RETURNS TO INVESTMENTS IN COCOA RESEARCH IN NIGERIA

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RETURNS TO INVESTMENTS
IN COCOA RESEARCH IN NIGERIA

By

AYOADE ABIDOGUN
B.Sc., M.Sc., (London)

A thesis in the Department of
AGRICULTURAL ECONOMICS

Submitted to the Faculty of Agriculture and
Forestry in partial fulfilment of the
requirements for the degree of

DOCTOR OF PHILOSOPHY

of the

UNIVERSITY OF IBADAN

National Cereals Research Institute,
Moor Plantation,
Ibadan.

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I certify that this work was carried out by Mr. Ayoade Abidogun in the Department of Agricultural Economics, University of Ibadan.

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ABSTRACT

The low level of agricultural productivity in many countries of the Third World constitutes a drag on economic development. In any effort to break the deadlock technological change is *sine qua non*. "Aid" and "technical assistance" have proved generally disappointing as means of stimulating change. Increasingly, developing countries have become painfully aware that development has to be internally generated. In this whole process scientific and technological research is of crucial significance. The organisation of agricultural research in Nigeria is examined and its impact on agricultural productivity evaluated. It is concluded that the performance of agricultural research has been generally poor. However there seems to be some notable exception. The phenomenal increase in cocoa output over the years has often been linked, among other factors, with the introduction of improved varieties and control of pests and diseases. There is thus some indication that cocoa research may have been productive in the past.

But how significant has been the contribution of research to cocoa output? Can the value of such contribution *vis-a-vis* its costs stand the test of

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social profitability? This study attempts to estimate empirically the returns to investments in cocoa research in Nigeria. For this purpose two models are developed. The first is the index-number model in which the productivity index of improved cocoa varieties is used to measure the downward shifts in the long-run cocoa supply function as a way of estimating the annual values of resource "savings" resulting from increased productivity. The annual values of resource savings (representing the social returns) are then weighed against the costs in terms of annual research (including extension) expenditures. The estimated internal rate of return from the resulting cash flow is found to be very high. The second model is a production function incorporating research (including extension) expenditure as an explanatory variable. The result of regression analysis on time series data indicates a high level of significance for the research variable. Converting the research coefficient into an internal rate of return the result obtained corroborated that of the index-number approach.

A major implication of the findings is that there has been gross under-investments in cocoa research in the past. It thus deserves a greater share of resources on grounds of allocative efficiency. Furthermore, given

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the high pay-offs from investments in cocoa research, it could serve as a model in terms of organisational structure, system of financing, staff recruitment and training policy, etc., thus providing valuable insights into more effective means of mobilising scarce resources for greater productivity in the lagging sectors of agricultural research.

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ACKNOWLEDGEMENTS

I wish to acknowledge with gratitude the assistance rendered by various individuals, corporate bodies and institutions during the preparation of this thesis. First, my thanks go to my supervisor, Professor S. O. Olayide, for his guidance and helpful suggestions in planning the research, and for his criticism during the writing stages of the thesis. My thanks also go to several members of the Department of Agricultural Economics, University of Ibadan, for their support.

Without the willing cooperation and enthusiasm of many organisations, undertaking this research would not have been easy. The following deserve special mention: the Cocoa Research Institute of Nigeria, for giving me access to valuable records and precious documents not only of its own, but also those of its predecessor, the West African Cocoa Research Institute; the Ministry of Agriculture and Natural Resources of the old Western State and its successors in Ogun, Ondo and Oyo States, for supplying data and information on aspects of their respective extension programmes and

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activities; the old Western State Cocoa Development Unit and its successors in Ogun, Ondo and Oyo States, for sharing with me their working experience of the scheme as well as supplying data; the old Western Nigeria Marketing Board and the Nigerian Cocoa Board for providing data and useful background information on cocoa marketing; and the Computer Centre, University of Ibadan, for processing the data.

Credit goes to Mr. N. S. Onwuanishia who typed the manuscript and assisted in editing. Lastly, I am grateful to my wife for her patient understanding and encouragement at all times in the preparation of this thesis.

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CHAPTER I

GENERAL INTRODUCTION

1.1 Preliminary considerations

In these closing years of the United Nations Second Development Decade (1970-79) the development problem of the Third World countries remains intractable as ever. Indeed relative to the industrial nations many of these countries have actually stagnated over the years. For instance, while the average percentage annual increase in the income per capita of poor countries changed from 2.3 to 2.5 between 1950 and 1967, the corresponding figures for rich countries during the same period are 2.8 and 3.6 respectively (see Table 1.1). It has thus become increasingly clear that the hopes placed on official programme of "aid", hopes that, first, financial aid would provide the necessary infrastructure and communications, power and public services which would secure rapid development, have not materialized.

Similarly, later emphasis placed on the need of support by "technical assistance" which would provide the "missing component" of skills and experience has

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TABLE 1.1

Changes in income in rich and
poor countries: 1950 to 1975

	Average percentage annual increase		
Total income	1950-60	1960-67	1967-75*
Rich	4.0	4.8	5.0
Poor	4.6	5.0	6.0
Income per capital			
Rich	2.8	3.6	4.0
Poor	2.3	2.5	3.0

Source: "Partners in Development: Report on the Commission on International Development," Pall Mall Press, 1969.

* Estimates based on Samuelson, P.A., Economics, tenth edition, McGraw Hill, Kogakusha Ltd, 1976, p.763, Fig. 138-2.

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proved to be largely illusory in the context of bridging the gap between industrialized and low-income countries.

A number of reasons have been given as to why aid has failed to make any significant impact on the development of Third World countries. First, it is argued that aid merely helps to sustain governments that have little or no commitment to economic and social progress of their societies beyond perpetuating their own priviledged classes. Aid thus enables such regimes to postpone or even avoid painful decisions to carry out necessary reforms in their institutions and practices. Second, it is charged that aid transfers unsuitable institutions, practices or attitudes from rich to poor countries, thereby strengthening the dualism in the structure of the latter economies, reinforcing the elites of priviledge and wealth, and raising the costs of development against the poor countries with consequent possibility of diminishing significant economic and social advance. Third, by being made conditiohal to the acceptance of proposals for change in domestic policies and administration based on an inadequate understanding of local conditions; being tied to the procurement in the donor country; or being tied to specific projects which gain donor approval: the benefits of financial aid may be significantly diminished. Fourth, the

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debt service, built up, absorbs an ever increasing part of the foreign exchange available to the poor country whether earned or acquired by further loans and grants. Fifth, that technical assistance requires supporting facilities which impose severe constraints on the already undermanned administrative machinery of the recepient country. For instance, the pre-investment surveys make heavy demands on scarce professional manpower and technical services, personal housing, office space and transport, so that "institution building" favoured by the donors involves locking up all these other essential services for little or no immediate gain. Finally, that the high standards of living enjoyed by technical assistance exports bring about dissatisfaction among their local counterparts, leading to demand by the latter of higher salaries and fringe benefits.

Regardless of the merits of these arguments against the effectiveness of foreign aid in promoting economic development, more significant is the current general awareness among developing nations themselves that the development effort must be based largely on their own self-reliance. This awareness is reflected in such slogans as "trade, not aid." Such a recognition seems inevitable

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because the problems involved are so deeply domestic.[1]

One area in which the spirit, at least, of self-reliance has of recent been most evident in some countries is in food production. For example, Nigeria's current campaign of "Operation Feed the Nation" - as that of Ghana's "Operation Feed Yourself" before it - is an attempt to increase food production through self-efforts in the face of mounting food imports that have characterised West African economies since the 1960's.[2] The possible success of such campaigns lies mainly in generating an increase in the effective hectareage under food cultivation.

However, in the context of economic development, what is needed in low-income countries are <u>substantial increases in agricultural</u> productivity. And this can only come about through technological change. As Schultz has said, "Despite all that has been written on how to improve the mix of factors of poor communities, the increase in real income to be had from a better allocation of existing factors are small" and that "agriculture will remain niggardly under such circumstances."[3] The issue of technological change

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1 Seers, D. and L. Joy (eds.), Development in a divided world. Penguin Books, 1970. p.35.

2 Oluwasanmi, H.A., West African development in the 60's. <u>Proceedings on factors of agricultural growth in West Africa</u>. ISSER, University of Ghana, Legon, 1973.

3 Schultz, T.W., Transforming traditional agriculture. New Haven, Yale University Press, 1964. 212 pp.

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C thus merits serious attention.

1.2. Technological change in agriculture

The causes of economic development have received considerable attention in economic literature. It is generally agreed among economists that technological change is a vital factor in this process. Technological change occurs when there is addition to existing stock of knowledge, new techniques, better resource combination, different pattern of organisation and similar changes resulting in more output per unit of input. Technological change is thus an upward shift in the production function.

Technological change in agriculture, over time, has significant implications for general economic development. With unchanging level of resources - particularly land and labour - technological change will result in increasing agricultural supply. But given the characteristic low income elasticity of demand for farm products, such increasing supply cannot be sustained indefinitely. Hence resources, especially labour, will have to move out of agriculture, possibly into employment in the secondary and tertiary sectors of the economy where their marginal productivities might be higher.

The failure of the agricultural sectors of industrialized countries to adjust sufficiently to technological

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advance by releasing what are in effect redundant resources lies behind the necessity for their agricultural support policies. Since agricultural products in general have a low price - as well as low income - elasticity of demand (together with the fact that agriculture as an industry approaches the classical concept of perfect competition), increasing aggregate output means declining farm factor earnings. The farmer, paradoxically, is thus penalised by a falling income precisely because of rising agricultural productivity. Hence the main thrust of agricultural support policy in most of these countries is to reduce the disparity between farm and urban incomes. Such support measures tend to perpetuate the resource imbalance in the agricultural sector and therefore, in the face of unceasing technological progress, may be largely self-defeating. The problem of agriculture in industralized countries is thus one of too rapid a rate of technological change relative to the adjustment problem of farm resource structure.

By contrast, developing countries are faced with the problem of stimulating technological change in their agricultures. The predominance of this sector in the economy, employing the bulk of total labour force and producing most of the gross domestic product is itself a manifestation of the low productivity of the sector.

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What are the essential ingredients of technological change in terms of policy prescriptions for developing countries? Attempts have been made to explain changes in the aggregate agricultural input-output ratio in developed countries, using the concept of industry level production function. The earliest studies related increasing output to conventional inputs (land, labour and capital).[4] However the studies left varying amounts of output increase unexplained. This unexplained element has been termed "the residual" and is usually attributed to ghost factors like "technological change" and improved managerial skill. Thus while the term "technological change" may be a useful device for expository purposes, it is far from being adequate as an analytical concept for explaining economic growth.

Glenn Johnson[5] has argued that "unconventional" inputs, among which he groups improvement in the human agent, increase in managerial skills as well as technological advance, should not be treated as factors of production

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4 Solow, R.M., Technical change and aggregate production function, Review of Economic Statistics 39: August 1957, 312-19.

5 Johnson, G.L., A note on non-conventional inputs and conventional production function, In Eicher C. K and L.W. Witt(eds.), Agriculture in economic development, McGraw-Hill Book Company, 1964. pp 120-4

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in any sense. He contends that on the contrary, technological advance involves a new factor of production or previously unknown way of combining old factors of production; in which case the "scientific" procedure requires finding out what new factor or combination of factors of production have been discovered. Once this was done its productivity could be measured and the production function relationship involving that factor or combination could be determined in a straight-forward conventional manner.

More recent studies based on this approach have resulted in a reduction of "the residual".[6,7] First, account had to be taken of the improved quality of the capital as well as its quantity. For example instead of using only the number of tractors as a relevant capital input, qualitative aspect such as horsepower, engine type, steel quality, whether they protect the operator from bad weather, etc., all of which enhance their productivity could be taken into account by developing a suitable composite measure. Second, the measurement of labour input,

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Labor

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6 Griliches, Z., Measuring inputs in agriculture: A critical survey, Journal of Farm Economics 42(5); 1411-22.

7 Griliches, Z., The sources of measured productivity growth: U.S. agriculture 1940-60. Journal of Political Economy, 21 (4); 331-46

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takes account of the quality of the human agent, as well as the man-hours worked, since a positive relation is known to exist between the level of skills and knowledge of farm workers and their productivity. For instance, the labour input could be adjusted for the increasing number of years spent in education by agricultural workers. Third, it has been suggested that part of the residual can be explained by the increasing size of holdings with substantial economies of scale and a trend towards increasing specialization. Finally, by including agricultural research and development expenditure as an input in the aggregate production function, the unexplained residual element was reduced. ie the effect of research = unexplained production. Labour = definite

Quite clearly then, new technology is conceptually an integral part of the factors of production employed in bringing about the output. Hence, by correctly specifying the factors of production, the technology is also being specified. One implication of this is that rather than look upon technological change in vague terms like "labour-saving," "capital saving" or "neutral," we can identify the capital and labour components of the unspecified new factors of production and make it an integral part of the analysis. Once the new factors have been identified they may be found to be substitutes for, or compliments

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of, particular old factors of production. In the context of economic planning, particularly for developing countries, such identification enables us to assess the costs and returns to investment of discovering, developing and producing these new factors of production.

As we have noted, the problem of economic development in most developing countries is one of agricultural development. However, as Schultz has emphasised, traditional agriculture, employing only the factors of production at its disposal, is incapable of growth except at high cost, and that conversely investment in modern agricultural factors can be high by growth standards.[8] Such modern factors of production include material inputs like genetically improved seed varieties, chemical fertilizers and mechanisation equipment as well as improved human capital through acquired managerial skills, knowledge and other capabilities required to successfully adopt these new material inputs. The discovery, development and production of these inputs lie in the domain of agricultural research.

8 Schultz, T. W., op.cit.

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1.3 Research and technological change

In spite of its acknowledged importance as a source of technological change and hence of economic development, the treatment of research in an economic framework is of relatively recent origin.[9] This limited emphasis on its economic aspects is reflected in the lack of appropriate data. Consequently, much of recent discussions have been based on personal impressions and evidence from developed countries rather than on factual analysis.[10] Nevertheless evidence such as is available suggests that developing countries invest very little in research compared with industrialized countries.[11] Table 1.2 for instance shows that whereas the developed countries spent ₦10.80 on research per farm in 1965, the corresponding figure for developing countries is only ₦0.67.

How can technological change in developing countries be accelerated through agricultural research? The inappropriateness of importing improved technology from developed countries is well recognised. This is even more

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9 Evenson, R.E. and Y. Kislev, Agricultural research and productivity. New Haven, Yale University Press, 1975. p.15

10 Evenson, R. E. and Y. Kislev, op.cit., p.15

11 Abaelu, J. N., Building the foundations of Nigeria's agricultural growth: Public expenditures on agricultural research, Bulletin of Rural Economics and Sociology, 8(1); 61-75.

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TABLE 1.2

Agricultural research and extension: comparative statistics 1965

		Ratio of expenditure to value of total agricultural production		Expenditure per farm ₦ per year*	
S/No.	Region	Research	Extension	Research	Extension
1.	North America	1.01	0.53	59.68	31.27
2.	Northern Europe	0.93	0.53	20.87	10.73
3.	Southern Europe	0.38	0.41	1.56	1.61
4.	Oceania, South Africa, Rhodesia	1.61	0.80	121.08	60.05
5.	Eastern Europe & USSR	0.64	0.39	4.80	2.96
6.	Latin America	0.17	0.19	1.01	1.12
7.	Middle East and North Africa	0.55	0.55	0.20	3.10

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TABLE 1.2 (cont'd)

		Ratio of expenditure to value of total agricultural production		Expenditure per farm ₦ per year*	
S/No.	Region	Research	Extension	Research	Extension
8.	South and South East Asia	0.24	0.31	4.58	0.35
9.	East Asia	0.79	0.57	1.79	3.31
10.	Sub-Saharan Africa	0.45	0.38	1.79	1.49
	Developed countries	0.874	0.496	11.06	6.27
	Developing countries	0.259	0.289	0.69	0.76

Source: Evenson, Robert E. and Yoav Kislev. Agricultural research and productivity. New Haven and London, Yale University Press. 1975. p. 18.

* Original figures in U.S. dollars converted to naira at the equivalence of 1 dollar to 0.64 naira (June 1978 exchange rate).

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so for agricultural technology in view of its biological nature. Differences in biological requirements mean that breeds of dairy cows, for instance, that are highly productive in the temperate countries may be unsuitable for the tropical environment. Soils also vary from one area to another, and this variation affects crop requirements with respect to water, fertilizer, and cultivation practices. There are thus very few agricultural inputs that are ready-made for developing countries.

However, there is available a corpus of knowledge which has enabled developed countries to evolve factors and techniques of production that are suited to their own requirements, and on which developing countries are themselves free to draw to develop similar new factors appropriate to the conditions that are specific to their own agriculture. For instance, the genetic principles governing hybridization are the basis of all hybrid maize. Yet to benefit from such established knowledge, a country needs to apply the technique to develop a superior variety for a particular maize-growing area. Most modern agricultural factors, particularly those of a biological nature, therefore have to be "locally produced" using established scientific and technical knowledge as "raw materials."

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From this discussion two major conclusions can be drawn. One is that the contents and orientation of research in developing countries should emphasise adaptive or developmental research. This area of research tends to be neglected in these countries in favour of the more "glamorous" academic or basic research.

Second, there is need to step up investment in agricultural research, While Lewis,[12] for instance, considers that the amount of fund devoted to research should not be less than 0.5% of the gross domestic product it has been found that most Third World countries devote less than 0.3%. Yet even in developed countries where more funds are devoted to research, returns to investment in research is higher than those realized on other public projects (see Table 1.3).

However, high as the returns from research may be, the "producer" in agricultural research cannot appropriate all of the benefits from its production. This is because, especially for biological inventions, the producer cannot effectively patent his discoveries since the original material may be capable of being multiplied indefinitely without any need to go back to the inventor. This gap between the social and the private benefit-cost ratios

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12 Lewis, A.W., Theory of economic growth. London. Unwin University Books, 1955, p.176

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TABLE 1.3

Selected estimates of the economic contribution of agricultural research

Study		Country	Product	Time Period	Internal rate of return
Griliches	(1958)	U.S.	Hybrid Corn	1940-1955	35-40
Peterson	(1967)	U.S.	Poultry	1915-1960	21-25
Ayer	(1970)	Brazil	Cotton	1949-1967	77
Evenson	(1971)	U.S.	Agricultural Sector	1949-1959	47
Tang	(1963)	Japan	Agricultural Sector	1880-1938	35
Ardito Barletta	(1970)	Mexico	Crops	1943-1963	45-93

Source: Evenson, R.E. and Yoar Kislev, Agricultural research and productivity, New Haven, Yale University Press, 1975. p.12

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together with the zero marginal pricing inherent in the production of scientific knowledge (like all public goods and utilities) marks it out as an area for government intervention.

1.4. Specification of the problem

In many ertswhile colonial territories, agricultural research institutions were established several decades before the post-war era of conscious economic planning. In Nigeria, for instance, the first experimental station was established in Ibadan in 1899. Yet it is common knowledge that the farmer today continues to employ untrammelled the farming methods practised by generations before him. He uses little or no modern inputs and techniques like genetically superior seed varieties, plant protection measures and chemical fertilizers; depending for maintenance of soil fertility on shifting cultivation. Has agricultural research then been ineffective in Nigeria?

The question of grossly inadequate investment in research by developing countries has already been highlighted. Inadequacy of research investment of course implies poor staffing and lack of proper equipment and other research infrastructures. But beyond all these, there are other factors that may well have militated against the transfer of technology to the farm level over the years.

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One has been the lack of a clear-cut and consistent government policy on agricultural development.[13] This in turn has resulted in lack of a cohesive and coordinated approach to research policies and programmes. For instance, an agricultural development policy based on large-scale system - such as farm settlements and plantations - would require that research focusses on such aspects as mechanisation, sole-cropping and other factory-like processes. On the other hand, a policy based on encouraging higher productivity among small traditional farmers would concentrate on new inputs like improved seed varieties and chemical fertilizers, orienting the use of this to multiple cropping which constitutes the framework of Nigerian farming system. For the most part however, the experience in this country has been that research recommendations have been based, irrespective of whatever government policy may happen to be in operation, on sole-cropping. Yet as Norman has found in a study in northern Nigeria, "there are valid reasons of a technological, sociological

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13 Norman, D.W. and E.B. Simmons, Relevant research priorities for farm development in West Africa. <u>Proceedings of conference on factors of economic growth in West Africa</u>, ISSER, University of Ghana Legon, 1973. p.44.

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and economic nature for farmers reluctance to change to a sole-cropping system."[14]

Second, the field of agricultural research has for too long been dominated exclusively by the physical scientist. The result is that, given the nature of his training, undue emphasis has always been placed on recommending technical rather than economic optimum. For example he is apt to prescribe a rate of fertilizer application that yields the highest physical output which if adopted clearly results in a misallocation of resources in a situation of positive input price.

Third, the extension services, as the Third National Development Plan has put it, "have been bedevilled by lack of sound composite training and the limited number of extension workers." For instance it has been estimated that while about 12,800 staff in the junior cadre were required for extension services in 1970, only about 8,500 were actually employed. Similarly, only 1,000 senior staff were on the ground compared with an estimated requirement

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14 Norman, D. W., Crop mixtures under indigenous conditions in northern Nigeria. Proceedings of conference on factors of economic growth in West Africa, ISSER, University of Ghana. Legon, 1973. p.142

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of 2,800 (Table 1.4). The problem of man-power shortage becomes aggravated against the background of functioning in a predominantly illiterate community. When farm people are literate, farm journals, bulletins, pamphlets and the press generally constitute important media. The use of such media are for many purposes cheaper and more effective than organising meetings with farmers on the basis of oral presentations.

Amidst these handicaps to the overall effectiveness of research, it is generally agreed that research in Nigeria's export crops has made impressive contributions to increased production of these crops.[15] Perhaps the most spectacular in this respect has been cocoa. Reviewing the production of cocoa in the post-war years "Agricultural Development in Nigeria" has this to say, "The remarkable upsurge in West African production - in which Nigeria participated fully - can only be explained by the coming into bearing of young trees, an increasing proportion of which were of Amazon and selected high-yielding Amelonado varieties, and the effects of spraying against diseases and pests."[16] Cocoa Research can thus be regarded

15 Nigeria. Federal Ministry of Agriculture and Natural Resources. Agricultural development in Nigeria 1973-85. Lagos. 1974.

16 Ibid., p.112.

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TABLE 1.4

Projections of total population, farm families and staff requirements up to 1985

	1963/64	1969/70	1984/85
Total Population of Nigeria (Millions)	54.98	67.2	99.7
Agricultural Population (Millions)	38.47	46.2	62.8
Number of Farm Families (Millions)	6,41	7.7	10.5
Staff Requirements:			
(i) Junior staff:			
(a) Extension and Field Services	6,410	7,700	10,500
(b) Non-extensions	2,137	2,566	3,500
(c) Private sector	2,137	2,566	3,500
Total: Junior Staff	10,684	12,832	17,500
Actual number employed: Junior Staff	3,991	8,539	-

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TABLE 1.4 (Cont'd)

	1963/64	1969/70	1984/85
(ii) Sehior Supervisory and Specialist Staff:			
(a) Extension and Field Services	1,282	1,540	2,100
(b) Non-extension	854	1,027	1,400
(c) Private sector	214	257	350
Total: Senior Staff	2,350	2,824	3,850
Actual number employ (Senior Staff)	650	1,000	-

Source: Federal Ministry of Agriculture and Natural Resources, Agricultural development in Nigeria 1973-85, Lagos, 1974.

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as a beacon showing the kind of contributions that research can make to increasedagricultural production and productivity.

But if the benefits of cocoa research appear obvious, the costs of achieving those benefits are by no means so, especially as they involve expenditures stretching back several years. In other words, how really profitable has cocoa research been in terms of investment? The answer to these question should prove of more than academic interest to policy makers and research administrators in Nigeria for at least three major reasons. First, such stock-taking could be a good thing in itself since it provides information on how much resources have been committed to a particular activity, thus contributing to the documentation of the nation's economic history.

Second, it provides a basis for a more rational allocation of resources within agricultural research and also between agricultural research and other sectors of public investment. At present, allocation of resources, particularly of finance, between and within sectors appear to bear no discernible relationship with accepted investment criteria.[17]

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17 See for example the three national development plan documents todate.

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Third, if cocoa research is found to have proved acceptably profitable, an analytical study of the factors that have contributed to its success both within and outside the research set-up could have significant implications for the organisation and conduct of research into other agricultural commodities . Such implications include improvement in genetic vigour with a view to raising their present generally low level of performance and productivity.

1.5. Objectives of the Study

The major objective of this study is to develop an appropriate model for estimating the social returns to investment in cocoa research, with a view to ascertaining the adequacy of investment in cocoa research and by inference agricultural research in general. The specific objectives of the study are:

(i) To estimate alternative rate of returns to cocoa research through a production function model with a view to assessing its marginal productivity and relating this to the social rate of return;

(ii) To analyse the organisation, structure and conduct of cocoa research with a view to identifying the factors that might have helped or hindered the effectiveness of research;

(iii) To evaluate the recent reorganisation in agricultural research in the context of

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research efficiency;

(iv) To examine the present system of research funding in relation to research efficiency;

(v) To examine research information and extension in relation to efficient transfer of research technology to the grassroots.

1.6. Plan of study

This introductory chapter has discussed certain aspects of economic development in contemporary developing countries within its international setting; the process and consequences of technological change in agriculture and the role of research in bringing about such a change. More specifically, an attempt has been made to isolate the set of problems faced by agricultural research in Nigeria and this has facilitated the specification of the main objectives of the study.

In Chapter II, a review of the organisation of research in Nigeria is made, starting with the colonial period through the period of internal self-government and post-independence civil administration to the present military administration era. Against this background, research personnel and administration, research funding and infrastructures and research information and dissemination are discussed. And lastly an attempt at general evaluation

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of research impact on agricultural production is made.

Chapter III deals more specifically with cocoa research in relation to the history of cocoa production in Nigeria and the importance of the crop in the economy. It discusses the establishment and activities of the former inter-territorial cocoa research organisation, the West African Cocoa Research, and its national successor, the Cocoa Research Institute of Nigeria; and focusses on its major achievements in the areas of disease control and the development of high-yielding varieties. It also examines the prospects of new directions in cocoa research against the background of current government policy on cocoa production and world market outlook for the crop.

Chapter IV deals with review of literature and describes the methodology of this study, providing the background for the development of the models used, namely the index-number model and the production function approach.

In Chapter V, the social returns to cocoa research is estimated using the index-number model developed in the previous chapter. The sources and limitation of the data used are discussed. Some policy implications of the results are highlighted.

Chapter VI gives an alternative estimation of returns to cocoa research using the production function approach.

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Again, the sources and limitations of the data used are discussed and the policy implications of the findings are considered.

The policy implications of the whole study are discussed in Chapter VII with special emphasis on the issues of new dimensions in research administration, approach to research funding, training research personnel, periodic research reviews, research information collation, dissemination, and utilisation, research economics, and extension research.

Chapter VIII, containing the summary and conclusion of the study, deals specifically with a summary of major findings and recommendations, limitations of the study, and areas for further research and conclusion.

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CHAPTER II

AGRICULTURAL RESEARCH IN NIGERIA

2.1 Organisation of agricultural research

The changes in the organisation of agricultural research in Nigeria have followed very closely the political and constitutional history of the country. For this reason, the organisation of agricultural research is here discussed against the background of the various landmarks in the political and constitutional development of Nigeria. Broadly speaking, four periods can be identified. These are the colonial period running from 1861 to 1950; internal self-government period, 1951 to 1960; the post-independence civil administration period, 1960 to 1966; and the post-independence military administration period, from 1966 to-date.

2.1.1 Colonial period 1861 - 1950: The beginning of agricultural research in Nigeria can be traced to the establishment of a botanical research station in 1893 by Sir Claude McDonald. Later, in 1899, the British Cotton Growing Association (BCGA) acquired

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an area of 10.4 km^2 on Moor Plantation, Ibadan for experimental work on cotton. In 1910, the government took over from the BCGA the experimental work on cotton, and Moor Plantation, the seat of the Association, was chosen as the temporary headquarters of the Agricultural Department for Southern Provinces which had hitherto been run as part of Agricultural and Forestry Department with Olokemeji as headquarters.

In keeping with the prevailing political set-up under which the Northern Provinces and the Southern Provinces were administered as separate units, a Department of Agriculture for the Northern Provinces was established in 1912. However, coming into being virtually on the eve of the First World War, these departments had little time to expand before the onset of hostilities. As the 1921 Annual Report on the Agricultural Department has put it,

> When reviewing the results achieved since their initiation, it should be remembered that both agricultural departments were very small indeed until just before the war; and that the war started before the increased staff had settled to their work. Thereafter the staff were depleted until there was sometimes only one officer actually present in each protectorate. In some cases the agricultural stations and work had to be handed over to junior officers of other departments,

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in addition to their own duties![1]

If the situation was bad enough for agriculture as a whole, agricultural research suffered an even greater neglect as this excerpt from the same report shows:

> In regard to this part of the work (work at the experimental farms) on which all future progress must depend, I found on arrival that the state of affairs was very far from satisfactory, especially in the Southern Provinces. Little has been done before the war started; and during the war, the small staff of European officers was mainly occupied in duties connected with 'peripatetic introduction' in the Southern Provinces, and cotton extension work in the North. Thus, little attention was devoted to the experimental investigations, the carrying out of which necessitates much time being spent on the experimental farms.

Although the political amalgamation of North and South was effected in 1914, it was not until 1921 that the Northern and Southern Agricultural Departments were merged into one department. This merger marked the beginning of an era of continuity and stability in agricultural organisation that was to span the next fifteen years or so. During this period, considerable progress was made in research. For example, whereas before 1921, research was confined to the selection in

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1 Nigeria. Annual report on the Agricultural Department, Southern Provinces for the period 1st January 1920 to 31st March 1921, Lagos. 1921.

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crop varieties, mainly of cotton, during this period, research was initiated in a whole range of agricultural commodities and specialities. These include research work in oil palm breeding and small-scale extraction techniques; cocoa establishment trials; soil chemistry; stock breeding; locust control; green manuring; and mixed farming.

By far the most important line of research during the "Faulkner Strip Layout" era (as the period came to be known) are those on green manuring in the Southern Provinces and mixed farming in the North. These were based on the need to replace shifting cultivation with some form of permanent cropping system capable of maintaining soil fertility. In view of the enormous resources devoted to its prosecution over a considerable time period, it may be pertinent here to comment briefly on its outcome.

The main feature of green manuring is the incorporation of a leguminous crop into a rotation system. The leguminous crop found to be the most satisfactory in this case was mucuna, a non-edible crop that had to be buried green into the soil or burnt after its seeds must have matured. While its technical effectiveness in the maintenance of soil fertility - and even its bringing about increases in yields of other crops in the rotation -

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was in no doubt (see table 2.1) such a rotation was found to be unacceptable to the farmer. Two reasons have been given for this. The first was that the farmer grudged the labour of turning the soil over in order to bury the green manure. Secondly, it seemed to him a far-fetched idea that one should grow a crop that was otherwise utterly useless in order to improve another crop that was to be grown the following year.

