equate the shadow wage at or near the market wage rate (the ray OE). Conversely, the goal of maximising current employment implies a shadow wage that is at, or near, zero (ray OC).

The shadow wage clearly influences the selection of land tenure systems. If plantations have higher capital-labour ratios than family farms a high shadow wage will penalise family farms more than plantations. On the other hand a low shadow wage will tend to favour the less mechanised family farm.

1.3 Maximising consumption over time and the shadow wage

Equation (2.36) showed that consumption over time is maximised by high current savings and large surpluses. With a neo-classical saving function, wages are a cost since they are a reduction in the surplus. For an evaluation, therefore, the shadow wage, when consumption over time is the development goal, is placed above labour's social marginal product. Wage payments are a cost in the potential surplus that could have been reinvested. Consequently, the shadow wage is higher than labour's social marginal product by some premium. The premium is the value of savings in terms of consumption to society, and the higher the premium the higher the shadow wage.

Using the Little-Mirrlees formula the shadow wage of unskilled labour is:[9]

$$P_L = C - \left(\frac{C - M}{S}\right) \qquad (4.6)$$

where P_L is the shadow price of labour, C is the consumption of a new wage labourer, M is the marginal product in his former employment, and S is the premium on saving. The formula can be interpreted as a reduction C from project surplus less an amount for the value of additional consumption $\left(\frac{C - M}{S}\right)$

If the market wage and consumption (C) of, for example, an unskilled plantation employee is greater than his marginal product (M) on a family farm, there is an increase in consumption of C - M.[10] The economic

cost of employing the unskilled labour is, therefore, the extraction C from project surplus less the social worth of additonal consumption $\left(\frac{C - M}{S}\right)$. The higher the value of savings in terms of consumption (S > 1) the lower is the social worth of consumption and the higher the shadow wage.

The formula was used to impute the shadow wage for Colombian agricultural labour in 1971. The social marginal product of labour (M) was estimated at 22 pesos a day. The Appendix presents the data available for the estimate. Consumption (C) was assumed equal to the plantation wage rate which in 1971 was 38 pesos a day.[11] All that remains is to estimate S.

Litte-Mirrlees present three methods for estimating S. All require considerably more data than are available so that S must be a crude estimate. For Malaysia, for example, Little assumed S at unity which allowed M to be used as the shadow wage.[12] However, S could only be unity in Colombia if a Vanek fixed coefficient model were assumed. Chapter Two showed that in Vanek's model, a foreign exchange constrained economy may increase domestic saving with little, if any, effect on the growth rate. So S would be placed at unity if there were no premium on saving. Yet, Nelson's variable coefficient model gave some scope to domestic saving and so S will be greater than unity.

To calculate S Little-Mirrlees suggests the following formula:

$$S = 1 + \tfrac{1}{2}(R - V)T \qquad (4.7)$$

where R is the return on the marginal investment, V the rate at which the utility of consumption is falling and T the time until consumption will

become as valuable as saving. Theoretically, R is the internal rate of return on the marginal public project but since such a figure is difficult to obtain an estimate was made of the interest rate at which the government could borrow abroad. This was placed at 10 per cent. This coincides with the estimated social opportunity cost of capital in Colombia.[13] An estimate of V is the growth rate of real wages and of consumption. The growth rate of real wages is a proxy since it indicates the social time preference of consumption.[14] For the rural sector the growth rate of real wages has been 1.4 per cent a year. The value of T is clearly arbitrary, but from the development progress of Colombia suboptimality of savings will be longlasting. T was placed at thirty years. Substituting in the formula S becomes $(1.042)^{30} = 3.44$.

Consumption (C) and the social marginal product (M) are 38 and 22 pesos a day respectively (see Appendix 1). Substituting these values into equation (4.7) the shadow wage is 33 pesos a day. This is 89 per cent of the market wage.

For projection purposes consumption (C) is expected to rise by 2.2 per cent a year. This is above the historical rate (1.6 per cent), but the growth rate of real wages can be expected to accelerate.[15] Both Currie and the ILO assume that labour will become more productive. From its historical rate of 2 per cent over the period 1964 - 1970, average labour productivity is projected by the ILO to rise to 3.5 per cent a year over the period 1970 - 1985.[16] Allowing some margin for additional saving and tax payments, 2.2 per cent a year increase in consumption appears a reasonable estimate. To ease computation, projections of the shadow wage

are made in blocks of five years from year -2 in the life of a palm oil unit. This obviates the calculations of adjusting annual data, but incorporates the growth of consumption over time.[17]

The shadow wage will be the same on both tenure systems. The shadow wage is applicable to labour whose consumption rose as a result of the project. If net profits accrue from palm oil production, consumption on the family farm can be expected to increase; hence, the additional consumption must be included as a cost. Since labour on family farms and plantations differ little except in their place of work, there is no reason why the social worth of their additional consumption will differ. Hence $\left(\frac{C - M}{S}\right)$ in equation (4.6) will be assumed the same on both plantations and family farms.

1.4 Maximising current employment and the shadow wage

The time horizon assumed by Little-Mirrlees is sufficiently long that income is discounted at a low rate. A more myopic time horizon would give greater weight to current employment by raising the discount rate. It would also affect the shadow wage,

The effect of a more myopic time horizon on the shadow wage will be to lower the shadow wage from the level imputed by the Little-Mirrlees method. From equation (4.7), if either T is zero or the rate of time preference (V) is high, savings become no more valuable than consumption. The premium S therefore equals unity. With S = 1 the planning wage from equation (4.6) reduces to the social marginal product of labour (M) which

can be zero, positive or negative.[18]

A reduction in the shadow wage will clearly improve the relative position of the production technique and the land tenure system with the lower capital-labour ratio. Family farms can be expected to improve their position relative to plantations.

To evaluate the tenure systems additional criteria are used. The reason for additional criteria is that the social marginal product of labour measures contributions to output rather than employment. A shadow wage based on social marginal product is valid for the development goal of economic efficiency and Pareto Optimality as much as for current employment.

Chapter Two showed that a potential conflict exists between maximising current employment and current output. If production techniques have low capital-labour ratios but high capital-output ratios, a choice must be made between output and employment. A shadow wage based on labour's social marginal product may, therefore, not maximise employment but output.[19] To preclude this possibility, the two additional criteria indicate the capital-labour ratios on the two tenure systems. They compare the capital-labour ratio on the two tenure systems.

1.5 Net saving of foreign exchange and the shadow wage

Chapter Three explained that the palm oil project was established as an import substitute. This section aims to examine whether net imports were reduced. A net reduction in palm oil imports shifts the import constraint to the right in Figure 2.6.

To evaluate the land tenure systems, two criteria will be used.

The criteria will examine if the value of inputs imported during the lifetime of the tenure systems is less than the value of imports substituted by the tenure systems. If the value of inputs imported is less, foreign exchange has been saved. Using the notation in equations (4.1) and (4.2) the criteria is:

$$\sum_{t=-1}^{t=30} Z_t^* > \sum_{t=-1}^{t=30} C_{Mt}^* \qquad (4.8)$$

A positive sum indicates a net saving of foreign exchange.

The above criterion suffers from two serious deficiencies. Firstly, foreign exchange savings are not discounted. Clearly, this reduces the value of the criterion. Secondly, no account is taken of the domestic cost of saving foreign exchange. A project can yield a positive sum and yet may be inefficient in its use of domestic resources.

A preferable criterion is the internal exchange rate.[20] It discounts foreign exchange savings and it measures the domestic opportunity cost of the project. Using earlier notation the internal exchange rate is:

$$\frac{C_{Lt}^* + C_{St} + C_{Dt}^*}{(1+i)^{31}} \Big/ \frac{Z_t^* - C_{Mt}^*}{(1+i)^{31}} \qquad (4.9)$$

where the numerator is the discounted domestic cost of producing palm oil, and the denominator is the discounted foreign exchange saved by the tenure regime. The denominator is clearly derived from equation (4.8).

If the discount rate is accepted as a true measure of the cost of capital and the official exchange rate as a true measure of the value

of the peso, the internal exchange rate criterion indicates whether a land tenure system saves foreign exchange. The official exchange rate converts domestic costs into foreign exchange, and if the cost of converting domestic resources into foreign exchange on the tenure system is less than the official exchange rate, the land tenure saves foreign exchange.

The shadow pricing of inputs is complicated once foreign exchange is a constraint. The Little-Mirrlees method would convert all inputs - including labour inputs - into world prices, in order to represent domestic inputs into their equivalent foreign exchange cost. To convert into world prices requires a detailed breakdown of costs, and no such data are available for Colombia. Hence, only output is shadow priced at its world price.

The shadow wage used for the internal exchange rate depends on which constraint is most binding. If domestic saving is the principal constraint, the opportunity cost of labour must include the additional consumption brought about by employment. This would be the Little-Mirrlees shadow wage. Conversely, if foreign exchange is the principal constraint the shadow wage must be less than the Little-Mirrlees shadow wage. A high shadow wage would favour high capital-labour ratios. Yet Chapter Two showed that high capital-labour ratios tend to be import-intensive. If the objective is to save foreign exchange, low capital-labour ratios are desirable.

To take account of both constraints, two shadow wages are used. Initially, the shadow wage is high. In Colombia, consumption is a cost since whatever is not consumed would be saved as foreign exchange.[21] Hence, the Little-Mirrlees shadow wage of 33 pesos is used. However, in Colombia, the principal constraint is foreign exchange and low capital-labour ratios may be desirable.[22] To take account of this, the shadow wage

Table 4.1 The Empirical Evaluation of Tenure Systems

Development Goal (1)	Shadow Wage (pesos per day) (2)	Criteria (3)	Desirable Tenure Systems (4)	Difference in Ranking (5)
1) Consumption over time	33	$\sum_{t=-1}^{t=30} \frac{Zt - Ct}{(1+i)31}$	Plantation	4 per cent
2) Current employment and output	22	$\sum_{t=-1}^{t=30} \frac{Zt - Ct}{(1+i)31}$	Family farm	More than 3 per cent
3)	26	$\sum_{t=-1}^{t=30} \frac{Zt - Ct}{(1+i)31}$	Family farm	3 per cent
4) Current employment	22	$\sum_{t=-1}^{t=30} \frac{Ct}{\text{Man-year}}$	Family farm	Col. $9418
5)	22	$\sum_{t=-1}^{t=30} \frac{Ct}{CLt}$	Family farm	0.29
6) Net foreign exchange saving		$\sum_{t=-1}^{t=30} Zt - \sum_{t=-1}^{t=30} C_{Mt}$	Plantation	US $7 per hectare US $5 per hectare
7)		$\sum_{t=-1}^{t=30} \frac{C_{Mt}}{\text{hectares}}$	Family farm	Col. $342
8)	33	$\frac{CLt + CSt + CDt}{(1+i)31} \Big/ \frac{Zt - CMt}{(1+i)31}$	Plantation	Col. $3.5
9)	22	$\frac{CLt + CSt + CDt}{(1+i)31} \Big/ \frac{Zt - CMt}{(1+i)31}$	Family farm	Col. $1.4

of twenty-two is also used.

1.6 Results

The two tenure systems were compared for each of the goals. The shadow wage was adjusted to comply with the relevant concept of opportunity cost. The results can be seen in Table 4.1. The left-hand column has the three development goals and column three shows the criteria. Columns four and five show the results.

1.6.1 Maximising consumption over time

The shadow wage was placed at 33 pesos per man day and projected over the lifetime of the two tenure systems at an annual increasing rate. By year thirty the shadow wage rate for unskilled labour had reached 58 pesos per man-day. This and the other costs and revenues are shown in Tables A:XV to A.XXV for both tenure systems.

On the basis of their respective rates of return the plantation proved superior. The plantation has an internal rate of return of 14 per cent compared with 10 per cent on the family farm. The difference of 4 per cent is shown in Column five of Table 4.1. As the Little-Mirrlees criterion intended, low capital-labour ratios penalise family farms. The production technique and land tenure system with the higher capital-labour ratio would be selected. Currie's agricultural strategy of mechanised farming is endorsed.

1.6.2 Maximising current employment

Once the development goal becomes the maximisation of current employment, the shadow wage is reduced from the Little-Mirrlees wage. The shadow wage is reduced to 22 pesos which is an estimate of labour's social marginal product. Plantations and family farms were ranked by their internal rates of return. Family farms yielded a higher return. The return on plantations was 17 per cent compared with over 20 per cent on family farms.

The evaluation did not prove sensitive to changes in the shadow wage. The shadow wage was raised to 26 pesos which was over two-thirds of the market wage. Family farms continued to yield a higher return (19 per cent compared with 16 per cent on plantations). A shadow wage less than 22 as expected reinforced the dominance of the family farms: the divergence in the rates of return of family farms and plantations widened.

Two further tests were made. The reason was to preclude the possibility that output rather than employment would be maximised. This was explained more fully in Chapter Two.

The first test was to estimate the cost of generating a many-year of unskilled labour. Over the economic lifetime of the plantation and the family farm total costs were divided by the total number of man-days. This was converted to man-years by assuming a 250 day-year.[23] On the plantation, the cost of the plant and the number of man-years employed in the plant were excluded to prevent bias. These calculations are shown in Table A.XXV. The results strongly endorsed the family farm. The cost of generating a

man-year of unskilled employment on the plantation was twice that on the family farm. On the plantation, the cost was Col. $17,490 per man-year; the family farm the cost was Col. $8,072. Even so plantations compare favourably with the other vegetable oil crops in Colombia. The cost of generating a man-year of employment with cotton, sesame and soybean crops exceeded the cost of plantation palm oil.[24]

The final test was to compare labour coefficients. The labour coefficient is the percentage of labour costs as a proportion of total costs. The labour coefficient on the plantation regime was 0.39, and on the family farm regime 0.68. Again both regimes compare favourably with other commercial crops in generating employment. The family farm proved superior to all but one commodity group.[25]

1.6.3 Net foreign exchange saving

Equation (4.8) gave positive results for both plantations and family farms. Using criterion six in Table 4.1 this means that both tenure systems saved more foreign exchange than they incurred; that the cost of imported inputs was less than the foreign exchange equivalent of output. Over their economic lifetimes, the plantation made a net foreign exchange saving of US $8 million and the family farm US $93,150. Dividing through by size of units, plantations saved US $16.00 per hectare and family farms US $9.00 per hectare. Using criterion six, therefore, plantations are the more desirable tenure system since their net saving per hectare is greater.

The reason for the higher net foreign exchange saving per hectare

on plantations than on family farms lies on the revenue side. This is partly due to the inclusion of palm kernel oil in the plantation revenue, and its omission from the revenue schedule of the family farm. On the cost side, family farms are more desirable. The foreign exchange cost per hectare, as shown by criterion seven in Table 4.1 is lower on family farms than on plantations. The cost per hectare is US $872 compared with US $1,214 on plantations. Inclusion of palm kernel revenue improved the relative position of family farms. The net foreign exchange saving on family farms is raised to US $11.00 per hectare. Yet it still is below the US $16 net saving on plantations.

The internal exchange rate is the more sophisticated criterion. As noted earlier, it discounts the foreign exchange saving and indicates the opportunity cost of making that saving. Both tenure systems were compared using equation (4.9). The discount rate was placed at 11 per cent. Harberger has estimated the social opportunity cost of capital in Colombia at 10 to 11 per cent.[26] The higher figure was used because other sources have suggested that the private rate of return on capital may be as high as 25 per cent.[27] All foreign exchange was converted into domestic currency at the official exchange rate in the beginning of 1971 which was US $1 = Col. $20.95.

The internal exchange rates were compared using shadow wages of 33 and 22 pesos a day. The results can be seen in Table 4.1, and the calculations in Tables A.XXIII and A.XXIV.

Using a shadow wage of 33 pesos, the internal exchange rate

criterion clearly endorsed plantations. The internal exchange rate is Col. $21.6 = US $1 on family farms compared with Col. $18.1 = US $1 on plantations. This indicates that the opportunity cost of earning US $1 is less on plantations than on family farms. In addition, the opportunity cost on family farms is higher than the official exchange rate. This means that Colombia would pay less to import palm oil directly than to produce palm oil domestically on family farms. On plantations, the opportunity cost is less than the official exchange rate; hence, palm oil production on plantations saves net foreign exchange.

Alternatively, the shadow wage was placed at 22 pesos. A shadow wage of 22 implies that foreign exchange rather than domestic saving is the binding constraint. It yielded a favourable result to family farms. The internal exchange rate is Col. $13.6 = US $1 on family farms compared with Col. $15 = US $1. Both tenure systems are feasible import substitutes since their opportunity costs are less than the official exchange rate of Col. $20.95 = US $1. However, on family farms, the opportunity cost is less than on plantations. Hence, if the principal constraint is foreign exchange, family farms are the desirable land tenure system.

Conclusions

This section aimed to evaluate two land tenure systems which produce a homogeneous crop, palm oil. Three different development goals were postulated, and each tenure system was evaluated by the appropriate criteria. Indirectly, the evaluation was directed at the two agricultural policies proposed for Colombia.

To evaluate the tenure regimes for their ability to maximise consumption over time, the planning wage was established at 33 pesos a man-day. With a higher capital-labour ratio, the plantation was ranked above the family farm regime. Empirically, plantation regimes are socially preferable if consumption over time is the development goal. The Currie policy of mechanised plantation agriculture is endorsed.

On the other hand, maximising current employment led to a clear preference for the family farm. By all four criteria, as seen in Table 4.1, family farms are superior in maximising current employment. This is an endorsement of the ILO strategy.