However, a more fundamental reason for its rejection by farmers would seem to be that the alternative to its adoption, namely shifting cultivation, was more attractive, given the existing availability and abundance of virgin land. This is borne out by the fact that where

> the position shows more promise this year, particularly in the neighbourhood of Ogbomosho . . . the land has become impoverished through continual burning, clearing and farming. The people fully realise that their land is deteriorating and that they have to go further and further away from the town to find land fertile enough to grow their food crops; they have therefore readily listened to advice about this matter and many are eager to give green manuring a trial.[3]

Apart from such flashes in the pan however, the novelty on the whole proved unacceptable to farmers so

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3 Nigeria. Annual report on the Agricultural Department 1935. Lagos, 1936. pp 15-16.

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TABLE 2.1

Mean yields under green manuring experiments

(a) Moor Plantation Ibadan

	Yams kg/hec.	Cotton kg/hec.	G'nuts kg/hec.	Maize kg/hec.
1st Cycle 1922-25	8285	184	1236	2263
2nd Cycle 1926-29	8613	229	1486	2290
Increase in yield during 2nd cycle	328	45	250	27

(b) Ilorin

	Yam/Cotton (Inter-planted) kg/hec.	2nd year Maize/Guinea-corn inter-planted kg/hec.	3rd year Mucuna (dug in)
1st cycle	1st year 9776 82	2nd year 1416 429	3rd year (not weighed)
2nd cycle	4th year 12,348 179	5th year 1278 747	6th year (not weighed)
Increase in yield during 2nd cycle	2,572 97	138 318	-

Source: Annual Report on the Agricultural Department, 1929, p.12

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that as later as 1946, the Annual Report for Western Provinces had this to say,

> These rotations were unattractive to the local farmers, however, mainly because they only gave four main crops in four years, whereas the farmers themselves took six or more crops in the same period . . . As the farmers in the areas concerned were not short of land for bush fallowing, it was not possible (or even desirable at this stage of research) to persuade them to adopt the new rotations.[4]

By comparison, the corresponding introduction in the Northern Provinces, mixed farming, seemed to have enjoyed considerable popularity among farmers (see Table 2.2). Mixed farming involved the use of ploughs and farm yard manure. Its acceptance was such that applications from farmers to participate had to be turned down because of the difficulties in obtaining ploughs and suitable cattle in sufficient numbers.[5]

The onset of the Second World War inevitably slowed down progress in research, most of the resources being devoted to producing food for army and civilians, and to increasing the production of export crops like palm pro-

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4 Nigeria. Annual report on the Agricultural Department 1945. Lagos. Government Printer, 1946. p.37.

5 Nigeria. Annual report on the Agricultural Department, 1945. Lagos, Government Printer, 1946, p.20.

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TABLE 2.2

Number of mixed farmers in the Northern Provinces up to the year 1945

Year	No Started during the year	Failures during the year	Total continuing at the end of the year
1928	3	-	3
1929	9	5	7
1930	13	3	17
1931	31	4	44
1932	71	7	108
1933	84	19	173
1934	139	14	298
1935	348	25	621
1936	474	41	1,054
1937	445	66	1,433
1938	321	156	1,598
1939	231	270	1,559
1940	483	222	1,820
1941	413	202	2,031
1942	297	366	1,962
1943	406	243	2,125
1944	512	390	2,247
1945	590	290	2,547

Source: Annual report on the Agricultural Department 1945, p.21

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ducts and rubber which could no longer be obtained from Malaya because of Japanese war activities. One feature of research up to the Second World War was its close link with other activities of the Department of Agriculture. As a result research was an integrated affair between laboratory and field work.

The end of the war ushered in further political changes under the 1946 Richard Constitution which created three administrative regions, North, West and East. In line with this new arrangement, the Department of Agriculture was organised into three regional units, each headed by a Deputy Director, with a Director at the centre co-ordinating the regional departments. Apart from everything else this period marked the beginning of a separate existence for research, with regional departments concentrating on matters relating to agricultural extension. This break between research and other activities meant a more tenuous link than hitherto between the laboratory and the field, a pattern that seemed to have intensified over the years.

2.1.2 Internal self-government period, 1951-1960:

The trend towards regionalization which began in 1946 took on a greater tempo, cummulating in virtual political autonomy and self-government for each of the regions during

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the decade. The ministerial system of government was introduced in 1951, following the adoption of the McPherson constitution. Under the new system, the Department of Agriculture came under the Ministry of Natural Resources at the Centre, headed by an Inspector-General of Agriculture who was responsible to the Minister, while the Regional Agricultural Departments - also within a ministerial set-up - were headed by a Director of Agriculture respectively. However, agricultural research was administered under a central Research Organisation for which the Inspector-General had a direct responsibility.

The opening years of this decade witnessed considerable expansion in agricultural research activities. For instance, apart from research programmes initiated and financed within the Agricultural Department, a number of new research projects financed from external sources were started or greatly expanded. These include projects financed from the Colonial Development and Welfare Fund - namely, the Rice Research Scheme in Badeggi and the Maize Rust Research Unit at Moor Plantation, Ibadan. Furthermore this was the period during which autonomous West African Inter-territorial research organisations were founded notably the West African Oil Palm Research Institute (with a sub-station of the older West African

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Cocoa Research Institute being established in Nigeria in 1952).

The year 1954 could be regarded as an important watershed in the history of agricultural organisation in Nigeria. In that year, as a result of further constitutional development, the responsibility on all agricultural matters was allocated to the Regional Governments, leaving agricultural research on the concurrent legislative list. Consequent upon the new arrangements a Federal Department of Agricultural Research was established under the direction of a Director of Agricultural Research who was responsible to the Federal Minister of Research and Information. A Council of Natural Resources comprising of ministers responsible for agriculture was established for co-ordinating the various programmes of research throughout the country. In general, it was agreed that the Federal Department of Agricultural Research should engage in research of fundamental and long-term nature while the Regions should concern themselves primarily with short-term or applied research. Furthermore a Technical Committee composed of the Director of Agricultural Research, Regional Directors of Agriculture and a representative of the Faculty of Agriculture of the University College, Ibadan was set up to advise the Council.

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With the attainment of Regional self-government variously in 1958 and 1959, the break between the Centre and the Regions in matters of agricultural administration became completely formalised. The result of this was that the organs of co-ordination for agricultural research - the National Council for Natural Resources and its Technical Committees - functioned more on the basis of a gentlemen's agreement, lacking the necessary statutory powers for their assignment.

2.1.3 <u>Post-independence civil administration period, 1960-1966</u>: The euphoria following the attainment of national independence in 1960 brought in its wake rising expectations for "life more abundant." The immediate post-independence years was thus marked by vast increased in government expenditures aimed at accelerating general development. As with other areas there was intensive regional competition in expanding agricultural research activities, the emphasis being in the main on export commodities.[6]

The main thrust of agricultural development effort during this period particularly in the two Southern Regions was on large-scale agricultural system of the

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6 Nigeria. Federal Ministry of Agriculture and Natural Resources. Agricultural development in Nigeria 1973-1985, Lagos, 1974.

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farm-settlement type. This represented a big departure from the past history of agricultural development policy which had always emphatically rejected large-scale schemes. Such shift in emphasis could be expected to have affected the direction of research efforts. This may well have accounted for the neglect of food crops research during this period, since it seemed to have been the prevailing belief that large-scale mechanisation was the cure for all the ills of low agricultural productivity. In the circumstances such research as there was on food crops was haphazard, lacking any clear-cut policy direction. Furthermore in the absence of an effective machinery for co-ordination of agricultural research throughout the country there was inevitably a large area of overlapping and even outright duplication of research efforts among the Regions and between the Regions and the Federal Department of Agricultural Research.[7]

One possible reason why export crops research fared better during this period was that being mostly tree crops, the mechanisation notion was largely inapplicable; so that research could continue without change of direction

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7 Compare, for instance, the Annual Reports of the various Regional Agricultural Research Divisions throughout this period.

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from its previous one of evolving higher-yielding varieties. Another reason, of course, was that as the country's main source of foreign exchange earning then, it enjoyed a greater financial support, thanks to generous grants from the Regional Marketing Boards which, like its predecessors, the Commodity Marketing Boards, had accummulated (as well as inherited) financial "surpluses" from the export sales of these very crops.

The importance of these crops to the Nigerian economy and hence the need to enhance their production potentials was further underlined during this period by the former inter-territorial research organisations dealing in these crops being constituted into autonomous national research institutes. Thus in 1964 the Cocoa Research Institute of Nigeria (CRIN) and the Nigerian Institute for Oil Palm Research (NIFOR) as well as the Nigerian Institute for Trypanosomiasis Research (NITR) were established along similar patterns as their inter-territorial predecessors (Appendix I). Since the day-to-day operations of these institutes were mostly outside the bureaucratic routine of the civil service, their autonomy no doubt was a contributing factor to whatever success they might have achieved. This contrasts markedly with the organisation of food crops research which had always been run under a civil service set-up.

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Nevertheless the Federal Government was not unaware of the need to re-organise food crops research as well under autonomous institutes. Indeed, acting on a report by Sir Frank Engledow on the re-organisation of the Federal Departments responsible for agricultural, veterinary, forestry and fisheries research,[8] the government actually passed an enabling legislation in form of the Scientific and Industrial Research Ordinance No. 35 of 1959 for the establishment of research institutes in these areas.

It was against this background that the Northern Region Government constituted the Agricultural Research Division of its Ministry of Agriculture and Natural Resources into the Institute for Agricultural Research under the financial and administrative control of the Ahmadu Bello University, Zaria - a lead that was to be followed later by the Government of Western State which similarly transferred its own Agricultural Research Division to the University of Ife. Still the lack of effective research co-ordination at the national level remained a serious set-back to the proper conduct of research. The

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8 Engledow, F. L. Report on the federal organisation for agriculture, veterinary, forestry and fisheries research. Sessional paper No. 4 of 1959. Federal Government Printer, Lagos, 1959.

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establishment in 1968 of a Ministry of Agriculture and Natural Resources at the Federal level went a long way towards providing a focus for national co-ordination of agricultural development activities, including research.

2.1.4 <u>Post-independence military administration period, 1966 to-date</u>: The military coup and counter-coup of 1966 brought in their wake a serious political crisis that cummulated in the 30-month Nigerian civil war. As was to be expected, the activities of the new Federal Ministry of Agriculture and Natural Resources were during the war period severely circumscribed, so that it was not until after the cessation of hostilities that it was able to come into its own. In the aftermath of the civil war with its policy of resettlement, rehabilitation and reconciliation, food matters naturally came into prominence. It was not surprising therefore that the first major impact of the Federal Ministry of Agriculture and Natural Resources was the sponsorship of a National Agricultural Development Seminar in July 1971. The main aim of the Seminar was to evolve a national policy on agricultural development.

Even more significant for research was the inauguration about the same time of the Agricultural Research Council of Nigeria (ARCN), a statutory body charged with

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the specific function of coordinating research activities throughout the country. However, although the Council settled down promptly, establishing a secretariat staffed by high-ranking scientific personnel, its full functioning was held in abeyance because the Research Institutes (Establishment) Order, which was to formally establish research institutes under its aegis, was not promulgated until the close of 1975. Under the Order, fourteen institutes were established, each under a governing board (see Appendix IV). One feature of these new institutes was that each was restricted to conducting research into one or a few related crops. For instance, the National Roots Crops Research Institute was to conduct research into crops like yam, cassava and potatoes, while the National Cereals Research Institute was to confine its research activities to maize, rice and grain legumes.

In spite of the eventual completion of all formalities however, the ARCN never really took off the ground in the end. This was because it was superceded by a new body, the Nigerian Science and Technology Development Agency (NSTDA) which was established in January 1977. The NSTDA has a broader scope than the ARCN, covering medical and industrial as well as agricultural research.

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2.2 Research personnel and administration

Of all research resources personnel is perhaps the most crucial and certainly the most limiting in developing countries. This is due in part to the fact that it requires talent and long years of specialized training to produce a research scientist. This inherent limitation in supply calls for efficient administration if available personnel are to be effectively utilized.

In Nigeria the earliest organization of research particularly during the colonial era was one of close integration with extension. For this reason it was not always clear which personnel were specifically for research and which were purely extension staff. Nevertheless some staff came to be appointed on the basis of their scientific discipline. The earliest of this group, an entomologist, was appointed about 1910. Apart from the addition of a mycologist a couple of years later nothing much happened until 1924 when research officers increased to eight. This period also seemed to mark the turning point in a more efficient administration of research personnel with perhaps some recognition of the need for interdisciplinary approach. For instance, that year's annual report had this to say on the work of research

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officers.

> The policy laid down is the concentration of most of each individual's energies on only one problem at one time, and on the concentration, whenever circumstances call for it, of the efforts of several officers on the same problem. The value of such team work in dealing with problems of applied science is generally recognised in theory; but, in Government Agricultural Departments, it is not actually a very common practice, for it frequently appears to involve a sharing of the satisfaction of achievement which is not always acceptable to the workers. But although this attitude is neither unnatural nor entirely unreasonable, there is little doubt that a policy of concentration and cooperation is frequently most advantageous, and often even essential.[9]

By and large with increases in research staff over the years, research efforts were directed to improving export commodities. Thus work was concentrated on such crops as cocoa, cotton, groundnuts and palm produce. Such a policy can be said to be rational since returns to research efforts can be expected to be high, given the high value of these export commodities. Another feature of the growth in number of research personnel was that each specialized discipline began to emerge as separate sections for purposes of administration. For instance,

9 Nigeria. Annual report on the Agricultural Department 1924. Lagos 1925. pp. 1-2.

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whereas in the annual reports of the Agricultural Department up to the Second World War research activities were reported under general programmes, such reports now came under their own research sections like Chemistry, Botany, Entomology, etc. This trend intensified with regionalization in 1946 cummulating in the establishment of a central research organisation in 1951. Again for purposes of effective utilization of the relatively limited research personnel this arrangement would seem to be rational since to have regionalized research like other areas of agriculture would have resulted in spreading available research personnel too thin on the ground.

The situation however changed with the complete regionalization of all agricultural matters in 1954. Thereafter, research personnel like other staff were placed under the control of their respective regions. This decentralization of administrative control on research personnel resulted in much duplication of research efforts, especially as there was no effective machinery for research co-ordination among the various regions. It was against this background that the Agricultural Research Council of Nigeria was established in 1971. The decree establishing the Council gave it very wide powers in the administration of research generally. A complementary

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decree, the Agricultural Research Institute Decree spelling out the relationship of the ARCN with the research institutes was promulgated in 1973 (Appendix III). Among other things, the decree specifically gave the ARCN the powers of appointment, promotion and discipline of research staff in all research institutes. The provisions of this decree together with those of the previous ARCN decree thus gave an adequate coverage to the need for a central administration of research personnel.

The emphasis on research personnel in the new set-up was in evidence in the structure of the ARCN secretariat itself, which established a Division of Manpower Training. Indeed perhaps the only standing achievement of its credit was the study on agricultural manpower requirements in the whole country which it undertook in conjunction with the FAO and which was concluded just in time before the supercesion of ARCN by the NSTDA.[10]

2.3 Research funding and infrastructure

Research funding and the provision of infrastructure are clearly related. Thus scarcity of funds over a long

10 Nigeria. Agricultural Research Council of Nigeria. Report of the national seminar on manpower planning for agricultural development in Nigeria. Ibadan, 1977.

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period can be expected to result in inadequate provision for research infrastructure. Among the items of research infrastructure may be included equipment, laboratory buildings, green houses, library - all of which depend directly on research funding. In addition there is another category of research infrastructure which are by way of externalities to research institutes and whose provision is outside the funding of the research establishments themselves. In this category can be included the proximity of research centres to universities which thus provide an "intellectual atmosphere" as well as certain physical facilities that may ordinarily not be available to a research establishment, e.g. computer facilities, electron microscope, conference facilities etc.

In Nigeria, the first category of infrastructure has perhaps been the more important, since agricultural research is largely of the applied type. Consequently research funding is particularly relevant in considering the adequacy of such infrastructure. How has funding of research, particularly in relation to the provision of infrastructure, fared in Nigeria? As already noted, agricultural research was closely integrated with extension activities up to the Second World War, so that it was not always clear where research ended and extension began.

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By the same token there was no distinction between funds for research and extension. Moreover, given the relatively low level of sophistication in research activities in these early years, research fund requirements were likely to be minimal. For instance, the dominant research programme for over two decades from 1921 was a rotation system incorporating green manure in the south and mixed farming in the north. Clearly the level of infrastructure required for such lines of research in form of equipment, laboratory buildings etc. were necessarily minimal since they were largely field-oriented. Hence it could be reasonably assumed in the absence of documentary evidence that not much of research infrastructure was built up during this period.

The post second-world-war years witnessed an expansion of research facilities, a trend that intensified with the regionalization of agricultural research in the fifties. In the main, research infrastructures were built around three regional centres, namely, Samaru in the North, Umudike in the East, and Ibadan in the West. Apart from these, however, research infrastructures were also expanded in the university faculties of Agriculture, notably Ibadan, Ife, Ahmadu Bello, and University of Nigeria, Nsukka.

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Like the activities of the regional research centres, research funding was not coordinated. Given the inevitable duplication and overlapping in research activities under such a situation aggregate investment in research, meagre though it has been in relative terms, was in effect dissipated. Again the rationalization of funding and provision of research expenditure is one of the objectives of the establishment of the ARCN.

2.4 Research information dissemination

The dissemination of findings constitute an important aspect of the research process. As Ashton and Rogers have put it, "The learned paper which sits on the shelf gathering dust is of little benefit to anyone."[11] Dissemination of research information is even more vital to applied research like in agricultural research where the real objective is consciously to raise farm productivity. Indeed for agricultural research "it is a tenable proposition that a research is not completed until its findings have been understood by those who are in a position to act on the results."[12]

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11 Ashton, J. and S. J. Rogers, Agricultural adjustment - a challenge to economists. Journal of Agricultural Economics (Manchester) 18(20), p. 186.

12 Ashton, J. and S. J. Rogers, op.cit

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In Nigeria the dissemination of agricultural research information has taken various forms which can be grouped into two main categories on the basis of "audience type." The first category consists of those forms aimed largely at scientific and professional audience, and include publications in scientific journals, departmental bulletins, the holding of conferences, seminars and workshops. The main value of these forms of dissemination is that it enables other researchers to keep abreast of developments in their respective fields. The second category of research information dissemination is by extension methods which are of course aimed at getting the farmers to adopt research findings. These include farm visits, meetings, the use of mass media (press, radio and television), demonstration farms, agricultural shows and farmers festivals, and "progressive farmers" approach.

Farm visits by extension workers is the most direct form of communicating research information to farmers, particularly in a predominantly illiterate society. The effectiveness of this method of extension depends on the ratio of extension workers to farming population, a ratio which in Nigeria like in other developing countries is far from the ideal. For instance while the ratio of extension workers to farm families in developed countries

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is 1:400-500 the corresponding figure for Nigeria has been put at 1:2000.[13] Furthermore, this ratio says nothing about the low quality of the personnel. Typically, the organisation of the extension network is such that the category of staff directly in day-to-day contact with the farmer are predominantly field overseers. These grades of staff have little formal education beyond the primary level and hardly any vocational training in agriculture.

The progressive farmer strategy offers a big attraction as an extension method, particularly where extension workers are spread thinly on the ground. Under this strategy, extension resources are concentrated on relatively few farmers who are most likely to accept and adopt innovations with the expectation that they will in turn act as demonstration agents in the diffusion of information and improved practices. Various forms of this strategy have been tried in Nigeria at different times. These range from using "progressives" among traditional farmers themselves to creating an entirely new class of farmers who by virtue of education and agricultural training could be expected to adopt improved practices

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13 F.A.O., Agricultural development in Nigeria 1965-1980 Rome, 1966, p.300.

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as a matter of course. In the latter group are included the farm school programmes of the post Second World War years under which young farmers were trained in farm schools for a couple of years after which they went back to their respective villages to put their acquired knowledge into practice. The Niger Agricultural Project established in 1950 also had a component that aimed at producing a community of farm settlers with superior farming skills.[14] This "revolutionary" approach reached its highest development in the farm settlement scheme of the sixties.

The demonstration farm has been recognised as an important tool of extension since the establishment of the Department of Agriculture itself. Indeed the main stations like Moor Plantation and Samaru were demonstration as well as research farms. Apart from the main stations, model farms - as the demonstration farms were then called - were established in several "agricultural districts which were too remote from the Agricultural Stations for farmers conveniently to visit the latter."[15] Apart from demonstrating new skills and improved farming

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14 Baldwin, K.D.S. The Niger agricultural project, Oxford, Basil Blackwell, 1957, 221p.

15 Nigeria. Annual report on the Agricultural Department, Southern Nigeria for the year 1913. Lagos, 1914 p.10

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practices, these farms also supplied improved varieties of seeds, seedlings and breeding stock. This tradition has continued and in fact has intensified all through the constitutional changes especially with regionalization. Thus with its poliferation, demonstration farms have been called different names among which are experimental unit farms, Native Authority farm centres, extension work stations etc.

Agricultural shows as a means of disseminating research information also has a long history, the first show having been held in Lagos in 1910. As in the case of the demonstration farms, agricultural shows have become a part of the extension routine over the years. The main purpose of the agricultural show is the exhibition of farm products especially for their qualities and high yields with a view of fostering a spirit of competition among farmers in attaining high quality and yields by adopting improved farming practices. The show also provides a forum for researchers to acquaint farmers with their latest findings such as new crop varieties, improved husbandry methods and processing techniques. In this context it may be mentioned that apart from the conventional type of agricultural show which is usually organised by the extension services of Ministries of Agriculture,

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the organisation of what is usually called "field days" or "farmers days" have in recent years become popular among research institutes. On such occasions farmers have the opportunity to obtain first-hand information on various research activities and programmes being carried on in the institute, particularly those that have immediate relevance for farmer adoption.

Another trend in the dissemination of research information is that after decades of existence of research and extension as separate organisational entities, the research institutes are beginning to incorporate extension activities into their own set-up through the formation of an Agricultural Extension Research Liasion Service (AERLS). This has reached full development at the Institute for Agricultural Research of Ahmadu Bello University which originated the idea. Indeed the activities of this Institute's AERLS have expanded to the extent that it has now been constituted into an autonomous body, separate from its parent institute.

Also, of major significance on the current extension scene is the National Accelerated Food Production Programme (NAFPP) initiated by the Federal Ministry of Agriculture and Natural Resources in 1972. The National Accelerated Food Production Programme (NAFPP) is another developing

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medium for the dissemination of research information to farmers. Basically, the programme which was launched in 1973 is an attempt to integrate research, extension and agro-service (material and service inputs) and to bring to bear their synergistic effect on increasing the productivity of certain selected crops. The crops are rice, maize, millet, sorghum, wheat and cassava. Operationally the programme is organised into three national crop centres based in research institutes as follows: the Rice/Maize Centre at the National Cereals Research Institute, Moor Plantation, Ibadan; the Millet/Sorghum/Wheat Centre at the Institute of Agricultural Research, Ahmadu Bello University, Samaru; and the Cassava Centre at the National Root Crops Research Institute, Umudike. These centres work in close collaboration with state extension services to develop crop varieties and cultivation methods which are tested on specific sites and individual farms through what are known as mini-kits. Mini-kits are specially prepared packages of seed of different varieties, fertilizers of different analysis, and recommended quantities of the right pesticides. It is claimed that the use of mini-kits as a research and teaching tool reduces the

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period between the proof of an improved practice and its mass-adoption from 7-9 years to 2-3 years.[16]

Finally, the use of the mass media for disseminating research information has taken on an increasing importance in recent years. Both radio and television in many parts of the country now feature agricultural information in their regular programmes in addition to news coverage of special occasions like meetings, seminars, workshops, conferences etc. pertaining to agricultural matters. Similarly, some sections of the press carry special columns on scientific information including those on agricultural research. All in all, there exists a wide variety of channels through which research information could be disseminated. While a few are of recent development, many have been part of the history of Nigerian agriculture itself.

2.5 General evaluation of research impact

Agricultural research in Nigeria has been in existence now for four decades, the first experimental station having been established in Ibadan in 1899. Given its fairly long history, what has been its impact on agricul-

16 International Institute for Tropical Agriculture, The NAFPP: A new dimension for Nigerian agriculture . Ibadan, 1977.

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tural development in the country?

One significant factor to be borne in mind in considering the impact of research on agricultural development is that largely as a result of British colonial policy of "protectorate" administration rather than wholesale colonisation, Nigerian agriculture has continued in its socio-cultural small-scale setting. Thus, the conduct of research and dissemination of research information has had to operate in a milieu of mass illiteracy, subsistence-oriented production, and primitive implements that characterise the shifting cultivation system of the Nigerian small-holder.

It is common knowledge that there has been little change in the state of farming technology over the years. This is often attributed to the neglect of food crops research.[17] However, this is not borne out by historical evidence. What could be asserted is that the research efforts have made little impact on food production - which is different from saying that no efforts were made. On the contrary, available evidence suggests that from early times in the history of research, efforts were

17 Oluwasanmi, H.A., West African agricultural development in the '60's. Proceeding of Conference on factors of economic growth in West Africa, Legon 1973, p.2.

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directed to tackling the fundamental problem of food production, namely, the need to develop a system of continuous cropping capable of maintaining soil fertility in place of traditional shifting cultivation. For instance, during the period from 1921 up to the end of the Second World War, agricultural research was dominated almost exclusively by experiments on "green manuring" in the south and "mixed farming" in the north. Thus for some twenty-five years, agricultural research was pre-occupied with attacking the problems of low food productivity from the roots, as it were. It is interesting to speculate on whether some acceptable substitute for shifting cultivation would have been evolved. However, as it turned out, the end of the Second World War marked the beginning of rapid constitutional and political changes which resulted in successive re-organisations of the Department of Agriculture and resultant changes in research policies and programmes. Even then, research in food crops have continued, albeit by focussing on individual crops rather than as part of a farming system.[18]

There are many reasons for the lack of research impact on traditional farming practices. One is that the

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18 See, for instance, the annual reports of both Federal and Regional Research establishments from 1946 to the 1960's

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relative abundance and availability of land favours the continuance of the traditional shifting cultivation; there is therefore no incentive to adopt improved practices. Secondly, the communal land tenure system is not suited to present-day requirement of cash crops production.[19] Thus the occupier of agricultural land has no real incentive to improve or even to maintain the fertility of the land he is cultivating. Thirdly, agricultural research has not always progressed evenly on all fronts, so that the adoption of an improvement in one area of farming may be handicapped by lack of corresponding innovation in other complementary areas. For example, the increase in output from the adoption of modern practices like improved varieties and fertilizer application may be nullified by lack of adequate processing and storage methods for the resulting excess. Fourthly, there is the non-application of what Norman and Simmons[20] have called the "relevance criteria" in the formulation of research policies and programmes. For example, inter-cropping is known to be the predominant system of farming in most parts of the

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19. F.A.O., Op.cit.

20 Norman, D.W. and E. B. Simmons, Determination of relevant priorities for farm development in West Africa, Proceedings of the conference on factors of agricultural growth, Legon 1973, p.142

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country. Yet research has continued to attack the problem of low productivity by recommending practices based on sole cropping. The application of the relevance criteria should lead to the formulation of research programmes aimed at increasing crop yields within the framework of a crop-mixtures system, a system which farmers continue to prefer for "valid reasons of a technological, sociological and economic nature.[21]

In face of the seeming indifference of small holders to improved farming techniques, official reaction has been an attempt to induce agricultural development through the alternative system of large-scale production units. Starting with plantations in the 1950's, large-scale system of production was intensified in the sixties by the establishment of farm settlement schemes in the then Eastern and Western Regions. Amplifying the government's view with regards to large-scale production unit, the 1962-68 Western Region Plan asserted, "As for modernising agriculture, a good start has already been made by the

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21 Norman, D. W. Crop mixtures under indigenous conditions in northern part of Nigeria. Proceedings of the conference on factors of agricultural growth, Legon, 1971, p.142

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establishment of farm settlements, by the setting up of plantations, and by founding of farm institutes to train young farmers."[22] Thus, out of the ₦37 million provision for primary production during the plan period, about ₦19.5 million was allocated to various forms of large-scale production units.[23] By comparison, the amount earmarked for small-holder production by way of agricultural extension was under ₦6 million.

Experience with these schemes has been generally disappointing. Most of the results envisaged have not materialised. In particular the high expectation that the "demonstration effects" of farm settlement scheme would rub off on the small-holders have turned out to be an illusion. Indeed, contrary to the positive assertion that "the impact which these farm settlements will make to the overall productivity of farmers in the Region has never been in doubt,"[24] some studies suggest that their demonstration effects have actually been negative.[25]

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22 Nigeria. Federal Ministry of Economic Development. National development plan 1962-68, Lagos,1962 p.273

23 Ibid, p. 342

24 Ibid., p. 290

25 Idachaba, F. S., The 'demonstration effects' of farm institutes and settlements: Theory and evidence, Bulletin of Rural Economics and Sociology (Ibadan) 8(2); 207, 1973.

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Developments in recent years have been towards a reversion of governmental support for small holder production. For example of a total of some ₦61 million provided for Federal Capital Expenditure on agriculture during the 1970-74 National Development Plan, ₦17 million was allocated to "Federal Assistance to Agriculture," which is presumably a catchall title for various projects in support of small holder production.[26] The same pattern is noticeable in states appropriations for agriculture during the period. The 1975-80 Development Plan too, places similar emphasis on small-holder production through such programmes as the National Accelerated Food Production Project (NAFPP); irrigation projects, "small-holder" tree-crop projects (cocoa, oil palm and rubber) and fertilizer distribution.[27]

Given the disillusionment with large-scale production units, what prospects do small-holders offer as agents of agricultural development, especially with regard to the transfer of technology? If their contribution to the pre-petroleum, export-crop economy is any guide, there

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26 Nigeria. Federal Ministry of Economic Planning and Reconstruction. The four-year development plan, 1970-74. Lagos, 1970 p.115.

27 Nigeria. Federal Ministry of Economic Development, Third national development plan 1975-80, Lagos, 1975, Vol. 1. pp 15-18

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may be some justification for optimism in this direction. True, much of the increase in production of export crops in the past was due to factors like price incentives, improved transportation facilities and the utilization of surplus land. However, there is evidence that research played a dominant role in some specific crops. For example between 1953 and 1964 cocoa export rose from 105,000 to 200,000 metric tons. According to FAO, this remarkable upsurge "can only be explained by the coming into bearing of young trees, an increasing proportion of which were of Amazon varieties and selected high-yielding Amelonado varieties, and the effects of spraying against diseases and pests."[28] To the extent that the level of research achievements in this direction is a pointer to similar possibilities for research in other crops, an examination of the organisation and conduct of cocoa research may be illuminating.

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28 F.A.O., op.cit

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CHAPTER III

COCOA RESEARCH

3.1 History of cocoa production in Nigeria

Cocoa production in Nigeria dates back to late nineteenth century, the first plantation of the crop having been established near Bonny in 1874.[1] But cocoa farming did not spread until the early part of the twentieth century[2]. In 1911, Nigeria produced 4,000 tons, compared with 150,000 tons for the West Indies, and 40,000 tons for Ghana (then Gold Coast).[3] However, during the next two decades, the rate of growth surpassed those of the other areas. For example between 1914 and 1938, African, American and world production grew five hundred, one hundred and fifty, and two hundred and fifty

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1 African affairs, 45, 1946 p. 152

2 The preponderance of Nigeria's cocoa production has for a long time now come from the "Cocoa Belt" in what is now Ogun, Oyo and Ondo States. The estimated production from this area is 95 per cent of the country's production.