The goal of maximising net foreign exchange led to an inconclusive result. Foreign exchange costs per hectare are lower on family farms than on plantations, yet the net foreign exchange saving of plantations was greater than that of family farms. The reason was shown to lie in the revenue schedule of family farms.

The internal exchange rate similarly was inconclusive. The desirable tenure depends on the constraint facing Colombia. If Colombia is constrained by inadequate domestic saving plantations are desirable. They maximise net foreign exchange saving with the shadow wage at 33 pesos. Alternatively, if Colombia is constrained by foreign exchange, family farms are preferable. Their opportunity cost of net foreign exchange saving is less than on plantations.

The limitations of the above conclusions should be noted. They are valid only for intra-sectoral decisions and for marginal changes. They also depend on the assumption that only one goal at a time is maximised.

2. An Empirical Examination of the Micro Model

Introduction

The micro model showed that if certain conditions hold, the capital-labour ratio on plantation regimes will be higher than the capital-labour ratio on family farm regimes. The section below intends to indicate whether the conditions will hold in the Colombian palm oil industry.

1. To show that $(L/N)_f < (L/N)_p \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}}$

Equation (2.20) gave the condition for the capital-labour ratio on plantations $(K/L)_p$ to exceed the capital-labour ratio on family farms $(K/L)_f$ as $(L/N)_f < (L/N)_p \left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}}$ where $(L/N)_f$ and $(L/N)_p$ refer to the labour-land ratio on family farms and plantations respectively, and α and γ to the respective shares of labour and land.

Initially, this section will impute values to factor shares, afterwards the relationship between $(L/N)_f$ and $(L/N)_p$ will be examined. Clearly, if $(L/N)_f$ exceeds $(L/N)_p$, the value of $\left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}}$ is critical if equation (2.20) is to hold. If the share of output going to labour (β) is zero and $\alpha = \gamma = 0.5$ then $\left(\frac{1}{\alpha}\right)^{\frac{1}{\gamma}} = 4$, which means that $(L/N)_f$ cannot exceed $(L/N)_p$ by more than four times if equation (2.20) is to hold. The higher the value of β and the lower the values of α and γ, the greater the multiple by which $(L/N)_f$ can exceed $(L/N)_p$. The more likely is the condition to hold.

Estimates of factor shares in Colombian agriculture have been made by Berry from 1960 census data.[28] As Table 4.2 indicates, family

farm and plantation regimes fall within the three wealthiest deciles. Only

Table 4.II Labour and Capital Shares in Colombian Agriculture, 1960

Decile in Income Distribution	Approximate Size of farm (hectares)	Hired Labour Share	Imputed Pure Labour Share	Total Labour Share	Capital and Land Share
1	<1	723	13.9	86.2	13.8
2		70.2	14.9	85.1	14.9
3		80.8	9.6	90.4	9.6
4	1 - 2	80.6	9.7	90.3	9.7
5		81.9	9.0	90.9	9.1
6	2 - 3	57.7	21.1	78.8	21.2
7	3 - 5	30.3	34.8	76.1	34.9
8	5 - 10	7.5	40.4	47.9	52.1
9	10 - 20	1.8	25.3	27.1	72.9
10	>20	1.2	5.7	6.9	83.1
AVERAGE		18.9	14.4	33.3	66.7

Source: A. Berry, Land Distribution, Income Distribution and the Productive Efficiency of Colombian Agriculture. Yale Growth Center Discussion Paper No. 108, Yale University, March 1971, tables 5 and 6 (mimeographed).

the wealthiest 30 per cent are those with sufficient land either to be family farmers or to hire labour. Some 70 per cent of farm families earn

the majority of their income as hired labour.[29]

The family farm is defined in Chapter One as a unit which does not hire labour. The Comité Interamericano de Desarrollo Agricolá (CIDA) defines a family farm as a unit which can support two to four workers.[30] If labour is not hired and the unit supports no more than four workers, the family farm regime must fall within the eighth and ninth deciles. The family farm regime cannot be below the eighth decile because the proportion of income going to hired labour is high whereas in the eighth and ninth decile the proportion of total income going to hired labour is between 7 and 16 per cent. The family farm regime will not be in the tenth decile because the importance of hired labour increases. In the tenth decile the proportion of total income to hired labour is 21 per cent.

Plantation regimes correspond approximately to the tenth decile. Farm sizes are large and the proportion of hired labour increases. Berry presents a detailed breakdown of factor shares on units over 20 hectares.[31]

The total labour share (α) on family farm and plantation regimes is low. Labour's share is not more than 0.48 and may be as low as 0.28 on family farms. On plantation, labour's share is 0.07 which is the lowest among the deciles. On units of 500 hectares labour's share fall below 0.07. Moreover half of labour's share on units of 500 hectares is due to technical personnel.[32] An estimate of pure labour share which excludes human capital would place a value on α of approximately 0.02.

In Table 4.II, capital is a composite figure that includes land

hence, β and γ cannot be separated. The composite figure is positively related to size with $\beta + \gamma$ rising to 85 per cent for farms over twenty hectares. For units over 2,500 hectares, the composite figure for capital rises to 95 per cent. If β forms a large proportion of capital γ will be low, and equation (2.20) is likely to hold.

That the share of land (γ) in palm oil production is low is indicated by the cost of land as a proportion of total cost. In Colombia, the plantation Coldesa paid three million pesos for 6,000 hectares which is an approximate cost of US $71 a hectare.[33] Even at current prices, a hectare of land costs less than 10 per cent of the total cost of establishing a hectare of oil palms.[34] On an annual basis, the Instituto Colombiano Agropecuaria (ICA) imputes a rent of only 1500 pesos for a 500 hectare unit.[35] Over the first five years, the rent constitutes less than 1 per cent of total investment costs.

Conversely, the data indicate that β is high in palm oil production. On a one hectare unit investment expenditures alone have been estimated at US $393.[36] If payment for extension work is included, the investment cost per hectare is US $522. In the initial two years of a family farm in Colombia, investment capital amounts to US $257 a hectare. In addition, working capital amounts to US $53 a hectare. Similarly, on plantation regimes capital is a major proportion of total cost.[37] On a 500 hectare palm oil plantation capital accounts for 54 per cent of total cost. If skilled personnel is included capital is 74 per cent of total cost. A 1956 study of a 5,000 hectare plantation placed the proportion of investment expenditures at 15 per cent of total expenditures over the plantation's life.[38] Working capital raised the total capital input to 80 per cent of total expenditures.

The combination of high capital share (β) and low land share (γ) reinforces the low value for α. Low values for both α and γ increase the multiple by which $(L/N)_f$ can exceed $(L/N)_p$.

Whether the labour-land ratio is higher or lower on plantations than on family farms may vary by countries. Myint for West Africa states that the labour-land ratio on family farms is less than the labour land ratio on plantations.[39] If $(L/N)_f$ is less than $(L/N)_p$ then equation (2.20) will clearly hold. The values for α and γ are irrelevant. However, the possibility exists that $(L/N)_f$ is greater than $(L/N)_p$.

The labour-land ratio on family farms may exceed the labour-land ratio on plantations for three reasons. Firstly, labour is hired on plantations and will be hired until the value of marginal product is equal to the positive market wage. Labour on the family farm is not hired. Family labour may be used until their marginal product becomes zero. Hence, the cost of labour to family farms is less than to plantations. Secondly, the cost of land will tend to be less on plantations than on family farms. One of the characteristics of Latin American agriculture is that land is underutilised on large-scale holdings. Underutilisation implies a low imputed cost. A lower rent on plantations reinforces the higher labour-land ratio on family farms than on plantations. Thirdly, plantations tend to apply labour saving innovations to economise on labour. Labour saving innovations reduce the labour-land ratio. On the other hand, family farms apply land saving innovations and these raise the labour-land ratio.

That $(L/N)_f$ exceeds $(L/N)_p$ is supported by data from Colombia.[40] It is shown in Table 3.II. In 1960, 31 per cent of the agricultural labour

force worked on family farms which account for 23 per cent of the agricultural land. The labour-land ratio is 0.12 men per hectare. On plantations, 4 per cent of the agricultural labour force accounted for 50 per cent of the agricultural land. The labour-land ratio on plantations is 0.007 men per hectare. Hence $(L/N)_f$ exceeds $(L/N)_p$ by a multiple of seventeen.

Disaggregation by crop continues to yield a higher labour-land ratio on family farms but the multiple is reduced. On a family farm producing palm oil the labour-land ratio is thirteen man-years per hectare, on a 500 hectare plantation, the labour-land ratio is eight man-years, and on a 5,000 hectare plantation, the labour-land ratio is seven man-years.[41] The labour-land ratio is greater on family farms, but by a multiple less than two. During the peak years of a family farm the number of man-years per hectare is 0.46, and on a 500 hectare plantation, the number of man-years is 0.30. The labour-land ratio on family farms is less than twice that on plantations.

The relative labour-land ratios suggests that equation (2.20) will hold. If $(L/N)_f$ is greater than $(L/N)_p$ by a multiple of less than two the share of capital (β) could be zero and equation (2.20) hold. As the section suggests β is likely to be greater than zero in palm oil production. Hence equation (2.20) will tend to hold for palm oil.

2. To show that $APP_L = \theta MPP_L$ where $0 < \theta < 1$ and that $\lambda < \psi$

In the micro model two assumptions were made. First, that the cost

of labour on plantations is higher than the cost of labour on family farms. In equation (2.21) this assumption was stated as $APP_L = \theta MPP_L$ with $0 < \theta < 1$. Secondly, an assumption was made that credit facilities for plantations are less costly and more accessible than those for family farms. In equation (2.29) this assumption was expressed as $\lambda < \psi$. Since Chapter Five presents reasons for both assumptions, this chapter will do no more than indicate that both assumptions are plausible. Further data can be found in Chapter Five.

That labour costs are higher on plantations than on family farms is indicated by high wage rates on palm oil plantations.[42] In 1970, the average wage rate paid in Colombia was twenty pesos a day, on palm oil plantations the wage rate was thirty-two pesos a day.[43] Monthly earnings of the average male agricultural labourer in 1970 was 560 pesos, working only twenty-two days a month palm oil labourers earned more than 700 pesos.[44] The higher labour costs on plantations are also due to the social security payments that plantations are required to make. Further, plantations are subject to Colombia's labour legislation which demand medical, educational and other facilities for employees. Family farms are exempted. Consequently, both higher wage rates and the enforcement of social legislation force up the cost of labour on plantations above the cost of labour to family farms. Harberger for Colombia estimates that the cost of labour on family farms is half that of the cost of labour on plantations.[45]

Chapter Five presents in detail the data for assuming that plantations pay less for credit and have more credit available than family farms. With over half of the agricultural credit going to 10 per cent of

farms the distribution of credit is clearly skewed. The data indicate that plantations are the beneficiaries of the skewed distribution.

3. To show that the production function allows factor substitution in response to factor price changes.

Of particular interest to this thesis is the marginal rate of technical substitution in palm oil production. A zero marginal rate of technical substitution precludes adjustments in the factor price ratio from changing the capital-labour ratio. A zero marginal rate of technical substitution exists when isoquants are L-shaped and factor proportions are fixed.

The sensitivity of the capital-labour to adjustments in the factor price ratio can be estimated by the elasticity of substitution. The more sensitive the capital-labour ratio to the marginal rate of technical substitution, the higher the elasticity of substitution. The higher the elasticity of substitution the more able the government is to change capital-labour ratios by factor price changes.

While no estimate has been made of the elasticity of substitution in palm oil production, the data appear to show that the elasticity of substitution is high. Firstly, estimates of the elasticity of substitution in underdeveloped countries are high. The figure of unity has been accepted as a reasonable estimate for underdeveloped countries.[46] Two studies, one on Puerto Rico and the other on Argentina estimated the elasticity of substitution at one, and another study on five Latin American countries including Colombia estimated the elasticity at 0.8.[47] Nelson estimated

0.7 for Colombia.[48] Secondly, agriculture perhaps has greater substitution possibilities than manufacturing industry. If this is so palm oil would tend to yield a high elasticity of substitution.

To estimate the elasticity of substitution data are needed on the average product of labour, wage rates, and, for agricultural commodities, on the average product of land.[49] For palm oil such data are not available. Instead this section will aim to show that the marginal rate of substitution is positive by comparing production techniques of family farms and plantations. If palm oil is produced on farms of the same size by different techniques the indication is that technical substitutability exists.

To indicate that technical substitution exists in the same country, family farms are compared within two regions of Nigeria.[50] In the production of palm oil there are wide variation in labour inputs. For planting cover crops, the number of man-days per hectare varies from one to twelve. For maintenance the number of man-days per hectare ranges from half to fourteen. Total establishment labour inputs within the same region vary from eighty-five man-days to 173 per hectare. In the other region, the establishment labour input rises to 240 man-days per hectare. This is almost triple the lowest establishment labour input. For mature oil palms the variations in man-days per hectare are only slightly less. Within the same region of Nigeria the number of man-days per hectare ranges from 20 to 50. In the other region the number of man-days is 64.

Variations in man-days per hectare are reflected by the labour coefficient. The labour coefficient is the labourer's proportion of total cost. Within the same region of Nigeria during the establishment

period the labour coefficient ranges from less than 50 per cent to 79 per cent. The range between the regions is even wider.

Data from other countries increases the variation in factor inputs. In the first two years of palm oil production in Colombia on a family farm the number of man-days per hectare varies from 109 to 166.[51] On a ten hectare family farm this is a difference of 570 man-days, or over two man-years. For the same period in Guinea, the number of man-days is 125 and in Nigeria 111.[52] On a mature family farm, the number of man-days per hectare of oil palms ranges from a high of 117 in Colombia to fifty-one in Guinea. In the Western Region of Nigeria a hectare of mature oil palms requires twenty man-days.

The disparity in labour inputs on family farms that produce palm oil indicates that the marginal rate of technical substitution in positive.[53] Similarly, the disparity in capital input indicates that the isoquant is convex. In Nigeria, the cost of capital per hectare during the establishment period can be almost twice as much on one family farm than on another within the same region. The capital coefficient varies by more than two times from one family farm to another.

For plantations similarly the marginal rate of technical substitution appears positive. In Colombia there are wide variations in capital and labour inputs. The variation in capital inputs is largely due to mechanical inputs. Certain operations can be either highly mechanised or labour intensive, and on plantations the technique applied depends largely upon factor costs. In Colombia labour costs are higher than in Africa and have induced substitution of capital for labour.[54] The higher

labour costs have tended to result in highly mechanised operations on certain plantations.

On three of the plantations in Colombia, operations tend to be highly mechanised.[55] For example, Indupalma has six Caterpillar tractors and twelve wheeled-tractors and Coldesa has twelve tractors, fifteen other transport vehicles and thirty-five pieces of machinery.[56] Risaralda has twenty-eight vehicles and pieces of machinery. The result can be seen in certain operations. On the above plantations mechanical saws and bull-dozers are used to clear land. To clear and to level a hectare of land at Indupalma takes thirty-two hours of caterpillar and an input only three hours of unskilled labour. At Risaralda, thirty-eight hours of machinery are needed to clear a hectare of land. Unskilled labour accounts accounts for a mere 8 per cent of the total cost. Similarly, in road and bridge construction certain of the plantations use machinery. A hectare of road and bridge building takes 117 hours of caterpillar, and labour accounts for 15 per cent of the total cost.

On other plantations, the same operations are labour intensive and use little machinery. The plantations Casacara and Palmarina only have two tractors each.[57] Land clearing by hand may require 170 man-days per hectare. On the 500 hectare plantation thirteen man-days per hectare are required. In road and bridge construction labour constitutes 60 per cent of the total cost. With the regional disparity in labour costs in Colombia the proportion of labour varies by region.

For other countries also there are clear indications that on plantations capital can be substituted for labour.[58] In Malaysia and in the

Congo land clearing can either be capital intensive or labour intensive. In Malaysia with labour intensive operations, the labour coefficient is 70 per cent, with capital intensive operations the labour coefficient is less than 50 per cent. In the Congo the same land clearing operations may take fifty man-days per hectare or ninety-nine man-days per hectare. In the Congo nursery land clearing may take sixty-two man-days per hectare or 193 man-days. With such variation within the same countries, the marginal rate of technical substitution appears positive.

In other operations of plantations labour intensive or capital intensive techniques can be applied. In Malaysia the number of man-days to harvest a hectare of palm oil a year varies from twenty-two to thirty-three. In Africa to prune a hectare of palm oil requires from five to twelve man-days, in the Congo alone the man-days to prune a hectare of palm oil varies from four to ten. In the Ivory Coast maintenance of adult plantations may take thirty man-hours per hectare a year or one tractor hour per hectare. With such variations in labour and capital use, the marginal rate of technical substitution appears positive.

From the data the marginal rate of technical substitution appears positive on both family farms and plantations. More data are available on plantations than on family farms, yet from data in Nigeria family farms have wide variations in labour and capital inputs. On plantations there is considerable evidence to indicate that certain operations may be either labour or capital intensive. If technical substitutability exists adjustments in factor price ratios can change the capital-labour ratio.

Chapter Notes

1. The feasibility studies were prepared over the years 1969-1971 for the area of Tumaco. Instituto Colombiano Agropecuario (ICA), "Oleaginosas Perennes", Cali, 1971 (Mimeo). For further information see the Appendix.

2. "For most families and most crops five hectares can be considered the minimum of crop land needed to earn enough to support some minimum level of living." International Bank for Reconstruction and Development, (IBRD) Economic Growth of Colombia: Problems and Prospects, Baltimore, Johns Hopkins University Press, 1972, p. 238.