3 Galletti, R., K.D.S. Baldwin and I.O. Dina, Nigerian cocoa farmers, Oxford University Press, 1956.

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per cent respectively. By comparison, Nigerian production during the same period expanded by one thousand two hundred per cent (see Table 3.1).

In 1929, Nigeria's share of world cocoa production was 10 per cent, rising to 14 per cent by the 1950's when she became the third largest producer (after Ghana and Brazil). She moved to the second position in the mid 1960's, supplying about 19 per cent of total world production (Table 3.2). Thereafter it decreased steadily until 1970/71 when it again rose briefly to about 20 per cent - an all-time high. Production in recent years seems to have stabilized at about 14 per cent of world production, pushing Nigeria back in the process to the third place.

It is perhaps pertinent to mention that the Nigerian cocoa industry was developed and has been sustained almost exclusively by small-holders. Government aid was not forth-coming until 1926 when a produce inspection service was set up with the object of raising the quality of cocoa as well as other export crops. This intervention together with war-time export control arrangements resulted in better quality of produce exports.

The Cocoa Marketing Board established in 1947 successfully used its price-fixing powers to effect even

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TABLE 3.1

Growth of cocoa production

Period ending:	In '000 metric tons : average of four-year periods				Change from preceeding period per cent			
	Nigeria	Africa*	America	World	Nigeria	Africa*	America	World
1914	4.1	91.8	151.1	249.3	..	..	..	..
1918	11.0	125.4	169.7	301.7	+ 164	+ 37	+ 12	+ 21
1922	23.2	216.3	187.0	410.1	+ 111	+ 73	+ 10	+ 36
1926	38.1	295.0	178.9	480.9	+ 64	+ 36	- 4	+ 17
1930	48.6	317.6	177.0	503.1	+ 28	+ 8	- 1	+ 5
1934	66.3	374.1	185.0	566.7	+ 36	+ 18	+ 5	+ 13
1938	90.9	351.4	208.2	667.6	+ 37	+ 21	+ 13	+ 18

* Including Nigeria

Source: Galletti, R., K. D. S. Baldwin and I. O. Dina, Nigerian cocoa farmers, Oxford University Press, 1956, p.1.

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TABLE 3.2

Nigeria's cocoa production as percentage of World production

Season	Production (metric tons)	Percentage of World Prdduction
1965/66	184,632	14,99
1966/67	267,273	19.60
1967/68	238,653	17.56
1968/69	187,533	15.02
1969/70	222,969	15.59
1970/71	307,915	20.60
1971/72	256,604	16.13
1972/73	241,286	17.16
1973/74	190,900	13.48
1974/75	214,000	13.81

Source: Statistical Information on Western State of Nigerian Controlled Produce, Western Nigeria Marketing Board, April 1976.

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greater improvement in the quality of cocoa export. For instance in 1947/48, 47 per cent of cocoa purchased by the Board was of grade one quality, 25 per cent grade two, 21 per cent grade three and 7 per cent grade four. In 1950/51 the Board's purchases were 95 per cent grade one and 5 per cent grade two, with grades three and four no longer sold (Table 3.3). This course of action as indeed its other policies has been the subject of severe criticism.[4] It is contended that the minimum quality prescribed by the Boards was always higher than the lowest quality acceptable on the world market, and that such prohibition of inferior but commercially marketable grades of produce represented a loss not only to the producers but to the economy at large. On the other hand, some economists have hailed the improvement in produce quality as having contributed to the Nigerian economy.[5,6]

Another significant government intervention in cocoa production is in pests and diseases control. Following

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4 Notably by Bauer. For a definitive study of the Marketing Boards see Bauer, P.T., West African trade, (London) Routledge and Kegan Paul Ltd, 1963.

5 Clayton, E.S., Freedom and welfare in developing countries, <u>Farm Economist</u> 10(6), 1963.

6 Hill, Poly. Fluctuations in incomes of primary producers. <u>Economic Journal</u> . . . June 1963

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TABLE 3.3

Nigeria Cocoa Marketing Board producer prices for cocoa and distribution of purchase between grades, 1947-54

Year	Producer Prices Grades				Proportion of quantity bought Grades				Quantity bought
	I	II	III	IV	I	II	III	IV	
	₦ per ton				per cent				'000 tons
1947-48	122	120	114	96	47	25	21	7	75
1948-49	240	230	210	180	76	21	2	1	109
1949-50	200	190	150	-	89	10	(a)	-	99
1950-51	240	220	Grades		95	5	Grades		110
1951-52	340	310	no		96	4	no		108
1952-53	340	310	longer		95	5	longer		109
1953-54	340	310	bought				bought		97

(a) less than 0.5

Source: Nigeria Cocoa Marketing Board records

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the outbreak of swollen shoot disease during the second world war, the government conducted a swollen shoot virus survey throughout the cocoa-producing area. Since there was no known cure, this led to a massive "cutting out" campaign with a view to preventing the disease from spreading to healthy trees. This failed to control the disease, and government resorted to sealing off those areas that were badly affected by the disease (the "Areas of Mass Infection" - AMI) by the establishment of "a cordon sanitaire" around them. The two areas declared as AMI were around Ibadan and Ilaro. The most striking development was the introduction in 1954 of spraying against black pod disease through the training of farmers and subsidies for chemicals. This together with spraying against capsid pests reduced yield loss considerably.

Even more deleterious to sustained production is the fact that 65 per cent of existing hectarage have passed their economic life.[7] In 1964, the Western Region Ministry of Agriculture initiated a special Cocoa Development Scheme. This was aimed at replanting 5,200 hectares of old cocoa farm and to establish 4,000 hectares of new plantings over four years. Participating farmers

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7 Nigeria. Western State Programme of the Third National Development Plan 1975-80.

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who must belong to co-operative societies were to adopt a package of recommended practices under the close supervision of extension staff. The government also provided grants for replantings and credit for new plantings through the Agricultural Credit Corporation. The project was expected to be implemented through a loan from the World Bank. However the targets had to be reduced because the expected World Bank loan was not forthcoming. The hectarage actually planted was less than 1,600 hectares for replanting and 1,560 hectares for new planting.

During the 1970-74 Development Plan, the scheme for rehabilitation, which was started under the special Cocoa Development Scheme, was given a new impetus by the establishment of the Cocoa Development Unit as an autonomous body, with the assistance of the World Bank in form of loan and technical know-how. Under the new project a total of 10,926 hectares of replanting as well as 10,926 hectares of new planting were to be undertaken at a total cost of ₦8.3 million. Following a favourable report of a World Bank mission which reviewed the project in 1973, it was recommended that the scheme be extended from the total of 17,604 to 42,694 hectares at an additional cost of ₦13 million. With the creation of three states out of the erstwhile Western State, each with its

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own Cocoa Development Unit, indications are that the scheme of replanting and new plantings would be more intensified. For instance, by the 1976/77 planting season, a total of 45,919 hectares have been achieved. The year-by-year hectarage achievement in the three states are shown in Table 3.4.

Another factor that has been identified as having had a negative effect on cocoa production is the Marketing Board pricing policy which has for long imposed a heavy burden of tax on producers and fixed producer prices at levels far below world market prices.[8,9] For instance in 1966/67 the producer price paid was only 35.6 per cent of world market price (see Table 3.5). In 1973 the government reviewed the pricing policy of the Marketing Board. In particular, the taxation element was eliminated, and prices were to be fixed more in line with the world market. Furthermore in 1977, the whole Marketing Board system in Nigeria was overhauled, the regional set-up being replaced by Commodity Boards. The Marketing Board system

8 Olatunbosun, D. and S.O. Olayide, Effects of the marketing boards on the output and income of primary producers. International conference on marketing board system, NISER Ibadan, 1971.

9 Olatunbosun, D. Pricing policy and supply response in cocoa production: the Nigerian case. Proceedings on cocoa economics research conference, Legon, April 1973

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TABLE 3.4

Cocoa Development Unit: Hectarage achievement in states comprising the old Western State 1972-76

Year	New Planting			Replanting			Total Plantings (hectares)
	Ondo	Ogun	Oyo	Ondo	Ogun	Oyo	All States
1972	754	78	330	301	178	554	2195
1973	1342	134	878	798	258	1223	4633
1974	1919	510	761	751	409	2464	6978
1975	1832	1340	846	2193	991	4499	11,699
1976	3059	2144	1485	4684	1297	7743	20,414
Total	8906	4206	4300	8691	3133	16481	45,919

Source: Western State Cocoa Development Unit records

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TABLE 3.5

Nigerian producer price as percentage of world price

Year	World price per metric ton*	Nigerian producer price per metric ton	Nigerian producer price as percentage of world price
	Naira		
1958/59	694	371	53.5
1959/60	562	351	62.5
1960/61	445	367	82.5
1961/62	354	251	70.9
1962/63	335	268	80.0
1963/64	404	256	63.4
1964/65	375	250	66.7
1965/66	277	130	46.9
1966/67	386	207	53.6
1967/68	476	203	42.6
1968/69	639	203	31.8
1969/70	831	317	38.1

P.T.O.

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TABLE 3.5 (cont'd)

Year	World price per metric ton*	Nigerian producer price per metric ton	Nigerian producer price as percentage of world price
	Naira		
1970/71	611	303	49.6
1971/72	465	318	68.4
1972/73	541	366	67.7
1973/74	1171	399	34.1
1974/75	1980	580	29.3
1975/76	2212	652	29.5

* The figures used are London prices.

Sources: Gill and Duffus, Cocoa market report, No. 270; Western Nigeria Marketing Board, Statistical information on Western State of Nigeria controlled produce, Ibadan, April 1976.

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in Nigeria could thus be said to have come full circle since the post-second World War period.

What is the outlook for cocoa production in Nigeria? In the words of the Western State Programme of the Third National Development Plan, the massive investment in cocoa and positive response which is expected, will result in the output of cocoa in the state as shown in Table 3.6.[10] These targets ranging from 200,000 to 369,600 tonnes are substantial. If the stipulated targets are achieved, Nigeria would regain her previous position in the world market as the second largest producer of cocoa by 1980.

3.2. Cocoa and the Nigerian economy

Of all Nigeria's traditional export crops, cocoa has made the greatest impact on the economy, especially during the pre-petroleum era. Given the concentration of production in Western Nigeria, cocoa has always dominated the economy of that part of the country almost exclusively. Thus the production of cocoa has contributed immensely to the economic progress of Western Nigeria in terms of reformatory effects on certain traditional

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10 Nigeria. Western State programme of the third national development plan 1975-80.

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TABLE 3.6

Projected output of cocoa 1975-80
(metric tons)

1975-76	1976-77	1977-78	1978-79	1979-80
200,000	324,000	336,000	341,600	369,600

Source: Western State Programme of the Third National Development Plan 1975-80, p. 18

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institutions notably land tenure, raising farmers income, and providing government with revenue and resources for the developmental effort. However, its contributions to the national economy at large has been no less remarkable, especially as an earner of foreign exchange as well as being an important component of the gross domestic product. The impact of cocoa on the economy could therefore be assessed in relation to these factors. In doing so, emphasis is focussed on the period up to the 1960's when the distorting influence of petroleum export was yet to affect the picture.

The cultivation of cocoa per se has had some modifying effects on the traditional land tenure system. Since under the customary system of land tenure the right of the individual over the trees planted by him is recognised, the cultivation of cocoa means an indefinite interest on the part of the producer in a particular plot of land. It also means an abrogation of shifting cultivation which is a feature of the customary system. While the reversionary right of the community to a plot of land remains unimpared by the cultivation of cocoa, this situation does give ample scope for tendencies towards individualization of land ownership.[11] For instance, the cultivator

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11 See Helleiner, G.K. Peasant agriculture, government and economic growth in Nigeria. Homewood, Illinois. Richard D. Irwin, Inc. 1966.

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has the right to mortgage his crop or pledge it against indebtedness. Above all the individual at death can transfer the right over the trees to his heirs, thereby circumscribing the reversionary right to the community of the land carrying his crop. In successive generations, such land may, in practice, be lost to the community. This modified situation vis-a-vis the pure form of traditional tenure has significant implications for the farmer's willingness to invest in his piece of land.

On a more spectacular plane, cocoa production has created opportunities for increasing farmers' incomes over the years (Table 3.7), mostly as a result of rising commodity prices. In particular, the boom period of the post Second World War years resulted not only in unprecedented increases in producer income but also led to considerable rise in the general standard of living in the then Western Region as this exerpt from Baldwin Galletti and Dina shows:

> In everything that goes to improve the material standard of life beyond bare necessities of food and shelter, the inhabitants of the Western Region seem to enjoy at least twice as much as those in the Eastern Region and in most respects three times as those of the Northern Region. Nor, though the towns get the lion's share of the imports, is the material improvement confined to cities and towns. In the consump-

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TABLE 3.7

Incomes received by farmers from sales of cocoa, 1939/40 - 1975/76

Year	Income received (₦ million)	Year	Income received (₦ million)
1939/40	2.8	1961/62	36.0
1940/41	2.8	1962/63	34.0
1941/42	3.0	1963/64	44.4
1948/49	25.0	1964/65	68.2
1949/50	22.0	1965/66	22.2
1950/51	28.6	1966/67	45.2
1951/52	36.2	1967/68	42.6
1952/53	36.8	1968/69	36.0
1953/54	32.6	1969/70	64.4
1954/55	31.0	1970/71	81.7
1955/56	40.0	1971/72	67.8
1956/57	38.0	1972/73	64.7
1957/58	22.0	1973/74	75.0
1958/59	38.2	1974/75	69.2
1959/60	45.0	1975/76	70.5
1960/61	54.0		

Source: Helleiner (1966), Central Bank of Nigeria Economic and Financial Review, several issues, Western Nigeria Marketing Board.

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> tion of textiles, iron sheets, and cement, cigarettes, beer and kerosene, the Yoruba farming settlement is ahead of most of Africa.[12]

Even more spectacular is the contribution of cocoa to government revenue, particularly at the regional level. This contribution has come mostly in form of produce sales tax. From Table 3.8 it can be seen that cocoa contributed more than 70 per cent of the total revenue from produce sales tax for each year between 1960 and 1968.[13] Furthermore the Marketing Board reserves accummulated over the years provided an important source of investment funds especially in the 1950-60 decade. Development in the first half of the century depended largely on loans raised overseas. Between 1950 and 1959, however, the Marketing Boards replaced the foreign investor as a source of investment funds for the public sector. By 1954, the Commodity Marketing Boards reserves was over ₦163 million after ₦68 million had already been allocated for economic development and research out of which the Cocoa Marketing Board contributed 35.7 and 39.3 per cent respectively

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12 Galletti, R., K. D. S. Baldwin and I. O. Dina. op.cit.

13 To this must be added the indirect benefit of duties accruing to government from the imports for which cocoa exports help to pay.

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TABLE 3.8

Contribution of Cocoa Marketing Board to general reserves and appropriations 1949-54

Year	General Reserves (end of year)			Appropriations for Development and Research (Cumulative to end of year)		
	All Marketing Boards	Cocoa Marketing Board	Cocoa Marketing Board's Share	All Marketing Boards	Cocoa Marketing Board	Cocoa Marketing Board's Share
	(₦million)	(₦million)	(%)	(₦million)	(₦million)	(%)
1949/50	94.4	43.6	45.5	17.0	6.6	38.8
1950/51	131.6	66.0	50.2	22.8	6.6	29.0
1951/52	135.8	52.0	38.0	49.8	23.2	47.0
1952/53	154.0	52.6	34.2	59.6	23.6	40.0
1953/54	163.4	58.4	35.7	68.2	26.8	39.3

Source: Compiled from Annual Reports of Commodity Marketing Boards 1949/50 to 1953/54

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(see Table 3.8). With the setting up of the Capital Development Fund in 1956/57, the amount provided by the Regional Marketing Boards (which replaced the Commodity Boards in 1954) from 1954 to 1960 were even larger. Thus the Federal Government borrowed ₦22 million while the Western Region Government received a grant of ₦22 million and borrowed a further ₦20 million, raising thereby more than two-thirds of the amount paid into the Capital Development Fund in 1956-57. Again the contribution of the Western Region Marketing Board (which is in effect the successor to the Cocoa Marketing Board) between 1954 and 1960 ranged from 34.7 to 53.1 per cent to general resérces; and 45.0 to 71.4 per cent to loans to government and public corporations (Table 3.9).

Some of these appropriations for development and research from Cocoa Marketing Board reserves was in form of grants (which totalled ₦17 million) to the Western Region Production Board. The schemes undertaken by the latter Board include the establishment of a number of plantations and farming projects, pioneer oil palm mills, rice mills, citrus processing factories and rubber processing factories. In addition, it awarded a large number of university scholarships in the field of agriculture and engineering. In later years its successor,

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TABLE 3.9

Contribution of Western Région Marketing Board to general reserves, appropriations for development and research and loans to Government and publiccorporations 1954/55-1959/60

Year	General Reserve (end of year)			Appropriations for Development and Research (Cummulative to end of year)			Loans to Government and Public Corporation (outstanding at end of year)		
	All Regional Boards	Western Region Marketing Board	Western Region Marketing Board's Share	All Regional Boards	Western Region Marketing Board	Western Region Marketing Board's Share	All Regional Boards	Western Region Marketing Board	Western Region Marketing Board's Share
	(₦m)	(₦m)	(%)	(₦m)	(₦m)	(%)	(₦m)	(₦m)	(%)
1954/55	138.2	65.8	47.6	23.4	14.2	63.0	4.0	1.8	45.0
1955/56	124.0	49.4	39.8	38.8	24.0	61.8	30.4	21,8	71.4
1956/57	132.8	46.0	34.7	43.8	25.4	57.9	46.6	30.0	64.4
1957/58	146.8	67.4	45.9	46.8	27.0	57.4	51.4	29.6	57.6
1958/59	176.0	93.4	53.1	47.4	25.4	53.6	63.0	36.0	57.0
1959/60	170.6	83.8	49.1	64.6	42.4	65.6	67.4	41.6	61.8

Source: Compiled from Annual Reports of Regional Marketing Boards 1954/55 to 1959/60

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the Western Nigeria Development Corporation (WNDC), undertook a number of industrial projects like cement and textile manufacturing as well as many agricultural projects either by itself or in partnership with foreign capital and technical know-how.

Apart from these investments by its "agents" the Cocoa Marketing Board itself undertook many development schemes. Up to September 1951, the Board had appropriated over ₦7 million for agricultural and other schemes; notably ₦1 million for feeder roads; ₦1.2 million for a project on production of fibre bags; ₦0.72 million for the Nigeria Cocoa Survey; and ₦2.45 million for endowment to the Faculty of Agriculture of the University College, Ibadan. The Board also contributed substantial sums to the West African Cocoa Research Institute. All together the appriopriations of the Cocoa Marketing Board by 1953-54 totalled ₦26.8 million, while its successor, the Western Region Marketing Board had spent ₦42.4 million by 1959-60.

Enormous as these investments have been, the development projects undertaken - involving as they did a considerable amount of capital goods that had to be imported - would not have been possible without the availability of foreign exchange. And here again lies the importance of cocoa to the economy, that is, as an

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earner of foreign exchange. Before the Second World War, cocoa exports paid for more than 20 per cent of Nigeria's imports. With high prices and large volume of production during the post war years it was paying for nearly 30 per cent of imports.[14] Table 3.10 shows the year-by-year share of imports paid for by cocoa between 1950 and 1968.

Apart from being a traditional earner of foreign exchange in its raw state, cocoa has also assumed increasing importance as a raw material in domestic industries. For example, between 1964 and 1965 a number of cocoa processing plants were established. These include a 30,000-ton capacity processing plant, a small processing and chocolate manufacturing plant and a packaging operation by Cadbury. Another project, a combined palm kernel and cocoa processing plant set up in the Bendel State, manufactures cake and powder. These cocoa-based industrial projects provide another source of foreign exchange earnings. Furthermore the use of local raw materials means a saving in foreign exchange which would have been required to import the final products.

Given the importance of cocoa to the Nigerian economy as evidenced by its various contributions discussed above,

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14 Galletti, R., K. D. S. Baldwin and I. O. Dina op.cit. p.10.

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TABLE 3.10

Share of imports paid for by cocoa, 1950-74

Year	Cocoa export		Total value of domestic exports ₦ million	Cocoa's share of domestic export %	Total value of imports ₦ million	Cocoa's share of imports %
	Volume ('000 metric tons)	Value ₦ million				
1950	102.0	38.0	176.8	21.4	123.6	30.7
1951	123.4	59.0	223.2	25.3	169.0	34.9
1952	117.0	53.8	150.2	21.5	226.4	23.8
1953	106.0	50.0	241.6	20.6	216.4	23.0
1954	100.4	78.6	292.4	26.9	228.0	27.3
1955	90.2	52.4	259.6	20.2	272.2	19.2
1956	119.4	48.0	264.4	18.1	305.4	15.7
1957	138.0	52.0	248.2	21.0	304.8	17.0
1958	88.9	53.4	265.4	20.1	334.0	16.0
1959	145.6	76.6	327.0	23.9	356.8	21.3

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TABLE 3.10 (contd)

Year	Cocoa export		Total value of domestic exports ₦ million	Cocoa's share of domestic export %	Total value of imports ₦ million	Cocoa's share of imports %
	Volume ('000 metric tons)	Value ₦ million				
1960	160.1	73.6	338.4	21.6	431.8	17.0
1961	187.6	67.4	347.2	19.4	445.0	14.7
1962	198.5	66.8	337.2	20.4	406.4	16.4
1963	178.0	64.8	379.8	17.1	415.2	15.6
1964	200.7	80.2	428.8	18.7	407.6	15.8
1965	311.4	85.4	536.8	16.2	540.6	15.5
1966	194.0	52.6	566.2	9.3	512.6	10.3
1967	249.3	109.4	482.4	23.0	447.2	24.5
1968	211.9	103.2	422.2	25.0	386.4	26.7
1969	173.6	105.2	567.0	18.6	183.0	57.5
1970	195.9	133.1	825.6	16.1	336.7	39.5

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TABLE 3.10 (contd)

Year	Cocoa export		Total value of domestic exports ₦ million	Cocoa's share of domestic export %	Total value of imports ₦ million	Cocoa's share of imports %
	Volume ('000 metric tons)	Value ₦million				
1971	271.7	143.1	1109.2	12.9	536.6	26.7
1972	227.5	101.1	1348.7	7.5	536.8	18.8
1973	218.9	112.4	2126.3	5.3	629.0	17.9
1974	159.0	159.0	5243.1	3.0	651.5	24.4

Source: Compiled from data from Federal Office of Statistics, Digest of statistics, several issues.

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it is not surprising that the government has always shown concern for the cocoa industry. Indeed on many occasions it has seized the initiative in sponsoring programmes aimed at increasing cocoa output. Among such programmes have been the promotion of produce quality through the establishment of a produce inspection service; encouragement of pests and diseases control through farmer-training and subsidies for spraying chemicals; rehabilitation of aged trees through replanting and new planting. Above all, the government has always been actively involved in technical research into the problems of cocoa production.

3.3. The beginnings of cocoa research

The beginnings of research into the problems of cocoa production date back to the inception of the Agricultural Department early this century. According to the 1910 Annual Report of the Agricultural Department,

> His Excellency the Governor reported insects were attacking young cocoa plants in a plantation at Sapele. This plantation was inspected by the Director of Agriculture . . . Some of [these] insects were forwarded to the Entomologist . . .[15]

Similarly, the fungus parasite causing the "die back" and

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15 Nigeria. Annual Report on the Agricultural Department 1910, Government Printer, Lagos. p.15.

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the "brown root" disease were reported to have been observed in cocoa plantations.

Apart from random observations of this nature on private farms, experimental farms were also established to study various crops, including cocoa, notably in Agege, Onitsha and Calabar. Nevertheless research into problems of cocoa production remained limited for some three decades. This situation can be attributed to the fact that most cocoa plantations in Nigeria during this period were still young and were as yet relatively free from the ravages of pests and diseases and resultant decline in production to which older trees are usually susceptible. The complacency that seemed to typify the research efforts in this period is exemplified by this extract from the 1936 Annual Report;

> In our study of cocoa problems we are in a fortunate position. Production is increasing steadily and it is unlikely that a set-back will occur in future. We therefore have time to go ahead with our experimental work in preparation for the time when the farmer will require assistance.16

By contrast, cocoa production in the then Gold Coast's Eastern Province was already on the decline about this period. Thus the need to give advice on the re-establish-

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16 Nigeria. Annual report on the Agricultural Department 1936, Lagos, Government Printer 1937. p.35.

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ment of cocoa in the derelict areas led to the creation of the Central Cocoa Research Station in that country in 1937. Although similar experiments on cocoa regeneration were started in the same year on some private farms at Agege (one of the oldest cocoa-growing areas in Nigeria which was beginning to show signs of old age) these experiments were on the whole rudimentary, so that by 1941 the same complacent attitude was still discernible in that year's annual report:

> We are still fortunate in being able to report that no occurrence of the swollen shoot disease of Gold Coast has yet been discovered in Nigeria. A specialist Officer of the Gold Coast visited in 1941 to maintain cooperation on cocoa research matters between the two colonies and was able to check and confirm our field observations that the disease has not yet reached us.[17]

However, a drastic fall in cocoa production in 1943 seemed to have provided a jolt, as can be seen in this extract,

> The production of cocoa was the lowest for nine years. There is no doubt that as a result of the low prices in recent years, the increasing incidence of sahlbergella and the high cost of labour, the cocoa industry has received a check. New planting has virtually ceased, and attention given to established plantations has been reduced

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17 Nigeria. Annual report on the Agricultural Department, 1941. Lagos, Government Printer, 1942.

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> to far below what was essential... The situation was carefully reviewed during Dr. Tempany's visit and, as a result, a West African Research Station has been set up at Tafo in the Gold Coast to investigate cocoa diseases and pests. Nigeria has undertaken to carry out a survey of the cocoa area, the primary objects of which are a search for the possible presence of swollen shoot and the incidence of capsid bugs.[18]

This survey undertaken between 1944 and 1949 was to reveal not only the widespread existence of swollen shoot virus infection throughout the cocoa-producing area, but also that certain areas around Ibadan (especially Egbeda, Badeku and Olanla districts) were heavily infected. Another badly infected area was Ilaro in Egbado district. These two zones were the so-called Areas of Mass Infection (AMI). Given the findings of the survey, the creation of the West African Cocoa Research Institute could not have come at a more opportune time in the history of cocoa production in Nigeria.

3.4. The West African Cocoa Research Institute (WACRI)

In 1943, Dr. H. A. Tempany, the Agricultural Adviser to the Colonial Office visited West Africa following

18 Nigeria. Annual report on the Agricultural Department 1943. Lagos, Government Printer 1944. p.26

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disturbing reports concerning the spread of cocoa pest and diseases in that region against the background of an increased demand for cocoa beans, the export of which had once more become possible. Having toured cocoa areas in both Nigeria and the Gold Coast, he confirmed the previous reports on pests and diseases and came to the conclusion that what was required, if the threat of destruction hanging over cocoa plantations was to be averted, was nothing short of a concerted effort by scientists to investigate these pests and diseases and to devise control measures against them.

3.4.1 Original disease research scheme: The scheme that emerged following this tour - the Cocoa Disease Research Scheme - entailed the creation of a team of scientists working on a West African basis under the administrative control of the Resident Minister. This team was to be made up of entomologists, pathologists, botanists, chemists and agronomists under a Director of Research. This scheme was taken as emergency measure solely to combat pests and diseases, and was to be reconsidered in three years with the object of deciding whether it would continue on a temporary basis or whether it would become a permanent body possibly incorporated into a West African Agricultural

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Research Institute.

For the three year trial period minimum capital equipment would be required, and the secondment, as opposed to appointment of staff, would make unnecessary any immediate decision on the future of the scheme. The Central Cocoa Research Institute at Tafo, which had been created by the Gold Coast Government in 1938 for the specific purpose of cocoa research was selected as the headquarters for the scheme.

An essential counterpart to the scheme was a survey of the cocoa farms in Nigeria and the Gold Coast, since there was a lack of knowledge regarding the whereabouts of diseases and pests within the cocoa-growing areas themselves. An Advisory Committee was set up under the chairmanship of the Director of Research to coordinate the work of the research scheme and that of the surveys.

3.4.2. The birth of WACRI: The original scheme as proposed was however only of short duration before it became modified into a permanent institution. At the first meeting of the Advisory Committee in April 1944, a resolution was unanimously passed calling for the temporary character of the scheme to be changed to a permanent one at the earliest possible date. As the Gold

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Coast cocoa producers' representative on the committee put it,"As long as cocoa exists in the Gold Coast, there is need for Cocoa Research."[19]

Events of a financial nature hastened the possibility of creating a permanent Cocoa Research Institute. Profits from the West African Produce Control Board (a body set up during the war period to control produce marketing in British West Africa) were considered to be a legitimate source from which to finance the proposed Institute and the initial surveys in Nigeria and the Gold Coast. The revised draft organisation which placed the scheme on a permanent footing was handed over to the Resident Minister in West Africa by July 1944. This draft with little modification was confirmed by the Secretary of State for the Colonies, thus giving birth to the West African Cocoa Research Institute which was later given legal effect by an ordinance in 1947.

3.4.3. Policy and organisation of the Institute: The policy of the Institute was a carry-over from the original scheme which was that research was to be concentrated

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19 West African Cocoa Research Institute. Annual report, April 1947 to March 1948, London, Crown Agents for the colonies, 1948.

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on pests and diseases that posed immediate threat to the West African cocoa industry. More especially, this meant the conduct of full investigation into the bionomics of the cocoa capsids, Sahlbergella singularis, Hagl., and Distantiella theobroma, Dist., their parasites, predators and food plants, and into the virus disease of cocoa and the vectors and alternative host plants of these viruses, with a view to the discovery of practical measures of control. However, as a permanent research establishment, the Institute's work was broadened out to include all matters relating to cocoa which affect the efficiency of West African production.

The Ordinance establishing the Institute made provision for a Management Committee with considerable powers, both financial and administrative. Membership of the Committee was constituted as follows:

The Chairman nominated by the Secretary of State

Four members nominated by the Governor of the Gold Coast

Four members nominated by the Governor of Nigeria

The Director nominated by the Secretary of State.

The composition of the Committee followed this pattern until 1954 when in keeping with political and constitutional developments in both colonies the West African

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Cocoa Research Institute (Amendment) Ordinance was promulgated. The amendment provided that the Governments of the Gold Coast and Nigeria should be consulted by the Secretary of State when appointing a Director of the Institute and a Chairman of the Management Committee. Furthermore in place of four members on the Management Committee each of the Governments were to nominate members not exceeding five in number, of which in the case of the Gold Coast two should be members of the Cocoa Marketing Board who had been recommended by the Board for nomination.

The Management Committee appointed a standing Sub-Committee known as Technical Committee, consisting of the Directors of Agriculture of Nigeria and the Gold Coast, with the Director of Cocoa Research as Chairman and with powers to co-opt specialist advisers. The duties of the Sub-Committee include the consideration of all technical matters with which the Management Committee and the Institute are concerned and to present their considered opinion on such matters to the Management Committee.

The Institute was organised into four divisions: Entomology, Botany and Pathology, Chemistry and Soil Science, and Agronomy. Each was under a divisional head who was responsible to the Director for the day-to-day running of the division. There was a Principal Research

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Officer who was "to give guidance in the details of research to all divisions and to act in the Director's absence." This post was upgraded to that of Deputy Director in 1948.