3. A "plantation" as in Chapter One is defined by a minimum land size, a pattern of monoculture and intensive cultivation.

4. Among those who favour use of the internal rate of return are A. Merrelt and A. Sykes, The Finance and Analysis of Capital Projects, London, Longmans Green and Co. Ltd., 1963. Those who reject its use are J. Hirschleifer, "On the Theory of Optimal Investment Decisions", Journal of Political Economy, vol. 66 (July 1958), pp. 329-352 and M. Dryden, "Capital Budgeting Treatment of Unertainty and Investment Criteria", Scottish Journal of Political Economy, vol. 11 (November 1964, pp. 235--259.

5. As for example by the recent United Nations, Guidelines for Project Evaluation, Industrial Development Organisation, (ID/SERH/2), 1972.

6. Domestic capital inputs include part of fertiliser inputs, transport, machinery and pesticides. Import capital inputs include farm machinery, fertiliser and seeds. By including these capital inputs some proportion of the "capital" in oil palms is incorporated. imputing a value to the capital stock of oil palms is therefore partly obviated.

7. Equation (4.4) indicates that output in any year depends upon the year in which the palms were planted. Oil palms give higher yield per hectare for years after year until ten years after planting. Oil palm planting is staggered due to the sophisticated nature of the crop which limits the number that can be planted in any one year.

8. A. Sen, Choice of Techniques, New York, Kelley, 1968.

9. Organisation for Economic Cooperation and Development (OECD), Manual of Industrial Project Analysis in Developing Countries, Vol II (by Little and J. Mirrlees), Development Centre, Paris, 1969.

10. The increase in consumption is composed of two components. To assume that the farm family member consumes his average product (a > m), those who remain on the farm will increase their consumption by a - m, while the labourer himself on the plantation will increase his consumption by c - a. (c - a) + (a - m) = c - m.

11. 38 pesos a day was the wage rate paid by the two largest palm oil producers (Indupalma and Coldesa) to their contract labour.

12. OECD, A Social Cost Benefit Study of the Kulai Palm Oil Estate, (by I. Little and D. Tipping), Development Centre Case Study No. 2, Paris 1972.

13. A. Harberger, Project Evaluation: Collected Papers, Chicago, Markham Publishing Col, 1972.

14. V is the rate of time preference. The rate of growth of real wages can be used as an estimate because that indicates the marginal utility of consumption. The higher the rate of growth of real wages the higher will V be. The assumption is made that savings and taxes out of wages are negligible.

15. Departamento Administrativo Nacional de Estadisticas (DANE). Buletin Mensual de Estadisticas No. 238, May 1971.

16. International Labour Office (ILO), Towards Full Employment, Geneva, 1970, p. 28.

17. This technique was used for projection purposes by Little and Tipping, op. cit.

18. The shadow wage can be expressed as:

$$\frac{(Cw - C\pi)\lambda}{1 + (1 - C\pi)\lambda} W$$

where Cw and Cπ are the marginal propensities to consume of wage earners

and capitalists respectively, W the money wage rate and λ the value of saving in terms of consumption. The shadow wage will be zero either when $\lambda = 0$ (the amount of saving is optimal) or when $C_w = C_\pi$. In addition two further conditions are necessary. Firstly, the social marginal product of labour must remain at zero over the whole lifetime of the project, and over 30 years of a palm oil unit this is implausible. Secondly a zero shadow wage implies that no supplementary expenditures are necessary when employing labour. If these conditions are not fulfilled the shadow wage will be positive. If $\lambda = 1$ and if $C_w = 1$ the planning wage will be equal to the money wage rate. A. Sen, op. cit.

19. "It is surprising that manpower planners have shied away from benefit-cost analysis of labour intensive relative to capital intensive techniques of production . . . since such analysis would throw much scope on the potential scope for employment creation in developing countries." O. Mehmet, "Benefit-Cost Analysis of Alternative Techniques of Production for Employment Creation", International Labour Review, vol. 104 (July-August 1971), p. 38.

20. This is a variety of the "Bruno test". M. Bruno "The Optimal Selection of Export Promoting and Import Substituting Projects", in Planning the External Sector: Techniques, Problems and Policies ed. by United Nations, Industrial Development Organisation, New York, 1967, pp. 88-136.

21. "Every increment of domestic consumption has some foreign exchange cost. For primary products other than coffee potential exports are directly reduced by domestic consumption." J. Sheehan, "Imports, Investment and Growth - Colombia", in Development Policy - Theory and Practice ed. by G. Papanek, Cambridge, Harvard University Press, 1963, p. 99.

22. "Usually it appears that the foreign exchange constraint is the more restrictive . . . this is not to say that lack of internal capital may not be a constraint but only that too much importance has been given to it." L. Currie, "The Exchange Constraint on Development - a Partial Solution to the Problem", Economic Journal, vol. 81 (December 1971), p. 888.

23. Berry assumes a 250 man-days per year in Colombia. A. Berry, "Land Distribution, Income Distribution and the Productive Efficiency of Colombian Agriculture", Yale Growth Center Discussion Paper No. 108,

Yale University, 1971.

24. International Bank for Reconstruction and Development (IBRD), "Economic Position and Prospects of Colombia", Restricted Report No. WH - 2110C, 1972, table 7.4.

25. Loc. cit.

26. Harberger, op. cit.

27. R. Nelson, T. Schultz, R. Slighton, Structural Change in a Developing Economy, Princeton University Press, 1971.

28. Berry, op. cit.

29. That more than 70 per cent of Colombia's farm families earn the majority of their income as hired labour is mentioned by Herman Festenhausen, "Agrarian Reform and Development", Land Reform in Chile, Colombia and Venezuela. Agency for International Development, Washington D.C., vol. V June 1970, p. 8.

30. Comite Interamericano de Desarrollo Agricola, Tenencia de la tierra y desarrollo socio-economico del sector agricola en Colombia, Washington D. C., 1967.

31. Berry, op. cit., p. 22.

32. loc. cit.

33. The 6,000 hectares were acquired in the early 1960's.

34. In Colombia, the cost of land is approximately 3,000 pesos a hectare, and the cost of establishing a hectare of palm oil between 30,000 and 35,000 pesos.

35. Instituto Colombiano Agropecuario, "Costo de la produccion para una hectarea de palma africana unidad de 500 hectareas", ICA Oleaginosas Parennes, Cali, n.d. (mimeographed).

36. H. Blume, "Societé pour le developpement et l'Exploitation du Palmier à l'Huile", African Studies, vol. xxx (1971), pp. 175-192.

37. "The essence of the economic structure of a plantation is better revealed by the fixed capital investment allocation than by an other single measure". David L. MacFarlane and Matthew A. Oworen, "Investment in Oil Palm Plantations in Nigeria", Economic Development Institute, University of Nigeria, August 1965, p. 40.

38. Federacion Nacional de Cultivadores de Palma Africana, "La Palma Africana en Colombia", Colombia, July 1967.

39. "Mines and plantations are large-scale enterprises which normally require more labour per unit of land than peasant agriculture", Hyla Myint, The Economics of Developing Countries, London, Hutchinson, 1964. p. 53.

40. The data come from Felstehausen, "Agrarian Reform and Development, op. cit., p. 9.

41. The figures for the family farm and the 500 hectare plantation are derived from the technical data given in the Appendix. Figures for the 5,000 hectare plantation come from Federaccion Nacional, La Palma Africana en Colombia, op. cit.

42. The marginal product of labour will be higher on plantations than on family farms. This will tend to produce higher wage rates. However, there are also distortions in the labour market on plantations which may force up wages.

43. The average wage is for hot climates without food. DANE Boletin mensual de Estadistica (nos. 253-254 Bogota, August and September 1972), p. p. 163-164. The plantation wage rate comes from Q. Vasquez, "Aspectos tecnicos del cultivo de la Palma de Aceite", Cucuta, 1970. (mimeographed).

44. DANE, Boletin mensual de estadistica (no. 238, Bogota, May 1971), p. 88.

45. "For unpaid family members . . . we imputed an average value of labour equal to 50 per cent of the average earnings of wage and salary workers in agriculture." Arnold C. Harberger, Project Evaluation (Chicago: Markham Publishing Co. 1972) p. 134.

46. "the . . . estimate of unity has been widely quoted and perhaps accepted as the 'best' estimate of substitution in developing countries". ST. J. O'Herlihy "Capital Labour Substitution and the Developing Countries: a Problem of Measurement", Oxford Bulletin of Economics and Statistics vol. XXXIV (August 1972), p. 273. This is either for aggregate output or for manufacturing output.

47. Ibid., A review and criticism of the three studies are undertaken, also the references are given.

48. Nelson, Schultz and Slighton, op. cit. p. 95.

49. As for example by K. H. Norrie, "Capital Labour Substitution and Technical Change in the Early Wheat Economy", University of Calgary Department of Economics Research Paper No. 7, n.d. (Mimeographed).

50. Data for Nigeria family farms comes from FAO. Agricultural Development in Nigeria 1965-1980, Rome, 1966.

51. Data on family farms comes from the sample and from Instituto Colombiano Agropecuario, "Costo de production para una hectarea de Palm African a nivel de pequeño agricultor, zona de Nariño", ICA Oleaginosas Perennes,, Cali, 1971, (Mimeographed).

52. Data on Guinea come from Blume, op. cit.

53. This assumes that output and technology are constant.

54. The assertion about relative labour costs is used to explain why palm oil operations in Colombia are more capital-intensive than those in Africa. M. Ollagnier, "La plantacion de palmera de aceite de San Alberto", Oleagineux, No. 10 (October 1966), p. 554-560.

55. Ibid.

56. Data on labour and capital inputs on Indupalma, Coldesa and Risaralda are from personal interviews on the plantations.

57. Cofiagro, "Palmas oleaginosas de Cascara Ltda", Bogota, 1969. (Mimeographed). Cofiagro, "Palmas oleaginosas de la hacienda Palmarina", Bogota, n.d. (Mimeographed).

58. The data below are either given directly, or are calculated from C.W. Hartley, The Oil Palm, London, Longmans, Green and Co. Ltd., 1967.

CHAPTER FIVE

POLICY IMPLICATIONS AND CONCLUSION

Introduction

In Chapter Two, land tenure systems were compared theoretically, and important policy implications emerged. These policy implications were shown in matrix form. This chapter will examine the policy implications in greater detail and deduce from them specific policy measures. The purpose is to illustrate how certain policy measures can change tenure systems.

The policy variables are the cost of labour and the cost of capital. Specific policy measures are proposed which can adjust the cost of labour and the cost of capital. Since the capital-labour ratio is a function of the wage-rental ratio, adjustments in the relative cost of labour and capital will affect the capital-labour ratio. Indirectly land tenure systems will be affected.

Distortions in the cost of labour and the cost of capital are examined. These distortions are important because they are able to nullify policy measures. The distortions produce a divergence in the capital-labour ratio. By distorting the capital-labour ratio they may nullify attempts to change land tenure systems.

Adjustments in the exchange rate are excluded as a policy measure for two reasons. First, distortions caused by an overvalued exchange rate have been reduced by the sliding peg exchange rate. The peg is adjusted automatically for changes in the relative domestic-foreign price level. Consequently, the exchange rate is no longer an exogenous policy variable. Second, the exchange rate is too blunt an instrument. Selective policy measures may be more effective.

The final section will summarise the principal conclusions of this thesis.

1. Policy Implications

1.1 Technological dualism[1]

Technological dualism is a variant of the inter-sectoral models applied to one sector only. In developing countries, sectors tend to be bifurcated into a) economic units which use modern technology and b) those economic units which rely on traditional skills. Within the same sector there will be large-scale units using modern production techniques and small units which continue to apply traditional methods of production. In the production of certain crops, such as wheat, the dichotomy is characterised by the mechanised plantation and the non-mechanised family farm.[2]

Technological dualism exists because of factor price distortions. They prevent modern technology from diffusing throughout the sector. In a perfectly competitive world the new technology would produce falling costs and falling prices. Non-innovators would either revert to non-market

agriculture or leave the land. The traditional sub-sector would thereby disappear. However, factor price distortions may check the diffusion process. They allow non-innovators both to survive and to compete successfully. The result is a technologically dualistic pattern of production.[3]

Two distortions which produce technological dualism are the cost of labour and the cost of capital. The distortions produce divergent capital-labour ratios within the same sector. If factor prices are not equalised the cost of factors will vary from one farm to another. Certain farms will pay more for labour and less for capital than others. With the capital-labour ratio a function of the wage-rental ratio, the capital-labour ratio will diverge. If the function is positively related, the higher wage-rental ratio will produce a higher capital-labour ratio. In Colombia, this appears to be the case with plantations. Plantations appear to pay more for labour and less for capital than family farms; hence, their capital-labour ratios are higher.

In Chapter Two, the micro model explained divergent capital-labour ratios by different maximising behaviour. Plantations were shown to favour higher capital-labour because they maximise profits. The existence of distortions therefore reinforces the conclusions of the micro model. Plantations will tend to have higher capital-labour ratios than family farms, partly because of their maximising behaviour, and partly because they pay more for labour and less for capital than family farms.

1.1.1 Dualism in the capital market

From the evidence available, large farms in Colombia appear to

enjoy a) a lower cost of credit and b) greater accessibility to credit than small farms. Technological dualism is clearly reinforced if the units most likely to mechanise pay less for their credit and have more credit available.

The cost of credit is low for all farms in Colombia. The principal source of agricultural credit is the Caja Agraria. As Table 5.I shows, the cost of credit in 1971 from the Caja ranged from 7 per cent for working capital to 13 per cent for long term (15 years) farm purchases. Except for the commercial banks and Cofiagro no other institutions charged an interest rate above 12 per cent. For certain purposes the cost of credit was as low as 4 per cent.[4]

During recent years Colombia has been experiencing an inflation rate of over 8 per cent. Annual inflation of 8 per cent combined with nominal interest rates of 4 to 12 per cent yield real interest rates which are low or negative. With the capital-labour ratio as a positive function of the wage-rental ratio, the low cost of credit will increase the capital-labour ratio on all farms.

Plantations, however, will enjoy an even lower cost of credit than the family farms for two reasons. First, plantations are less risky than family farms, and creditworthiness rather than the expected productivity of the investment, is the only criterion in much of Colombian bank lending.[5] Second, the administrative costs of lending to a few large farms such as plantations are lower than lending to many small borrowers such as family farms.

Table 5.I The Availability of Institutional Credit in Colombian Agriculture in 1970

Institution	No. of Loans	%age of Total	Amount of Loans (Col. $)	%age of Total	Average (Col. $)	Interest Rate (%age)[1]
Caja Agraria	348,134	80	3,398,272	56	9,761	7 - 13
INCORA	25,000	6	187,800	3	7,512	4 - 12
Banco Ganadero	5,755	1	446,824	7	77,641	9 - 11
Commercial Banks	57,818	13	1,864,502	31	32,248	14
Cofiagro[2]	187	-	209,794	3	1,121,893	10 - 14.5
	436,894	100	6,107,192	100	13,979	

Source: International Bank for Reconstruction and Development, "Economic Position and Prospects of Colombia", Report No. WH-211a. January 1972, tables 7.5, 7.6.

1. The interest rate is for 1971.
2. The interest charged by Cofiagro is assumed equal to that charged by the Private Investment Fund.

Not only is their credit cheaper, but plantations have readier access to credit than family farms. Of the five agricultural credit institutions, as shown in Table 5.I, only the Caja Agraria and INCORA lend to family farms. The Banco Ganadero, commercial banks and Cofiagro deal almost exclusively with large units such as plantations. Together the

latter three distribute 41 per cent of the institutional credit. Family farms are therefore excluded from a considerable portion of the available credit. The palm oil industry can be used as an illustration. In 1970, Caja Agraria, the Private Investment Fund (FIP) and Cofiagro together loaned over 23 million pesos to the palm oil industry. The Private Investment Fund and Cofiagro cater for units over 100 hectares, whereas the Caja concentrates on smaller farms. Yet of the total credit the loans of the Caja accounted for less than 1 per cent. The bulk was reserved exclusively for plantations.[6]

There is evidence that even the two institutions catering for smaller units, (the Caja Agraria and INCORA), tend to favour large farms.[7] Griffin has demonstrated a bias of the Caja towards larger farms.[8] Typical crops of large farms such as cotton receive loans that are almost ten times the average loans on typical smallholder crops. During 1967/1968 loans of less than Col. $5,000 (US $250) accounted for three-quarters of the total number of Caja loans, but they accounted for less than a quarter of the total value.[9] Similarly, the evidence from INCORA suggests that it has shifted to larger borrowers in order to reduce administrative costs.[10]

Family farms therefore are largely excluded from such credit sources as the Banco Ganadero, the commercial banks and Cofiagro. If further the institutions such as the Caja and INCORA, designed to cater to family farms, are concentrating more on large farms, family farms will have less credit available to them than plantations. This is illustrated by the pattern of lending. Less than half of the total agricultural

credit goes to the bulk (90 per cent) of the borrowers.[11]

1.1.2 Dualism in the labour market

In Colombia, the wage-rental ratio on plantations is higher than on family farms not only because plantation have a lower cost of capital but also because their cost of labour is higher. The higher wage-rental ratio will produce a divergence in capital-labour ratios.

While little detailed data exists on wage rates among different farming units, economic and non-economic forces will tend to produce a wage rate on plantations that is above the imputed wage rate on family farms. If labour must move to a plantation, an incentive will be required to induce the migration so that plantation wages will equal the average product of family farm labour plus a premium. It is also plausible that the disutility of work on plantations is greater than on family farms, so that family labour will be prepared to work for lower wages than plantation labour. Finally, trade unions may be powerful and cohesive among the hired labour on a plantation. This non-economic distortion would create a divergence of wage rates on family farms and plantations.