At a very early stage in its development, the Institute had an Entomological station at Owena in Nigeria, mainly for observation on insect pests of cocoa. In 1954, a Sub-Station was opened in Ibadan to intensify research into problems peculiar to Nigeria. By 1957 the Sub-Station was being headed by a Deputy Director.

3.4.4 Funding: As has been mentioned above, the availability of profits from the West African Produce Control Board was an important factor in hastening the creation of a permanent cocoa research institute. It is therefore not surprising that the funding of the West African Cocoa Research Institute was at the very outset placed on a long-term footing. In 1947, ₦2.5 million was allocated to cocoa research. Of this ₦800,000 was to meet the cost of cocoa Survey in Nigeria and the Gold Coast, and the expenditure already incurred by the Institute for the previous three years. The balance of ₦1.6 million was invested in United Kingdom Government securities by the Crown Agents for the Colonies. It was estimated that the interest from and the periodic sale of these securities

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would bring in an annual income of ₦140,000 for six years, and thereafter the income would be reduced until the fund became exhausted in twenty years.

However, even at the time of allocation, the expected annual income from these investments was already being considered inadequate. For example the 1947/48 report raised doubts as to whether an income of ₦140,000 would be sufficient to meet future annual recurrent expenditure of the Institute in view of increased costs of equipment and apparatus. It went on to suggest that in order to adequately provide for the full programme of research, over a 20-year period, an additional ₦2 million would be required.[19] In 1948 the Gold Coast Marketing Board and the Nigerian Cocoa Marketing Board made an allocation of ₦1,380,000 and ₦620,000 respectively, thus bringing the total fund in trustee stock to some ₦3.6 million as at 31st March 1949. Even so, the interest from these investments was considered insufficient to meet the Institute's annual recurrent expenditure which in these early years was estimated at over ₦180,000. It was therefore expected

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19 West African Cocoa Research Institute. Annual report, April 1947 to March 1948, London, Crown Agents for the colonies, 1948. p.9.

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that it would be necessary to liquidate certain holdings as the need arose.

In 1954 the Managing Committee "observed with grave concern that the Institute's capital funds were becoming depleted and were, in fact, barely sufficient to finance the work of the Institute for another five years"[20] Again the situation was promptly rectified by the endowments of ₦2,693,760 from the Gold Coast Marketing Board and ₦1,210,240 from the Nigerian Board. The total sum so received was said to be sufficient at the current rate of expenditure to guarantee the Institute's continuation for another twenty years, that is up to 1974. However, the Institute as an inter-territorial research organisation was dissolved in 1962. As at 1st April 1962 the balance of its endowment stood at almost ₦4 million.

It is clear from all these that the West African Cocoa Research Institute throughout its existence enjoyed a most generous financial support. Indeed, the Institute virtually dictated - and received without cuts - its own financial requirements. Above all, the financial provisions were made on a guaranteed long-term basis, thus

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20 West African Cocoa Research Institute. Annual report, April 1954 to March 1955, London, Crown Agents for the colonies, 1955.

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enabling it to plan and execute its research programmes untramelled by year-to-year limitation and uncertainty of funds that normally characterise the set-up in the Civil Service.

3.4-5. Staffing: Coming into being as it did towards the end of the Second World War, when there was a general shortage of scientists the world over, WACRI was fortunate in its staffing position from the onset. Thus, out of the approved vacancies of 20 scientific staff, it was able to start with a strength of 15, including some seconded from the Gold Coast Department of Agriculture. As the 1947 Annual Report said,

> At a time when qualified scientific staff is in short supply, the Institute is fortunate in having three-quarters of its establishment filled.[21]

This good beginning has been maintained in all subsequent years, so that, in spite of inevitable normal staff turn-over, there was never a year when the scientific staff strength was ever below 15. Indeed, the situation was one of progressive improvement with all available vacancies filled in later years. Furthermore, a look at the composition of the staff by disciplines shows a good

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21 West African Cocoa Research Institute. Annual report, April 1947 to March 1948, London, Crown Agents for the colonies, 1948, p.7

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coverage vis-a-vis the Institute's requirements.

Another significant factor in the staffing was that the Institute was able to augment its staff through secondment arrangements with older and well established research organisations. Thus there was a constant stream of staff secondment from the Rothamstead Experimental Station dating back to 1951 and continuing throughout the existence of the Institute. In 1957/58, a team of specialists was seconded from the Colonial Pesticides Research Unit, Arusha, Tangayika to form a West African Fungicides Research Unit which was attached to the Institute's Sub-station at Ibadan to work on the fungicidal control of black pod disease. Other research bodies which contributed specialist staff to the Institute through secondment include the United Kingdom Agricultural Research Institute, the East of Scotland College of Agriculture, the Canadian Technical Assistance Scheme, and the National Vegetable Research Station, Warwicks, England.

Notwithstanding its relatively favourable staffing level however, the Institute established a scholarship scheme as early as 1947, aimed at training West Africans for its future scientific staff requirements. The scholarships were of two types. The first was to provide for attendance at Universities to allow scholars to obtain

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first degrees and post-graduate qualifications necessary for appointment to specialist staff positions; while the second type provided laboratory training to increase the technical ability of the junior establishments. Some awards were subsequently made under the scheme.

On the whole, the Institute enjoyed considerable stability in the level and composition of staff all through the period of its existence, partly through a vigorous recruitment policy and partly through an arrangement of co-operation in staff secondment with other research bodies. At the time of its dissolution, in 1962, it has built up such staff strength that even at its Ibadan Sub-station there was an adequate number of Specialist Staff to enable any succeeding cocoa research establishment in Nigeria take off successfully.

3.5. Cocoa Research Institute of Nigeria

The West African Cocoa Research Institute was of course created and developed by the British Colonial Administration. Its control and management, in spite of its inter-territorial status, therefore, raised little or no problem. With constitutional developments leading to political independence of the Gold Coast in 1956 as the sovereign state of Ghana, a new element came into the picture. In the wake of her independence, the prevailing political

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climate in Ghana - as the first black African state - was that of making a "clean break with the colonial past." In the circumstances, many inter-territorial organisations became victims of this "break", among the early ones being the West African Currency Board and the West African Airways Corporation. Indeed, the Managing Committee of WACRI had to call a special meeting in 1959 "in connection with the Ghana Government's decision *not* to take over the Institute's main station at Tafo",[22] apparently against all expectations. The surprising thing therefore was that WACRI could survive until 1st October, 1962 when it was formally dissolved as an inter-territorial body.

Following the dissolution of WACRI, the Ibadan Sub-station was reconstituted into the West African Cocoa Research Institute (Nigeria) under a Director, and the Nigerian members of the former WACRI Managing Committee were appointed members of the Management Committee of the reconstituted body. However, this was clearly a stop-gap measure. In December 1964, the Cocoa Research Institute of Nigeria (CRIN) was established by the Research Institutes Act (which also established the Nigerian Institute for

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22 West African Cocoa Research Institute. Annual report 1958-59, London, Crown Agents for the colonies, 1959 p.9 (our italics).

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Oil Palm Research and the Nigerian Institute for Trypanosomiasis Research (both of them also successors to the former West African inter-territorial research institutes as well). Under the Act the responsibility of the new Institute was expanded to cover coffee and kola as well as cocoa.

3.5-1 Policy and organisation: The policy in respect of cocoa research as well as the organisation of CRIN remained essentially the same as those of its predecessor. Like WACRI, it was an autonomous body with similar organisation and arrangements: a Governing Council (as the Managing Committee was now called); specialist research divisions (Plant Breeding, Agronomy, Plant Pathology, and Soils and Chemistry) each under a head of division who is responsible to the Director for the day-to-day running of the division; a Deputy Director to assist the Director in the management of the Institute, and to act in the Director's absence; etc.

Following the creation of the Agricultural Research Council of Nigeria (ARCN) and subsequent promulgation of the Research Institutes (Establishment) Order of 1975, CRIN along with all other research establishments in the agricultural sector was reconstituted under the aegis of the ARCN. Under the new arrangement, the Institute still

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had a Governing Board, except that it had somewhat less powers than its predecessor. However, the ARCN had not really settled down to its functions before it was superceded by another umbrella body, the NSTDA, in 1977. The new body has responsibility for research not only in agriculture, but also in medicine and industry. Under the NSTDA, the Institutes emerged with a greater degree of autonomy than was the case under the ARCN (see Appendix V). However the new organisational relationship between the NSTDA and the Research Institute is still in the process of evolving.

3.5-2 Funding: The funding of CRIN from the outset took the form of annual grants contributed by the then Regional Governments in proportion to the importance of coca in their respective economies, with the highest contribution naturally coming from the Western Region Government. But from 1972 the Federal Government took over the entire financing of the Institute.

If WACRI had a generous financial base, CRIN's position in this respect was even more so. Right from its inception the annual grant in any year has never been less than ₦1 million. Apart from annual grants, it also obtains income from other sources such as interest from Crown Agents Deposit Account (part of the assets inherited from WACRI) and interest from local bank accounts as well as

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from sundry sales (cocoa, firewood, auction, etc.). The result has been that the Institute was able to record continuously a surplus of income over expenditure for several years; so that by 1974 the accummulated surplus amounted to about ₦3.7 million (see table 3.11). It must be mentioned that these annual grants are meant for recurrent expenditure and exclude capital expenditure for which additional provisions are made. For instance, about ₦4.2 million was voted for the Institute's capital development programme under the second National Development Plan 1970-74.

It can therefore be concluded that cocoa research since 1944 has enjoyed enormous financial support, first under the West African Cocoa Research Institute and later under the Cocoa Research Institute of Nigeria.

3.5-3 Staffing: The establishment of CRIN came at a period of massive drive for the "Nigerianisation" of senior positions in all sectors of the public service. Given the specialized nature of research, in terms of the calibre of its manpower requirements, it was clear that an institution like CRIN could not afford to pursue a Nigerianisation policy indiscriminately. It was no doubt in realization of this that it embarked right from its inception on a programme of in-service-training for newly recruited graduate staff. Thus, out of a total scientific staff

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TABLE 3.11

Income and accumulated surplus funds of CRIN 1965-1975

Year (April-March)	Naira			
	Annual Grant	Other Receipts	Total Income	Accummulated Fund from annual surpluses of income over expenditure
1965/66	1,005,786	37,733	1,043,519	975,239
1966/67	1,116,806	77,925	1,194,731	1,488,273
1967/68	1,000,000	75,736	1,075,736	2,003,604
1968/69	1,020,000	78,950	1,098,950	2,012,822
1969/70	1,085,460	86,342	1,171,802	2,502,420
1970/71	1,000,000	129,522	1,129,522	2,593,679
1971/72	1,009,841	201,657	1,211,498	3,206,439
1972/73	1,333,000	217,961	1,550,961	3,413,013
1973/74	1,300,000	173,710	1,473,710	3,695,679
1974/75	1,115,020	217,961	1,332,981	4,131,716

Source: CRIN records

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of 33 in 1964/65, eighteen were on in-service-training at the post-graduate level. Furthermore the scholarship award scheme initiated by WACRI was intensified, particularly for undergraduate courses in scientific disciplines. For example in 1964/65 ten undergraduates in various Nigerian universities were being sponsored by the Institute.

This scheme has proved successful in stabilizing the staffing position. By 1972/73, scientific staff with postgraduate degrees numbered 22 (compared with only 6 in 1965), while another 9 were still on in-service-training. Moreover the in-service-training scheme has enabled the Institute to direct training emphasis to critical areas of staff shortage. All in all, CRIN not only has been able to maintain the level of staff strength inherited from its predecessor, WACRI, but through a vigorous inservice training programme as well as scholarship awards, it has succeeded in establishing a stable hierachy of research personnel, thus ensuring a continuity in the execution of its research programmes.

3.6. Impact of cocoa research on production

Nigeria's production of cocoa rose phenomenally in the first four decades of the century, reaching its peak both absolutely and in proportion to world production in

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the period ending 1942/43, after which it began to decline.[23] This decline was attributed to a whole range of factors including the "increasing incidence of sahlbergella."[24] Dr. Tempany, the Agricultural Adviser to the Colonial Office, confirmed "disturbing reports concerning the spread of cocoa pests and diseases in West Africa" after touring cocoa areas both in the Gold Coast and Nigeria.[25] The outcome of this visit led in 1944 to the establishment of WACRI which was later succeeded by CRIN. What has been the impact of cocoa research on production?

World production of cocoa was beginning to recover in the immediate post-war years. Between 1946/47 and 1958/59 world production rose from 713,000 metric tons to 831,000 metric tons, an increase of about 17 per cent. It rose 30 per cent to 1,166,500 metric tons by 1960/61, attaining 1,525,000 metric tons by 1964/65. Production between 1958/59 and 1964/65 thus virtually doubled.

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23 Galletti, R., K. D. S. Baldwin and I. O. Dina, op.cit. p.2.

24 Nigeria. Annual report on the Department of Agriculture 1943-44. Lagos, Government Printer, 1945, p.26

25 West African Cocoa Research Institute. Annual report 1944-45. London, Crown Agents for the colonies, 1945. p.5.

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Practically the whole of these increases have come from West Africa.[26] This remarkable upsurge in West African production has been attributed to the coming into bearing of young trees an increasing proportion of which were of Amazon and selected high-yielding Amelonado varieties and the effects of spraying against pests and diseases. These factors to which the phenomenal increase in West African production has been attributed are of course the outcome of research, specifically research in disease and pests control and development of improved varieties.

3.6.1 Disease and pest control: As was mentioned earlier the immediate stimulus to the creation of WACRI was the need for "a concerted drive by scientists to investigate [cocoa] pests and diseases and to devise control measures against them."[27] And as we have also seen earlier in this chapter, the original plan was in fact an emergency measure solely to combat pests and diseases rather than the establishment of a permanent research institute dealing with general problems affecting the efficiency of West African cocoa production as it turned out to be. It is

26 F.A.O, Agricultural development in Nigeria 1965-1980, Rome, 1966. p.45

27 Ibid., p.5

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not surprising therefore that WACRI devoted considerable resources to research on pests and diseases.

An essential aspect of research into pests and diseases was the need to have information concerning the whereabouts of diseases and pests in the cocoa-growing areas. Not only was there no knowledge about this at the inception of WACRI but there was an astonishing ignorance regarding the position of the cocoa areas themselves, especially where new plantings had not yet come into bearing. A survey of cocoa farms was therefore undertaken in the Gold Coast and Nigeria, starting in 1944. The immediate objectives of these surveys were (a) to find where cocoa was being grown (b) to note the presence or absence of swollen-shoot disease, and (c) to observe the degree of damage caused by Capsids (Sahlbergella and Distantiella).

Of all WACRI research activities, swollen shoot virus disease has received the most prominence from the very outset. The Institute soon came out with the recommendation that controlling the spread of the disease could only be done by cutting out infected trees. The implimentation of this recommendation by the Gold Coast Government led to disturbances in that country leading to the setting up of a Commission of enquiry in 1948. The cutting-out policy was also initiated in Nigeria. In 1950 this policy

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was replaced by one of "sealing off" the Areas of Mass Infection (40,000 hectares around Ibadan and 10,000 hectares around Ilaro). However, frequent surveys outside the AMI are undertaken and diseased trees and contacts uprooted and destroyed, government paying forty kobo compensation per tree so destroyed. By this method the disease has been kept well under control. Given the enormous costs and unpopularity of the cutting-out recommendation, research was directed to finding cocoa strains that are resistant to swollen-shoot attack.

Another disease on which research has been done is the black pod. This is a fungus disease caused by Phytophthora palmivora. Research into chemical control of the disease was started in 1948. In 1956 the Western Region Government started a campaign of cocoa spraying against black pod through farmer training and subsidies for chemicals. This has resulted in widespread annual spraying against black pod as well as other diseases and pests.

Capsids constitute serious insect pests on cocoa. The two most important species affecting cocoa in West Africa are Sahlbergella singularis Hagl. and Distantiella theobroma, Dist. The former attacks the shoot and pods of mature cocoa, while the latter confines its activities

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mainly to young trees and sometimes pods. They affect cocoa yield through emitting a toxic substance thereby destroying the tissues around the point of penetration. Again the Western Nigeria Government following recommendations by WACRI launched a campaign of spraying against capsid in 1957. Table 3.12 shows the estimated annual acreages sprayed against pests and diseases between 1957 and 1977.

3.6.2 Development of Improved Varieties: The original cocoa variety introduced into Nigeria is the West African Amelonado. It has been estimated that about 90 per cent of cocoa hectarage in Nigeria today is Amelonado. The variety produces the first commercial yield of 114-170 kg per hectare 5-7 years after successful establishment. From about 15 years onwards a yield of 570 - 1140 kg per hectare may be expected under good management.

In 1944, cocoa pods of the Upper Amazon origin were introduced by WACRI from Trinidad and after a quarantine period in Accra the resultant plants were planted out at WACRI Tafo in 1945. In 1945/46 it had already been observed that the Upper Amazon progenies in WACRI showed outstanding vigour. In 1946/47 good pods were harvested from 67 trees comprising 14 types mainly of the Upper Amazon origin. By 1948 the precocity and generally superior

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TABLE 3.12

Consumption of spraying chemicals and estimated area sprayed in Western Nigeria, 1956 - 1977

Year April-March	Capsid Control		Blackpod Control		
	Consumption of capsidicides (litres)	Estimated hectares sprayed	Consumption of coppersulphate (metric tons)	Consumption of cuprous oxide (metric tons)	Estimated range of hectare sprayed
1956/57	-	-	127.5	535.5	36,800 - 73,600
1957/58	82,000	21,280	56.1	158.1	11,320 - 22,640
1958/59	246,000	63,840	230,5	147.9	15,060 - 30,120
1959/60	413,400	107,280	459.0	322.3	31,740 - 63,480
1960/61	399,380	103,680	466.1	362.1	34,420 - 68,840
1961/62	372,240	96,600	546.7	429.4	40,660 - 81,320
1962/63	590,730	153,300	723.2	443.7	46,000 - 92,000
1963/64	862,010	227,433	730.3	587.5	55,200 - 110,400
1964/65	1,253,840	339.606	1020.0	756.0	73,660 - 147,330

/continued

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TABLE 3.12 (cont'd)

Year April-March	Capsid Control		Blackpod Control		
	Consumption of capsidicides (litres)	Estimated hectares sprayed	Consumption of coppersulphate (metric tons)	Consumption of cuprous oxide (metric tons)	Estimated range of hectare sprayed
1965/66	523,660	136,236	1097.5	562.0	72,800 - 145,600
1966/67	912,330	237,355	1233.3	592.6	103,100 - 207,600
1967/68	633,270	164,753	2140.0	715.0	149,280 - 298,400
1968/69	36,580	146,330	282.2	846.5	20,120 - 31,840
1969/70	63,560	254,250	215.5	645.4	15,140 - 26,840
1970/71	101,980	407,730	240.4	721,2	16,800 - 26,020
1971/72	92,280	371,090	420.3	1260.7	30,310 - 41,850
1972/73	45,260	181,040	70.5	220.1	4,150 - 10,410
1973/74	84,880	339,520	280.3	840.5	20,130 - 31,390

/continued

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TABLE 3.12 (cont'd)

Year April-March	Capsid Control		Blackpod Control		
	Consumption of capsidicides (litres)	Estimated hectares sprayed	Consumption of coppersulphate (metric tons)	Consumption of cuprous oxide (metric tons)	Estimated range of hectare sprayed
1974/75	39,020	156,070	270.2	218.2	5,180 - 20,440
1975/76	46,450	185,810	210.9	632.7	15,180 - 24,100
1976/77	192,690	770,750	140.3	420.6	10,120 - 21,820

Sources: Western Nigeria Ministry of Agriculture and Natural Resources; Tree crop project; Western Nigeria Marketing Board, Statistical information on Western State of Nigeria controlled produce.

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performance of these progenies were acknowledged. Because of certain characters like vigour, precocity, heavy subsequent yielding and acceptable flavour it was decided to establish multiplication plots with open-pollinated seed (F_2 illegitimate) from the trees belonging to the approved selections (F_1). These multiplication plots or seed gardens were to raise seeds (F_3 illegitimate generation) for the farmers plantings. It is this cocoa type that is now popularly known as F_3-Amazon.

F_3-Amazon has been described as "one of the major achievements of WACRI."[28] It is relatively easy to establish, high-yielding and early-maturing, coming into bearing within 3-4 years of planting. It is better able to withstand adverse conditions because of its wide parental background. Although it is susceptible to mirids (<u>Calonectria rigiduscula</u>) and swollen shoot virus, it will withstand and recover from attacks much better than Amelonado. F_3-Amazon will yield up to 220 kg per hectare in the third year and could go up to 1700 kg at full maturity.

Starting from 1954 the Western Nigerian Ministry of

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28 Toxopeus, F., Amazon cocoa in Nigeria. Annual report of the West African Cocoa Research (Nigeria) 1963-64, Ibadan. p.13

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Agriculture and Natural Resources established cocoa nurseries throughout the region for the sale of seedlings of the new variety to farmers. Table 3.13 shows the annual distribution of F_3 Amazon cocoa seedlings from these nurseries and the estimated areas planted and successfully established between 1954 and 1976. The spectacular upsurge in cocoa production observed in the sixties is the result of trees of this new variety coming into bearing.

However, the F_3 Amazon is not the only new variety that has been developed. In 1963 CRIN (still WACRI (Nigeria) at that time) embarked on what was called "The Second Nigerian Breeding Programme." The ultimate objective of this programme was that of producing a variety of cocoa types of "a good general yielding potential well adapted to the specific difficulties of the various areas." In particular, work was to be concentrated on the production of types that could establish under marginal conditions, tolerant to cocoa swollen shoot virus with low virus content in the plant when infected, and black pod resistance. From this programme 15 promising progenies were selected and christened "CRIN Establishment-Ability Elite Progenies". As well as having an improved establishment ability over the F_3 Amazon, these progenies also have higher yields. Polyclonal seed gardens were established in various

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states to produce these hybrids for farmers planting. They have since achieved widespread distribution throughout the country and are already making an impact on production.

3.7 New directions in Cocoa Research

As we have seen, cocoa research in West Africa has concentrated over the last three decades on production problems, especially the control of cocoa diseases and pests and the development of new varieties with higher yielding potential, improved establishment ability, etc. This exclusive concern with production problems derives partly from the fact that until recently the only market outlet forcocoa was through export. Thus to maximise the contribution of cocoa to the GNP (and especially as an important earner of foreign exchange) meant the planting of varieties with high yields, the control of devastating pests and diseases, and the use of improved cultural practices.

While the problems of production remain the focus of cocoa research, increasing possibilities for local processing of cocoa and its products have led CRIN to broaden the scope of its research into what is commonly referred to as "processing and utilization". Basically, the objective of this line of research is to investigate

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alternative uses for cocoa besides the current conventional uses for chocolate and other confectioneries. Already some progress has been made in this direction. The best known outcome of research along this line is "cocoa wine". Other promising areas are the use of cocoa pod husks as a component in livestock feeding stuff, processing of cocoa juice into jam and jellies, and possible uses for butter from fungus-infected cocoa pods. Given the increasing pace of industralization in the country and the instability of world commodity markets, research in processing and utilization seems likely to loom larger and larger among the activities of CRIN in the coming years.

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CHAPTER IV

REVIEW OF LITERATURE AND METHODOLOGY

4.1. Research as a public good: some theoretical considerations

One distinguishing characteristic of a purely private good is that it can be subdivided so that each part can be competitively sold separately to a different individual, with no external effects on other individuals. By contrast a public good (also known as social or collective good) confer benefits which involve external consumption effects on more than one individual. Once such a good is produced, it becomes available to everybody, although the benefits derived from a unit of output may vary from one consumer to another. The consumption of one unit of such a good can in no way diminish the consumption by another individual of the same unit. Examples of a public good include national security, fire brigade services, roads and research knowledge.

Given the externality effects of the benefits acruing from the consumption of a public good, for example, research

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information, the price mechanism cannot operate, since in a free market, potential consumers would not reveal their true preferences, knowing that once one unit of the good is produced the benefits of that unit would be available to everyone. Hence the private sector would not undertake the production of such goods, since it cannot appropriate much of the benefits acruing from their production. Rather the state not uncommonly finds itself as a producer in this area, supply being determined through the political process (e.g. the ballot box) in place of the market naira-vote.

A further justification for state intervention in the production of research knowledge as well as other public goods can be made on grounds of pricing effeciency. As we noted above, the consumption of one unit by one individual does not diminish the consumption by another individual of that same unit. This means that the marginal cost of the last consumer taking advantage of existing research findings, for instance, is zero. Therefore to charge a positive price will not conduce to socially optimal resource allocation. The loss in total welfare involved in charging a positive price in this situation is highlighted in Figure 4.1.

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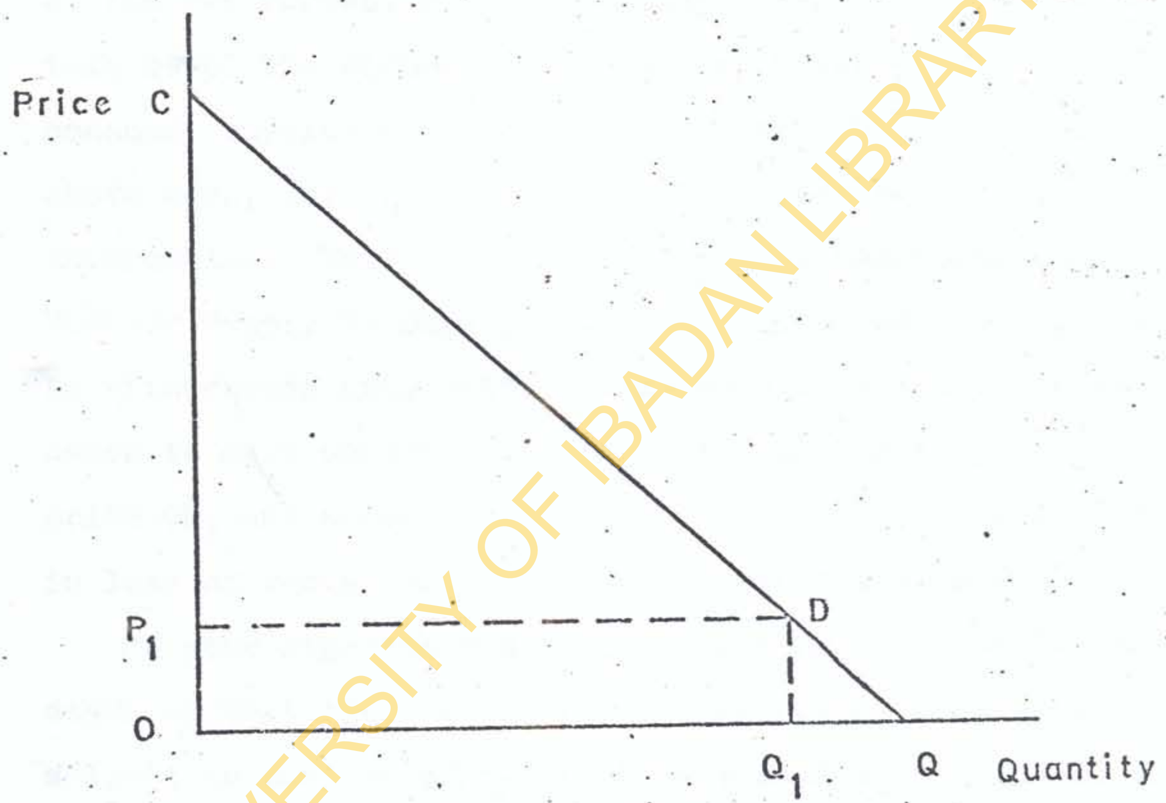

Fig. 4.1 Welfare effect of charging positive price for use of research information

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CQ is the aggregate demand curve for research information. The supply curve is co-linear with the horizontal axis OQ (i.e. marginal cost is constant at zero). Equilibrum is established at Q, the point of intersection of the two curves, with a quantity OQ and price zero. At this level the highest total welfare measured by the consumer surplus COQ, is obtained. Now suppose a price above zero, say OP_1, is imposed on the use of research information. This will limit effective demand to CQ_1.[1] However supply OQ once produced cannot be contracted, say by withdrawing some units, since output is indivisible. Hence to deny consumers who are not willing to pay the price OP_1 any access to research information will result in loss of social welfare amounting to the area DQ_1Q.

A more rigorous analysis of this problem can be made assuming that there are costs to the producer in imposing a limit to the use of research information and that he will want to maximise returns to these costs, i.e. to equate marginal cost with marginal revenue (price). The costs are those incurred in the efforts to prevent research informa-

1 Although OQ_1 can be regarded conceptually as the quantity of research information units which will be available at price OP_1, strictly speaking it is a proxy for the number of consumers willing to pay the price OP_1 for use of the entire stock of research information OQ since the latter cannot be withdrawn in part.

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tion from "leaking" to anybody unwilling to pay up to the price OP_1. Thus the marginal cost - and hence the supply - curve[2] will be OS as in Figure 4.2. The point of intersection of the supply and demand curves, D, represents the market equilibrum for the producer. The loss in welfare to society resulting from restriction of use to payment of price OP_1 remains DQ_1Q. However a further point of interest here is that since production is being run on the public account, society incurs a needless additional cost equal to the area ODQ_1 in making any effort at all to restrict the use of research information already produced to only those who are prepared to pay a price OP_1. The total costs to society of the allocative inefficiency involved is thus given by the area ODQ.

But, clearly, a zero price implies one hundred per cent subsidy. Where is the subsidy to come from? The obvious answer is, of course, from taxes. However it has been argued that taxation as a source of financing public goods is not equitable on the grounds that it would amount

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2 The curve is one of increasing marginal cost because as more and more consumers pay for the use of research information it would require increasing marginal effort to ensure that the information is not "disseminated" or resold to prospective consumers by the original purchasers, given the non-exclusive nature of its consumption.