From the data, the economic and non-economic forces produce a dualism in wage rates. Plantation wages are above the average in agriculture. In 1963, the Colombian average agricultural wage was 8 pesos a day; workers on plantations were earning up to 30 pesos.[12] In 1970, the average agricultural wage for men was 19 pesos, men on palm oil plantations were earning 32 pesos.[13] The dualism in wage rates is on the same scale as that found in manufacturing.[14] Only on tobacco plantations

are wages less than the average wage in agriculture.[15]

Money wages are only one component of the cost of labour. Labour costs also include fringe benefits. Fringe benefits in Colombia are generous and are statutory for hired labour.[16] They include minimum wage laws, social security payments and provisions under the labour code. Their effect is to raise the cost of labour.

Social security payments are up to 65 per cent of money wages, so that a wage rate of 38 pesos a day costs plantations a further 25 pesos.[17] This is a total labour cost of 62 pesos. In addition, hired workers are entitled to bonuses and holiday pay. The labour code stipulates that workers shall be paid a bonus amounting to one month's wages every six months. Holiday pay is statutory once a year. Plantations are also legally obliged to provide housing, schooling and medical facilities.[18]

The cost of fringe benefits in Colombia is important. They may stimulate the adoption of mechanised techniques.[19] By raising the cost of labour, capital substitution will be relatively more profitable. This is important in a country where one-third of the agricultural labour force work on plantations.[20]

Family farms on the other hand are exempt from social legislation. Their cost of labour is the average produce alone. They are not obliged to provide any fringe benefits.

The exemption of family farms from social legislation clearly tends to produce a lower labour cost on family farms than on plantations. Not only are money wages lower but family farms are not responsible for indirect costs. Fringe benefits reinforce wage differentials in producing a lower labour cost.

1.2 Factor price adjustments

The lower labour cost on family farms than on plantations reinforces the different capital costs. Plantations pay more for labour and less for capital than family farms. The effect is to produce higher capital-labour ratios on plantations than on family farms. The factor price distortions, therefore, have created technological dualism.

For policy purposes the existence of dualism is important. As Chapter Two showed consumption over time is maximised by high capital-labour ratios and plantations. Policy measures therefore will be directed at maintaining technological dualism. They will aim to raise capital-labour ratios and support plantations. Conversely, maximising current employment and net foreign exchange saving are maximised by low-capital-labour ratios and family farms. Policy measures will be directed at "contrived dualism".[21] Policy measures will aim to reduce factor price distortions. The purpose will be to affect the distortions by deliberate intervention in the factor market in support of family farms.

The policy implications of the three development goals were shown at the end of Chapter Two. If the only two policy variables are labour

and capital, the policy implication for maximising consumption over time is a fall in the cost of capital. For maximising current employment the policy implications are a rise in the cost of capital and a fall in the cost of labour.

1.2.1 Adjusting the cost of capital

The cost of capital can be adjusted by a) changes in the cost of credit and b) changes in the cost of capital inputs. The availability of capital can also be changed.

1.2.1.1 The cost of credit. The goal of current employment requires that capital costs are raised. This might be achieved by a higher cost of credit. However, raising the cost of credit will create a number of adverse effects.

First, the higher cost of credit will attenuate the skewed distribution of loans. Farms which can afford to pay will benefit and these will be larger farms. If the goal is current employment this is contrary to the desired land tenure arrangement. Family farms would be penalised and yet these are the very farms that ought to be favoured. Second, higher credit costs would increase returns on saving deposits and benefit farms which can afford to save. Here too, the beneficiaries would tend to be plantations rather than family farms. Pecuniary saving is not the principal form of saving on family farms.[22] Hence they could not take advantage of the higher returns. Third, higher credit costs will discourage application of techniques which can raise output. To take advantage of capital inputs credit is necessary at a low enough cost to

yield positive returns.

The goal of maximising consumption over time requires a reduction in the cost of credit. This is inadvisable for two reasons. First, personal saving would be reduced. It is already very low in Colombia.[23] Potential savings are channelled into cars and lottery tickets.[24] Since real interest rates are very low reducing nominal interest rates would still further deter personal saving. Second, credit availability rather than credit cost would determine credit distribution even more than at present. The result may be growing distortions in the capital market.

1.2.1.2 The cost of capital inputs. - The cost of capital can be changed by influencing the price of capital inputs. The inputs may be mechanised or non-mechanised. Non-mechanised techniques may be desirable whatever the development goal, but mechanised techniques would be desirable only when consumption over time is the development goal.

The policy measures examined are changes in tariff rates, tax policies and depreciation rates.

One policy measure to change the price of capital inputs would be by adjusting nominal tariffs. Tariffs have been one of Colombia's principal measures of checking imports and of protecting infant industries. Even though the average nominal tariff (67 per cent) is lower than the other Andean Group countries, it is still very high.[25] Nominal tariffs on machinery and transport range from 187 per cent to 260 per cent. On certain commodities they rise to 500 per cent.[26] Lowering the tariff rate would reduce the

cost of capital. It would also reduce the distorting impact of tariffs.[27]

Alternatively, the goal of current employment requires a rise in the cost of capital inputs. A selective tariff on farm machinery could be reintroduced. Exempted from import restrictions in 1968, the real value of farm machinery sales more than doubled by 1970.[28] However, reintroducing tariffs may merely extend the replacement period rather than induce the substitution of labour for machinery.[29]

Another policy measure is to change taxes or subsidies. The goal of consumption over time implies raising capital-labour ratios and a policy that favours plantations. Capital-labour ratios can be raised by reducing domestic taxes on farm machinery. On certain agricultural machines the domestic tax is 20 per cent of the purchase price.[30] Capital costs could be lowered by a reduction in the tax. Subsidies could also be offered.

Subsidies have been offered for a variety of non-mechanised inputs. Among the inputs are fertiliser, technical expertise and irrigation. Subsidies have tended to be selective, both by crop and by farm size. Fertiliser, for example, has been subsidised for coffee cultivation. The subsidy of 25 per cent of the cost was available only in certain regions. These regions were predominantly farmed by large rather than small coffee-growers. The result was to subsidise large farms.[31] Conversely technical expertise has been subsidised in the palm oil industry and the principal beneficiaries are small farms. The Instituto Colombiano Agropecuario (ICA) has twenty-three agronomists specialised in palm oil.[32] Their

services are free of charge to small producers. Large producers are required to pay. This is an approximate saving to small producers of 250 pesos per hectare a year. Similarly irrigation has been selectively subsidised. Half of Colombia's irrigation is on farms of over 200 hectares. (less than 2 per cent of the number of farms). This is in spite of the evidence that demand for irrigation on small farms is very high.[33]

Subsidies could be extended, particularly to fertiliser. An indicator of the profitability of fertiliser application is the domestic cost of fertiliser compared with the cost of farm output. A rise in the relative cost of fertiliser indicates that the application of fertiliser is less profitable. In Colombia, the price of fertiliser has been rising faster than the price of farm output; hence, there is diminishing incentive to apply fertiliser.[34] A subsidy on fertiliser use could restore relative prices. A defect of this policy is the foreign-exchange cost. Imports constitute 85 per cent of some fertiliser inputs.[35]

The final policy measure to change the cost of capital inputs is an adjustment in depreciation rates. Depreciable investment such as farm machinery becomes more profitable when depreciation allowances are generous in the time that items can be written off. This measure would be favoured with the development goal of consumption over time. Conversely the goals of current employment and foreign exchange saving favour depreciation rates which penalise mechanisation. Either the time over which items can be increased or the depreciable amount can be reduced.

Depreciation allowances in Colombia are subject to a number of distortions.[36] First, depreciation allowances are very rigid. Depreciation

must be linear. Yet this is too rigid in the case of machinery subject to obsolescence. In addition, only three depreciation rates are allowed. The rates may give little indication of the probably useful life of capital inputs. Second, depreciation allowances do not cover costs: by law 10 per cent must be written off as a loss. Hence, they do not cover historical costs. Third, Colombia suffers from inflation and so depreciation allowances do not cover replacement costs. Basing depreciation on historical costs in an inflation exaggerates the profitability of investment, since replacement costs are not covered.

To encourage mechanisation depreciation allowances can be made more flexible.[37] For example, the rates might vary with the degree of capital intensity. Firms which have more than one shift could have accelerated depreciation. Also non-linear depreciation could be allowed. If compensating losses were allowed long gestation investments such as palm oil would be more profitable. Long gestation projects may require large depreciable capital inputs. An additional incentive to mechanise would be abolition of the law which requires 10 per cent written off as loss.

To discourage mechanisation depreciation allowances could be made less generous. The rates could be increased or the depreciable total reduced. The effect would be to lower capital-labour ratios.

1.2.1.3 The availability of credit. - The skewness of credit distribution has already been demonstrated. Large farms have greater accessibility to credit than small farms.

If consumption over time were the development goal the skewed distribution of credit would be reinforced. Plantations rather than family farms would continue to receive the bulk of the credit. Moreover, the credit distribution would be reinforced. Plantations rather than family farms would continue to receive the bulk of the credit. Moreover the credit could be selectively distributed. Credit could be made available particularly to finance mechanised techniques.

Alternatively if policy-makers were maximising current employment or net foreign exchange saving credit would be channelled to family farms and non-mechanised techniques. This would be a policy measure of contrived dualism.

1.2.2 Adjusting the cost of labour

Chapter Two showed that a decrease in the cost of labour may be desirable. If current employment is the development goal the capital-labour ratio must fall. This implies a decrease in labour costs.

The cost of labour has two components; the money rate and fringe benefits. Labour costs can be decreased either through a reduction in the wage rate or a reduction in fringe benefits.

1.2.2.1 Reducing the wage rate. - When unskilled labour is paid more than its social marginal product some compensation may be necessary to employers. In Colombia, plantations pay unskilled labour above its social opportunity cost. Theoretically therefore plantations may deserve some compensation.

The compensation could be a subsidy on the overvalued labour.

Subsidies on labour have the advantage of biasing the choice of techniques towards non-mechanised rather than mechanised techniques. However, they have two disadvantages. First, plantations, but not family farms, would benefit. The subsidy would not affect the self-employed. Yet family farms may be the desirable land tenure system. Second, a subsidy is probably politically unfeasible in Colombia.[38]

A subsidy would be necessary only if the government could not control money wages. Control of wages would enable the government to set the level of money wages at the shadow wage. This would eliminate the overvaluation of labour. It would also eliminate the conflict between development goals. The level of employment will have no effect on consumption expenditures if the government controls money wages. Money wages can be established so that the level of employment is sufficient for total consumption (BE) as shown in Figure 4.1 to exceed AH and for the surplus FE to equal GH. Both current employment and consumption over time could be maximised.

A labour subsidy may be based either on the number of labourers employed or on the size of pay roll.[39] The former appears preferable for two reasons. First, the rationale for the subsidy is that wages of unskilled rather than skilled labour have been distorted in the market. Consequently, the aim of the subsidy is to stimulate employment of unskilled labour, and to benefit farms which hire unskilled labour. A payroll subsidy would subsidise farms which hired a high proportion of skilled rather than

unskilled labour, whereas a subsidy on the number employed would give the desired weighting to unskilled labour. Second, a payroll subsidy might induce employers to grant wage increases that would not otherwise be granted. The effect would be a further distortion of the labour market.

The subsidy on numbers employed could take the form of a tax rebate per employee.[40] The tax rebate can be illustrated in Figure 4.1. If the social opportunity cost of labour is the shadow wage OC, the cost to the plantation of hiring OA labourers is AH, which exceeds the social cost of employing the labour AI. The difference HI is the amount by which labour on the plantation is overvalued.

If no subsidies were granted the profit maximising employment is OA and output AG. At G the marginal product of labour equals the market wage rate (OE) and profits (GH) are maximised. At G however employment is less than the socially optimal level of employment (OB) and a subsidy would be necessary to induce labour absorption.

The subsidy per employee can be less than the difference between the market wage and the shadow wage. Labour absorption will occur if profits are the same as they would be in competition. If the additional labour AB is hired the government can grant a subsidy ED where ED = GH - EF. With this subsidy profits will equal GH. The subsidy is less than the difference between market and shadow wages. The difference in the two wages rates is EC/OB which exceeds the rebate necessary per worker ED/OB by DC/OB.

The tax rebate could be offset by higher profit taxes so that the amount collected in taxes does not fall. In addition a higher profit tax rate would provide an incentive to plantations to take advantage of the tax rebate.

1.2.2.2 Reducing fringe benefits. - The purpose of reducing fringe benefits is both to reduce the degree of mechanisation and to increase the degree of capital intensity.[41] The degree of mechanisation is reduced if labour is substituted for machinery. The degree of capital intensity is increased if the existing capital stock is more fully utilised.

In Colombia, fringe benefits have had adverse effects on both the degree of mechanisation and the degree of capital utilisation. They have raised the degree of mechanisation and reduced the degree of capital intensity. They have raised the degree of mechanisation by increasing the cost of labour. Fringe benefits are approximately 70 per cent of the basic wage.[42] This is less than in some other South American countries, but its effect is to stimulate mechanisation.[43] Fringe benefits have reduced the degree of capital intensity by causing underutilisation of capital. Shift work is discouraged by the labour law.[44]

To increase the degree of capital intensity and reduce the degree of mechanisation, the cost of fringe benefits can be transferred from the employers to the public by taxes. Sales taxes, taxes on the amount of machinery, or profit taxes, could be levied. The effect would be to lower labour costs to employers but yet not reduce rural living standards. Lower

labour costs would reduce the degree of mechanisation and increase the degree of capital intensity.

Summary

This section has examined certain policy measures which can change the cost of capital and reduce the cost of labour. The purpose of these policy measures is to change land tenure system via changes in the capital-labour ratio. They are summarised in Table 5.II.

Table 5.II. Summary of the Policy Measures

Policy Goal	Policy Implication	Policy measure
Consumption over time	Cost of capital down.	Reduce cost of capital inputs. lower tariffs lower taxes/increase subsidies more flexible depreciation Capital availability. increase capital to plantations.
Current employment	Cost of capital up.	Raise cost of capital inputs. increase taxes Capital availability increase capital to family farms
	Cost of labour down.	Reduce money wage. labour subsidy Reduce cost of fringe benefits to employers. transfer cost to public by taxes.
Net foreign exchange saving	Cost of capital up Cost of labour down	As above.

The goal of consumption over time is maximised by high capital-labour ratios and plantations. This implies a reduction in the cost of capital. The section showed that reducing the cost of credit may not be feasible. Consequently the cost of capital must be reduced by lowering the cost of capital inputs. All three measures examined could be effective. The three measures are a reduction in tariffs, lower domestic taxes and more flexible depreciation taxes. A reduction in tariffs and more flexible depreciation allowances would also remove distortions in the economy. The final policy measure examined was to reinforce the rationing of capital funds to plantations.

The goal of current employment is maximised by low capital-labour ratios. This implies a rise in the cost of capital and a fall in the cost of labour. To raise the cost of capital higher taxes may be the only desirable policy measure. Higher credit costs will tend to penalise family farms. Higher tariffs and less flexible depreciation rates will attenuate distortions. Domestic taxes may be the only desirable measure to raise capital costs. Capital can be made more available to family farms by contrived dualism. The existing distortions can be offset by deliberately rationing credit to family farms.

The goal of net foreign exchange saving would combine policy measures that resulted in higher capital costs and lower labour costs.

The policy variables analysed have been capital and labour costs. Yet other policy variables, such as adjustments to the cost of land, could be efficacious in changing land tenure systems.

2. Conclusions

2.1 Thesis conclusion

The thesis set out to compare two land tenure systems for their impact on development. Development was defined by three goals; consumption over time, current employment and net foreign exchange saving. The two tenure systems were compared theoretically and empirically for their impact on these goals. The context was the Colombian agricultural sector.

The theoretical comparison was based on different production techniques used by the two tenure systems. A micro model showed that plantations tend to have higher capital-labour ratios than family farms. The model explained the divergence in capital-labour ratios by the behavioural functions of the tenure systems. Plantations were postulated to maximise profits, family farms to maximise total output. Chapter Five showed how the divergence could be reinforced by factor price distortions. The different production techniques were compared for their impact on the three development goals.

The tenure systems were compared empirically by cost-benefit analysis. Two palm oil units were compared. They fitted the definitions of a family farm and a plantation. Inputs and outputs were shadow-priced, and the shadow price of unskilled labour was adjusted for the three development goals. The tenure systems were compared by nine criteria. The conclusions of the empirical comparison endorsed the theoretical comparisons.

The final section examined two factor prices which can indirectly change land tenure systems. The section indicated the factor price distortions which had contributed to technological dualism in Colombian agriculture. These distortions are important if factor prices are policy variables. The factor prices were adjusted by a number of policy measures.

The thesis arrived at five principal conclusions:

1) The thesis showed that if development is defined by multiple goals, a single land tenure system may not maximise all the goals; hence, a cost is involved in choosing between land tenure systems. It is a cost which has been neglected in the literature. By comparing tenure systems, the cost has been explicity demonstrated. The purpose of the thesis is not to make a choice between tenure systems; it is merely to clarify the costs.

The tenure systems were compared by three goals and nine criteria. Neither tenure system maximised all the goals or criteria. The cost, therefore, is the opportunity cost of not maximising other goals. In choosing a particular tenure system this opportunity cost can be shown. In the thesis it was shown in the theoretical macro model. It was also quantified.

Whenever development is defined by multiple goals this cost may exist. When time horizons differ a cost is almost inevitable. The thesis has attempted to illustrate the cost by assuming only three goals. Should the objective function include multiple and multidimensional goals clarification of the cost becomes both more necessary and more difficult.

This thesis has attempted to show the importance and to ease the difficulties.

2) The thesis indicated which land tenure system maximises each of the development goals.

The thesis indicated that if the goal is consumption over time and the social discount rate is low, the desirable agricultural strategy is large-scale mechanised farming. Plantations were shown theoretically to maximise consumption over time. Their higher capital-labour ratio minimised wage payments and accelerated capital accumulation. This conclusion was confirmed by the cost-benefit study of the two tenure systems. Plantations were superior to family farms by a 4 per cent discount rate.

Alternatively, family farms maximise current employment. Family farms are clearly superior in maximising employment given the present output-mix on farms. More intensive use of land could generate considerable employment. However, the thesis has concentrated on a single crop. It has shown that if both plantations and family farms produce the same crop family farms still tend to maximise current employment. The reason is that family farms tend to have lower capital-labour ratios than plantations.

If the development goal is net foreign exchange saving, the theoretical section showed that family farms are the desirable land tenure system. With their lower capital-labour ratio they have lower import coefficients than plantations. The empirical section, however, was less conclusive. Family farms only dominated plantations when the shadow wage

was 22 pesos a day. Otherwise plantations made a larger net saving of foreign exchange. The discrepancy was shown to be the result of the revenue schedule. Foreign exchange costs per hectare were less on family farms, but so were their revenues per hectare. The result is a lower net saving on family farms than on plantations.

3) The thesis has demonstrated the use of factor prices in changing land tenure systems. The political power structure in Colombia precludes land reform. An alternative means of changing tenure systems is indirectly through factor price adjustments. If production techniques are determined by land tenure systems and their maximising behaviour, tenure systems will tend to adopt particular production techniques. Factor prices can be used to influence production techniques and hence indirectly to change land tenure systems.

The thesis has indicated two factor prices which can be adjusted. They are the price of labour and the price of capital. The direction of change of these two variable was shown in matrix form at the end of Chapter Two. Specific policy measures were examined in Chapter Five.

The price of labour was diaggregated into the money wage rate and fringe benefits. The price of capital was disaggregated into three components; the cost of credit, the cost of capital inputs and the availabiiity of capital.

In order to maximise consumption over time the policy measures are a reduction in nominal tariffs, a tax and subsidy policy and a more flexible allowance for depreciation. Credit could also be made more

available to plantations rather than family farms.

To maximise current employment either a rise in the cost of capital or a fall in the cost of labour may be necessary. The most efficient measure to raise the cost of capital was shown to be a tax policy. To lower the cost of labour either a wage subsidy or a transfer of fringe benefit costs is recommended. It is recognised that certain of these measures may be politically unfeasible.

The goal of net foreign exchange saving implies a combination of these policy measures. Both the cost of capital and the cost of labour need to fall, and this implies a combination of the measures noted above. To reduce the cost of capital tariffs and taxes can be lowered and depreciation allowances eased. Reducing the cost of labour implies a labour subsidy and a transfer of fringe benefits.

The policy measures will influence the capital-labour ratio and indirectly change land tenure systems. Their advantage is that they may be more feasible politically.

4) Using a number of simplifying assumptions, the thesis shows that agricultural production techniques are functionally determined by the maximising behaviour of land tenure systems. The thesis indicates production techniques will differ between land tenure systems producing the same crop.

The model assumed a Cobb-Douglas production function with the same coefficients on both tenure systems. With these simplifying

assumptions the model was able to demonstrate the functional relationship. The two tenure systems have different objective functions. These objective functions were shown to determine production techniques. The capital-labour ratio was shown to diverge between plantations and family farms. Plantations tend to have higher capital-labour ratios than family farms.

5) The methodological innovation of this thesis has been the cost-benefit study of land tenure systems. There have been no similar studies undertaken. No other studies have compared land tenure systems by different development goals.

In spite of its imperfections, cost-benefit analysis is a useful technique in developing countries. It obliges planners to examine costs and benefits. It also classifies the costs of decision-making. Currently there are two opposing perspectives of development. One view is that of the International Labour Office. Time horizons would be short and the development goal would be current employment. The other view is held by the United Nations and the Organisation of Economic Cooperation and Development. Their view is a long-term goal of capital accumulation. Each perspective has its own shadow price of labour. The costs of decision making can be clarified by adjustments to the shadow price. The clarification of these costs by cost-benefit analysis is an innovation.

2.2 Suggestions for further research

The thesis has concentrated on the macro rather than the micro implications of land tenure systems . The micro implications of land

tenure systems have been thoroughly analysed in the literature, but the macro implications have been neglected. It is in this area that further research is needed.

1) Further research is needed on the conflict of tenure systems in maximising development goals.

a. At the theoretical level this implies an expansion of the objective function to include more development goals. Regional goals particularly could be included.

b. At the empirical level further research is needed on cost-benefit analysis to compare tenure systems. If conflicts do occur between land tenure systems, the opportunity cost of each tenure system needs to be clarified. Particular emphasis needs to be placed on the shadow pricing of labour and land.

2) Further research is needed on the relative efficiency of mechanised and non-mechanised techniques. The problem is partly empirical Mechanised techniques are defined here as techniques which increase depreciable capital; non-mechanised as techniques which may increase working capital. More research is needed into whether working capital such as fertiliser are labour-using or labour-saving. If they are labour-using the distinction between mechanised and non-mechanised techniques is very important. Non-mechanised techniques can be defined as inputs - including working capital - which absorb labour. This can be contrasted with mechanised techniques which displace labour.

3) The use of factor prices as policy measures in changing land tenure systems has been neglected. An empirical study of the effects of

factor prices is needed. One possibility is to examine an area which has certain inputs subsidised. If the production techniques and land tenure systems differ from an area which has not been subsidised, then factor prices appear important. A more conclusive test is to examine production techniques before and after subsidies in the same region. If production techniques and land tenure systems change, the change can be partly attributed to factor prices.

Chapter Notes

1. The term comes from H. Myint, Economic Theory and the Underdeveloped Countries, London, Oxford University Press, 1971, chapter XIV.

   "There seems to be a strong dualism developing with the smaller farms not getting any larger, not becoming fewer and apparently making quite slow progress in substituting improved practices for traditional methods." L. Atkinson, "Changes in Agricultural Production and Technology in Colombia", United States Dept. of Agricultural Economic Research Service, 1969, p. 11.

3. The process is explained mathematically in R. Nelson, J. Schultz and R. Slighton, Structural Change in a Developing Economy, Princeton, Princeton University Press, 1971, pp. 103-127.

4. Such as land improvements.

5. "Creditworthiness of the applicant, not the expected return of the proposed investment, is the only consideration in much bank lending in Colombia." International Bank for Reconstruction and Development (IBRD), Economic Growth of Colombia: Problems and Prospects, Baltimore, Johns Hopkins University Press, 1972, p. 256.

6. Ministerio de Agricultura, "Estado actuel de las oleaginosas comestibles", Minagricultura, Bogota, 1970.

7. If data were available a more useful comparison would be on the value of output rather than by size and number of farmers.

8. K. Griffin, "Coffee and the Economic Development of Colombia", Oxford Bulletin of Economics and Statistics, vol. 30 (May 1968), pp. 105-127.

9. IBRD. op. cit., p. 256.

10. H. Felstehausen, "Agrarian Reform and Development in Colombia", in Land Reform in Chile, Colombia and Venezuela, Agency for International Development (AID), Spring Review of Land Reform, vol. V, June 1970.

11. Griffin, op. cit. This may be due partly to the smaller degree of risk aversion on plantations than on family farms.

12. The data on wage rates comes from the International Labour Office (ILO) Plantation Workers, Report No. 69, Geneva, 1966, p. 110.

13. Appendix 1 presnets more detailed data.

14. R. Slighton, "Relative Wages, Skill Shortages and Changes in Income Distribution in Colombia", Rand Corp., 1968.

15. This was true at least in 1963, see ILO, op. cit.

16. For details on fringe benefits, see ILO, op. cit., pp. 113-146.

17. It should be noted that this is the maximum and applies only to permanent labour (employed for at least one year). See page 120.

18. Housing obligatory if more than fifteen workers need to be housed, schooling is obligatory for undertakings with a capital of 800,000 pesos or more, and medical facilities are obligatory if more than 15 persons are housed on the plantation. See ILO, op. cit., pp. 176-229.

19. ". . . social security contributions of this dimension constitute important stimuli towards the adoption of capital-intensive techniques and hinder the absorption of the rapidly growing labour force". M. Wolfe, "Social Security and Development - the Latin American Experience", in The Role of Social Security in Economic Development, (edited by E. Kassalow), United States Dept. of Health, Education and Welfare, Research Report, No. 27, Washington D.C., 1968.

20. ILO, op. cit., p. 283.

21. This is an expression used by P. Dorner and L. Felstehausen, Agrarian Reform and Employment: the Colombian Case," International Labour Review, vol. 102 (May 1970), pp. 221-241.

22. For sources of saving and capital accumulation on family farms see P. Raup, "The Contribution of Land Reforms to Agricultural Development: an Analystical Framework", Economic Development and Cultural Change, vol. 12, (October 1963), pp. 1-21.

23. Personal saving constitutes approximately 10 per cent of domestic savings. T. King "Personal Savings" in Financing Development in Latin America, edited by K. Griffin, London, MacMillan and Co., 1971, pp. 152-182.

24. A. Prest, "The Role of Labour Taxes and Subsidies in Promoting Employment in Developing Countries", International Labour Review, vol. 103, (April 1971), pp. 315-333.

25. Nominal tariffs are the lowest in manufacturing except for Bolivia IBRD, "Economic Position and Prospects of Colombia", Report No. WH-211a, 1972, table 8.3.

26. Nelson, Schultz and Slighton, op. cit., p. 206.

27. The distorting effects of tariffs are demonstrated by I. Little, T. Scitorsky and M. Scott, Industry and Trade in Some Developing Countries, London, Oxford Unfveristy Press, 1970.

28. The value of sales went from 1,286 (index of 100 in 1952) to 2,834 in 1970. Banco de la Republica, "Series estadisticas y graficos", Departamento de Investigaciones Economicos, December 1970, table F - 3.

29. The year before import restrictions were lifted (1967) a third of the tractors in Colombia were over ten years old. Atkinson, op. cit.

30. On certain tractors, the duty is 20 per cent. Data come from personal interviews with Leonidas Lara E. Hijos, Bogota in 1971.

31. This point is made by Griffin, "Coffee and the Economic Development of Colombia", op. cit.

32. At least this is the number planned for 1973. Instituto Colombiano Agropecuario (ICA), "Programma de acturidades", Programa Nacional de Oleaginosas Perennes, Cali, 1970.

33. Dorner and Felstehausen, op. cit.

34. The index of fertiliser prices (base year 1958) was 318 in 1967 compared with 267 for agricultural products. Departamento Administrativo Nacional de Estadisticas, Contribucion al estudio del desempleo en Colombia, Bogota, 1971, p. 52.

35. IBRD, Economic Growth of Colombia, op. cit., p. 248.

36. These distortions are reviewed by R. Musgrave, Bases para uria reforma tributaria en Colombia, Banco Popular, 1969, pp. 109-117.

37. Changes in depreciation allowances are suggested by ILO, Towards Full Employment, Geneva, 1970, pp. 179-183.

38. This point has been made by Lauchlin Currie in personal correspondence.

39. Arguments are fully presented by Prest, op. cit.

40. This comes from W. Cline, Potential Effects of Income Distribution on Economic Growth, New York, Praeger, 1972.

41. The concepts are defined in Chapter One.

42. This includes pensions. ILO, Towards Full Employment, op. cit. p. 205.

43. At least the social security costs on average are less; see Wolfe, op. cit. for data on Argentina, Chile and Uruguay.

44. This is examined in ILO, Towards Full Employment, op. cit., pp. 205-207.

APPENDIX

1. Shadow Pricing

1.1 The shadow wage of unskilled labour

The shadow wage rate used for unskilled labour is based on the output of landless or near-landless peasants. It is considered that this best reflects the social marginal product of unskilled labour. This is the output the economy sacrifices by labour's employment on palm oil plantations and family farms.

The concept of a zero shadow wage is rejected on several grounds. Unemployment, while high in Colombian rural areas, may be seasonal. Unemployment and underemployment accounts for 21 per cent of the agricultural labour force, yet at certain times of the year this may be considerably reduced.[1] The second reason for rejecting a zero shadow wage is that additional expenditures may be incurred by labour employed on the palm oil units. Finally, a zero shadow wage assumes that labour will be surplus over the entire lifetime of the project. For a project that lasts thirty years such as a palm oil unit this is an unduly pessimistic view of Colombia's development prospects.

An alternative possibility would be to use the market wage rate.[2] This implies that there are no distortions in the labour market. However,

as Chapter Five has noted, there are distortions in the Colombian labour market. Not only are market wages on plantations higher than the average agricultural wage, but fringe benefits also distort plantation labour costs. Social legislation requires that plantations pay 65 per cent of the wages of permanent workers for social security benefits. If social security payments supplement wages which are already higher than the average, plantation wages are clearly distorted. They offer little guidance to labour's social marginal product.

Wages of non-permanent labour might be used. Such labour is non-unionised and does not enjoy the fringe benefits of permanent labour. Instead of social security benefits of 65 per cent of the market wage, temporary workers receive only 15 per cent. On palm oil plantations the lower cost of temporary labour has resulted in their substitution for permanent labour. Plantations obtain labour through a subcontractor who allocates the labour to specific tasks. At Risaralda wages for temporary labour in 1970 were 35 pesos a day. At Coldesa and Indupalma wages in 1971 were 38 pesos a day.[3] These figures could be used as labour's social marginal product.

However, the wages were considerably above the average wage for Colombia. This can be seen from Table A.1. The national average for male labour is 19 pesos a day.

Table A.I Agricultural Labour Costs in Pesos for Men in Warm Climates without Food: 1970 by selected regions

Regions	Minimum	Maximum	Most Frequent
Antioquia	10.00	20.00	14.00
Atlantico	15.00	20.00	19.50
Cauca	12.00	20.00	14.60
Cesar	20.00	30.00	24.70
Chocó	10.00	20.00	15.55
Magdalena	15.00	24.00	19.55
Meta	20.00	28.00	24.60
Nariño	8.00	20.00	11.25
North Santander	16.00	25.00	19.45
Risaralda	18.00	24.00	19.75
Sanlander	15.00	25.00	17.76
Valle del Cauca	15.00	25.00	17.40
Caquetá	25.00	30.00	24.70
National Average	10.00	25.00	19.30

Source: Departamento Administrativo Naccional de Estadisticas, Boletin Mensual de Estadisticas, Nos. 253-254, August 1972, p. 163.

The divergence may be partly explained by the location of the plantations. Colombia has considerable disparities in wage rates and in the growth rates of wages. As Table A.I shows Caquetá wages were three times higher than those in Nariño. Moreover, its growth of wages was

higher.[4] Risaralda and Indupalma are located in regions which have higher than average wage rates. Coldesa, while it is in a region of average wage rates, (Antioquia), hires almost 1,000 labourers. The area Turbo is not densely populated, and to attract labour Coldesa must pay labour considerably above its alternative supply price.

To estimate the social marginal product of labour, the proportion of labour which is landless was estimated. The proportion is approximately 70 per cent. As Table 4.II showed 70 per cent of the labour force earned the majority of their income as hired labour. The daily wage of this 70 per cent in 1960 ranged from 3.50 pesos to 7.25 pesos.[5] Assuming an annual rise in money wages of 15.5 per cent, which is the average increase of agricultural wages in warm climates, the range would be from 17 to 35 pesos in 1971.[6]

More recent data gives an average wage for a male labourer as 560 pesos a month.[7] If one assumes a working month of 25 days, the average male was earning 22 pesos a day. For 1971, this can be projected to 26 pesos a day.

Finally Table A.I gives an average wage in Colombia of 19 pesos. For 1971 this can be projected to 22 pesos. The figure is below the 26 aggregate figure but above the minimum projected from the 1960 census. In the absence of further data 22 pesos appears a plausible estimate of labour's social marginal product in 1971

The shadow wage of the owner-operator is more difficult to impute. His labour is not diverted from a competitive market. Yet in palm oil

production there is a close relationship between the opportunity cost of a hired palm oil labourer and an owner-operator of a palm oil farm. In the first place, the physical labour is identical. In the second place, the owner operator is located adjacent to the plantations. If the disutility of labour on his own farm were greater than the wage rate paid on the plantation, the owner-operator could join the plantation labour force with no incovenience. This thesis will accordingly assume that the owner-operator, and family, value their physical labour at the shadow wage of hired labour.

1.1.1 Skilled labour

Skilled labour is priced at its market wage. The absence of a surplus of skilled personnel justifies using the market wage.

1.2 Land

As with labour, so the social cost of land is its productivity in the best alternative use. Chapter Three indicated that land is underutilised in Colombia. Less than a quarter of its total land surface is used for agriculture and at the time of the census only 3 per cent of the total land surface was under cultivation. While much of Colombia's surface is unusable there are areas such as the plains of Meta or the forests of Nariño that are suitable for oil palms.[8]

The establishment of palm oil indicates the limited use for land. Bananas, pineapples and oil palms compete for the use of tropical areas, but the land cultivated under oil palms was not previously planted. The

land had been either forests or pasture-land for extensive cattle grazing.[9]

The lack of alternative uses for tropical areas and the quantity of land available suggest a zero shadow price. To place a zero shadow wage on land implies that the marginal productivity of land will be zero even at the turn of the century. Theoretically, one should know its productivity in the year 2000 and discount backwards. However, over thirty years using a discount factor of 15 per cent, the present worth is no more than 5 per cent of its future value. This is sufficiently insignificant that it can be ignored.[10]

Land improvements are costed separately. Roads, drains and other infrastructure have a positive shadow price.