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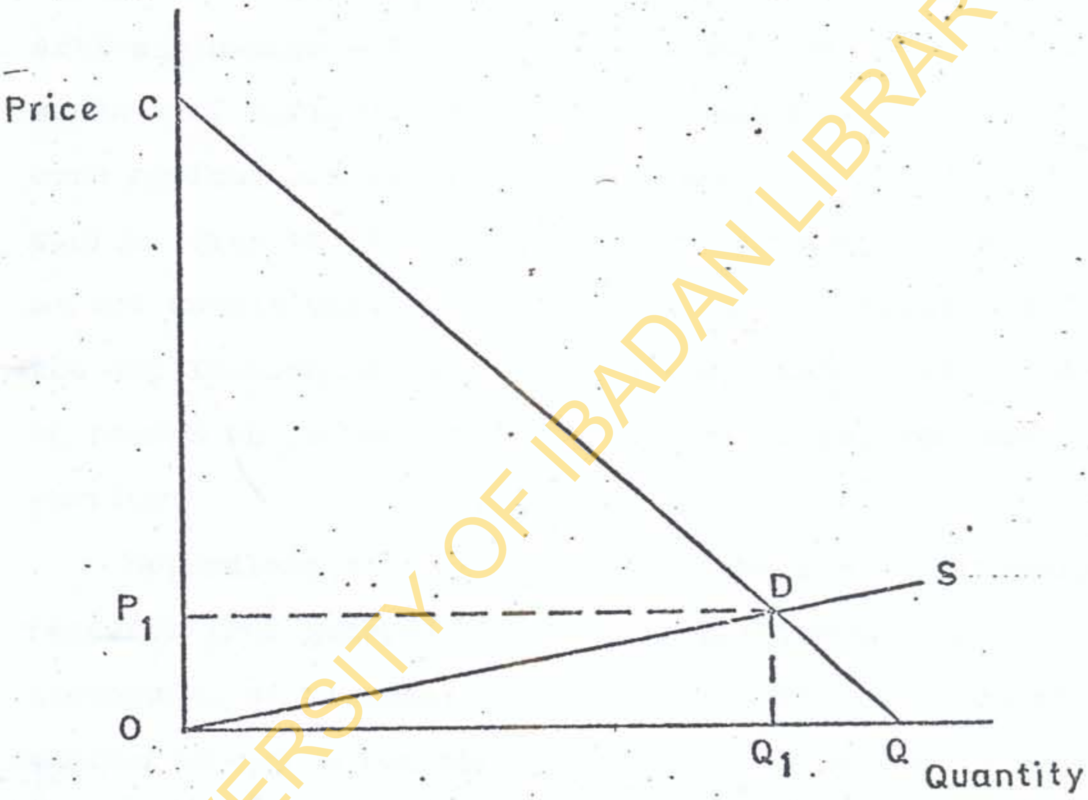

Fig. 4.2 Costs of efforts to restrict use of available research information

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to tax payers who are not consumers of the goods in question subsidising those who are.[3,4] Agricultural research as a public good probably occupies a unique position as an exception to this argument. This is because every individual in society is of biological necessity an active consumer - in a literal as well as in an economic sense - of agricultural products, especially food. Furthermore agriculture as an industry, more than any other, approximates to the concept of perfect competition in its market conditions. Thus increased output resulting from the application of research knowledge can be expected to be passed on to consumers in form of larger consumer surplus.

Regardless of the merits and demerits of financing research from general taxes, more pertinent from the standpoint of economic development is the question of whether research can and does stand the test of social profitability as measured by accepted investment criteria.

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3 See, for example, Introducing economics. By McCormick <u>et al</u>. Penguin Education, 1974. pp 383-384.

4 In this context the financing of cocoa research in Nigeria can be said to be equitable, since the bulk of it has come from the "surpluses" generated by the cocoa industry itself through the Marketing Board System.

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Such indication remains the only justification for continuing state intervention in research, notwithstanding acknowledged peculiarities that render the field economically unattractive to private initiative. Ultimately, then, society will have to reckon the opportunity cost of supporting research as with any other investment ventures.

4.2. Estimates of agricultural research productivity

The importance of the advance in knowledge in increasing production has long been recognised in economic literature. For instance, Alfred Marshal not only rated knowledge very high but considered it as the most powerful engine of production.[5] Frank Knight treated "all increase in useful knowledge regardless of what it is about as a produced means of production"[6]. However only in the last two decades have attempts been made to estimate empirically the contribution of "advance in knowledge" to economic growth. Two main methods have been used in this estimation in the agricultural sector. These are the aggregate production function approach and the investment evaluation

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5 Marshal, Alfred, Principles of economics. 8th edition London. MacMillan, 1930.

6 Knight, Frank H., Diminishing returns from investment. Journal of Political Economy, 52: March 1944, 26-47.

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approach.

4.2-1 <u>Aggregate production function approach</u>: The pioneer in this field is Robert Solow. Using an aggregate production function, he related increasing output to the raw inputs of the quantities of land, labour, capital and other conventional inputs in the United States between 1909 and 1949.[7] The study attributed to technological change varying amount of output left unexplained by conventional factors of production like labour and capital. This residual (unexplained element) was reflected in the production function shifting upwards at a rate of about one per cent per year for the first half of the period and two percent per year for the last half. In spite of its wide acclaim, this study has been criticized for not coming to grips with the real essence of technological change. This would have been achieved by including not only the old factors but also the new factors embodying new techniques of production.

In a later paper, Solow[8] attempted to correct this by treating the formation of new capital goods as a "carrier"

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7 Solow, Robert M., Technical change and the aggregate production function. <u>Review of Economics and Statistics</u>, 39: August 1957, 312-19.

8 Solow, Robert M., Technical progress, capital formation and economic growth, <u>American Economic Review</u>, 52, May 1962, 76-86.

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of new technical knowledge, thus taking into account the production effects of some of the new factors of production. Salter[9] also employed similar treatment by relating technical knowledge to techniques of production and introducing these techniques into the production function as integral parts of the observable factors of production.

The studies discussed so far were concerned mainly with assessing "technological change" rather than estimating research productivity per se. Nevertheless such work could be regarded as indirect measures of research productivity since technological change is the embodiment into new capital, production techniques and new skills, of knowledge emanating from research. Moreover as we move from fundamental research to applied research the dichotomy between technological change and research findings will tend to disappear. Thus in agricultural research, for instance, the end-products of research like higher-yielding seed varieties, improved cultural practices, etc. represent in themselves new technology which can be adopted directly in production.

9 Salter, W.E.G., Productivity and technical change. Monograph 6 of the Department of Applied Economics, University of Cambridge, Cambridge University Press 1960.

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In recent years attempts have been made to estimate research productivity by itself using the same approach. Peterson has estimated the production function for poultry in the United States, including state experimental station research expenditures as a separate variable[10]. Employing a Cobb-Douglas type of production function he used cross-sectional data on commercial poultry farms for 1959, with the value of each observation being an "average per farm" in each state for all variables, except research where the value of observation is total poultry research in the corresponding state experimental station. The form of the function with the variables is

$$Y = AX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}E \ldots \quad (1)$$

where

Y is the value of poultry products sold

A is a constant term

X_1 is the interest on land and buildings

X_2 is the expenditure for hired labour

X_3 is feed purchased

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10 Peterson, Willis L., Return to poultry research in the United States, Journal of Farm Economics, 49 (3), 1967, 656-669.

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X_4 is chick (or poults) purchased

X_5 is expenditure for poultry research at the state experimental station (average of 1954 and 1956),

and

E is the error term.

In this study the research coefficient was found to be significant at the 0.001 level. Converting the marginal product of the expenditure on research at the state level he obtained a return to capital of 600 per cent after adjustments for expenditures on private research and the USDA and extension expenditures. One assumption of the study is that poultry output is related to the size of research expenditure. This can only be expected to be so over an appropriately long period, taking account of its gestation period. But by using the average of two years expenditure, the study implies that it is current research that affects current production, while in fact research done several years back can be expected to enhance the output of more recent one. The study thus over-estimates the productivity of poultry research.

One interesting use of the production function approach in the estimation of the productivity of the

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research system is a recent study by Evenson and Kislev.[11] It is interesting because it attempted a global coverage in its estimate of agricultural research productivity as well as for its somewhat unorthodox methodology as compared with other studies using the production function approach. The procedure adopted here is to regard the relationship between research and productivity as of "a two-staged nature". First, scientific inputs produce a set of outputs (i.e. knowledge in various areas). In the second stage, this knowledge is incorporated in the agricultural production process and affects agricultural productivity. For the first stage, a general "knowledge production function" was specified as follows, knowledge being measured by the number of publications in agricultural sciences:

$$P_j = f(S_j, E_j, P_{14j}, G_j, N_j) \quad . \; . \; . \; (2)$$

where

$P_j = \sum_{i=1}^{13} P_{ij}$ is total number of publications in agricultural sciences in country j.

11 Evenson, Robert E. and Yoav Kislev, Agricultural research productivity, Yale University Press, 1975.

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and

P_{ij} is publications in sector i in country j for 14 sectors

P_{14j} is publications in plant physiology

S_j is scientific man-years in agricultural research

E_j is expenditure on agricultural research

G_j is GNP per capita

N_j is number of newspapers per 10,000 people

The variable P_{14j} (publications in the field of plant physiology) is meant to measure related "supporting" scientific knowledge in each country, while per capita GNP and number of newspapers per 10,000 people are alternative measures of the level of socio-economic development.

The second stage in the aggregate analysis of research productivity in agriculture is undertaken using the production function with the algebraic form:

$$y_{it} = f(X)e^{d_j + y_{jt}} \quad \ldots \quad (3)$$

y_{it} is total agricultural product in country j in year t(j = ... 36) (t = 1 for 1955, 5 for 1960, 10 for 1965, 13 for 1968)

X is a vector of inputs:

x_1 land

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x_2 labour

x_3 livestock

x_4 fertilizers

x_5 machinery

x_6 technical education

x_7 research knowledge

dj country-specific level coeffecient

yj country-specific time trend

$f($ $)$ Cobb-Douglas function

Estimating the production function using cross-section data from thirty-six countries, the authors reported that the research variable, measured by publications, performed better in regression than the proxies - fertilizers, technical education and schooling which have been suggested by Hayami and Ruttan.[12]

Without going into further details about their findings there are a number of points that arise regarding their

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12 Hayami, Y. and V. W. Ruttan. Agricultural development: An international perspective. Baltimore and London, Johns Hopkins Press, 1971.

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methodology. First it is not clear what useful purpose a "two-staged" estimation procedure serves since the estimation of research productivity can be made directly without first assessing an "intermediate product". Secondly, the emphasis on "publications" as a measure of research productivity is open to question in any attempt to estimate the productivity of applied research, the value of whose findings lies more in their application to production than in publications. On the whole their procedure would seem more suitable for estimating the productivity of fundamental research.

Beyond the shortcomings of individual studies discussed within the production function approach, how "reliable" is the general approach itself as a method of estimating research productivity? First, the form of the production function involves some subjective judgement. It is therefore impossible to show conclusively that one particular function is the correct one. To that extent estimated values may be far from the true ones. Secondly, in theory, the production function assumes an instantaneous relationship between inputs and output, whereas in practice the relationship is measured over time. In particular, there is a considerable time lag between inputs and output in research. Thirdly, the approach assumes a smooth mathematical

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function while research as an investment process is discontinuous. Moreover, the output resulting from its investment is by its nature also discontinuous. Hence the introduction of research into a production function raises considerable problems as does the inclusion of any other capital inputs.[13] In this connection, the use of investment evaluation techniques offers a more satisfactory approach to the estimation of research productivity.

4.2-2 Investment evaluation approach: Griliches' pioneering work on the economics of research using investment evaluation techniques to estimate returns to hybrid corn in the United States[14] is generally acknowledged as a classic.[15,16] In view of its contribution to the development of methodology

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13 For a discussion of some of these problems see Yotopoulos, P.A., From stock to flow capital inputs for agricultural production function: A microanalytic approach. Journal of Farm Economics 49(2): 1967. p.476.

14 Griliches, Zvi, Research costs and social returns: Hybrid corn and related innovations, Journal of Political Economy 66, October 1958.

15 Schultz, T.W., Transforming traditional agriculture, Yale University Press, 1964, p. 135.

16 Abaelu, J.N., The Nigerian oil palm sector revisited. Nigerian Journal of Economics and Social Studies 13 (3); 1971. p. 293

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in this field, it may be pertinent here to attempt a brief review of the study itself, with particular reference to its theoretical framework.

Treating research as a production process, Griliches estimated the inputs in form of research expenditures from 1910 to 1955; and output by assuming that gross returns are approximately equal to increase in corn production plus a price-changing adjustment. He then deducted the additional cost of producing hybrid seed from these gross returns to arrive at a flow of net social returns. By using appropriate rates of interest all costs and returns were brought forward to 1955 and a rate of return computed. While the estimation of costs appear fairly straighforward, measuring gross returns is more complex. Griliches went about this measurement by equating the social value of the increase resulting from the adoption of hybrid corn to the loss in total corn production that would have resulted if there were no hybrid corn. This loss is measured as in Figure 4.3.

Using Griliches notations, D is the unchanging demand curve while S is the supply curve with the adoption of hybrid corn. At this supply level the equilibrum price is P_1; Now suppose hybrid corn were to "disappear". The supply curve S would shift upwards to S' with output reduced from

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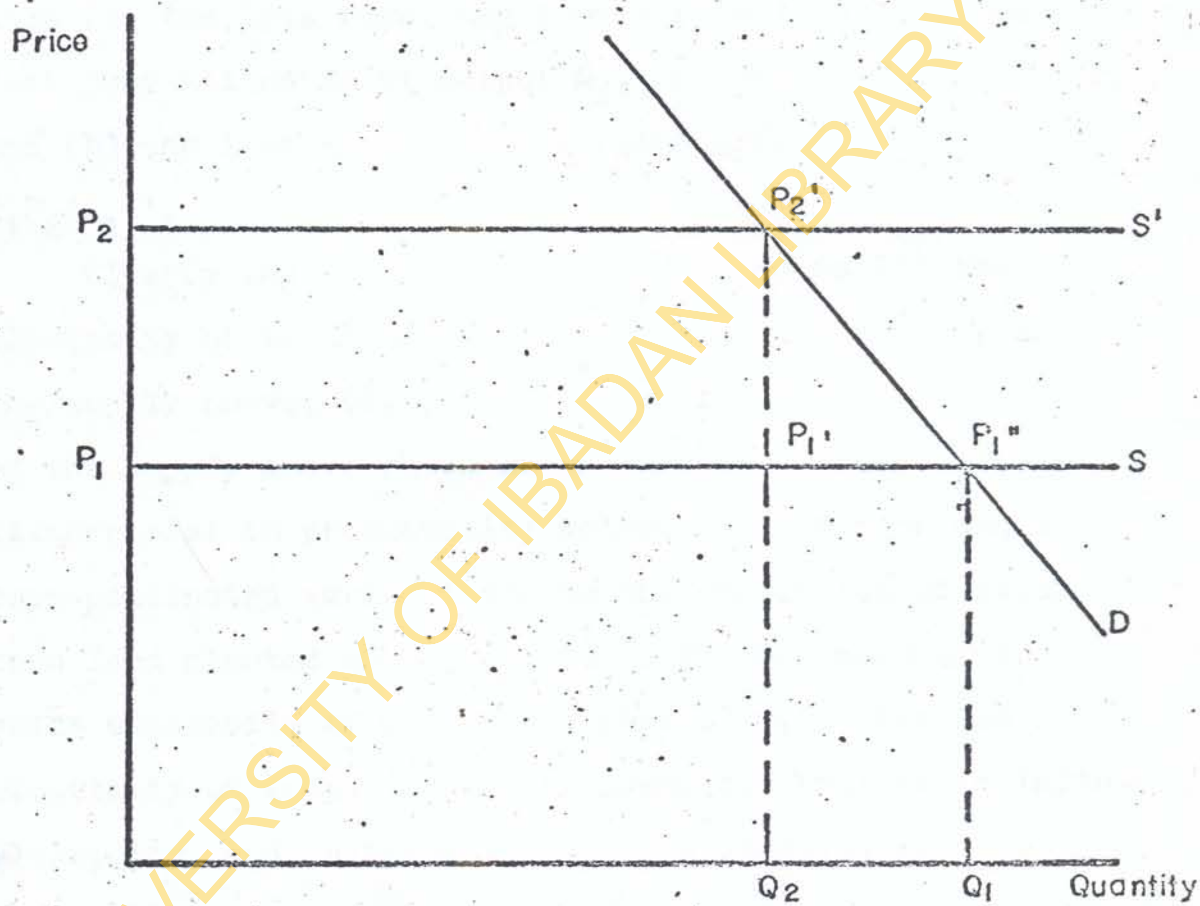

Fig. 4.3: Measurement of loss in total corn without hybrid corn, assuming an infinitely elastic curve.

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Q_1 to Q_2 and equilibrum price moving from P_1 to P_2. The "disappearance" of hybrid corn would thus result in a loss to society of the total area under the demand curve represented by $P_1P_2P_2'P_1''$. This area can be separated into (a) the loss resulting from a rise in production cost over all units of output Q_2, represented by $P_1P_2P_2'P_1'$, and (b) the loss in consumer surplus given by triangle $P_1P_2'P_1''$.

Clearly the area $P_1P_2P_2'P_1''$ depends on (i) the elasticity of the demand curve, (ii) the elasticity of the supply curve, (iii) the degree of the upward shift of the supply curve which is in turn determined by the differential in productivity between hybrid corn and the open-pollinated variety, and on the proportion of total corn land planted under hybrid. Griliches assumed a price elasticity of demand for corn of 0.5. For the elasticity of supply Griliches assumed, first an infinite elasticity, and, alternatively, zero elasticity. The first alternative is shown in Figure 4.3. A linear approximation of the area $P_1P_2P_2'P_1''$ is given by

$$\text{Loss 1} = kP_1Q_1 \left(1 - \tfrac{1}{2} kn\right). \;.\; . \quad (4)$$

where

k is the percentage change in yield

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P_1 is previous equilibrum price of corn

Q_1 is previous quantity of corn produced

n is the absolute value of the price elasticity of demand for corn.

Calculating the loss under the alternative assumption, i.e. with elasticity of supply being zero, he assumed that the supply curve shifts k per cent to the left from S to S' (Figure 4.4). The rectangle $Q_2'P_1''Q_1$ measures the loss in corn production at the old price P_1, while the triangle $P_1P_2'P_1''$ is the additional loss in consumer surplus. The total loss is therefore given by

$$\text{Loss 2} = kP_1Q_1\left\{\left(1 + \left(\tfrac{1}{2}\right)\cdot\frac{k}{n}\right)\right\} \quad \ldots(5)^{17}$$

Clearly Loss 2 results in a higher estimate than Loss 1.

17 This formula represents the corrected version as pointed out by T.D. Wallace and accepted by Griliches himself. Wallace also argued that the area $P_1P_2P_2'P_1''$ would be a more relevant measure than the area $Q_2P_2'P_1''Q$ which was actually used. However Griliches insisted that his definition was more sensible than the suggested alternative arguing that with the suggested definition an infinitely elastic demand function would mean no social gain from hybrid corn which was clearly wrong: whereas his own definition would still value the increase in output at the constant price. See Carl K. Eicher and Lawrence W. Witt (Ed), Agriculture in economic development, McGraw Hill, 1964, pp.305-306.

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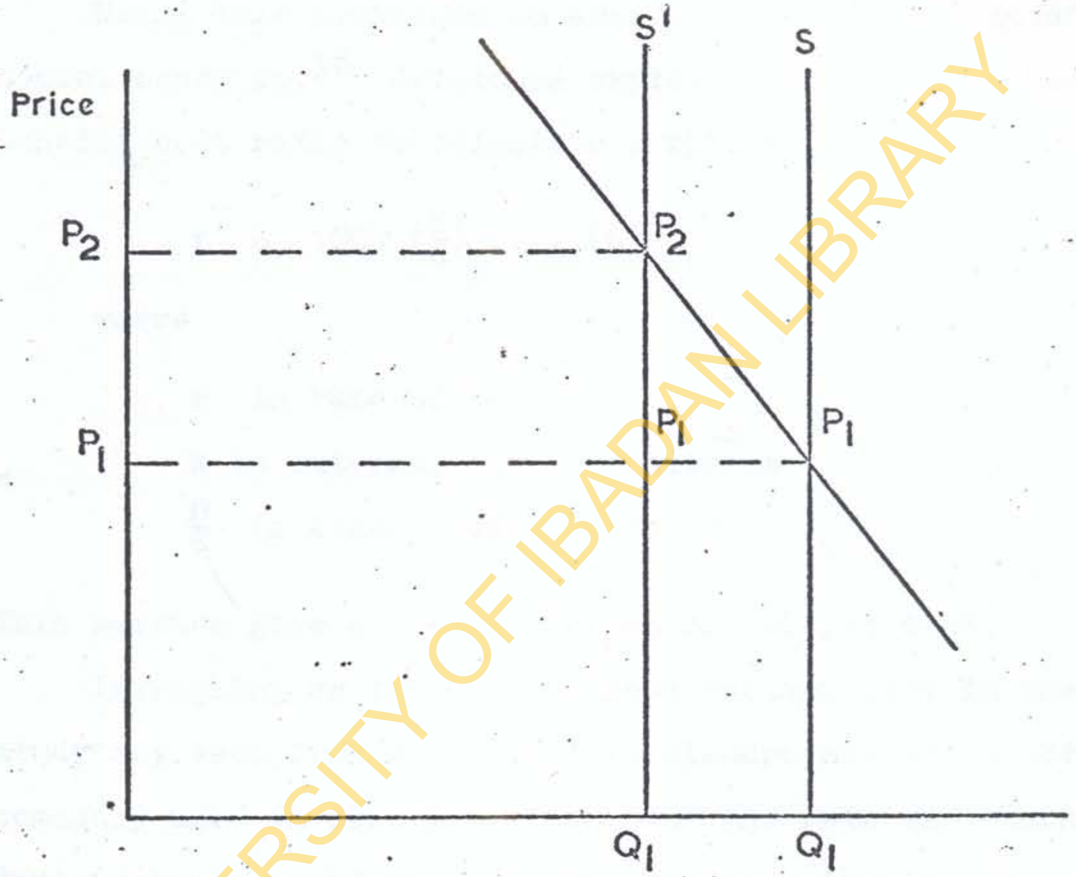

Fig. 4.4: Measurement of loss in total corn without hybrid assuming zero supply elasticity.

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The two estimates, in fact, bracket estimates to be obtained by assuming any intermediate elasticities of supply between zero and infinity.

Using this technique to arrive at an estimation of social benefits,[18] Griliches employed a variant of the benefit-cost ratio to calculate a rate of return thus:

$$r = 100k\left(\frac{B}{C}\right) \quad .... \ (6)$$

where

r is rate of return

k is external rate of interest

$\frac{B}{C}$ is benefit-cost ratio

This measure gave a rate of return of 700 per cent.

Intriguing as the benefit-cost variant used in the study may seem from a theoretical standpoint, it is not commonly used in practice. Moreover the rate of return derived by it might well be confused with the internal rate of return which is a more universally accepted measure of return. Also, by using the internal rate of return, the result can be more easily compared with those of other investment projects. Griliches, in addition, calculated

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18 The formula for Loss 1 was used for Griliches' estimate.

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the internal rate of return, obtaining an estimate of 35 to 40 per cent.[19]

Following Griliches, several other studies on returns to agricultural research or aspects of it were conducted. Notable among these are those of Peterson and of Ardito-Barletta. Using the "Index-number" technique, a modification of the Griliches model, Peterson estimated the internal rate of return to investment in poultry research in the United States.[20] The index-number approach utilizes the productivity indexes to measure downward shifts in the long-run poultry supply function in order to estimate the annual value of "resources saved" as a result of increased efficiency in the production of poultry products. This "saving" in resources was measured by

$$KQ_1P_1 + \tfrac{1}{2}K^2P_1Q_1/n - \tfrac{1}{2}Q_oK^2P_1\left(\frac{P_1}{P_o}\right)\left(\frac{en}{n+e}\right)\left(\frac{n-1}{n}\right)^2 \quad ..(7)$$

---

19 Griliches tried to show that there is actually no difference between the two rates of return he calculated if allowances are made for a lag of approximately 10 years between the date of investment and the date at which the perpetual flow of returns begins.

20 Peterson, Willis L., op.cit.

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where

K is percentage decrease in supply function of poultry products that would occur should new inputs used by poultry farmers suddenly disappear.

Q_1 is quantity of poultry products with the use of new poultry inputs

P_1 is equilibrum price with the use of new poultry inputs

Q_o is quantity of poultry products without new inputs

P_o is equilibrum price without new poultry inputs

e is the elasticity of supply

n is the elasticity of demand.

Relating the flow of annual net social returns to the flow of annual poultry research expendituresh he obtained an internal rate of return of 14 to 21 per cent.

Ardito-Barletta used a slight variation of this formula to derive a rate of return to agricultural research in Mexico.[21] He measured social benefit as being equal to:

$$P_1 Q_1 Kp \left\{ 1 + \frac{K}{2n} \left[1 - \left(\frac{1-n}{n+e} \right)^{2e} \right] \right\} \quad \ldots \ldots (8)$$

21 Ardito-Barletta, N., Costs and returns of agricultural research in Mexico, unpublished PH.D dissertation, University of Chicago. 1970.

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where

P_1 is current deflated price

Q_1 is quantity produced the equivalent period of time

K is percentage yield increase due to improved crop variety

p is percentage area of land planted under improved variety

n is price elasticity of demand

e is price elasticity of supply.

In summary virtually all past estimates have ranked agricultural research very high in terms of internal rate of return (see Table 1.3). The returns are in all cases higher than those realised in other public investments. However these studies relate mainly to the economically more developed countries. Indeed it has been argued that underdeveloped countries, in general, do not appear to have clearly recognised the importance of scientific research in their programme of economic development. For instance, Abaelu, using expenditure on research per farmer as an index of the scale of national commitment to agricultural research, has found that, in Nigeria, this was only 16 kobo in 1969/70, rising to about 35 kobo in 1971/72. This

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compares with an annual expenditure per farmer of about ₦56 in the United States.[22] The low level of investment in research in less-developed countries would in turn affect the number and quality of research personnel as well as laboratory equipment and other infrastructure. Moreover, in the predominantly illiterate environment typical of most developing countries, dissemination of available research information constitute a further handicap to the productivity of research. Given this situation, what has been the performance of agricultural research in developing African countries and especially Nigeria?

Economic literature offers little or no guide on this aspect. About the only available references in this respect are the studies of Fogg[23] and Purvis[24] respectively, both of which employ theoretically unsatisfactory methods in

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22 Abaelu, J.N., Building the foundations for agricultural growth: Public expenditures on agricultural research, <u>Bulletin of Rural Economics and Sociology</u>, 8(1): 1973

23 Fogg, C.D., Economic and social factors affecting the development of small-holder agriculture in Eastern Nigeria. <u>Economic Development and Social Change</u>, 13 (3): 1965.

24 Purvis, M.J., Report on a survey of the oil palm rehabilitation scheme. CSNRD report No. 10, Michigan State University, 1968.

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their estimates. Calculating the contribution of hybrid palms to the Nigerian economy Fogg obtained an output-input ratio of 7:1. This is an over-estimate: arising from a failure to make certain necessary adjustments in the calculation. First, allowance was not made for the output of improved trees in existence prior to replanting with hybrids. Secondly, public expenditures towards the breeding and agronomic research on hybrid palms were regarded as "sunk costs". Thirdly, no account was taken of the proportion of total oil palm land that had been replanted with hybrids. Purvis study suffers from much the same defects. In effect there are no acceptable estimates of return to agricultural research that could be considered useful as a guide to planning and investment allocation in Nigeria.

4.3. Methodology adopted

The main objective of this study, as stated earlier, is to estimate the realized returns to investment in cocoa research in Nigeria. In doing this, two approaches are used. These are (1) the index-number approach and (2) the production function approach.

4.3.1. Index-number approach: The index-number approach involves, first, developing a formula for a measure of

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the value of social benefits generated by increases in cocoa productivity. The measure of productivity used here is the increase in yield resulting from planting improved cocoa varieties F_3 Amazon and hybrids over the traditional Amelonado variety. For this purpose the yield increase per hectare for any year is derived from the difference in yields between the improved varieties and the Amelonado variety that would otherwise have been planted. This yield difference is estimated by using yield profiles of the improved and unimproved varieties supplied by the Cocoa Research Institute of Nigeria (CRIN). This is computed for the total hectares of improved varieties already mature, i.e. plantings that are 4 years old and above up till the 35th year which is regarded by CRIN scientists as the end of the economic life of improved varieties. However, as the economic life of Amelonado is estimated at 38 years from planting, yield increase from the 36th to 38th year in respect of new varieties is taken as negative, being equal to the figure of yield in each of these years that Amelonado will normally have yielded.

The need arises for the development of a formula for the measurement of gross social benefits. In Figure 4.5, D is the demand curve for Nigeria's cocoa while S_1 is the supply curve with the availability and adoption of improved

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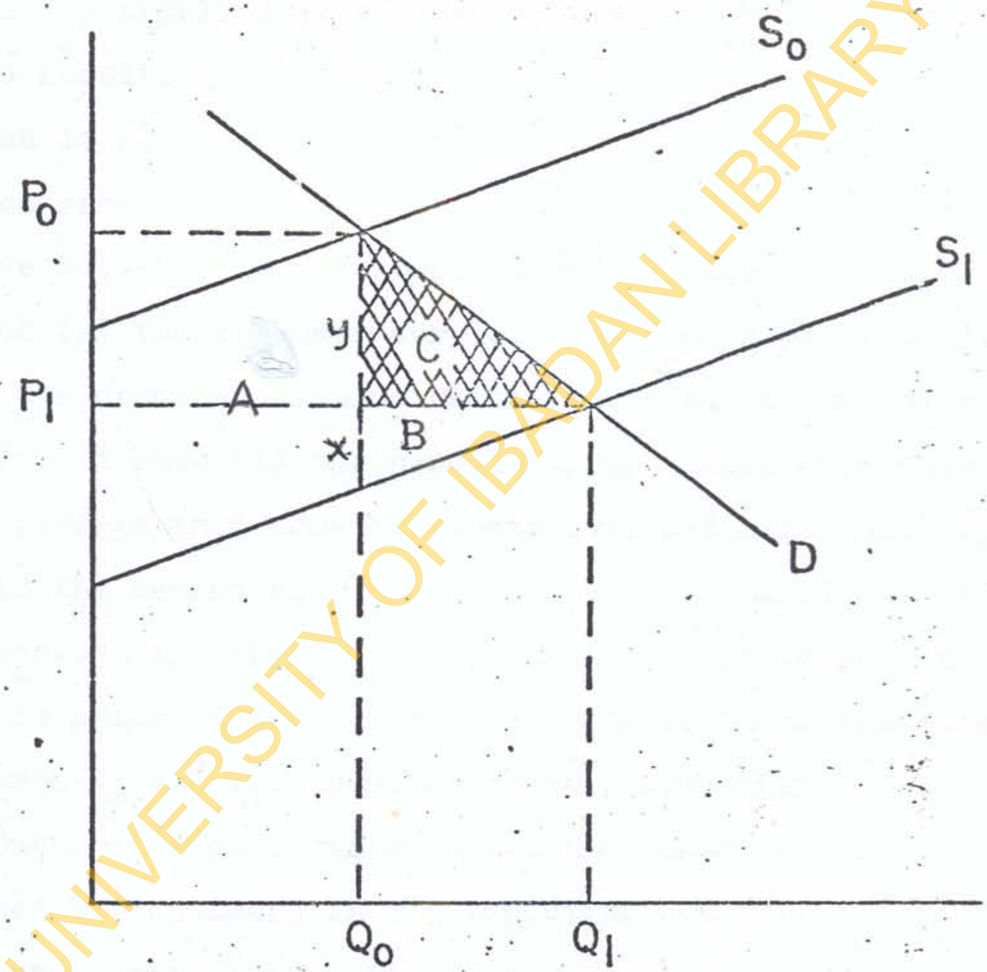

Fig. 4·5: Shift in supply curve from planting of new cocoa varieties.

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varieties. The equilibrum price at the supply level Q_1 is P_1. Now suppose the new varieties were suddenly to disappear. The supply curve would shift leftward. With demand remaining unchanged the new equilibrum price is now P_o while quantity supplied is reduced from Q_1 to Q_o. The total loss resulting from the shift in the supply curve (and which is equivalent to the gross social benefits from Cocoa research) is measured by the area under the demand curve between the two supply curves. This area is made up of (a) the consumer surplus represented by triangle C, (b) the producer surplus which itself can in theory be separated into (i) the parallelogram marked A representing the savings in production costs over all units of output up to the second equilibrum output Q_o and (ii) the triangle B representing the excess of the demand price over the supply price of the additional units of the difference between Q_o and Q_1. However since practically all cocoa produced in Nigeria is exported the consumer surplus is gained by consumers in the importing countries. Hence the gross social benefits to the Nigerian economy is A + B.