1.3 Government taxation

To avoid double-counting direct and indirect taxes are deducted from commercial accounts. Conversely subsidies are included.

Data on world prices of machinery and vehicles are known so they can be converted into Colombian pesos by using the official exchange rate. However, not all taxes were known and so estimates were necessary.

Subsidies were unimportant except for technical expertise which is provided free to family farm oil producers. To adjust for this and to prevent any bias, technical expertise was included for the family farm at the same rate per hectare as on plantations.

1.4 Imported and non-imported inputs

Where available c.i.f. prices were used for imports. Where they were unavailable an estimate was made of duty and other charges. The domestic price of fertiliser and pesticides overstates its foreign exchange component by approximately one-quarter. Port-to-user margins are 20 per cent and duty a minimum of 5 per cent. In spite of the crudeness of the estimate the cost of fertiliser and pesticides do not affect the relative positions of plantations and family farms. The cost per hectare of fertiliser and pesticide is the same for both tenure systems.

For non-imported inputs data on taxes were available either from the manufacturers or from retailers. Taxes were deducted where appropriate.

1.5 Output

Unlike certain projects the direct benefits from producing palm oil are readily identifiable and can be easily quantified. It is less easy to decide whether they should be quantified in domestic prices or in foreign trade prices. Under conditions of Pareto Optimality in the domestic market, and free trade equilibrium abroad, (ignoring transport costs) no divergence between domestic price and foreign trade price exists. Divergencies emerge once distortions appear.

Palm oil is an import substitute with the possibility that it may be exported once domestic demand for edible oil is satisfied. If it is treated as a tradeable good, its c.i.f. price would be the shadow price. On the other hand, the value of imports, which palm oil as an import

substitute allows, could be the shadow price. Owing to tariffs or a rising supply price the two may be very different. As much for convenience as for theoretical correctness, this thesis will use the world price c.i.f. as the shadow price of palm products.

For Colombia, the price is assumed perfectly elastic. There will be no need to impute marginal import costs.[11] The assumption is valid since Colombian production of palm oil would not affect world prices. In palm oil, Colombian productions amounted to 1.8 per cent of world production and to 2 per cent of world trade in 1968.[12] By 1980, the projected proportions are 1.1 per cent and 1.8 per cent.[13]

The world price of palm oil is assumed to be US $160 per metric ton of palm c.i.f. Colombia and US $146 per metric ton of palm kernel oil. These assumed prices compare with US $212.50 and US $287.50 respectively, projected by the F.A.O. in 1985.[14] The assumed prices in the thesis are lower than those projected by the F.A.O. in 1966, because world prices since 1967 have fallen sharply. They are approximately the same as those used by Little and Tipping in 1971.

The shadow price of palm oil from family farms is 67.6 per cent of the world price per ton. It is less than the world price because family farms do not have extraction plants. To extract oil from the fruit, family farms are obliged to sell the fruit to plantations which have extraction plants. In Colombia, family farms receive Col $4,600 a ton of oil, which is 67.6 per cent of plantation's revenue of $6,800 a ton.[15] This proportion is extrapolated to the world price. The shadow price of palm oil from family farms is, therefore, US $108.40 a ton.

All prices are converted at the rate of US $1 = Col $20.95.

2. Statistical Sources

2.1 Sources

A number of data sources for palm oil exist in Colombia. Among the agencies which collect technical data on palm oil are the Instituto Colombiano Agropecuario (ICA), Corporacion Financiera de Fomento Agropecuario y de Exportaciones (COFIAGRO), and the Federacion Nacional de Cultivadores de Palma Africana (FEDEPALMA).[16] The technical data are, therefore, extensive. Moreover, judging by the consistency of the reports, the data are accurate.

To supplement the technical with more recent or detailed pricing information, certain palm oil units were sampled. The sampling was either by personal interview or by questionnaire. A list of the producing units was drawn up, and a grouping by size made.

The list was based on data from FEDEPALMA. A problem arose because of the doubtful existence of certain units in Caquetá. The Colombian land reform institute INCORA originally established 149 units in Caquetá, and the latest figures suggest that a total of 220 hectares had been planted. Not only does this give a mean size of 1.5 hectares, but I.C.A. acknowledges that a number of the units have since been abandoned. Since no reliable estimate of the number surviving has been made, it was decided to retain the original figure, at the same time recognizing it is an overestimate.

Stratified sampling by size was preferred to simple random sampling because of the dominance in the industry of a very few producers. The three largest units produce 75 per cent of the palm oil. In addition their technical data were extensive and often more recent than those from agencies. Hence, the sampling technique was designed to ensure that the three largest palm oil units were sampled.

No stratification by geographical area was made. This was because the sample to be taken from the groups was sufficiently large to ensure that most of the departments would be represented. It was recognised that production coefficients and input prices differ among the departments, often considerably. However, the differences in input prices are known, and agronomists are able to specify the production functions for each region. All but three palm oil regions were covered in this way. Table A.II. shows that the three regions planted a mere 8 per cent of the total palm oil area.

Table A.II. Location and Number of Palm Oil Units Sampled

Region	Number of Units	Area (hectares)	Average Size (hectares)	Proportion Sampled (per cent).	
Antioquia	1	2625	2625	100 %	
Cesar	5	6227	1246	89 %	
Magdalena	9	1827	203	57 %	
N. Santander	1	1580	1580	100 %	
Santander	3	2250	750	57 %	
Nariño	9	1160	129	0 %	Report
Meta	52	2706	52	30 %	
Valle del Cauca	3	680	217	59 %	
Caquetá	24	220	9	0 %	Report
Chocó	1	215	215	0 %	
	108	19,480			

Source: Ministerio de Agricultura "Estado actual de las oleaginosas comestibles en Colombia", Minagricultura, Bogotá, December, 1970.

The size sampling proportions were as follows: 100 per cent in the group of 1000 - 5000 hectares by interviews: 30 per cent in the group of 50 - 1000 hectares by interviews, questionnaires and reports: and 25 per cent in the group of the smallest size.

The distribution can be seen in Table A.111.

Table A.111. Proportion of Palm Oil Units Sampled by Size

Size (hectares)	Number of Units	Surface (hectares)	Average Area (hectares)	Proportion of Area (per cent)	Proportion Sampled (per cent)
50	77	1.743	23.	9 %	13 % + Report
50 - 500	23	5.100	222.	26 %	25 % + Report
500 - 1000	3	1.600	533.	8 %	33 %
1.000	5	11.047	2.209	57 %	100 %
	108	19.490			

Source: Ministerio de Agricultura "Estado actual de las oleaginosas comestibles en Colombia", Minagricultura, Bogotá, Decmeber, 1970.

Notes

1. Departamento Administrativo Nacional de Estadisticas (DANE), Boletin Mensual de Estaditicas, No. 238, May 1971, p. 80.

2. The use of market prices is advocated by R. McKean, Public Spending, New York, MacGraw Hill Book Co., 1968 and is used for Kenya by the Organisation for Economic Cooperation and Development (OECD), An Appraisal of Tea Production on Smallholdings in Kenya, (by N. Stern), Development Centre Studies, Case Study No. 2, Paris, 1972.

3. Data on wage rates were acquired by personal interviews on the plantations.

4. The rate of growth of regional money wages is given by DANE, Boletin Mensual de Estadistica, No. 225, April, 1971, p. 73.

5. A. Berry, "Land Distribution, Income Distribution on the Productive Efficiency of Colombian Agriculture", Yale Growth Center Discussion Paper No. 108, Yale University, March, 1971.

6. The rate of growth of wages comes from DANE, No. 225, op. cit.

7. DANE, No. 238, op. cit., p. 72.

8. The suitability of these areas is discussed by Instituto Colombiano Agropecuário (ICA), Projecto para aumentar la produccion y mejarar la productividad de la palma africana en el litoral pacifico, Document No. DP - T - 07, Tibaitatá, 1971.

9. M. Ollagnier and G. Martin, "La palmera de aceite en America Latina", Oleagineux, vol. 12 (December 1966), pp. 723-727.

10. This point is made in OECD, A Social Cost Benefit Analysis of the Kulai Oil Palm Estate, (by I. Little and D. Tipping), Development Centre Studies Case Study No. 1, Paris, 1972, p. 29.

11. If Colombia were not a price-taker marginal import costs would be important.

12. Commonwealth Office, Vegetable Oils and Oilseeds, Commonwealth Secretariat, pp. 171-176.

13. World production of palm oil is expected to double by 1980. This estimate is a medium figure. The higher estimates would give Colombia a still smaller proportion of world production and exports. Food and Agriculture Organisation (FAO), Monthly Bulletin of Agricultural and Statistics, vol. 21 (April 1972), pp. 11-15.

14. FAO, Agricultural Development in Nigeria, 1965-80, Rome, 1966.

15. ICA, "Costo de produccion para una hectarea de palma africana unidad cinco hectareas, zona de Tumaco", Oleaginosas Perennes, Cali, 1971 (mimeo).

16. For information on the most important reports published by these agencies see the Bibliography, particularly Section 4.

3. Cost and Revenue Schedule for a Small-holder of African palms; Area of Tumaco; 1971.

3.1. Description

The owner-operator is assumed to rely on family labour. The size of the family is one of the constraints on the optimal unit, and the labour input required limits the unit to ten hectares or smaller. In Nigeria the minimum size of a palm oil unit is two hectares. In Malaysia and the Ivory Coast the units are from three to twelve hectares. The size of the unit costed in Colombia is ten hectares.

Small-holder units are contiguous to plantations which process the small-holders' fruit. The plantation extracts fruit, provides infrastructure and offers expertise to small-holders. In return the plantation benefits from scale economies in the processing of palm oil.

Small-holders are assumed to concentrate on palm oil as their major cash crop. In reality they may also cultivate pineapples and cocoa as cash crops, as well as producing subsistence food by bush fallowing.

The small-holders costs do not include investments made by plantations. Therefore such costs as roads, extraction costs, administration are excluded.

Table A : IV

Establishment Cost per hectare on a family farm

Activity	Domestic Input (Col peso)	Foreign Exchange (Col peso)	No. of man-days
Year - 1. Land Clearing			
Cutting, burning	-	-	17
Clearing	-	-	10
Drains	386	-	50
Year - 1. Nursery and Planting			
Plant costs (150 x $9)	1,350	-	-
Loading	40	-	2
Transport	1,050	-	2
Pegging	-	-	3
Planting palms/cover	-	240	3
Fertilisation	-	54	2
Holing	5	-	10

Table A : V

Number of Man-days and Material Costs for Maintenance of a Family Farm

1. Man-days per hectare

	Years 1	2	3	4	5	6	7	8
Fertilisation	1	2	3	3	3	3	3	3
Clearing and control	57	42	26	19	19	19	18	18
Drain maintenance	9	9	9	9	9	9	9	9
Replanting	2	1	1	-	-	-	-	-
Pest control	1	2	2	2	2	2	2	2
Path maintenance	-	-	9	9	9	9	9	9
Pruning	-	-	-	5	6	6	6	6
Support	-	-	-	1	-	-	-	-
TOTAL	70	56	53	48	48	48	47	47

2. Cost of materials per hectare (pesos)

	Years 1	2	3	4	5	6	7	8
Imported inputs								
Fertiliser	53.63	66.50	230.96	230.96	395.40	395.40	395.40	395.40
Insecticide	73.87	168.70	135.73	135.73	252.30	252.30	252.30	252.30
Replanting	40.00	-	-	-	-	-	-	-
	167.50	235.20	366.69	366.69	647.70	647.70	647.70	647.70
Domestic Inputs								
Fertiliser	35.75	117.98	117.98	117.98	117.98	117.98	117.98	117.98
Supports	-	-	-	15.00	-	-	-	-
Pesticides	45.00	45.00	90.00	90.00	90.00	90.00	90.00	90.00
	80.75	162.98	207.98	222.98	207.98	207.98	207.98	207.98

Table A : VI

Harvest Costs per hectare

Year	Man-days/hectare
4	15
5	30
6	40
7	56
8	70
9	70
10	70

Table A : VII

Total number of man-days for ten hectares

Year	Man-days
-1	170
1	920
2	560
3	530
4	630
5	780
6	880
7	1,030
8	1,170
9	1,170
10	1,170

Revenue Schedule

Both plantations and family farms are assumed to be planted with Tenera palms. The yield per hectare is assumed the same for both tenure systems. The extraction rate of palm oil from palm fruit is 20 per cent. This is shown in Table A : XIII.

Table A : VIII

Yield and revenues by year on the family farm

Year	4	5	6	7	8	9	10	11
Tons/bunches/ hectare	5	7	11	14	16	18	19	19
Tons/oil/hectare	1.0	1.4	2.2	2.8	3.2	3.6	3.8	3.8
Total tons/oil	10	14	22	28	32	36	38	38
Total revenue (col. $)	22,700	31,780	49,950	63,560	72,640	81,720	86,260	86,260

The revenue schedule is obtained from the yield times the shadow price output which is given in the Appendix.

4. Cost and Revenue Schedule for a 500 hectare Plantation of African Palms, Tumaco Area, 1971.

The 500 hectare plantation is a medium-sized palm oil plantation in Colombia. The statistical appendix shows that plantations range from fifty to 5,000 hectares.

A 500 hectare plantation includes the major investment characteristics of plantation cultivation, but does not include all the infrastructure. For example investment costs of roads, extraction plants, buildings and vehicles are included; excluded are costs of schools and hospitals. In Colombia only the largest plantations are legally obliged to provide educational and medical facilities.

Planting on a 500 hectare plantation is assumed to be staggered. In year one 100 hectares are planted, in year two 200, and in year three 200. This is more realistic than assuming that all 500 hectares are planted in year one. The cost and revenue schedules are complicated by the staggered planting, but it is unrealistic to expect a new plantation to clear 500 hectares in one year.

4.1. Depreciable capital outlays

4.1.1. Buildings

There are six residential buildings, an office building, a plant building, a garage, and an office for stores. Their total cost is Col. $1,000,000.

4.1.2. Equipment

Equipment includes agricultural machinery, vehicles, electrical

and water plants, office equipment. It is disaggregated by imports and non-imports.

4.1.1. Plant

The extraction plant has a capacity per hour of three tons of bunches. It is domestically produced.

4.1.4. Replacement period

Owing to rigid depreciation allowances Colombia only allows linear depreciation. Accordingly buildings are assumed to be replaced every twenty years, equipment ten years.

The entire capital outlay of the plantation is shown in Table A : XV All costs are net of duty.

4.2. Establishment Costs per hectare

Table A : IX Establishment Costs per hectare on Plantations

Activity	Domestic Inputs	Imported Inputs	Number of Man-days
Pre-nursery:			
Seeds (319)	-	1,279	-
Preparation	70	-	1-1/2
Bag-filling	199	-	2
Maintenance	20	-	1/2
Nursery:			
Preparation	10	-	1
Maintenance	20	48	10
Land Clearing:			
Underbrushing	80	-	8
Felling	600	-	4
Burning	-	-	1
Plowing	2,755	-	-
	3,754	1,327	28

4.3. Planting costs per hectare

Table A : X

Planting costs per hectare on plantations

Activity	Domestic inputs	Imported inputs	Number of Man-days
Pegging	25	-	1
Planting	50	240	5-1/2
Fertilisation	10	54	1-1/2
Holing	-	-	1
	85	294	10

Table A : XI

Number of Man-days and Material Costs per hectare for Maintenance of a Plantation

	Years									
	1	2	3	4	5	6	7	8	9	10
Fertilisation	1	2	3	3	3	3	3	3	3	3
Clearing and control	27	23	19	17	15	13	13	12	11	11
Drain maintenance	3	4	4	4	4	4	4	4	4	4
Replanting	3	1	1	1	-	-	-	-	-	-
Pest control	2	4	4	5	5	5	5	5	5	5
Path maintenance	1	2	4	4	4	4	4	4	4	4
Pruning	-	-	-	1	2	3	4	5	5	5
Support	-	-	-	1	-	-	-	-	-	-
Inspection	1	1	1	1	2	1	1	1	1	1
	38	37	36	37	35	33	34	34	33	33

Cost of materials (pesos)	Years									
	1	2	3	4	5	6	7	8	9	10
Imported inputs	167.50	235.20	366.69	366.69	647.70	647.70	647.70	647.70	647.70	647.70
Non-imported inputs	109.40	215.48	380.68	440.18	407.08	407.08	407.08	407.08	407.08	407.08

Table A : XII

Harvest costs per hectare per year

Year	Yield of tons bunches/hectare	Material costs	Number of man-days		
			Cutting	Loading	Total
4	5	53.65	9	1	10
5	7	71.11	10-1/2	1-1/2	12
6	11	107.03	13	2	15
7	14	137.22	15	3	18
8	16	154.68	17	4	21
9	18	177.14	19-1/2	4-1/2	24
10	19	185.87	21	5	26

Table A : XIII

Plant costs

Year	Yield of tons bunches	Man-days per ton-bunch	Unit cost per ton bunch : materials	Total cost of materials	Total number of man-days
4	500	2.4	160	80,000	1,200
5	1,700	2.0	140	328,000	3,400
6	3,500	1.6	120	420,000	5,600
7	5,000	1.2	100	500,000	6,000
8	6,600	0.8	80	528,000	5,280
9	7,800	0.8	70	546,000	6,240
10	8,700	0.8	70	609,000	6,960
11	9,300	0.8	70	651,000	7,440
12	9,500	0.8	70	665,000	7,600
13	9,500	0.8	70	665,000	7,600

4.5. Skilled personnel

The skilled personnel are technical personnel, the administrative personnel and surveyors.