To estimate A + B in terms of P_1 and Q_1 let the price elasticity of demand be n and the price elasticity of supply e. Furthermore let K be the percentage yield decrease that would occur if new cocoa varieties were to

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disappear.

$$\therefore \quad A = Q_o (x + y)$$
$$B = \tfrac{1}{2}x(Q_1 - Q_o)$$

$$\therefore \quad A + B = Q_o (x + y) + \tfrac{1}{2}x(Q_1 - Q_o)$$

Expressing x in terms of elasticity of supply e

$$x = KP_{1/e} \ *$$

Expressing y in terms of elasticity of demand n

$$y = KP_{1/n}$$

Furthermore $(Q_1 - Q_o)$ can be written as KQ_1

$$\therefore \quad A + B = (Q_1 - KQ_1)(KP_{1/e} + KP_{1/n}) + \tfrac{1}{2}KP_{1/e} \cdot KQ_1$$
$$= KP_1Q_1 \left\{(1 - K)\left(\frac{1}{e} + \frac{1}{n}\right) + \frac{K}{2e}\right]$$
$$= KP_1Q_1 \left\{(1 - K)\left(\frac{n + e}{ne}\right) + \frac{K}{2e}\right] \quad \ldots (7)$$

This formula is employed in estimating the annual gross benefits using relevant price P_1, quantity Q_1, percentage change in supply due to adoption of new varieties K, elasticity of demand n, and elasticity of supply e. To arrive at the net returns any cost incurred by the farmers in realizing the productivity gain are deducted from the

* Taking the supply curve S_1, a change in supply from Q_1 to Q_o (which is by definition a proportional decrease of K in quantity supplied) results in a fall in price by x. This fall as a proportion of the original price P_1 is x/P_1. Therefore price elasticity of supply $e = KP_1/x$. Hence $x = KP_1/e$.

estimated gross social benefits. The flow of net returns in real terms is then related to research and extension expenditures in real terms, and an internal rate of return is computed. This is the rate which equates the flow of net returns to zero, and it can be expressed as:

$$\sum_{j=o}^{n} (b_j - c_j)\ (1 + r)^j + \sum_{k=1}^{m} \frac{b_k - c_k}{(1 + r)^k} = 0 \ldots (8)$$

where

b_j is past benefit in year j

c_j is past research and extension expenditure in year j

n is past number of years since research expenditure began

b_k is future benefit in year k

c_k is future research extension expenditure in year k

m is future number of years between now and the end of the economic life of improved cocoa plantings

r is internal rate of return

4.3.2. <u>Production function approach</u>: The main purpose of employing this approach in addition to the investment evaluation techniques, just discussed, is to provide an

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alternative estimate of returns using different data background. The estimate obtained by this method will be used as a check on the first estimate. In the production function approach the sum of expenditures on cocoa research and extension is included as a separate variable in an aggregate production function in order to estimate the marginal product of research.

In attempting to develop an appropriate cocoa production function, it is relevant to define the output, i.e. the dependent variable. For instance, since data used in this study come from time series, output must be defined as "annual output" which will constitute the unit of observation. This specification, in turn, will determine what factors will constitute the dependent variables. Clearly, for instance, the total hectares of cocoa trees in production in a particular year will come into the model. Another variable that could be included in the function is weather which affects output from year to year. Rainfall, for instance, is known to affect pod formation and development as well as lead to the spread of black pod disease through high relative humidity. Consequently, rainfall will be included as the weather variable.[25]

25 The relevant period of rainfall affecting the formation and development of pods is March to October.

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Without disease control measures, the effective output can be expected to fall below the biological yield of the crop. Indeed disease control has been an important aspect of cocoa cultivation in Nigeria in the last three decades. The degree of annual control can be expected to have some bearing on the effective yield. Finally, the research variable is incorporated into the model. We can thus specify our model as follows:

$$Q_t = f(A_t, W_{t-1}, D_t, T) \ldots\ldots \quad (9)$$

where

- Q_t is output in year t
- A_t is total hectares of trees in production in year t
- W_{t-1} is total rainfall between March and October in year t-1
- D_t is disease control index in year t
- T is research expenditure in year t-14 plus extension expenditure in year t-4

The research variable T requires some explanation. It is assumed that a research expenditure made in year t

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will not result in mass-adoption result until 10 years later. Furthermore it takes another 4 years (the period of gestation for cocoa) for such experimental benefit to come to fruit. Hence, the total period between research expenditure and the derivation of any benefit is 14 years.

In addition to purely research expenditures, considerable resources have been devoted over the years to extension activities especially in encouraging the adoption of improved varieties through the establishment of cocoa nurseries, distribution of seedlings at subsidized prices, technical supervision etc. These extension efforts have been intensified through the establishment of Cocoa Development Units in all major cocoa-producing states of the country. For this reason extension expenditures are included in the variable T. In doing this, it is assumed that extension expenditures in year t will affect production 4 years later, when the seedlings and technical supervision in plot lay-out, planting, etc. which constitute the bulk of extension efforts will result in first harvests of cocoa pods. Hence, extension expenditure is lagged by 4 years. We thus have the expression

$$T_t = R_{t-14} + N_{t-4} \quad \ldots (10)$$

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where

T_t is the research variable in year t in the production function

R_{t-14} is research expenditure in year t-14

N_{t-4} is extension expenditure in year t-4

The models developed in this Chapter will form the bases for the estimation of returns to cocoa research in Chapters V and VI respectively.

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CHAPTER V

RETURNS TO COCCA RESEARCH I

5.1 Index-number model

In this chapter we attempt to estimate empirically the internal rate of return to investment in cocoa research in Nigeria. The internal rate of return is that discount rate which makes the net present worth of the cash flow zero. This represents the average return to investment over the period between the start of the investment expenditure and the end of the economic life of the total area of cocoa trees planted with improved varieties. Since the pay-off from research expenditures (as well as the research expenditures themselves) extends from the past into the future our model must incorporate both compounding and discounting factors. The model will thus be

$$\sum_{j=o}^{n} (b_j-c_j)(1+r)^j + \sum_{k=1}^{m} \frac{b_k - c_k}{(1+r)^k} = 0 \quad \ldots \quad (1)$$

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where

b_j is net social returns in a past year j

c_j is total cost (research and extension) in a past year j

n is number of years since cocoa research expenditures began

b_k is net social returns in a future year k

c_k is total cost in a future year k from now

m is number of years between now and the economic life of improved cocoa plantings.

r is internal rate of return

For empirical estimation of internal rate of return, therefore, we shall require data on major items like annual total cost; increased yield due to adoption of improved varieties; and annual gross returns. While total costs can be derived directly from data on annual research and extension expenditures, social returns has to be estimated using the index-number model which we developed in the last chapter. This was obtained by using the productivity index of improved cocoa varieties to measure the downward shifts in the long-run cocoa supply function as a way of estimating the annual value of

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"resource savings" resulting from increased productivity of cocoa. As noted in the last chapter the resource savings are equivalent to the gross social returns which is equal to

$$KP_1Q_1 \quad (1 - K)\left(\frac{n + e}{ne}\right) + \frac{K}{2} \quad \ldots \qquad (2)$$

where

K is percentage decrease in the supply function of cocoa that would occur should new varieties adopted suddenly disappear.

P_1 is the world market price (deflated)

Q_1 is output of cocoa with the use of new varieties

n is elasticity of cocoa demand (absolute value)

e is elasticity of cocoa supply

Annual output from the plantings of any particular cocoa variety will depend on (a) the total hectareage of trees in production, and (b) the age distribution of trees in production. Accordingly, annual output in a year j of improved variety plantings Q_1 is given by the function

$$Q_1 = \sum_{i=4}^{35} Y_{Zi} H_{j-i} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

j = 1958/59, 1959/60, 1960/61,...,2039/40

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Output of Amelonado from the same hectareage is given by

$$Q_o = \sum_{i=7}^{38} Y_{Di} H_{j-i} \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (4)$$

By definition

$$K = \frac{Q_1 - Q_o}{Q_1} \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (5)$$

$$\therefore \quad K = \frac{\sum_{i=4}^{35} Y_{Zi} H_{j-i} - \sum_{i=7}^{38} Y_{Di} H_{j-i}}{\sum_{i=4}^{35} Y_{Zi} H_{j-i}}$$

$$= 1 - \frac{\sum_{i=7}^{38} Y_{Di} H_{j-i}}{\sum_{i=4}^{35} Y_{Zi} H_{j-i}} \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (6)$$

where

Q_1, Q_o and K are as defined earlier,

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Y_{Zi} is yield of improved variety at age i years

Y_{Di} is yield of Amelonado at age i years

H_{j-i} is hectares of improved variety planted in year j-i

From equations (2) to (6), therefore, the data required for estimates of annual social returns are in respect of (i) the yield profiles for Amazon and Amelonado cocoa varieties respectively, (ii) hectareage of improved cocoa variety in production year by year, (iii) cocoa prices for the relevant years, and (iv) the price elasticities of supply and demand (respectively) for cocoa. Given the stream of total costs (research and extension) as well as the stream of social returns, a cash flow table is constructed, from which an internal rate of return is calculated by an iterative procedure.

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5.2. Sources and limitationsof data

The data used in this study come mainly from time series. The availability of data is facilitated by the fact that the Nigerian cocoa industry is export-oriented and is therefore well documented by way of official records, special reports, and other published materials. The main data categories required are (1) data on total costs consisting of research and extension expenditures deflated by consumer price index; (2) data on gross revenue which is calculated from (a) the yield profile of improved varieties vis-a-vis that of the Amelonado variety, and (b) world market prices (again deflated by consumer price index and adjusted for marketing costs). The sources and limitations of data in respect of the various items are discussed below.

5.2.1. Research expenditures: The data on annual research expenditures from 1944/45 to 1962/63 come from the audited annual accounts of the West African Cocoa Research Institute, while those from 1964/65 to 1976/77 come from the annual accounts of the Cocoa Research Institute of Nigeria.[1] The revenue generated during each financial year from the

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1 For 1963/64, the accounts of the West African Cocoa Research Institute (Nigeria) was used. See chapter IV.

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Institutes' activities like sale of cocoa pods and other produce, interest on deposits, etc. was deducted from expenditure to obtain the net research expenditure. Since the West African Cocoa Research Institute served the cocoa-growing areas of West Africa (practically Ghana and Nigeria) the proportion of the expenditure due to Nigeria had to be imputed from the expenditures of the West African Cocoa Research Institute between 1944/45 and 1962/63. For this purpose the expenditures were weighted by a factor of ⅓ on the assumption that the contribution in 1947 of ₦610,000 by the Nigerian Cocoa Marketing Board (against ₦1,380,000 by the Gold Coast Marketing Board) to the West African Cocoa Research Institute endowment fund[2] can be taken as Nigeria's proportional share of the Institute's annual expenditures. One other ground for the choice of this weighting factor is that Nigeria's production of cocoa during the decade 1965/66 and 1974/75 represents about ⅓ the total production for Ghana and Nigeria combined (see Table 5.1).

With regards to the annual expenditures of the Cocoa Research Institute, these cover research on coffee, kola and (in recent years) tea for which the Institute also has

2 See Chapter IV.

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TABLE 5.1

Cocoa production in Ghana and Nigeria
1965/66-1975/76 (metric tons)

Year	Ghana's Production	Nigeria's Production	Total	Nigeria's Production as % of Total
1965/66	415,493	184,632	600,125	0.30
1966/67	380,902	267,273	648,175	0.41
1967/68	421,200	283,653	704,853	0.40
1968/69	332,115	187,533	519,648	0.36
1969/70	413,497	222,969	636,466	0.35
1970/71	396,199	307,915	704,114	0.43
1971/72	470,000	256,600	726,600	0.35
1972/73	415,700	241,300	657,000	0.36
1973/74	343,000	190,900	533,900	0.35
1974/75	377,960	214,000	591,960	0.36
1975/76	382,455	205,400	587,855	0.35
Total	4,348,521	2,562,175	6,910,696	0.36

Source: Statistical information on Western State of Nigeria controlled produce, Western Nigeria Marketing Board, Ibadan, April 1976.

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a statutory responsibility as well as for cocoa research. In order to impute the expenditures due to cocoa research, the annual expenditures for the Institute are weighted by ½ which is the fraction considered by officials of Cocoa Research Institute of Nigeria to be the maximum share of cocoa research in terms of relative resources devoted to the various crops. Further, as can be seen from equation (1) in this chapter, research expenditures (as well as gross returns) extend beyond 1976/77 into the future. Future annual expenditures were estimated by taking the average of the last five years ending in 1976/77. This figure is regarded as a constant annual expenditure after the year 1976/77, being an annual expenditure needed to "maintain" the stock of existing research knowledge rather than that which will generate further research knowledge over and above what is already known. The need to maintain the current stock of research knowledge arises in the face of malevolent nature. For example, pests and disease pathogens may develop resistance to current control measures: so that merely to maintain existing cocoa productivity new control measures may need to be devised. But even if nature were to remain benevolent such "maintenance" annual research expenditure might still

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be needed. For example, if all cocoa research expenditures were to be stopped now, resuming such research twenty years hence would involve considerable retraining of researchers and relearning of things that would have been forgotten.

In spite of the need for "maintenance" research expenditures, however, the magnitude of expenditure required for this seems unlikely in practice to be as high as the figure adopted in this study. To that extent, the estimated annual expenditures from 1977/78 onwards may be too high, leading to an underestimation of the rate of return.

5.2.2. Extension expenditures: Griliches[3] in his estimation of returns to hybrid corn in the United States regarded only pure research expenditures as costs, ignoring extension expenditures entirely. Peterson attempted a sort of compromise by calculating the rate of return to poultry in the United States with and without extension expenditures, declaring,

> It is not clear how extension expenditures should be handled in a study of this type. On the one hand, it might be argued that without extension activities farmers would not hear of new inputs

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3 Griliches, Zvi, Research costs and social returns: hybrid corn and related innovations. Journal of Political Economy, 66, October 1958.

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coming from research, or if they did hear, that they would be reluctant to adopt them without the backing of a non-pfofit organisation. On the other hand, one could argue that even without extension activities farmers would adopt new inputs as they become available because of information obtained from suppliers of farm literature and because of the profitability of new inputs. The latter argument is perhaps more valid for recent years because of advances in communication and transportation. No doubt the truth lies somewhere between these two points of view.[4]

For the present study, the view taken is that no estimate of the rate of return can be valid without including extension expenditures, for a number of reasons. First, as the West African Cocoa Research Institute's maiden annual report put it, "the Institute is essentially a fact-finding body and has no responsibility for executive action which is the function of the respective Government."[5] In other words, the Institute from the very outset had been concerned only with producing research information, expecting such information to reach the farmer through the Agricultural Department. In the circumstances, expenditures involved in getting the research findings to

4 Peterson, Willis L., Return to poultry research in the United States. Journal of Farm Economics 49(3), 1967.

5 West African Cocoa Research Institute. Annual report, April 1944 to March 1945, London, Crown Agents for the colonies, 1945.

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the farmer represent essential costs without which the pay-off of cocoa research would not have been realized. Secondly, given mass illiteracy among the generality of farmers and poor communication and transportation facilities in the economy at large, the cost represented by extension expenditures would still have been incurred even if the research institute, and not the Government, had been charged with responsibility for "executive action" as well as for "fact-finding". Thirdly, and most significant, extension has actually played a decisive role in bringing about a widespread adoption of improved cocoa varieties through the establishment of nurseries, distribution of seedlings at subsidized prices, and production loans and grants under the Cocoa Development Unit programmes, as well as extending technical information on associated farm practices. Extension expenditure data used in this study thus incorporate large elements of production costs that would otherwise have had to be incurred at the farm level. For this reason and because breakdowns of the aggregate figures are not available production costs are not treated separately in order to avoid double counting.

Data for extension expenditures come from Western Nigeria Estimates for various years dating from 1954/55.

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The figures used were those of "Actual Expenditure" column for the relevant years under the subhead "Encouragement of Cocoa Planting". The figures used for the 1966/67 to 1970/71 are from the subhead "Special Cocoa Scheme", while from 1971/72 the data are those of the Western State Cocoa Development Unit. On the latter source of data, it is assumed that all cocoa plantings occuring in the State since the establishment of the unit and its predecessor, the Special Cocoa Scheme, have been exclusively through this channel, since the annual establishment of nurseries and distribution of cocoa seedlings by the Ministry of Agriculture were discontinued with the establishment of this body. In order to relate these expenditures to the whole country they were weighted by a factor of 1.05 on the assumption that 95 per cent of the country's total cocoa production comes from Western Nigeria (See Table 5.2).

One limitation of these data is that by weighting the figures by this factor it implies that other parts of the country commit resources to cocoa production to the same extent on per hectare basis as does Western Nigeria. However this is not likely to be true in practice. This is because a state is likely to concentrate a largely dis-proportionate share of its resources to extension in the

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TABLE 5.2

Expenditures (₦million)

Year (April-March)	Research	Extension	Total	Total deflated by Consumer Price Index
1944/45	0.038	-	0.038	0.042
1945/46	0.064	-	0.064	0.071
1946/47	0.134	-	0.134	0.149
1947/48	0.050	-	0.050	0.055
1948/49	0.046	-	0.046	0.050
1949/50	0.050	-	0.050	0.053
1950/51	0.061	-	0.061	0.065
1951/52	0.061	-	0.061	0.064
1952/53	0.061	-	0.061	0.062
1953/54	0.061	-	0.061	0.061
1954/55	0.115	-	0.115	0.110
1955/56	0.062	-	0.062	0.057
1956/57	0.062	-	0.062	0.054
1957/58	0.061	0.230	0.291	0.249
1958/59	0.058	0.322	0.380	0.317
1959/60	0.058	0.410	0.468	0.418
1960/61	0.057	0.518	0.575	0.491
1961/62	0.317	0.400	0.717	0.565
1962/63	0.199	0.358	0.557	0.407
1963/64	0.198	0.272	0.470	0.367

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TABLE 5.2 (cont'd)

Year (April-March)	Research	Extension	Total	Total deflated by Consumer Price Index
1964/65	0.200	0.280	0.480	0.378
1965/66	0.199	0.286	0.485	0.370
1966/67	0.208	0.300	0.508	0.348
1967/68	0.267	0.246	0.513	0.364
1968/69	0.231	0.292	0.523	0.385
1969/70	0.303	0.292	0.595	0.402
1970/71	0.378	0.260	0.638	0.384
1971/72	0.378	0.260	0.638	0.369
1972/73	0.427	0.252	0.679	0.333
1973/74	0.516	0.462	0.978	0.466
1974/75	0.750	0.650	1.400	0.603
1975/76	0.785	1.620	2.405	0.756
1976/77	1.012	2.995	4.007	1.179
1977/78 Onwards	0.698	1.195	1.894	0.667

Sources: Cocoa Research Institute of Nigeria and Ministry of Agriculture and Natural Resources, Western State.

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crop or crops which loom large in its domestic economy. For instance the former Eastern and Mid-Western Nigeria where cocoa is also grown were more likely to spend a disproportionately low level of resources on cocoa on per hectare basis compared with oil palm and rubber respectively. In other words, the areas constituting the former Western Nigeria (Oyo, Ogun and Ondo States) where cocoa constitute a dominant export crop could be expected to devote more resources per unit of cocoa production than those of areas in which cocoa is a relatively minor crop. Extension expenditures may thus have been over-estimated.

5.2.3. <u>Yield profiles</u>: The yield profiles for Amelonado and Amazon varieties are required for the estimation of percentage shifts in the long-term cocoa supply function. The yield profile data were obtained from the Cocoa Research Institute of Nigeria and the Western State Ministry of Agriculture (Table 5.3). One limitation of using the yield profiles as a basis for the estimation of extra production resulting from the adoption of improved varieties is that this may lead to overestimates since it can be argued that the average farmer may not attain the yield levels described by the profile. The alternative to this approach would be to obtain the yield profiles of the two varieties on farmers holdings. How-

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TABLE 5.3

Comparative yield profile of Amazon and Amelonado cocoa varieties

Years from date of planting	Amazon (kg/hectare)	Amelonado (kg/hectare)	Difference in yield of Amazon over Amelonado (kg/hectare)	Difference in yield of Amazon over Amelonado reduced by half (kg/hectare)
0 - 3	-	-	-	-
4	227	-	227	113
5	397	-	397	198
6	568	114	454	227
7	739	227	512	256
8	908	340	568	284
9	1020	454	566	283
10	1136	510	626	313
11 - 20	1250	568	682	341
21 - 28	938	255	583	292
29 - 32	938	455	483	242
33	841	455	386	193
34	761	455	306	153
35	682	455	227	114
36	-	409	- 409	- 205
37	-	364	- 364	- 192
38	-	324	- 324	- 162

Sources: Cocoa Research Institute of Nigeria and Ministry of Agriculture and Natural Resources, Western State.

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ever, since information on comparative yield profiles of Amazon and Amelonado are not available for actual farmer's holdings, the procedure adopted here provides the most practical method of estimating the extra production resulting from adoption of new cocoa varieties. In order to meet the limitation of a possible overestimation vis-a-vis the average yield levels in actual farming situation the yield difference between the profiles was weighted by ½. With such weighting Table 5.4 shows the resulting yield profile compared with figures used as a working basis by the Western State Cocoa Development Unit as projected by the World Bank. It is to be noted that the World Bank projections have been found from experience by the Cocoa Development Unit to be very conservative, as farmers under the scheme have repeatedly obtained yields far in excess of the projected figures[6]. It can thus be seen that as a sensitivity analysis any estimate of rate of return based on our weighted yield estimates can be regarded as the lowest bound.

5.2.4. Area of improved varieties: This is another component of our formula for estimating the gross social

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6 This World Bank projection is understandably cautious since the scheme involves loan to the farmers which has to be paid back from future revenue.

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TABLE 5.4

Amazon Yield Profile: Weighted figures compared with CDU working figures

Years from date of planting	Weighted figures kg/hectare	CDU Working figures kg/hectare
0 - 3	-	-
4	113	112
5	199	224
6	341	292
7	483	616
8	624	785
9	737	953
10	823	953
11 - 13	909	953
14 - 20	909	953*
21 - 28	646	
29 - 32	696	
33	648	
34	608	
35	568	

* Decreases gradually thereafter

Sources: Cocoa Research Institute of Nigeria, Ministry of Agriculture and Natural Resources, Western State; and Western State Cocoa Development Unit.

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returns. The area of improved varieties in production include plantings from the 4th year to the 35th year of planting. This period of production is based on information from the Western State Ministry of Agriculture and the Cocoa Research Institute of Nigeria. The area in production was estimated on the basis of Amazon cocoa seedlings distributed by the Western Nigeria Ministries of Agriculture and Natural Resources between 1954/55 and 1970/71. From 1971/72 to 1976/77 the figures used were obtained from actual hectareage planted under the Cocoa Development Unit programme. Annual plantings and the cummulative hectareage of improved varieties in production are shown in Table 5.5. For future plantings of improved varieties after 1976/77, it is assumed that plantings of improved varieties will go on for the next 25 years at a rate of 29,000 hectares annually. These figures were arrived at as follows: For annual plantings after 1976/77, the 29,000 hectares adopted is the average of the previous 3 years ending in 1976/77. The number of years for which plantings would go on after 1976/77 was obtained by relating the rate of planting to total available land

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TABLE 5.5

Cummulative area of improved cocoa varieties in production 1944/45-1976/77

Year of Planting (June-May)	Hectares Planted (hectares)	Cummulative Area in Production (hectares)
1954/55	300	-
1955/56	1070	-
1956/57	1307	-
1957/58	1046	-
1958/59	1428	300
1959/60	3009	1370
1960/61	2744	2677
1961/62	3701	3723
1962/63	2989	5151
1963/64	2395	8160
1964/65	2546	10904
1965/66	2273	14605
1966/67	3729	17594
1967/68	3978	19989
1968/69	1931	22535
1969/70	863	24808
1970/71	1106	28537
1971/72	1026	32515
1972/73	2194	34446
1973/74	3832	35309
1974/75	6778	36425
1975/76	11,699	37441
1976/77	20,419	39635

Source: Ministry of Agriculture and Natural Resources, Western State.

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suitable for cocoa production, which is an estimated 725,000 hectares in 1977.[7]

A limitation of data under this item is that they ignore possible plantings of improved varieties by farmers who might not be participants in the Cocoa Development Unit programme. This will result in an under-estimate of the social returns.

5.2.5 Cocoa prices: Data on cocoa prices are needed to translate the physical quantity of increased cocoa production due to the adoption of new varieties into naira value. Since we are concerned with social returns, the appropriate price to use is that of the world market. The data used for this purpose were obtained from Gill and Duffus average London spot prices, converted from pound sterling per metric ton into naira per metric ton. The figures thus obtained were deflated by the consumer price index for Ibadan to express the prices in real terms (Table 5.6). Future prices (i.e. after 1976/77) are taken as the average of those of the last ten years in view of the price instability that characterises cocoa as an export commodity.

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7 The calculation is based on a survey by Smythe and Montgomery. See Smythe, A.J. and F. Montgomery, Soils and land use in central Western Nigeria. Ibadan. Government Printer, 1962.

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TABLE 5.6

Adjusted cocoa prices

Year (Oct-Sept)	World Market Price (₦ per metric ton)	Ibadan Consumer Price Index 1953 = 100	Deflated World Market Price (₦ per metric ton)	Deflated World Market Price Adjusted for Marketing Costs (₦ per metric ton)
1958/59	694	120	578	553
1959/60	562	112	506	481
1960/61	445	117	380	355
1961/62	354	127	279	254
1962/63	335	137	244	219
1963/64	404	128	315	290
1964/65	375	127	296	271
1965/66	277	131	211	186
1966/67	386	146	265	240
1967/68	476	141	338	313
1968/69	639	136	470	445
1969/70	831	148	561	536
1970/71	611	166	368	343
1971/72	465	173	269	244
1972/73	541	204	265	240
1973/74	1171	210	557	532
1974/75	1980	232	853	828
1975/76	2212	318	869	844
1976/77	2212	332	813	788
1977/78 onwards	1622	350	720	511

Sources: Gill & Duffus, Cocoa market reports, No. 270; Western Nigeria Ministry of Agriculture and Natural Resources, Western Nigeria, Tree Crop Planting Project; Federal Office of Statistics.

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This average is probably too conservative given recent cocoa market forcasts by Gill and Duffus.

5.2.6. Elasticities of supply and demand: The supply and demand factor contained in our formula on gross social returns involve the elasticities of supply and demand. The elasticity of supply used in this study is 0.08 being the average of short and long-term values obtained by Oni in a recent study using aggregate output data for Western Nigeria.[8] Similarly he estimated the elasticity of demand for Nigerian cocoa in the United States, the United Kingdom, the Netherlands, West Germany and Japan. The value adopted in this study 0.38 which is the average for the five countries.

5,3 Empirical results

As a first-step in the calculation of gross returns Table 5.7 shows the year-by-year estimate of K, i.e. the percentage shifts in the long-run cocoa supply function resulting from adoption of improved varieties. In Table 5.8 the annual gross returns are estimated, given (a) the the percentage shifts in the supply curve K, (b) the annual

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8 Oni, S.A., An econometric analysis of the provincial and aggregate responses among western Nigerian cocoa farmers. Unpublished Ph.D. thesis, University of Ibadan, 1972.

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TABLE 5.7

Estimates of percentage shifts in long-run cocoa supply function

Year (Oct.-Sept.)	Estimated Output of improved varieties from planting in production ('000 metric tons) Q_1	Estimated Output of Amelonado from the same hectareage ('000 metric tons) Q_0	Difference in output ('000 metric tons) $Q_1 - Q_0$	% Change in output due to use of improved varieties K
1958/59	0.068	0.000	0.068	100.0
1959/60	0.332	0.000	0.332	100.0
1960/61	0.804	0.034	0.770	95.8
1961/62	1.453	0.056	1.397	96.1
1962/63	2.357	0.305	2.052	87.1
1963/64	3.774	0.601	3.173	84.1
1964/65	5.597	1.054	4.543	81.2
1965/66	8.045	1.804	6.241	77.6
1966/67	10.869	2.775	8.094	74.5
1967/68	13.877	4.132	9.745	70.2
1968/69	17.056	5.645	11.411	66.9
1969/70	19.860	6.731	13.129	66.1
1970/71	23.925	8.785	15.140	63.3
1971/72	27.768	10.312	17.456	62.9
1972/73	31.356	11.917	19.439	62.0
1973/74	34.477	13.646	20.831	60.4

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TABLE 5.7 (cont'd)

Year (Oct.-Sept)	Estimated Output of improved varieties from planting in production ('000 metric tons) Q_1	Estimated Output of Amelonado from the same hectareage ('000 metric tons) Q_o	Difference in output ('000 metric tons) $Q_1 - Q_o$	% Change in output due to use of improved varieties K
1974/75	37.286	15.223	22.063	59.2
1975/76	39.780	16.664	23.016	57.9
1976/77	41.943	18.146	23.797	56.7
1977/78	44.419	19.253	25.166	56.7
1978/79	46.248	18.754	27.494	59.4
1979/80	47.447	16.187	31.260	65.9
1980/81	47.595	10.145	37.450	78.7
1981/82	50.741	6.664	44.077	86.9
1982/83	55.960	5.934	50.026	89.4
1983/84	63.024	6.903	56.121	89.0
1984/85	72.965	9.267	63.698	87.3
1985/86	83.452	12.165	71.287	85.4
1986/87	95.580	15.872	79.708	83.4
1987/88	109.015	21.378	87.637	80.4
1988/89	123.729	28.432	95.297	77.0
1989/90	138.729	35.069	103.660	74.6
1990/91	154.267	41.816	112.451	72.9

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TABLE 5.7 (cont'd)

Year (Oct.-Sept)	Estimated Output of improved varieties from planting in production ('000 metric tons) Q_1	Estimated Output of Amelonado from the same hectareage ('000 metric tons) Q_o	Difference in output ('000 metric tons) $Q_1 - Q_o$	% Change in output due to use of improved varieties K
1991/92	169.199	48.735	120.464	71.2
1992/93	182.863	54.752	128.111	70.1
1993/94	196.411	60.947	135.464	69.0
1994/95	209.443	69.005	140.438	67.1
1995/96	222.404	77.323	145.081	65.2
1996/97	235.303	86.128	149.175	63.4
1997/98	247.393	100.010	147.383	59.6
1998/99	260.728	111.110	149.618	57.4
1999/2000	270.609	118.539	152.070	56.2
2000/01	280.471	125.916	154.555	55.1
2001/02	290.445	133.154	157.291	54.2
2002/03	298.875	139.361	159.514	53.4
2003/04	307.313	144.727	162.586	52.9
2004/05	318.078	149.961	168.117	52,9
2005/06	330.321	153.739	176.582	53.5
2006/07	342.073	159.174	182.899	53.5

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TABLE 5.7 (cont'd)

Year (Oct.-Sept)	Estimated Output of improved varieties from planting in production ('000 metric tons) Q_1	Estimated Output of Amelonado from the same hectareage ('000 metric tons) Q_o	Difference in output ('000 metric tons) $Q_1 - Q_o$	% Change in output due to use of improved varieties K
2007/08	353.215	165.155	188.060	53.2
2008/09	362.958	171.669	191.289	52.7
2009/10	392.718	200.581	192.137	48.9
2010/11	394.200	202.507	191.693	48.6
2011/12	390.804	203.915	186.889	47.8
2012/13	388.641	209.788	178.853	46.0
2013/14	386.928	209.790	177.138	45.8
2014/15	386.789	210.144	176.645	45.7
2015/16	373.903	208.367	165.536	44.3
2016/17	352.695	201.078	151.617	43.0
2017/18	324.906	188.589	136.317	42.0
2018/19	292.730	174.009	118.721	40.6
2019/20	260.554	159.429	101.125	38.8
2020/21	228.378	144.849	83.529	36.6
2021/22	196.202	130.269	65.933	33.6
2022/23	164.026	115.889	48.137	29.5
2023/24	151.960	106.295	45.035	29.6

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TABLE 5.7 (cont'd)

Year (Oct.-Sept)	Estimated Output of improved varieties from planting in production ('000 metric tons) Q_1	Estimated Output of Amelonado from the same hectareage ('000 metric tons) Q_o	Difference in output ('000 metric tons) $Q_1 - Q_o$	% Change in output due to use of improved varieties K
2024/25	127.028	89.397	38.431	30.1
2025/26	115.762	80.633	35.129	30.3
2026/27	103.696	71.869	31.827	30.7
2027/28	91.630	63.105	28.525	31.1
2028/29	79.564	54.341	25.223	31.7
2029/30	67.498	45.577	21.921	32.5
2030/31	55.432	39.742	15.690	28.3
2031/32	43.366	33.907	9.459	21.8
2032/33	31.300	28.162	3.138	10.0
2033/34	27.278	25.388	1.890	7.0
2034/35	15.212	14.447	0.765	5.1
2035/36	4.389	5.114	-- 0.724	- 16.5
2036/37	- 5.410	5.248	- 10.658	- 97.0
2037/38	0.000	4.080	- 4.080	- ∞
2038/39	0.000	3.421	- 3.421	- ∞
2039/40	0.000	2.032	- 2.032	- ∞

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TABLE 5.8

Estimates of annual net returns from cocoa research

Year (Oct-Sept)	% Change in output due to use of improved varieties K	Estimated output from plantings in production ('000 metric tons) Q_1	Price/deflated by consumer index (₦ per metric) ton P_1	Supply and demand factor $(1-K)(\frac{n+e}{ne})+\frac{K}{2e}$	Net social returns (₦ million) $KQ_1P_1\left[(1-K)(\frac{n+e}{ne})+\frac{K}{2e}\right]$
1958/59	100.0	0.068	553	6.300	0.237
1959/60	100.0	0.332	481	6.300	1.006
1960/61	95.8	0.804	355	6.678	1.826
1961/62	96.1	1.453	254	6.651	2.359
1962/63	87.1	2.357	219	7.491	3.354
1963/64	84.1	3.774	290	7.731	7.116
1964/65	81.2	5.597	271	7.992	9.843
1965/66	77.6	8.045	186	8.316	9.655
1966/67	74.5	10.869	240	8.595	16.703
1967/68	70.2	13.877	313	8.982	27.388
1968/69	66.9	17.056	445	9.279	47.116
1969/70	66.1	19.860	536	9.351	65.797
1970/71	63.3	23.925	343	9.603	49.883

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TABLE 5.8 (cont'd)

Year (Oct-Sept)	% Change in output due to use of improved varieties K	Estimated output from plantings in production ('000 metric tons) Q_1	Price/deflated by consumer index (₦ per metric ton) P_1	Supply and demand factor $(1-K)(\frac{n+e}{ne}) + \frac{K}{2e}$	Net social returns (₦ million) $KQ_1P_1\left[(1-K)(\frac{n+e}{ne}) + \frac{K}{2e}\right]$
1971/72	62.9	27.768	244	9.639	41.079
1972/73	62.0	31.356	240	9.720	45.352
1973/74	60.4	34.477	532	9.864	109.278
1974/75	59.2	37.286	828	9.972	182.102
1975/76	57.9	39.780	844	10.089	196.125
1976/77	56.7	41.943	788	10.197	191.091
1977/78	56.7	44.419	511	10.197	131.233
1978/79	59.4	46.248	511	9.954	139.732
1979/80	65.9	47.447	511	9.369	149.695
1980/81	78.7	47.595	511	8.217	157.279
1981/82	86.9	50.741	511	7.479	168.517
1982/83	89.4	55.960	511	7.254	185.448
1983/84	89.0	63.024	511	7.290	208.951

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TABLE 5.8 (cont'd)

Year (Oct-Sept)	% Change in output due to use of improved varieties K	Estimated output from plantings in production ('000 metric tons) Q_1	Price/deflated by consumer index (₦ per metric ton) P_1	Supply and demand factor $(1-K)(\frac{n+e}{ne})+\frac{K}{2e}$	Net social returns (₦ million) $KQ_1P_1\left\{(1-K)(\frac{n+e}{ne})+\frac{K}{2e}\right\}$
1984/85	87.3	72.965	511	7.443	242.269
1985/86	85.4	83.452	511	7.614	277.286
1986/87	83.4	95.580	511	7.794	317.478
1987/88	80.4	109.015	511	8.064	361.171
1988/89	77.0	123.729	511	8.370	407.482
1989/90	74.6	138.925	511	8.586	454.707
1990/91	72.9	154.269	511	8.739	502.214
1991/92	71,2	169.199	511	8.892	547.392
1992/93	70.1	182.863	511	8.991	588.942
1993/94	69.0	196.411	511	8.090	629.505
1994/95	67.1	209.443	511	9.261	665.070
1995/96	65.2	222.404	511	9.432	698.900
1996/97	63.4	235.303	511	9.594	731.370

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TABLE 5.8 (cont'd)

Year (Oct-Sept)	% Change in output due to use of improved varieties K	Estimated output from plantings in production ('000 metric tons) Q_1	Price/deflated by consumer index (₦ per metric ton) P_1	Supply and demand factor $(1-K)(\frac{n+e}{ne})+\frac{K}{2e}$	Net social returns (₦ million) $KQ_1P_1\left[(1-K)(\frac{n+e}{ne})+\frac{K}{2e}\right]$
1997/98	59.6	247.393	511	9.936	748.628
1998/99	57.4	260.728	511	10.134	774.963
1999/2000	56.2	270.609	511	10.242	795.947
2000/01	55.1	280.471	511	10.341	816.625
2001/02	54.2	290.445	511	10.422	838.369
2002/03	53.4	298.875	511	10.494	855.840
2003/04	52.9	307.313	511	10.539	875.483
2004/05	52.9	318.078	511	10.539	906.160
2005/06	53.5	330.321	511	10.485	946.846
2006/07	53.5	342.073	511	10.485	980.532
2007/08	52.2	353.215	511	10.602	998.892
2008/09	52.7	362.958	511	10.557	1031.878
2009/10	48.9	392.718	511	10.899	1069.541

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TABLE 5.8 (cont'd)

Year (Oct-Sept)	% Change in output due to use of improved varieties K	Estimated output from plantings in production ('000 metric tons) Q_1	Price/deflated by consumer index (₦ per metric ton) P_1	Supply and demand factor $(1-K)(\frac{n+e}{ne})+\frac{K}{2e}$	Net social returns (₦ million) $KQ_1P_1\left[(1-K)(\frac{n+e}{ne})+\frac{K}{2e}\right]$
2010/11	48.6	394.200	511	10.926	1069.633
2011/12	47.8	390.804	511	10.998	1049.836
2012/13	46.0	388.641	511	11.160	1019.510
2013/14	45.8	386.928	511	11.178	1012.233
2014/15	45.7	386.789	511	11.187	1010.473
2015/16	44.3	373.903	511	11.313	957.549
2016/17	43.0	352.695	511	11.430	885.798
2017/18	42.0	324.906	511	11.520	803.305
2018/19	40.6	292.730	511	11.646	637.617
2019/20	38.8	260.554	511	11.808	618.331
2020/21	36.6	228.378	511	12.006	512.824
2021/22	33.6	196.202	511	12.276	413.556
2022/23	29.5	164.026	511	12.645	312.662

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TABLE 5.8 (cont'd)

Year (Oct-Sept)	% Change in output due to use of improved varieties K	Estimated output from plantings in production ('000 metric tons) Q_1	Price/deflated by consumer index (₦ per metric ton) P_1	Supply and demand factor $(1-K)(\frac{n+e}{ne})+\frac{K}{2e}$	Net social returns (₦ million) $KQ_1P_1\left\{(1-K)(\frac{n+e}{ne})+\frac{K}{2e}\right\}$
2023/24	29.6	151.960	511	12.636	290.446
2024/25	30.1	127.828	511	12.591	247.556
2025/26	30.3	115.762	511	12.573	225.360
2026/27	30.7	103.696	511	12.537	203.943
2027/28	31.1	91.630	511	12.501	182.045
2028/29	31.7	79.564	511	12.447	160.418
2029/30	32.5	67.498	511	12.375	138.721
2030/31	28.3	55.432	511	12.753	102.232
2031/32	21.8	43.366	511	13.338	64.436
2032/33	10.0	31.300	511	14.400	23.032
2033/34	7.0	27.278	511	14.490	14.314

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TABLE 5.8 (cont'd)

Year (Oct-Sept)	% Change in output due to use of improved varieties K	Estimated output from plantings in production ('000 metric tons) Q_1	Price/deflated by consumer index (₦ per metric ton) P_1	Supply and demand factor $(1-K)(\frac{n+e}{ne})+\frac{K}{2e}$	Net social returns (₦ million) $KQ_1P_1\left[(1-K)(\frac{n+e}{ne})+\frac{K}{2e}\right]$
2034/35	5.1	15.212	511	14.481	5.883
2035/36	- 16.5	4.389	511	- 16.785	- 5.495
2036/37	- 97.0	- 5.410	511	- 24.030	*
2037/38	- ∝	- 14.186	511	- ∝	*
2038/39	- ∝	- 8.921	511	- ∝	*
2039/40	- ∝	- 4.241	511	- ∝	*

* Mathematical estimates of gross returns using the value of K at these negative levels make no economic sense since, having reached the lowest point, it rises to infinity. This implies that at a time when its yield is supposed to be zero the improved variety has an infinitely larger return than that of the unimproved variety which still retains a positive yield at this time. This is of course absurd.

However the years concerned lie so far into the future (63 years from 1977) that they can be legitimately - and indeed have to be - ignored, given the rate of return (37%) obtained in this study. The need to employ an alternative and economic-sensical estimation procedure in respect of these years is thus obviated, their indications in the table being purely for completeness in covering the "life of the project".

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output of cocoa due to the adoption of improved varieties, Q_1, (c) the corresponding year's world market cocoa prices, P_1, and (d) the elasticities of supply and demand for Nigerian cocoa, n and e respectively. Given the estimates of net returns[9], as well as the estimates of costs in terms of research and extension expenditures, Table 5.9 shows the cash flow. By an iterative procedure the internal rate of return was calculated, choosing that compound-cum-discount rate which makes the sum of cash flow zero, as described by the formula in equation (1) above. This compound/discount rate was found to be 37 per cent. Thus the estimated internal rate of return is 37 per cent.

By way of sensitivity analysis with respect to yield estimates, the differentials in yield between Amazon and Amelonado were discounted by 0.5, thus bringing down the yield profile of Amazon to the level shown in Table 5.3. Table 5.10 shows the cash flow using the modified yield estimates. This gave an internal rate of return of 34 per cent. Thus even with Amazon/Amelonado yield

9 In this study the net returns are equivalent to the gross returns since the extra costs attendant upon the adoption of the new varieties (e.g. extra costs of raising improved seedlings etc.) are largely incorporated in extension expenditures.

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TABLE 5.9

Costs and returns of cocoa research
in constant million naira

Year	Expenditure on research and extension	Net social returns from improved varieties	Cash flow
1944/45	0.042	-	- 0.042
1945/46	0.071	-	- 0.071
1946/47	0.149	-	- 0.149
1947/48	0.055	-	- 0.055
1948/49	0.050	-	- 0.050
1949/50	0.053	-	- 0.053
1950/51	0.065	-	- 0.065
1951/52	0.064	-	- 0.064
1952/53	0.062	-	- 0.062
1953/54	0.061	-	- 0.061
1954/55	0.110	-	- 0.110
1955/56	0.057	-	- 0.057
1956/57	0.054	-	- 0.054
1957/58	0.249	-	- 0.249
1958/59	0.317	0.237	- 0.080
1959/60	0.418	1.006	0.588
1960/61	0.491	1.826	1.335
1961/62	0.565	2.359	1.794
1962/63	0.407	3.354	2.947
1963/64	0.367	7.116	6.749

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TABLE 5.9 (cont'd)

Year	Expenditure on research and extension	Net social returns from improved varieties	Cash flow
1964/65	0.378	9.843	9.465
1965/66	0.370	9.655	9.285
1966/67	0.348	11.703	16.355
1967/68	0.364	27.388	27.024
1968/69	0.385	47.116	46.731
1969/70	0.402	65.797	65.395
1970/71	0.384	49.883	49.499
1971/72	0.369	41.079	40.710
1972/73	0.333	45.352	45.019
1973/74	0.466	109.278	108.812
1974/75	0.603	182.102	181.499
1975/76	0.756	196.125	195.369
1976/77	1.179	191.091	189.912
1977/78	0.667	131.233	130.566
1978/79	0.667	139.732	139.065
1979/80	0.667	149.695	148.798
1980/81	0.667	157.279	156.612
1981/82	0.667	168.517	157.850
1982/83	0.667	185.448	184.781
1983/84	0.667	208.951	208.284
1984/85	0.667	242.269	241.602
1985/86	0.667	277.200	276.619

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TABLE 5.9 (cont'd)

Year	Expenditure on research and extension	Net social returns from improved varieties	Cash flow
1986/87	0,667	317.478	316.811
1987/88	0.667	361.171	360.502
1988/89	0.667	407.482	406.815
1989/90	0.667	454.707	454.040
1990/91	0.667	502.214	501.547
1991/92	0.667	547.392	546.725
1992/93	0.667	588.942	588.275
1993/94	0.667	629.505	628.838
1994/95	0.667	665.070	664.403
1995/96	0.667	698.900	698.233
1996/97	0.667	731.370	730.703
1997/98	0.667	748.628	747.961
1998/99	0.667	774.963	774.296
1999/2000	0.667	795.947	795.280
2000/01	0.667	816.625	815.958
2001/02	0.667	838.369	837.702
2002/03	0.667	855.840	855.173
2003/04	0.667	875.483	874.816
2004/05	0.667	906.160	905.493
2005/06	0.667	946.846	946.179
2006/07	0.667	980.532	979.865
2007/08	0.667	998.892	998.225

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TABLE 5.9 (cont'd)

Year	Expenditure on research and extension	Net social returns from improved varieties	Cash flow
2008/09	0.667	1031.878	1031.211
2009/10	0.667	1069.541	1068.874
2010/11	0.667	1069.633	1068.966
2011/12	0.667	1049.836	1049.169
2012/13	0.667	1019.510	1018.843
2013/14	0.667	1012.233	1011.566
2014/15	0.667	1010.473	1009.809
2015/16	0.667	957.549	956.882
2016/17	0.667	885.798	885.131
2017/18	0.667	803.305	802.638
2018/19	0.667	637.617	636.950
2019/20	0.667	618.331	617.664
2020/21	0.667	512.824	512.167
2021/22	0.667	413.556	412.889
2022/23	0.667	312.662	311.995
2023/24	0.667	290.446	289.779
2024/25	0.667	247.556	246.889
2025/26	0.667	225.360	224.693
2026/27	0.667	203.943	203.276
2027/28	0.667	182.045	181.378
2028/29	0.667	160.418	159.751
2029/30	0.667	138.721	160.050

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TABLE 5.9 (cont'd)

Year	Expenditure on research and extension	Net social returns from improved varieties	Cash flow
2030/31	0.667	102.232	101.565
2031/32	0.667	64.436	63.769
2032/33	0.667	23.032	22.365
2033/34	0.667	14.314	13.647
2034/35	0.667	5.883	5.216
2035/36	0.667	- 5.495	- 6.162
2036/37	0.667	*	*
2037/38	0.667	*	*
2038/39	0.667	*	*
2039/40	0.667	*	*

* See footnote on page 198

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TABLE 5.10

Cash flow for costs and returns based on discounting yield difference between Amazon and Amelonado by 50 per cent

Year	Cash flow (constant) (₦million)	Year	Cash flow (constant) (₦million)
1944/45	- 0.042	1960/61	0.220
1945/46	- 0.071	1961/62	1.008
1946/47	- 0.149	1962/63	1.870
1947/48	- 0.055	1963/64	3.444
1948/49	- 0.050	1964/65	6.351
1949/50	- 0.053	1965/66	6.467
1950/51	- 0.065	1966/67	11.130
1951/52	- 0.064	1967/68	17.902
1952/53	- 0.062	1968/69	30.114
1953/54	- 0.061	1969/70	40.426
1954/55	- 0.110	1970/71	32.172
1955/56	- 0.057	1971/72	25.092
1956/57	- 0.054	1972/73	30.028
1957/58	- 0.249	1973/74	68.649
1958/59	- 0.167	1974/75	131.811
1959/60	0.220	1975/76	120.328

/continued.

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TABLE 5.10 (cont'd)

Year	Cash flow (constant) (₦million)	Year	Cash flow (constant) (₦million)
1976/77	118.499	1991/92	455.492
1977/78	109.808	1992/93	492.422
1978/79	117.982	1993/94	529.038
1979/80	131.807	1994/95	564.259
1980/81	137.766	1995/96	599.289
1981/82	146.866	1996/97	634.151
1982/83	163.040	1997/98	666.827
1983/84	184.062	1998/99	702.868
1984/85	209.720	1999/2000	729.573
1985/86	243.098	2000/01	756.227
1986/87	279.603	2001/02	783.254
1987/88	294.359		
1988/89	332.600	2002/03	805.968
1989/90	373.670	2003/04	828.778
1990/91	415.135	2004/05*	857.868

* The cash flow is not continued beyond this point because thereafter the contribution to the Net Present Worth at the relevant discount rate is practically zero.

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differential reduced by 50 per cent - an assumption that is clearly extreme in the light of available evidence - the internal rate of return would fall by only 8 per cent. We can therefore reasonably conclude that the internal rate of return to investments in cocoa research is about 37 per cent.

5.4. Some policy implications

A 12-per cent return is usually considered an acceptable return to ordinary investment.[10] On this basis, we are justified in concluding that with a 37 per cent internal rate of return, past investments in cocoa research in Nigeria has been yielding high dividends. Thus, in spite of apparent generosity in funding cocoa research in the past, there has clearly been an under-investment in this area. Given Nigeria's commitment to economic growth as a social policy, she will need to place greater emphasis on social profitability as a major operational criterion for determining the size and composition of her investment programme. In this context, cocoa research clearly stands out as an area of investment deserving greater attention than it has so far received. As Griliches,

10 Gittinger, J. Price, Economic analysis of agricultural projects. The John Hopkins University Press, 1972 p.90.

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has remarked, "Conceptually, the decisions made by an administrator of research funds are among the most difficult economic decisions to make and evaluate, but basically they are not different from any type of entrepreneurial decision."[11]

Apart from under-investment in cocoa research in the past, the returns accruing to the Nigerian economy from such investment has been lower than its actual worth. This is because the return includes an externality component, since cocoa production in Nigeria is essentially export-oriented. Thus the consumer surplus (represented by triangle C in Figure 4.5) is passed on to overseas consumers, i.e. manufacturers of cocoa products. A significant reduction in the volume of total cocoa exports through the establishment of local cocoa processing plants, particularly for import substitution, will thus result in a higher rate of return to cocoa research by internalising some or all of the consumer surplus. Returns to investments in cocoa research could be raised even further if breakthroughs could be achieved in current research into cocoa products utilization such that certain

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11 Griliches, Zvi, op.cit.

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products of cocoa which are at present discarded could find profitable uses, as well as by exploring alternative uses for cocoa beans.

Finally, the rate of return to research in other areas of agriculture, especially food crops, is not known; but it is presumed to be low. Given the high pay-offs from investment in cocoa research, the latter could serve as a model in terms of its organisational structure, system of financing, staff recruitment and training policy, etc., thus providing valuable insights into more effective ways of mobilising scarce resources for greater research productivity in these lagging sectors.

5.5. Summary

In this chapter we have attempted to estimate the internal rate of return to investments in cocoa research. The costs involved expenditures on research and extension while the returns were measured by estimating the shifts in the long-term cocoa supply functions using the index-number model developed in the last chapter.

Data for research expenditures were obtained from the audited annual accounts of the West African Cocoa Research Institute from 1944/45 to 1961/62 when the Institute as an inter-territorial organisation was dissolved.

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The proportional share for Nigeria of these expenditures was inputed by weighting the figures by a factor of $\frac{1}{3}$ which is assumed to be the fraction she contributed to the Institutes total funds, based on relative contributions by the Nigerian Cocoa Marketing Board. From 1962/63 to 1976/77 the research expenditures data came from its national successor, Cocoa Research Institute of Nigeria. Since the Cocoa Research Institute of Nigeria also has responsibility for three other crops (kola, coffee and tea) the figures were weighted by $\frac{1}{2}$, as imputed values for expenditures on cocoa research. For the years beyond 1976/77 the average of the five previous years was taken as a constant annual expenditure needed to maintain current stock of knowledge in cocoa research.

Estimates of returns were derived from data on yield profile information provided by the Cocoa Research Institute of Nigeria, together with

(a) data from area of plantings under improved varieties obtained from Western State Ministry of Agriculture and Natural Resources;

(b) world market cocoa prices from Gill and Duffus,

and (c) elasticities of supply and demand for cocoa from a recent empirical study.

In the main the limitations of these data are such as will

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tend to result in an underestimation of returns.

A cash flow table was constructed from the streams of expenditures and net returns, and an internal rate of return computed, employing an iterative procedure. An internal rate of return of 37 per cent was obtained. Sensitivity analysis with respect to yield estimates showed only a small drop in the estimated rate of return. It is therefore concluded that the return to investments in cocoa research in Nigeria is about 37 per cent. This results clearly shows that investments in research in the past have yielded high dividends when it is realized that a twelve-per cent rate of return is usually considered an acceptable return to ordinary investment.

Our findings in this study carry a number of major implications for policy. First, for a developing country like Nigeria with aspirations for rapid economic development, social profitability should be a major consideration in the allocation of resources among various investment options. Given such a decision criterion, cocoa research should rank very high indeed. Secondly, a considerable share of the returns from cocoa research is at present lost to the Nigerian economy in form of consumer surplus. This is because the bulk of cocoa produced is at present exported as beans. Real returns to cocoa research could thus be raised by internalising the consumer surplus through the expansion of local processing and manufacture of cocoa products. Thirdly, returns to research can be raised even further through the intensification of current research by Cocoa Research Institute of Nigeria on utilization of cocoa products which are at present regarded as waste-products. Finally, with its high dividends, cocoa research can point the way to similar achievements in the lagging areas of agricultural research, especially food crops, by serving as a model in terms of organisational framework, staff recruitment and training policy, financing system, and above all the need for more generous funds in a sector that has suffered from gross underinvestment - as clearly demonstrated by the high rate of return to past investments in cocoa research itself.

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CHAPTER VI

RETURNS TO COCOA RESEARCH II

6.1 Production function model

In the last chapter the internal rate of return to investments in cocoa research was estimated using the index-number approach. In this chapter we shall attempt to estimate returns to cocoa research by an alternative approach, the production function approach, using the model developed in chapter IV. This model was specified as

$$Q_t = f(A_t, W_{t-1}, D_t, T, E) \quad . \; . \; . \qquad (1)$$

where

Q_t is output in year t

A_t is total hectares of cocoa trees in production in year t

W_{t-1} is total rainfall from March to October in year t-1

D_t is disease control index for year t

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T is research expenditure in year t-14 plus extension expenditure in year t-4

E is the error term.

A Cobb-Douglas form of production function was fitted to the model with time series data for the period 1944/45 to 1976/77. Our model can therefore be expressed as:

$$Q_t = KA_t^{b_1} W_{t-1}^{b_2} D_t^{b_3} T^{b_4} \quad \ldots \quad (2)$$

where K is a constant and the other variables are as previously defined. Transforming this into a linear function we have

$$\text{Log } Q_t = \text{Log } K + b_1 \log A_t + b_2 \log W_{t-1} + b_3 \log D_t + b_4 \log T \quad \ldots \quad (3)$$

Least square multiple regression techniques were employed in the estimation procedure.

6.2. Sources and limitation of data

6.2.1 Cocoa output: The data used as output are those of the annual cocoa exports between 1944/45 and 1976/77 and were obtained from the Western Nigeria Marketing Board.

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The data are likely to underestimate real output since they ignore the amount smuggled to neighbouring countries. Another source of discrepancy between output and volume of exports is the requirement of local cocoa processing industry. Nevertheless in the absence of reliable information regarding output, tonnage of exports is considered a close approximation to output. Table 6.1 shows annual cocoa exports from 1944/45 to 1976/77.

It may be pertinent to mention here that physical quantity rather than naira value of output was used. This is because, as the dependent variable in this case, it is more stable than gross income, being unaffected by fluctuations in exogenously-determined factors like price.[1] This is important since we are interested principally in this study in the dependence of output on research. For example, research may lead to an increase in physical output of cocoa, but may also result in lower prices and hence lower gross income in the process, given its low price elasticity of demand. Research would thus appear to have had a negative effect on output if gross income were used as a direct measure. On the other hand once

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1 Exogenously-determined, that is, from the standpoint of technical input-output relationship.

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TABLE 6.1

Nigerian export of cocoa beans, 1945-77

Year	Metric tons (to the nearest hundred)	Year	Metric tons (to the nearest hundred)
1945	78,300	1962	197,800
1946	101,600	1963	177,400
1947	112,800	1964	200,000
1948	92,500	1965	298,400
1949	105,700	1966	184,700
1950	101,600	1967	267,300
1951	123,000	1968	238,700
1952	116,600	1969	187,600
1953	105,400	1970	223,000
1954	100,000	1971	308,000
1955	89,800	1972	256,700
1956	119,000	1973	241,300
1957	137,500	1974	214,900
1958	88,600	1975	214,500
1959	145,100	1976	216,200
1960	159,600	1977	215,200
1961	186,900		

Sources: Western Nigeria Marketing Board; Statistical information on Western State of Nigeria controlled produce, Ibadan 1976.

Gill and Duffus: Cocoa market report (series)

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the dependence is determined in physical quantity, this can always be translated into money values using appropriate price adjustments.

6.2.2. Area of trees in production: The area of cocoa trees in production was taken as the annual hectareage of trees with ages ranging from seven to thirty-eight years. This range is based on the estimated economic life-span of the Amelonado variety. The data were derived from the records of annual cocoa plantings obtained from the Western State Ministry of Agriculture and Natural Resources (see Table 6.2).

6.2.3. Rainfall: The rainfall figures required in this study are the totals for March to October for the period 1944 to 1976. These figures were obtained from the Federal Metereological Department in respect of Ibadan, Ile-Ife and Ondo for which complete data were available for the relevant period. The average for the three centres for each year was used as the weather variable (See Table 6.3). One limitation of these data is that rainfall is made to represent the weather variable. Clearly weather includes a whole range of factors like relative humidity, temperature, length of daylight, solar radiation, etc. Ideally, therefore, all these factors should be integrated into

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TABLE 6.2

Estimated areas of cocoa trees in production in Nigeria (7-38 years) 1945-1976/77

Year	Hectares (to the nearest thousand)	Year	Hectares (to the nearest thousand)
1944/45	194,000	1961/62	393,000
1945/46	208,000	1962/63	396,000
1946/47	233,000	1963/64	401,000
1947/48	256,000	1964/65	406,000
1948/49	278,000	1965/66	410,000
1949/50	293,000	1966/67	413,000
1950/51	310,000	1967/68	415,000
1951/52	325,000	1968/69	420,000
1952/53	337,000	1969/70	424,000
1953/54	348,000	1970/71	427,000
1954/55	358,000	1971/72	432,000
1955/56	370,000	1972/73	434,000
1956/57	373,000	1973/74	435,000
1957/58	377,000	1974/75	436,000
1958/59	380,000	1975/76	437,000
1959/60	385,000	1976/77	439,000
1960/61	389,000		

Source: Compiled from Ministry of Agriculture and Natural Resources, Western State records.

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TABLE 6.3

Rainfall in millimetres (March-October)
1944-76

Year	Ibadan	Ile-Ife	Ondo	Average
1944	920	1020	1327	1089
1945	897	1067	1260	1075
1946	720	1360	944	1008
1947	1232	1218	1263	1238
1948	748	1338	1163	1083
1949	1127	1093	1133	1118
1950	773	1215	1140	1042
1951	1117	1095	1480	1230
1952	998	1467	1489	1318
1953	1022	1382	1317	1240
1954	1047	1302	1460	1270
1955	1345	1352	1255	1318
1956	704	1015	1268	995
1957	1503	1038	1158	1500
1958	962	1892	1077	1310
1959	1009	1186	1226	1140
1960	1320	838	1173	1110
1961	875	898	1063	945
1962	1462	1489	1384	1445
1963	1148	1508	1408	1355
1964	1138	1653	1453	1430
1965	1167	1412	1374	1318

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TABLE 6.3 (cont'd)

Year	Ibadan	Ile-Ife	Ondo	Average
1966	1068	1313	1323	1225
1967	796	1347	1235	1126
1968	1712	2052	2035	1933
1969	1141	1509	1511	1387
1970	1469	1214	1301	1335
1971	920	1079	1292	1097
1972	771	1472	1055	1099
1973	1309	1079	1487	1292
1974	1124	1316	1607	1349
1975	1054	823	982	953
1976	884	1006	1086	992

Source: Nigerian Meteorological Service

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a composite variable. However, apart from the methodological problems involved in this approach, there are no consistent data over the period under consideration for most of these other factors. Moreover rainfall is probably the most important weather factor as far as variability in cocoa output from year to year is concerned. This is because it is known to affect pod formation[2] on the one hand, and through relative humidity, the incidence of blackpod disease on the other. Since these two effects of rainfall bear most directly on cocoa output it seems not unreasonable to use rainfall as a proxy for the weather variable in our model. Another possible limitation of these data is that the average rainfall for Ibadan, Ile-Ife and Ondo may not be strictly representative of all cocoa-growing areas in the country. However, representing as they do the biggest producing area in terms of tonnage, the effect of rainfall on output in these places can be expected to reflect the situation on aggregate cocoa output.

6.2.4. Disease control index: The disease control index is based on the hectareage equivalent of the annual

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2 See McKelvie, A.D., The relationship between rainfall and main crop yield. Report of the cocoa conference 1957. p. 48.

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consumption of fungicides and capsidicides. Since disease control through the use of chemicals as a mass programme did not start until 1957/58 the annual disease control index for each of the years between 1944/45 and 1956/57 was taken as zero. The data for 1957/58 to 1967/68 were obtained from a recent work by Oni,[3] while those for the years 1968/69 to 1976/77 were obtained from the Western Nigeria Marketing Board. From the hectareage equivalents of chemical consumption a disease control index was derived year by year, following Oni[4] (See Table 6.4).