Technical Assistance.

Technical assistance costs Col $250 per hectare per annum. In year - 1 the cost is Col $500 per hectare to allow for advice on drainage location and seedlings.

4.5.1. Administrative personnel

These are the administrative staff and are permanent employees. In 1971 salaries their cost is Col $466,500 a year. The cost is assumed to increase as follows: 1/4 in year - 1, 1/2 in year 1, 3/4 in year 2, 7/8 in year 3 and the total $466,500 in year 4. The cost of their materials increases $45,000 in year -1 to $60,000 in year 2. It remains at $60,000 for the remainder of the plantation's economic life.

4.5.2. Surveyor costs

Surveying costs are Col $100,000 in year -1.

5. Receipts schedule

Yields per hectare on plantations are identical to those on family farms.

The revenue schedule is different for two reasons. Firstly, the price per ton of oil is the world price per ton instead of 67.7 per cent of the world price. Secondly, plantations extract palm kernels in addition to palm oil. The extraction rates are as follows: a 20 per cent extraction of palm oil from bunches, and a 4.5 per cent extraction rate of kernels from bunches.

Table A : XIV

Yield and Revenue Schedule for the Plantation

Year	Number of hectares producing	Tons/bunches a year	Tons/oil a year	Tons/kernel a year	Revenue/ oil US $	Revenue/ kernels US $	TOTAL REVENUE COL.$
4	100	500	100	22.5	16,000	3,285	404,021
5	300	1,700	340	76.5	54,400	11,169	1,373,671
6	500	3,500	700	157.5	112,000	22,995	2,828,145
7	500	5,000	1,000	225.0	160,000	32,850	4,040,208
8	500	6,600	1,320	297.0	211,200	43,362	5,333,074
9	500	7,800	1,560	351.0	249,600	51,246	6,302,724
10	500	8,700	1,740	391.5	278,400	57,159	7,029,961
11	500	9,300	1,860	418.5	297,600	61,101	7,514,786
12	500	9,500	1,900	427.5	304,000	62,415	7,676,394
13	500	9,500	1,900	427.5	304,000	62,415	7,676,394
-30	500	9,500	1,900	427.5	304,000	62,415	7,676,394

Table A : XV

Total Cost of Plantations

Year	Foreign Exchange	Skilled Personnel	Domestic Inputs	LABOUR			TOTAL COST (100 pesos)		
				33 pesos	26 pesos	22 pesos	33 pesos	26 pesos	22 pesos
-1	634,634	324,939	566,327	130,800	108,400	95,600	1,656.7	1,634.3	1,621.5
1	464,384	293,251	1,229,367	367,200	300,000	261,600	2,354.2	2,287.8	2,240.6
2	127,654	424,876	914,555	620,700	500,200	431,000	2,087.8	1,967.3	1,898.1
3	796,505	508,189	3,618,612	679,800	535,600	453,200	5,603.1	5,458.9	5,376.5
4	157,047	591,500	338,115	738,000	533,000	451,000	1,824.7	1,619.7	1,537.7
5	211,446	591,500	619,221	889,200	642,200	543,400	2,311.4	2,064.4	1,965.6
6	267,648	591,500	725,815	972,000	759,200	642,400	2,557.0	2,344.2	2,227.4
7	323,850	591,500	821,390	1,087,200	785,200	664,400	2,823.9	2,521.9	2,401.1
8	323,850	591,500	1,068,358	1,134,000	800,280	677,160	3,117.7	2,784.0	2,660.9
9	323,850	591,500	898,134	1,333,600	866,840	733,480	3,147.1	2,680.3	2,547.0
10	569,984	591,500	985,115	1,410,400	916,760	775,720	3,557.0	3,063.4	2,922.3
11	476,684	591,500	1,006,856	1,461,600	950,040	803,880	3,536.0	3,025.1	2,878.9
12	326,084	591,500	1,022,602	1,484,000	964,600	816,200	3,424.2	2,904.8	2,756.4
13	944,346	591,500	1,023,143	1,484,000	964,600	816,200	4,043.0	3,523.6	3,375.2
14	323,850	591,500	1,050,975	1,632,400	964,600	816,200	3,598.7	2,930.9	2,782.5
15	323,850	591,500	1,029,975	1,632,400	964,600	816,200	3,577.7	2,909.9	2,761.5
16	323,850	591,500	1,042,475	1,632,400	964,600	816,200	3,590.2	2,922.4	2,774.0
17	323,850	591,500	1,029,975	1,632,400	964,600	816,200	3,577.7	2,909.9	2,761.5
18	323,850	591,500	1,033,975	1,632,400	964,600	816,200	3,581.7	2,913.9	2,765.5
19	323,850	591,500	1,033,975	1,780,800	964,600	816,200	3,730.1	2,909.9	2,765.5
20	569,984	591,500	1,049,102	1,780,800	964,600	816,200	3,991.4	3,175.2	3,026.8
21	476,684	591,500	1,422,602	1,780,800	964,600	816,200	4,271.6	3,455.4	3,307.0
22	326,084	591,500	1,122,602	1,780,800	964,600	816,200	3,821.0	3,004.8	2,856.4
23	944,346	591,500	1,473,143	1,780,800	964,600	816,200	4,789.8	3,973.6	3,825.2
24	323,850	591,500	1,050,975	1,966,300	964,600	816,200	3,932.6	2,930.9	2,782.5
25	323,850	591,500	1,029,975	1,966,300	964,600	816,200	3,911.6	2,909.9	2,761.5
26	323,850	591,500	1,042,475	1,966,300	964,600	816,200	3,924.1	2,922.4	2,774.0
27	323,850	591,500	1,029,975	1,966,300	964,600	816,200	3,911.6	2,909.9	2,761.5
28	323,850	591,500	1,033,975	1,966,300	964,600	816,200	3,915.6	2,913.9	2,765.5
29	323,850	591,500	1,033,975	2,151,800	964,600	816,200	4,101.1	2,913.9	2,765.5
30	569,984	591,500	1,049,102	2,151,800	964,600	816,200	4,362.4	3,175.2	3,026.8

Table A : XVI

Total Cost of Family Farms

	Foreign Exchange	Skilled Personnel	Domestic Inputs	LABOUR			TOTAL COST (100 Pesos)		
				33 pesos	26 pesos	22 pesos	33 pesos	26 pesos	22 pesos
-1	-	1,000	3,860	5,610	4,420	3,740	10.5	9.3	8.6
1	4,615	1,000	25,258	30,360	23,920	20,240	61.2	54.8	51.1
2	2,352	1,500	1,630	18,480	14,560	12,320	24.0	20.0	17.8
3	3,667	2,000	2,080	17,490	13,780	11,660	25.2	21.5	19.4
4	3,667	2,500	2,230	22,680	16,380	13,860	31.1	24.8	22.3
5	6,477	2,500	2,080	28,080	20,280	17,160	39.1	31.3	28.2
6	6,477	2,500	2,080	31,680	22,880	19,360	42.7	33.3	30.4
7	6,477	2,500	2,080	37,080	26,780	22,660	48.1	37.8	33.7
8	6,477	2,500	2,080	42,120	30,420	25,740	53.2	41.5	36.8
9	6,477	2,500	2,080	46,800	30,420	25,740	57.9	41.5	36.8
10	6,477	2,500	2,080	46,800	30,420	25,740	57.9	41.5	36.8
11	6,477	2,500	2,080	46,800	30,420	25,740	57.9	41.5	36.8
12	6,477	2,500	2,080	46,800	30,420	25,740	57.9	41.5	36.8
13	6,477	2,500	2,080	46,800	30,420	25,740	57.9	41.5	36.8
14	6,477	2,500	2,080	51,480	30,420	25,740	62.5	41.5	36.8
15	6,477	2,500	2,080	51,480	30,420	25,740	62.5	41.5	36.8
16	6,477	2,500	2,080	51,480	30,420	25,740	62.5	41.5	36.8
17	6,477	2,500	2,080	51,480	30,420	25,740	62.5	41.5	36.8
18	6,477	2,500	2,080	51,480	30,420	25,740	62.5	41.5	36.8
19	6,477	2,500	2,080	56,160	30,420	25,740	67.2	41.5	36.8
20	6,477	2,500	2,080	56,160	30,420	25,740	67.2	41.5	36.8
21	6,477	2,500	2,080	56,160	30,420	25,740	67.2	41.5	36.8
22	6,477	2,500	2,080	56,160	30,420	25,740	67.2	41.5	36.8
23	6,477	2,500	2,080	56,160	30,420	25,740	67.2	41.5	36.8
24	6,477	2,500	2,080	62,010	30,420	25,740	73.1	41.5	36.8
25	6,477	2,500	2,080	62,010	30,420	25,740	73.1	41.5	36.8
26	6,477	2,500	2,080	62,010	30,420	25,740	73.1	41.5	36.8
27	6,477	2,500	2,080	62,010	30,420	25,740	73.1	41.5	36.8
28	6,477	2,500	2,080	62,010	30,420	25,740	73.1	41.5	36.8
29	6,477	2,500	2,080	67,860	30,420	25,740	78.9	41.5	36.8
30	6,477	2,500	2,080	67,860	30,420	25,740	78.9	41.5	36.8

Table A : XVII

Plantation Rate of Return when the Shadow Wage is 33 pesos

	Labour costs	Other costs	Total costs 100 pesos	Net Revenue 100 pesos	D.F. 15%	Present worth 100 pesos	D.F. 10%	Present worth 100 pesos
-1	130,800	1,525,900	1,656.7	-1,656.7	.870	-1,442.2	.909	-1,505.9
1	367,200	1,987,002	2,354.2	-2,354.2	.756	-1,779.8	.826	-1,944.6
2	620,700	1,467,085	2,087.8	-2,087.8	.658	-1,373.8	.751	-1,567.9
3	679,800	4,923,306	5,603.1	-5,603.1	.572	-3,205.0	.683	-3,826.9
4	738,000	1,086,662	1,824.7	-1,420.7	.497	-706.1	.621	-882.3
5	889,200	1,422,167	2,311.4	-937.7	.432	-405.1	.564	-528.9
6	972,000	1,584,963	2,557.0	271.1	.376	101.9	.513	139.1
7	1,087,200	1,736,740	2,823.9	1,216.3	.327	397.7	.467	568.0
8	1,134,000	1,983,708	3,117.7	2,215.4	.284	629.2	.424	939.3
9	1,333,600	1,813,484	3,147.1	3,155.6	.247	779.4	.386	1,218.1
10	1,410,400	2,146,599	3,557.0	3,473.0	.215	746.7	.350	1,215.6
11	1,461,600	2,075,040	3,536.0	3,978.2	.187	743.9	.319	1,269.0
12	1,484,000	1,940,186	3,424.2	4,252.2	.163	693.1	.290	1,233.1
13	1,484,000	2,558,989	4,043.0	3,633.4	.141	512.3	.263	955.6
14	1,632,400	1,966,325	3,598.7	4,077.7	.123	501.6	.239	974.6
15	1,632,400	1,945,325	3,577.7	4,098.7	.107	438.6	.218	893.5
16	1,632,400	1,957,825	3,590.2	4,086.2	.093	380.0	.198	809.1
17	1,632,400	1,945,325	3,577.7	4,098.7	.081	332.0	.180	737.8
18	1,632,400	1,949,325	3,581.7	4,094.7	.070	286.6	.164	671.5
19	1,780,800	1,949,325	3,730.1	3,946.3	.061	240.7	.149	588.0
20	1,780,800	2,210,586	3,991.4	3,685.0	.053	195.3	.135	497.5
21	1,780,800	2,490,786	4,271.6	3,404.8	.046	156.6	.123	418.8
22	1,780,800	2,040,186	3,821.0	3,855.4	.040	154.2	.112	431.8
23	1,780,800	3,008,989	4,789.8	2,886.6	.035	101.0	.102	294.4
24	1,966,300	1,966,325	3,932.6	3,743.8	.030	112.3	.092	344.4
25	1,966,300	1,945,325	3,911.6	3,764.8	.026	97.9	.084	316.2
26	1,966,300	1,957,825	3,924.1	3,752.3	.023	86.3	.076	285.2
27	1,966,300	1,945,325	3,911.6	3,764.8	.020	75.2	.069	259.8
28	1,966,300	1,949,325	3,915.6	3,760.8	.017	63.9	.063	236.9
29	2,151,800	1,949,325	4,101.1	3,575.3	.015	53.6	.057	203.8
30	2,151,800	2,210,586	4,362.4	3,314.0	.013	43.1	.052	172.3

At 10% = + 5,416.9

At 15% = - 1,188.9

By interpolation $10 + 5 \left(\frac{5,416.9}{6,605.8}\right) = 10 + 4.1$

= 14% = Internal Rate of Return on Plantation

Table A : XVIII

Family Farm Rate of Return when the Shadow Wage is 33 pesos

	Labour costs	Other costs	Total costs 100 pesos	Net Revenue 100 pesos	D.F. 10%	Present Worth (100 pesos)
-1	5,610	4,860	10.5	-10.5	.909	-9.5
1	30,360	30,873	61.2	-61.2	.826	-50.6
2	18,480	5,482	24.0	-24.0	.751	-18.0
3	17,490	7,747	25.2	-25.2	.683	-17.2
4	22,680	8,397	31.1	-8.4	.621	-5.2
5	28,080	11,057	39.1	-7.3	.564	-4.1
6	31,680	11,057	42.7	7.3	.513	3.7
7	37,080	11,057	48.1	15.5	.467	7.2
8	42,120	11,057	53.2	19.4	.424	8.2
9	46,800	11,057	57.9	23.8	.386	9.2
10	46,800	11,057	57.9	28.4	.350	9.9
11	46,800	11,057	57.9	28.4	.319	9.1
12	46,800	11,057	57.9	28.4	.290	8.2
13	46,800	11,057	57.9	28.4	.263	7.5
14	51,480	11,057	62.5	23.8	.239	5.7
15	51,480	11,057	62.5	23.8	.218	5.2
16	51,480	11,057	62.5	23.8	.198	4.7
17	51,480	11,057	62.5	23.8	.180	4.3
18	51,480	11,057	62.5	23.8	.164	3.9
19	56,160	11,057	67.2	19.1	.149	2.8
20	56,160	11,057	67.2	19.1	.135	2.6
21	56,160	11,057	67.2	19.1	.123	2.3
22	56,160	11,057	67.2	19.1	.112	2.1
23	56,160	11,057	67.2	19.1	.102	1.9
24	62,010	11,057	73.1	13.2	.092	1.2
25	62,010	11,057	73.1	13.2	.084	1.1
26	62,010	11,057	73.1	13.2	.076	1.0
27	62,010	11,057	73.1	13.2	.069	0.9
28	62,010	11,057	73.1	13.2	.063	0.8
29	67,860	11,057	78.9	7.4	.057	0.4
30	67,860	11,057	78.9	7.4	.052	0.4

At 10% - 0.3

= 10% = Internal Rate of Return on Family Farm

Table A : XIX

Plantation Rate of Return when the Shadow Wage is 22 pesos .

	Labour costs	Other costs	Total cost 100 pesos	Net Revenue 100 pesos	D.F. 20%	Present worth 100 pesos	D.F. 15%	Present worth 100 pesos
-1	95,600	1,525,900	1,621.5	-1,621.5	.833	1,350.7	.870	1,410.7
1	261,600	1,987,002	2,248.6	-2,248.6	.694	1,560.5	.756	1,699.9
2	431,000	1,467,085	1,898.1	-1,898.1	.579	1,099.0	.658	1,249.0
3	453,200	4,923,306	5,376.5	-5,376.5	.482	2,591.5	.572	3,075.4
4	451,000	1,086,662	1,537.7	-1,133.7	.402	455.8	.497	563.4
5	543,400	1,422,167	1,965.6	-591.9	.335	198.3	.432	255.7
6	642,400	1,584,963	2,227.4	600.7	.279	167.6	.376	225.9
7	664,400	1,736,740	2,401.1	1,639.1	.233	381.9	.327	536.0
8	677,160	1,983.708	2,660.9	2,672.2	.194	518.4	.284	758.9
9	733,480	1,813,484	2,547.0	3,755.7	.162	608.4	.247	927.7
10	775,720	2,146,599	2,922.3	4,107.7	.135	554.5	.215	883.2
11	803,880	2,075,040	2,878.9	4,635.9	.112	519.2	.187	866.9
12	816,200	1,940,186	2,756.4	4,920.0	.093	457.6	.163	802.0
13	816,200	2,558,989	3,375.2	4,301.2	.078	335.5	.141	606.5
14	816,200	1,966,325	2,782.5	4,893.9	.065	318.1	.123	602.0
15	816,200	1,945,325	2,761.5	4,914.9	.054	265.4	.107	526.0
16	816,200	1,957,825	2,774.0	4,902.4	.045	220.6	.093	455.9
17	816,200	1,945,325	2,761.5	4,914.9	.038	186.8	.081	398.1
18	816,200	1,949,325	2,765.5	4,910.9	.031	152.2	.07	343.8
19	816,200	1,949,325	2,765.5	4,910.9	.026	127.7	.061	299.6
20	816,200	2,210,586	3,026.8	4,649.6	.022	102.3	.053	246.4
21	816,200	2,490,786	3,307.0	4,369.4	.018	78.6	.046	201.0
22	816,200	2,040,186	2,856.4	4,820.0	.015	72.3	.04	192.8
23	816,200	3,008,989	3,825.2	3,851.2	.013	50.1	.035	134.8
24	816,200	1,966,325	2,782.5	4,893.9	.010	48.9	.03	146.8
25	816,200	1,945,325	2,761.5	4,914.9	.009	44.2	.026	127.8
26	816,200	1,957,825	2,774.0	4,902.4	.007	34.3	.023	112.8
27	816,200	1,945,325	2,761.5	4,914.9	.006	29.5	.02	98.3
28	816,200	1,949,325	2,765.5	4,910.9	.005	24.6	.017	83.5
29	816,200	1,949,325	2,765.5	4,910.9	.004	19.6	.015	73.7
30	816,200	2,210,586	3,026.8	4,649.6	.004	18.6	.013	60.4

At 15% = + 1,456.7

At 20% = - 1,918.9

By interpolation $15 + 5\left(\frac{1,456.7}{3,375.6}\right) = 15 + 2.16$

= 17%

Table A : XX

Family Farm Rate of Return when the Shadow Wage is 22 pesos

	Labour costs	Other costs	Total costs 100 pcs.	Net Revenue 100 pesos	D.F. 20%	Present worth 100 pcs.	D.F. 15%	Present worth 100 pesos
-1	13,740	4,860	8.6	-8.6	.833	-7.2	.870	-7.5
1	20,240	30,873	51.1	-51.1	.694	-35.5	.756	-38.6
2	12,320	5,482	17.8	-17.8	.579	-10.3	.658	-11.7
3	11,660	7,747	19.4	-19.4	.482	-9.4	.572	-11.1
4	13,860	8,397	22.3	0.4	.402	0.2	.497	0.2
5	17,160	11,057	28.2	3.6	.335	1.2	.432	1.6
6	19,360	11,057	30.4	19.6	.279	5.5	.376	7.4
7	22,660	11,057	33.7	29.9	.233	7.0	.327	9.8
8	25,740	11,057	36.8	35.8	.194	6.9	.284	10.2
9	25,740	11,057	36.8	44.9	.162	7.3	.247	11.1
10	25,740	11,057	36.8	49.5	.135	6.7	.215	10.6
11	25,740	11,057	36.8	49.5	.112	5.5	.187	9.3
12	25,740	11,057	36.8	49.5	.093	4.6	.163	8.1
13	25,740	11,057	36.8	49.5	.078	3.9	.141	7.0
14	25,740	11,057	36.8	49.5	.065	3.2	.123	6.1
15	25,740	11,057	36.8	49.5	.054	2.7	.107	5.3
16	25,740	11,057	36.8	49.5	.045	2.2	.093	4.6
17	25,740	11,057	36.8	49.5	.038	1.9	.081	4.0
18	25,740	11,057	36.8	49.5	.031	1.5	.070	3.5
19	25,740	11,057	36.8	49.5	.026	1.3	.061	3.0
20	25,740	11,057	36.8	49.5	.022	1.1	.053	2.6
21	25,740	11,057	36.8	49.5	.018	0.9	.046	2.3
22	25,740	11,057	36.8	49.5	.015	0.7	.040	2.0
23	25,740	11,057	36.8	49.5	.013	0.6	.035	1.7
24	25,740	11,057	36.8	49.5	.010	0.5	.030	1.5
25	25,740	11,057	36.8	49.5	.009	0.4	.026	1.3
26	25,740	11,057	36.8	49.5	.007	0.3	.023	1.1
27	25,740	11,057	36.8	49.5	.006	0.3	.020	1.0
28	25,740	11,057	36.8	49.5	.005	0.2	.017	0.8
29	25,740	11,057	36.8	49.5	.004	0.2	.015	0.7
30	25,740	11,057	36.8	49.5	.004	0.2	.013	0.6

At 15% = + 48.5

At 20% = + 4.6

= > 20%

Table A : XXI

Plantation Rate of Return when the Shadow Wage is 26 pesos

	Labour costs	Other costs	Total costs 100 pesos	Net Revenue 100 pesos	D.P. 15%	Present worth 100 pesos	D.F. 20%	Present worth 100 pesos
-1	108,400	1,525,900	1,634.3	-1,634.3	.870	-1,421.8	.833	-1,361.4
1	300,000	1,987,002	2,287.0	-2,287.0	.756	-1,729.0	.694	-1,587.2
2	500,200	1,467,085	1,967.3	-1,967.3	.658	-1,294.5	.579	-1,139.1
3	535,600	4,923,306	5,458.9	-5,458.9	.572	-3,122.5	.482	-2,631.2
4	533,000	1,086,662	1,619.7	-1,215.7	.497	-604.2	.402	-488.7
5	642,200	1,422,167	2,064.4	-690.7	.432	-298.4	.335	-231.4
6	759,200	1,584,963	2,344.2	483.9	.376	181.9	.279	135.0
7	785,200	1,736,740	2,521.9	1,518.3	.327	496.5	.233	353.8
8	800,280	1,983,708	2,784.0	2,549.1	.284	723.9	.194	494.5
9	866,840	1,813,484	2,680.3	3,622.4	.247	894.7	.162	586.8
10	916,760	2,146,599	3,063.4	3,966.6	.215	852.8	.134	531.5
11	950,040	2,075,040	3,025.1	4,489.7	.187	839.6	.112	502.8
12	964,600	1,940,186	2,904.8	4,771.6	.163	777.8	.093	443.8
13	964,600	2,558,989	3,523.5	4,152.8	.141	585.5	.078	323.9
14	964,600	1,966,325	2,930.9	4,745.5	.123	583.7	.065	308.5
15	964,600	1,945,325	2,909.9	4,766.5	.107	510.0	.054	257.4
16	964,600	1,957,825	2,922.4	4,754.0	.093	442.1	.045	213.9
17	964,600	1,945,325	2,909.9	4,766.5	.081	386.1	.038	181.1
18	964,600	1,949,325	2,913.9	4,762.5	.07	333.4	.031	147.6
19	964,600	1,945,325	2,909.9	4,766.5	.061	290.8	.026	123.9
20	964,600	2,210,586	3,175.2	4,501.2	.053	238.6	.022	99.0
21	964,600	2,490,786	3,455.4	4,221.0	.046	194.2	.018	76.0
22	964,600	2,040,186	3,004.8	4,671.6	.04	186.8	.015	70.1
23	964,600	3,008,989	3,973.6	3,702.8	.035	129.6	.013	48.1
24	964,600	1,966,325	2,930.9	4,745.5	.03	142.4	.010	47.5
25	964,600	1,945,325	2,909.9	4,766.5	.025	123.9	.009	42.9
26	964,600	1,957,825	2,922.4	4,754.0	.023	109.3	.007	33.3
27	964,600	1,945,325	2,909.9	4,766.5	.02	95.3	.006	28.6
28	964,600	1,949,325	2,913.9	4,762.5	.017	81.0	.005	23.8
29	964,600	1,949,325	2,913.9	4,762.5	.015	71.4	.004	19.1
30	964,600	2,210,586	3,175.2	4,501.2	.013	58.5	.004	18.0

At 15% = + 859.4

At 20% = - 2,328.1

By interpolation $15 + 5\left(\frac{859.4}{3,187.5}\right) = 15 + 1.35$

= 16%

Table A : XXII

Family Farm Rate of Return when the Shadow Wage is 26 pesos

	Labour costs	Other costs	Total costs	Net Revenue	D.F. 15%	Present worth	D.F. 20%	Present worth
			100 pesos	100 pesos		100 pesos		100 pesos
-1	4,420	4,860	9.3	-9.3	.870	-8.1	.833	-7.7
1	23,920	30,873	54.8	-54.8	.756	-41.4	.694	-38.0
2	14,560	5,482	20.0	-20.0	.658	-13.2	.579	-11.6
3	13,780	7,747	21.5	-21.5	.572	-12.3	.482	-10.4
4	16,380	8,397	24.8	-2.1	.497	-1.0	.402	-0.8
5	20,280	11,057	31.3	-0.5	.432	0.2	.335	0.2
6	22,880	11,057	33.9	16.1	.376	6.1	.279	4.5
7	26,780	11,057	37.8	25.8	.327	8.4	.233	6.0
8	30,420	11,057	41.5	31.1	.284	8.8	.194	6.0
9	30,420	11,057	41.5	40.2	.247	9.9	.162	6.5
10	30,420	11,057	41.5	44.8	.215	9.6	.135	6.0
11	30,420	11,057	41.5	44.8	.187	8.4	.112	5.0
12	30,420	11,057	41.5	44.8	.163	7.3	.093	4.2
13	30,420	11,057	41.5	44.8	.141	6.3	.078	3.5
14	30,420	11,057	41.5	44.8	.123	5.5	.065	2.9
15	30,420	11,057	41.5	44.8	.107	4.8	.054	2.4
16	30,420	11,057	41.5	44.8	.093	4.2	.045	2.0
17	30,420	11,057	41.5	44.8	.081	3.6	.038	1.7
18	30,420	11,057	41.5	44.8	.07	3.1	.031	1.4
19	30,420	11,057	41.5	44.8	.061	2.7	.026	1.2
20	30,420	11,057	41.5	44.8	.053	2.4	.022	1.0
21	30,420	11,057	41.5	44.8	.046	2.1	.018	0.8
22	30,420	11,057	41.5	44.8	.04	1.8	.015	0.7
23	30,420	11,057	41.5	44.8	.035	1.6	.013	0.6
24	30,420	11,057	41.5	44.8	.03	1.3	.010	0.4
25	30,420	11,057	41.5	44.8	.026	1.2	.009	0.4
26	30,420	11,057	41.5	44.8	.023	1.0	.007	0.3
27	30,420	11,057	41.5	44.8	.02	0.9	.006	0.3
28	30,420	11,057	41.5	44.8	.017	0.8	.005	0.2
29	30,420	11,057	41.5	44.8	.015	0.7	.004	0.2
30	30,420	11,057	41.5	44.8	.013	0.6	.004	0.2

Family Farm

At 15% = + 27.3

At 20% = - 9.9

By interpolation $15 + 5\left(\frac{27.3}{37.2}\right) = 15 + 3.6$

= 19%

Table A : XXIII

Internal Foreign Exchange Rate of Plantation Regimes (100) pesos

	Zt - Cmt	D.F. 11%	Present worth	Total Domestic Costs SWR = 33	Total Domestic Costs SWR = 22	D.F. 11%	Present Worth SWR = 33	Present Worth SWR = 22
-1	-634.6	.901	-571.8	1,022.1	986.9	.901	920.9	889.2
1	-464.4	.812	-377.1	1,889.8	1,784.2	.812	1,534.5	1,448.8
2	-127.7	.731	-93.3	1,960.1	1,770.4	.731	1,432.8	1,294.2
3	-796.5	.659	-524.9	4,806.6	4,580.0	.659	3,167.5	3,018.2
4	247.0	.593	146.5	1,667.6	1,380.6	.593	988.9	818.7
5	1,162.2	.535	621.8	2,099.9	1,754.1	.535	1,123.4	938.4
6	2,560.5	.482	1,234.2	2,289.3	1,959.8	.482	1,103.4	944.6
7	3,716.4	.434	1,612.9	2,500.1	2,077.3	.434	1,085.0	901.5
8	5,009.2	.391	1,958.6	2,793.9	2,337.0	.391	1,092.4	913.8
9	5,978.9	.352	2,104.6	2,823.2	2,223.1	.352	993.8	782.5
10	6,460.0	.317	2,047.8	2,987.0	2,352.3	.317	946.9	745.7
11	7,038.1	.286	2,012.9	3,060.0	2,402.2	.286	875.2	687.0
12	7,350.3	.258	1,896.4	3,098.1	2,430.3	.258	799.3	627.0
13	6,732.0	.232	1,561.8	3,098.6	2,430.8	.232	718.9	563.9
14	7,352.5	.209	1,536.7	3,274.9	2,458.7	.209	684.5	513.8
15	7,352.5	.188	1,382.3	3,253.9	2,437.7	.188	611.8	458.3
16	7,352.5	.170	1,249.9	3,266.4	2,450.2	.170	555.3	416.5
17	7,352.5	.153	1,124.9	3,253.9	2,437.7	.153	497.8	373.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	7,352.5	.124	911.7	3,443.4	2,441.7	.124	427.0	302.8
20	7,106.4	.112	795.9	3,458.5	2,456.8	.112	387.4	275.2
21	7,199.7	.101	727.2	3,832.0	2,830.3	.101	387.0	285.9
22	7,350.3	.091	668.9	3,532.0	2,530.3	.091	321.4	230.3
23	6,732.0	.082	552.0	3,882.5	2,880.8	.082	318.4	236.2
24	7,352.5	.074	544.1	3,645.9	2,458.7	.074	269.8	181.9
25	7,352.5	.066	485.3	3,624.9	2,437.7	.066	239.2	160.9
26	7,352.5	.060	441.2	3,637.4	2,450.2	.060	218.2	147.0
27	7,352.5	.054	397.0	3,628.9	2,437.7	.054	196.0	131.6
28	7,352.5	.048	352.9	3,628.9	2,441.7	.048	174.2	117.2
29	7,352.5	.044	323.5	3,851.5	2,441.7	.044	169.5	107.4
30	7,106.4	.039	277.1	3,866.6	2,456.8	.039	150.8	95.8

$$\text{Internal Foreign Exchange Rate} = \frac{\text{Present Worth of Domestic Cost}}{\text{Present Worth of Net Foreign Exchange Saving}}$$

$$= \frac{22,840.8}{26,415.6}$$

at 33 pesos a man-day $= \frac{22,840.8}{\text{US } \$1,260.9} = 18.1$

at 22 pesos a man-day $= \frac{18,944.3}{\text{US } \$1,260.9} = 15.0$

Table A : XXIV

Internal Foreign Exchange Rate of Family Farm Regimes (100) pesos

	ZT - Cmt	D.F. 11%	Present worth	SWR = 33	SWR = 22	D.F. 11%	Present Worth SWR = 33	Present Worth SWR = 22
-1	-	-	-	10.5	8.6	.901	9.5	7.7
1	-4.6	.812	-3.7	56.6	46.5	.812	46.0	37.8
2	-2.4	.731	-1.8	21.6	15.5	.731	15.8	11.3
3	-3.7	.659	-2.4	21.6	15.7	.659	14.2	10.3
4	19.1	.593	11.3	27.4	18.6	.493	16.2	11.0
5	25.3	.535	13.5	32.7	21.7	.535	17.5	11.6
6	43.5	.482	21.0	36.3	23.9	.482	17.5	11.5
7	57.1	.434	24.8	41.7	27.2	.434	18.1	11.8
8	66.2	.391	25.9	46.7	30.3	.391	18.3	11.8
9	75.2	.352	26.5	51.4	30.3	.352	18.1	10.7
10	79.8	.317	25.3	51.4	30.3	.317	16.3	9.6
11	79.8	.286	22.8	51.4	30.3	.286	14.7	8.7
12	79.8	.258	20.6	51.4	30.3	.258	13.3	7.8
13	79.8	.232	18.5	51.4	30.3	.232	11.9	7.0
14	79.8	.209	16.7	56.1	30.3	.209	11.7	6.3
15	79.8	.188	15.0	56.1	30.3	.188	10.5	5.7
16	79.8	.170	13.6	56.1	30.3	.170	9.5	5.2
17	79.8	.153	12.2	56.1	30.3	.153	8.6	4.6
18	79.8	.138	11.0	56.1	30.3	.138	7.7	4.2
19	79.8	.124	9.9	60.7	30.3	.124	7.5	3.8
20	79.8	.112	8.9	60.7	30.3	.112	6.8	3.4
21	79.8	.101	8.1	60.7	30.3	.101	6.1	3.1
22	79.8	.091	7.3	60.7	30.3	.091	5.5	2.8
23	79.8	.082	6.5	60.7	30.3	.082	5.0	2.5
24	79.8	.074	5.9	66.6	30.3	.074	4.9	2.2
25	79.8	.066	5.3	66.6	30.3	.066	4.4	2.0
26	79.8	.060	4.8	66.6	30.3	.060	4.0	1.8
27	79.8	.054	4.3	66.6	30.3	.054	3.6	1.6
28	79.8	.048	3.8	66.6	30.3	.048	3.2	1.5
29	79.8	.044	3.5	72.4	30.3	.044	3.2	1.3
30	79.8	.039	3.1	72.4	30.3	.039	2.8	1.2

Internal Exchange Rate = Col. $342,200

at 33 pesos a man-day = Col. $352,400 / US $16,334 = 21.6

at 22 pesos a man-day = Col. $221,800 / US $16,334 = 13.6

Table A : XXV

Labour Coefficients

Over the life of each of the tenure systems the costs are:

Plantation

Skilled Personnel	:	Col	$17,521,755
Foreign Exchange	:		12,721,248
Capital Inputs	:		33,396,861
Labour when PL = 22	:		22,040,640
			85,680,504
Minus Plant Costs	:		28,906,440
			56,774,064

Number of man-days (minus plant labour) : 811,600 = 3,246 man-years

= $17,490 per man-year

Labour Coefficient = 0.39

Family Farm

Skilled Personnel	:	Col	$73,000
Foreign Exchange	:		176,226
Capital Inputs	:		87,058
Labour when PL = 22	:		713,020
			1,049,304

Number of man-days : $31,240 = 125 man-years

= $8,394 per man-year

Labour Coefficient = 0.68

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