One possible limitation of the data may be that not all the chemicals might actually have been used in pest and disease control since some might have been hoarded, used for purposes other than for cocoa production, or even smuggled to neighbouring countries for sale, given heavy subsidisation of supplies. This may result in over-estimation of the degree of disease control. Against this however must be set the omission in the

3 Oni, S. A., op.cit. p.177.

4 Oni, S. A., op.cit.

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index, of non-chemical control measures: for example uprooting of disease-infected trees. This measure was used extensively in the forties and early fifties in the wake of government's efforts to control the swollen shoot virus disease. Such a technique may be significant considering that there is no other known control for this disease except by breeding tolerant/resistant cocoa varieties.

6.2.5 Research and extension expenditures: Research expenditures data were derived from the audited accounts of the West African Cocoa Research Institute for the period 1944/45 to 1962/63, and Cocoa Research Institute of Nigeria from 1963/64 to 1976/77. Nigeria's share of annual research expenditure was imputed by weighting the figures of the West African Cocoa Research Institute by $\frac{1}{3}$, this factor being chosen on the basis of her contribution to the Institutes endowment fund. Similarly the Cocoa Research Institute of Nigeria figures were weighted by $\frac{1}{2}$ as the proportion of resources devoted to cocoa.

Extension expenditures data were collected from the Western Nigeria Annual Estimates, the annual expenditure records of the Special Cocoa Development scheme and the Western State Cocoa Development Unit. Since the expenditures from these sources are only in respect of Western

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TABLE 6.4

Disease control index

Year (Oct-Sept)	Estimated hectares in production A	Hectares Sprayed against black pod B	Hectares sprayed against capsid C	Hectares of Swollen shoot virus disease uprooted D	Disease Control Index $\frac{B + C}{A - D} \times 100$
1957/58	373,750	16,992	21,280	-	10.24
1958/59	372,890	22,590	63,840	230	23.19
1959/60	373,420	47,616	107,280	380	41.52
1960/61	373,780	51,630	103,650	490	41.58
1961/62	371,450	61,000	96,600	260	42.46
1962/63	389,710	68,990	153,300	90	57.05
1963/64	366,260	82,790	227,430	130	87.73
1964/65	367,270	110,500	339,610	50	122.57
1965/66	368,164	109,210	136,240	-	66.67
1966/67	368,760	155,710	237,350	30	106.60
1967/68	367,650	223,950	164,750	30	105.73
1968/69	420,020	25,980	146,330	-	41.02
1969/70	424,450	20,990	254,250	-	64.85
1970/71	427,320	21,414	407,730	-	100.43
1971/72	432,120	36,080	371,090	-	94.23
1972/73	434,210	7,280	181,040	-	43.37
1973/74	435,430	25,760	339,520	-	83.89
1974/75	436,020	12,810	156,070	-	38.73
1975/76	437,380	19,540	185,810	-	46.95
1976/77	439,250	15,970	770,750	-	179.11

Sources: Oni, S.A., An econometric analysis of the provincial and aggregate supply responses among Western Nigeria cocoa farmers. Unpublished Ph.D thesis, University of Ibadan 1971.

Western Nigeria Marketing Board : Statistical information on Western State of Nigeria controlled produce (series).

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TABLE 6.4

Disease control index

Year (Oct-Sept)	Estimated hectares in production A	Hectares Sprayed against black pod B	Hectares sprayed against capsid C	Hectares of Swollen shoot virus disease uprooted D	Disease Control Index $\frac{B + C}{A - D} \times 100$
1957/58	373,750	16,992	21,280	-	10.24
1958/59	372,890	22,590	63,840	230	23.19
1959/60	373,420	47,616	107,280	380	41.52
1960/61	373,780	51,630	103,650	490	41.58
1961/62	371,450	61,000	96,600	260	42.46
1962/63	389,710	68,990	153,300	90	57.05
1963/64	366,260	82,790	227,430	130	87.73
1964/65	367,270	110,500	339,610	50	122.57
1965/66	368,164	109,210	136,240	-	66.67
1966/67	368,760	155,710	237,350	30	106.60
1967/68	367,650	223,950	164,750	30	105.73
1968/69	420,020	25,980	146,330	-	41.02
1969/70	424,450	20,990	254,250	-	64.85
1970/71	427,320	21,414	407,730	-	100.43
1971/72	432,120	36,080	371,090	-	94.23
1972/73	434,210	7,280	181,040	-	43.37
1973/74	435,430	25,760	339,520	-	83.89
1974/75	436,020	12,810	156,070	-	38.73
1975/76	437,380	19,540	185,810	-	46.95
1976/77	439,250	15,970	770,750	-	179.11

Sources: Oni, S.A., An econometric analysis of the provincial and aggregate supply responses among Western Nigeria cocoa farmers. Unpublished Ph.D thesis, University of Ibadan 1971.

Western Nigeria Marketing Board : Statistical information on Western State of Nigeria controlled produce (series).

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Nigeria, they were weighted by a factor of 1.05 in order to relate them to the whole country, on the assumption that 95 per cent of the country's total cocoa output comes from Western Nigeria[5].

The research variable in our model consists of research expenditure lagged 14 years plus extension expenditure lagged 4 years. As explained in Chapter IV the assumption here is that it will take 10 years on the average for research expenditure to mature in terms of reaching the stage of mass adoption of its findings. This assumption is based on the fact that it took 10 years (1944-1954) for the Amazon variety to be developed and adopted in Nigeria on a mass scale. Further, as a tree crop, it takes another 4 years from planting before coming into production. There is thus a total of 14 years gestation period between expenditure in research and the beginning of its pay-off. In other words, a research expenditure in year t does not result in any pay-off until the year t + 14. Similarly extension expenditures are assumed to have a gestation period of 4 years since

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5 For fuller details on source and much of the treatment and limitation of data on research and extension expenditures as may be applicable to this section see Chapter V page 9.

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annual expenditures involve mainly activities connected with cocoa planting and establishment e.g. production of seedlings, extending of technical information on planting methods, production grants and loans, etc. By their nature these expenditures will not begin to pay off until the trees come into production in the 4th year. Table 6.5 shows the research and extension expenditures.

The bulk of research expenditures is made up of the cost of scientific and other research personnel, laboratory equipment and other infrastructural facilities. Given the nature of these costs it is clearly inappropriate to deflate them by the consumer price index. Moreover increases in costs in research personnel, equipment and other research resources over the years are likely to be as much a reflection of quality changes as they are of changes in price levels.[6] To some extent, the same goes for extension expenditures. Given the need to bring out these quality changes over time (in view of the crucial

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6 For example scientific research personnel can be expected to change in quality over time through formal training (e.g. post-graduate courses), on-the-job experience, seminars, workshops etc., with corresponding rise in remunerations. Equipment tend to change in quality over time as old ones are replaced with more sophisticated and up-to-date, and, therefore, higher priced versions.

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TABLE 6.5

Research and extension expenditures (₦million)

Year (April-March)	Annual research expenditure R_t	Annual extension expenditure E_t	Lagged research expenditure R_{t-14}	Lagged extension expenditure E_{t-4}	Research/ extension Variable $T=R_{t-14}+E_{t-4}$
1944/45	0.038	-	-	-	-
1945/46	0.064	-	-	-	-
1946/47	0.134	-	-	-	-
1947/48	0.050	-	-	-	-
1948/49	0.046	-	-	-	-
1949/50	0.050	-	-	-	-
1950/51	0.061	-	-	-	-
1951/52	0.061	-	-	-	-
1952/53	0.061	-	-	-	-
1953/54	0.061	-	-	-	-
1954/55	0.115	-	-	-	-
1955/56	0.062	-	-	-	-
1956/57	0.062	-	-	-	-
1957/58	0.061	0.230	-	-	-

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TABLE 6.5 (cont'd)

Year (April-March)	Annual research expenditure R_t	Annual extension expenditure E_t	Lagged research expenditure R_{t-14}	Lagged extension expenditure E_{t-4}	Research/ extension Variable $T=R_{t-14}+E_{t-4}$
1958/59	0.058	0.322	0.038	-	0.038
1959/60	0.058	0.410	0.064	-	0.064
1960/61	0.057	0.518	0.134	-	0.134
1961/62	0.317	0.400	0.050	0.230	0.280
1962/63	0.199	0.358	0.046	0.322	0.368
1963/64	0.198	0.272	0.050	0.410	0.460
1964/65	0.200	0.280	0.061	0.518	0.579
1965/66	0.199	0.286	0.061	0.400	0.460
1966/67	0.208	0.300	0.061	0.358	0.419
1967/68	0.267	0.246	0.061	0.272	0.333
1968/69	0.231	0.292	0.115	0.280	0.395
1969/70	0.303	0.292	0.062	0.286	0.348
1970/71	0.378	0.260	0.062	0.300	0.362
1971/72	0.378	0.260	0.061	0.246	0.307

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TABLE 6.5 (cont'd)

Year (April-March)	Annual research expenditure R_t	Annual extension expenditure E_t	Lagged research expenditure R_{t-14}	Lagged extension expenditure E_{t-4}	Research/extension variable $T=R_{t-14}+E_{t-4}$
1972/73	0.427	0.252	0.058	0.292	0.350
1973/74	0.516	0.462	0.058	0.292	0.350
1974/75	0.750	0.650	0.057	0.260	0.317
1975/76	0.785	1.620	0.317	0.260	0.577
1976/77	1.012	2.995	0.199	0.252	0.451

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significance of resource quality for research output) the research variable is left undeflated.

6.3 Empirical results

The coefficients obtained by fitting the production function to time series data are presented in Table 6.6. It can be seen that in terms of overall fit our model is a good one as indicated by the value of the coefficient of multiple determination. In effect about 84 per cent of the variation in output is explained by the model. The Durbin-Watson test statistic indicates the absence of autocorrelated errors. Our model can therefore be said to be useful for predictive purposes.

Although we are principally concerned in this study with the research variable, the results as they affect other variables in terms of overall relationship may be mentioned in passing. Area of cocoa in production was found to be a significant variable with the expected positive sign. The weather variable has a negative sign. This is not unexpected when it is remembered that rainfall tends to raise relative humidity which in turn leads to a high incidence of black pod disease and hence a decline

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TABLE 6.6

Estimates of the aggregate Cocoa production function

Area in production A_t	Weather W_{t-1}	Disease control D_t	Research T	Durbin-Watson test statistic	Coefficient of Determination R^2
0.405**	-0.217	0.002	0.056**	2.089	0.843
(0.139)	(0.203)	(0.004)	(0.006)		

Standard error of estimate in parentheses

** Highly significant

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in cocoa output. The value of its coefficient is however not significant. The disease control variable has the expected positive sign although its coefficient is not significant. (The lack of significance may be due to the fact that disease control is itself an outcome of research. The research variable may thus in part have taken care of the disease control component. This probably explains the high multi-colinearity between the two variables - see next paragraph). Finally the research variable has the expected positive sign with a level of significance at 0.001.

The simple correlation matrix (Table 6.7) shows that there is a serious multicollinearity between the research and the disease control variables. For this reason the model was estimated with the disease control variable omitted.[7] However this made virtually no difference to the magnitude of either the coefficient of multiple determination or the research coefficient. The research coefficient in this case (like any regression coefficients

7 Following Heady and Dillon, only a coefficient greater than 0.80 is here considered so high as to warrant dropping one of the variables so correlated from the regression analysis. See Heady, E.O. and J.L. Dillon, Agricultural production functions, Iowa State University Press, 1961, p.136.

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TABLE 6.7

Simple correlation of the variables used in the time series production function

	Output Q_t	Area in production A_t	Weather W_{t-1}	Disease Control D_t	Research T
Q_t	1.000				
A_t	0.767	1.000			
W_{t-1}	0.078	0.280	1.000		
D_t	0.845	0.803	0.154	1.000	
T	0.906	0.753	0.128	0.899	1.000

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in the analysis) is the elasticity estimate. Since our main focus in this study is on returns to research, this was converted to marginal product, given by

$$y = \frac{Q_t b_4}{T} \quad \text{.........} \quad (4)$$

where y is marginal product, Q_t and T, taken at their mean levels, are as defined previously, and b_4 is the coefficient of T.

Substituting the relevant data in equation (4) the marginal product comes to 0.048 metric ton per naira of research expenditure. Converting this to naira value by multiplying by the average of cocoa prices (in real terms) for the period 1958/59 to 1976/77 (414 per metric ton) we obtain ₦20.09. Our estimate of marginal return to cocoa research is thus about ₦20.

6.4 Comparison of results with that of the index-number approach

How does our finding in respect of marginal return compare with the rate of return obtained under the index-number approach in Chapter V? For such a comparison the marginal return of ₦20 was converted into an internal rate of return. This is the rate of interest which makes the accummulated value todate of one naira invested a

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certain number of years ago equal to the discounted present value of a fifteen-naira annual return into perpetuity. This can be expressed algebraically as

$$(1+r)^n = y \sum_{k=1}^{m} \frac{1}{(1+r)^k} \quad \ldots\ldots\ldots\ldots (5)$$

where n is the period in years between expenditure and pay-off,

m is period in years between now and end of the pay-off,

y is marginal return,

r is the internal rate of return.

Equation (5) relates to a "homogeneous" naira expenditure. However, the naira yielding a marginal return of ₦20 in this study is a "composite" one, made up of a research component and an extension component with different periods of gestation. The equation thus needs to be modified to take account of this. For this purpose we need to know the proportional share of each component in the investment, in addition, that is, to their respective gestation periods. Given this, the equation for a composite investment can be expressed generally as follows:

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$$\sum_{j=1}^{m} p_j(1+r)^h = y \sum_{k=1}^{n} \frac{1}{(1+r)^k} \quad \ldots \quad (6)$$

with

$$\sum_{j=1}^{m} p_j = 1 \quad \ldots\ldots\ldots\ldots\ldots \quad (7)$$

where m is the number of components constituting the investment,

p_j is the proportional share of the j^{th} component of the investment,

h is the gestation period in years of the j^{th} component of the investment,

n is the future period in years over which the present value of y is to be earned,

y is the marginal return to the investment,

r is the internal rate of return to the investment.

For this study the corresponding values for the variables defined above are as follows:

m is 2 (research and extension)

p_j are 1/3 and 2/3 respectively. These were based on the average annual expenditure of research between 1944/45 and 1976/77, and of extension between 1958/59 and 1976/77, the ratio of the former to the latter being estimated at 1:2,

h is 14 for research and 4 for extension,

n is for practical purposes in perpetuity,

y is ₦20.

and r is the internal rate of return being estimated.

Substituting these values in equation (6) and estimating the internal rate of return by an iterative procedure a figure of 42 per cent was obtained. This compares favourably with an estimate of 37 per cent by the index-number approach.

6.5. Policy implications

In chapter V, certain policy implications arising from the magnitude of our estimated internal rate of return were highlighted. These policy implications apply a fortori to the findings in this chapter, given an even higher estimate of the rate of return obtained under the production function approach.

6.6. Summary

This chapter has been concerned with estimating the returns to investment in cocoa research by an alternative

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approach, the production function approach, as well as by employing a different data base. Our production function model involves cocoa output as the dependent variable with total area of trees in production, weather, disease control, and research as explanatory variables. A Cobb-Douglas form of production function was estimated by means of least square multiple regression on time series data.

Cocoa output data were based on annual exports. Area of trees in production was taken as the annual hectareage of trees ranging in age from 7-38 years. The weather variable was represented by total rainfall figures from March to October, taking the average for Ibadan, Ile-Ife and Ondo from 1944 to 1976. The disease control variables was based on hectareage equivalents of annual quantities of fungicides and casidicides supplied to farmers by the Western Nigeria Marketing Board.

The research variable was made up of annual research expenditure lagged 14 years plus annual extension expenditure lagged 4 years. This was based on the assumption that it takes about 10 years for research expenditure to result in a finding and for such a finding to become

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widely adopted. For a tree crop like cocoa it takes a further 4 years for the effect of the finding to begin to pay off; bringing the period between research expenditure and pay-off to 14 years. Similarly extension expenditures, most of which come at the beginning of planting of cocoa farms, do not mature until the 4th year.

Empirical results from the estimation of our production function showed that the model has a good explanatory power with a coefficient of multiple determination of 0.84. The Durbin-Watson test statistic showed an absence of auto-corrolated errors. We can therefore employ the model for predictive purposes. All the variables have the expected signs, with two of them (including the research variable) being highly significant.

The research variable was significant at a level of 0.001. Its coefficient converted to marginal return gave a value of ₦20.00. In order to compare this return with that obtained in the last chapter an estimate of internal rate of return was derived from the marginal return. The figure of 42 per cent compares favourably with 37 per cent estimated internal rate of return obtained using a different approach reported in the last chapter. We can therefore reasonably conclude that the internal

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rate of return to investments in cocoa research is about 42 per cent. The policy implications arising from the findings in this chapter are thus the same as those highlighted in chapter V, except that with the higher estimated return from this model they assume a greater urgency.

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CHAPTER VII

POLICY IMPLICATIONS

The last decade has witnessed a growing official concern over food production and productivity in Nigeria. This has derived from inadequate supplies resulting in inflationary food prices and mounting food import bills. Such concern is reflected in increasing resource commitment to food production campaigns, such as the National Accelarated Food Production Project (NAFPP), National Seed Service Scheme, the Fertilizer Subsidy and Distribution Programme, etc; cummulating in recent years in the all-embracing Operation Feed the Nation (OFN). Yet, despite the government's eagerness to encourage the commitment of an even greater resources to agriculture in the coming years[1] the absorptive capacity of the food production sub-sector is at present severely constrained by a lack of opening for new investment opportunities through a constant flow of innovations and improved technology.

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1 This can be seen in recent federal government measures such as the land-use decree, the guarrantee scheme for agricultural loans, the 5-year holiday tax for agricultural plantations, etc.

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Among the major policy implications of this study that were highlighted in chapter V is the need for reform in the organisational and institutional framework in the lagging areas of agricultural research, especially in food crops. As was noted in chapter III the organisation of cocoa research from its inception has always been such as to guarrantee a large measure of administrative, financial as well as institutional autonomy. Our findings indicating a high return to investments in cocoa research thus lend credence and quantitative support to the impressions that such organisational arrangements facilitate effective use and mobilisation of research resources.

By contrast, food crops research has traditionally been run as part of the civil service with its bureaucratic rigidity characterised by administrative delays, inept financial regulations and accounting procedure, and a reward system that places undue emphasis on seniority as a criterion for career advancement. Given the environment within which food crop research has had to operate therefore, it is little wonder that it has made little or no impact on the food farming economy. What are the key areas that call for organisational reform if food crops research is to achieve greater operational efficiency?

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To the extent that the experience in cocoa research is anything to go by, we can identify at least three major aspects. These include research administration, research funding, and the training of research personnel.

7.1 New dimensions in research administration

As was noted in Chapter III the administrative framework for cocoa research, both at the inter-territorial and national levels, guarranteed a considerable measure of functional autonomy. Thus it had its own management board that was responsible for formulating its policies with regard to research programmes, financial appropriations, staff conditions of service, etc., while the Director had full responsibility for the day-to-day running of the institute. Such an arrangement allowed for a flexibility of approach at both the policy and the execution levels.

Over the last decade or so there has been a trend towards giving greater autonomy along similar lines to the erstwhile civil service research establishments, cummulating in the creation of fourteen research institutes[2]

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2 See Appendix IV for details.

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under the general supervision of the Agricultural Research Council of Nigeria, a body that has recently been superseded by the National Science and Technology Development Agency.[3] In general these institutes have been constituted so that each restricts its activities to a specific commodity or group of related commodities. For example the National Cereals Research Institute is charged with the responsibility for research into rice, maize and grain legumes, while the National Root Crops Research Institute deals with cassava, yam and potatoes. The national coverage in their research activities necessitates the establishment of sub-stations in various ecological zones all over the country.

While it is yet too early to assess the full impact of the new set-up on research administrative effeciency, one particular aspect deserves some comment. This is the issue of national coverage by each institute in specific crops. First, it is not clear to what extent the new arrangement has actually prevented overlapping or even duplication of research efforts among research institutes. For example the National Cereals Research Institute is

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3 For an account of the various attempts at organisational reforms since 1971 see pages 42-43.

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supposed to work on rice, maize and grain legumes throughout the country. However it is known that the Institute for Agricultural Research, Samaru also works on maize among other crops. The reason usually given is that the latter is affiliated to the university and therefore should have no restriction placed on the scope of its research activities since it must acquire research information on any crop for the purpose of teaching. The same argument is advanced for the Institute of Agricultural Research and Training which is in a similar position. Yet all of these institutes derive their funds from the same direct source, the National Science and Technology Development Agency.

Secondly, while the idea of research institutes with national responsibilities may appear attractive, it seems more appropriate, and may even perhaps be the only alternative, for small countries. Given the geographical size and ecological diversity of Nigeria - against the background of a poor communication network, inadequate transport facilities and serious shortage of research personnel - the assumption of a nation-wide research responsibility by an institute poses enormous administrative problems, resulting in spreading scarce resources too thin on the

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ground for any real impact. It is here suggested that a more effecient arrangement in the Nigerian context is one in which the scope of an institute is restricted to a specific ecological zone. The crops that are important in that ecology will then be the materials to work with - a case, in other words, of each institute specialising along ecological lines rather than along commodity lines. The result of this will be that no research institute administrative headquarters will be more than a couple of hundred of kilometres from the most remote of its experimental sites. Apart from the greater administrative efficiency that can be expected, considerable resources at present used in constant commuting between headquarters and outstations and experimental plots could be conserved for actual research work. Furthermore, it will result in a fewer number of research institutes and hence a greater share of existing research resources for each institute.

Thirdly, the "criteria of relevance" in the determination of research priorities suggests that at the country's level of socio-economic development, research activities based on sole cropping is unlikely to find acceptance among the generality of farmers in the forseeable

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future. On the contrary it has been found that there are "valid reasons of a technological, sociological and economic nature for farmers' reluctance to change to a sole cropping system."[4] A research programme based on sole croppihg (as is inevitably the case in an institute specialising in specific crop area as under the present set-up) is to that extent irrelevant. Thus mixed cropping as an ecologically-determined factor will fit into an ecological-specialization arrangement.

In summary, the present arrangement will seem to constitute a strain on efficiency to the extent that it stretches scarce resources too thin on the ground, while not succeeding in removing overlapping of efforts among research institutes. Above all the main focus of research activities seems to be on sole cropping, whereas by applying the criteria of relevance to our research priorities the emphasis should be on mixed cropping. Such re-orientation calls for the organisation of the institute on the basis of ecological considerations rather than on basis of specific crops on a country-wide scale.

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4 Norman, D.W., Crop mixtures under indigenous conditions in Northern Nigeria. Proceedings of the conference on factors of economic growth in West Africa, ISSER. Legon 1971.

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7.2 New approach to research funding

One major implication of the high rate of return to cocoa research obtained in this study is that cocoa research suffers from gross underinvestment. For agricultural research as a whole such underinvestment can be expected to be even more pronounced. For instance according to Abaelu, Nigeria spent an estimated expenditure of 35 kobo per farmer on scientific research in 1971/72, compared with an annual expenditure of ₦56 by the United States.[5] Yet meagre as the resources devoted to research is when compared with those of developed countries, such resources are even less productive.[6] Given the scarcity of investible resources in many developing countries, raising research productivity through a more effective use and deployment of existing resources may well be the only feasible alternative to raising research productivity in the short run, and probably even in the long run if only to avoid the dissipation of additional resources when they do become available. How effective

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5 Abaelu, J. N. Building the foundations of Nigeria's agricultural growth: public expenditures on agricultural research. Bulletin of Rural Economics and Sociology, 8(1); 61-75.

6 Evenson, R.E. and Y. Kislev, Agricultural research and productivity. New Haven Yale University Press, 1975.

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has been the use of resources in agricultural research in Nigeria? There are of course many factors affecting the effectiveness of resource use. One major factor is the funding arrangement.

As has been noted, the funding arrangement for cocoa research were such as to guarantee long-term financial stability. For example, in the case of the West African Cocoa Research Institute, funds were made available for a 20-year period. So comfortable was its financial position that by the time it wound up as an inter-territorial organisation the balance of its endowment stood at almost ₦4 million as at 1st April 1962. Its successor, the Cocoa Research Institute of Nigeria, enjoyed much similar financial arrangement.[7]

By contrast the funding of food crops research has been tied to the annual government budgetary appropriations, and are thus subject to the vagaries of government fiscal policies. In the event, effective forward planning is difficult even on an annual basis, and almost impossible on a long-term basis. Worse still the April-March fiscal year means that whatever funds are to be allocated are

7 See Chapter III

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not known before the first day of April and may not be made available for many weeks thereafter. Yet major preparations for the year's agricultural research programmes need to be carried out well before the rains which are normally on by March. Furthermore, any vote remaining unspent by the end of March automatically lapses. This poses serious problems of expenditure timing. Experience has shown that in order to avoid their votes lapsing government departments usually go on a spending spree towards the end of the fiscal year, often on store items that may not be urgently required. This situation tends to aggravate the shortage of funds for essential research activities.

With the establishment of the Agricultural Research Council of Nigeria whose statutory responsibility included the funding of research, it was hoped that a more rational financing system for research would emerge. The hope appeared justified when in 1975 the Council introduced the programme budgeting system in the research institutes. However it soon became apparent that nothing much had changed, annual budgetary allocations for research as for other areas having continued to be based on no

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discernibly rational criteria. In particular, the same uncertainty as to the level of funds to be had for any fiscal year remains. There is thus a need to over-haul the entire system of financing agricultural research in the country if existing funds are to be put to more effective use. For a start, research financing needs to be placed on a long-term footing. For example it should be possible for allocations to be made to research through the National Science and Technology Development Agency on at least a five-year basis. Furthermore since funds are likely to be far short of requirements, allocation should be based on well-formulated research priorities based on perspective planning.

7.3 Training of research personnel

Perhaps the most crucial resource in research is personnel. This is because research is a creative occupation, rather than something of a mechanical process. It therefore demands high-calibre talents and specialized skills. In this context the training of personnel is of utmost importance in achieving a high level of efficiency in research. The training of research personnel could be considered at two levels. The first is the training of

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research scientists, while the other is the training of technical supporting staff.

In research establishments the world over research scientists are normally recruited from the ranks of university graduates, usually with post-graduate degrees in relevant subjects. Only such trained personnel are deemed to be capable of undertaking independent, original research. However, owing to the scarcity of fully trained research scientists, the practice in most research establishments in Nigeria has been to recruit fresh graduates with only a first degree with a view to sending them for post-graduate training after one or two years. The technical supporting staff include such cadres as laboratory technologists, technicians and miscellaneous field staff. In many research institutes there seems to be no clear-cut training policy for laboratory technologists and technicians, many of the staff in these cadres having been originally employed with requisite qualifications for the job, or enrolling for the relevant courses on a part-time basis on their own initiative.

How effective has the institutes training policy been, particularly in respect of research scientists? While the training policy has undoubtedly succeeded in raising

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the supply of scientific manpower in various disciplines, one or two flaws have become noticeable. First, until now training of research scientists has taken place abroad where conditions are generally different from those obtaining in Nigeria. Consequently the returning trainee sometimes suffers from a certain disorientation having to work with generally less sophisticated equipment and on research problems that appear far less glamorous, if more relevant to local agriculture. This has in some cases led to a drift of such research staff to the universities where they could at least work in a more academic environment not too dissimilar to what they were accustomed to in their training abroad. Secondly, the conditions of service in the research institutions have always been generally inferior to those of the universities. For example, whereas a Ph.D holder is appointed a lecturer on grade level 10 in the university, in the institute such a fellow can only be appointed as research officer grade I on grade level 09. Such disparities serve to intensify the drain from the institutes. The effect of this is the rapid turnover of trained staff with consequent disruption in the continuity of research programmes.

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Recent developments - notably diminishing supply of training funds, a growing difficulty of placement in foreign universities and an expanding number of research establishments - have led to expansion of facilities for post-graduate training in the local universities. This will hopefully lead to greater relevance in training and orientation to the conditions under which the trainees would work. In this connection there is need for the university faculties to work in close collaboration with the research institutes in evolving suitable post-graduate programmes. For instance, under such an arrangement it should be possible for candidates registered for higher degrees to work on aspects of on-going research programmes in the institute under the supervision of experienced research scientists in the Institute.

As for the problems of training of supporting staff, there are two aspects to it. First, the agricultural assistant/superintendent cadre who are mainly field staff. Since this group is at present trained in schools of agriculture originally established to train extension staff, their training has only a peripheral bearing on the requirements of research. It has been suggested in this connection that a special school with bias for research requirements

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be established to train research field workers.[8] The second aspect is the training for laboratory technologists. The situation at the moment is that this category of staff in the institutes enrol mostly on part-time basis for courses normally organised by the University of Ibadan for its own staff, leading to the award of the London City and Guild. Clearly dependence on this kind of arrangement as a major source of supply for such a key cadre of research staff is unsatisfactory. With as many as eighteen agricultural research institutes in the country there is an urgent need to establish schools to cater specifically for the training of agricultural laboratory technologists and technicians. Apart from providing a regular source of supply of this category of staff, there will be greater relevance in their training in terms of course content and orientation.

All in all, the training policy of research personnel needs to be critically reviewed with a view to enhancing its contribution to research productivity. First, post-graduate training for research scientists should emphasise participation by trainees in on-going research projects in their respective institutes. Thus, after the required

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8 FAO, Agricultural Development in Nigeria 1965-80. Rome. 1966, p.316.

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academic course work, the thesis should be based on aspects of the institute's research project, making use of available facilities within the institute. This might involve cooperative arrangements whereby experienced research scientists within the institute could be made at least a member of the committee of supervisors. Apart from making a positive and effective contribution to the institute's research programme while in training, the trainee will find himself better adjusted to the conditions under which he will have to work.

Secondly, training should be based on the identifiable requirements of each institute. For instance, there appears no conscious effort on the part of research institutes to identify areas of critical need at the recruitment stage. Rather, it would seem that scientific staff are recruited and appointed under a blanket title of "pupil research officer" with no specification as to particular specialties to which they are being appointed. Thus even with the relative specialisation at the first-degree level, a candidate with BSc (Agricultural Biology), for instance, is appointed a "pupil research officer" with little more than a vague assumption that he could fit into any field such as plant breeding, entomology or

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plant pathology. What determines the field he is eventually trained in at the post-graduate level may have nothing to do with the need of the institute. The effect of this is the existence of relatively abundant supply of personnel in some disciplines side by side with critical shortages in others. Training and recruitment policies thus need to be coordinated, so that staff are appointed not just under the blanket title of "pupil research officer" but as "pupil research officer (entomology)", "pupil research officer (plant breeding)" etc.

Thirdly, given the critical shortage of laboratory and other supporting staff, there needs to be a definite training policy for this category of staff as in the case of research scientific personnel. In particular there is need for the establishment of appropriate schools of agriculture and laboratory technology. In this context, research authorities could borrow a leaf from the field of medicine where a number of medical laboratory schools are already in existence.

Finally, in terms of effective overall utilization of trained research personnel in general, it is time appropriate scientific staff/supporting staff ratio was established. This would lead to greater rationalisation

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of the training policy as opposed to the present *ad hoc* decision rules of recruitment and training of staff in various cadres as well as of various disciplines in research.

7.4 Policy prescriptions

So far in this chapter we have considered certain factors that have been diagnosed as contributing crucially to the productivity of cocoa research, and their implications for enhancing the productivity of other areas of research, especially food crops. Beyond these identified factors, we shall in this section explore certain policy prescriptions, the adoption of which could result in greater rationalisation of the whole process of agricultural research as an investment venture with *expected* future pay-offs, rather than as some routine services whose provision is taken for granted.

7.4.1. Periodic research review: Throughout the history of agricultural research in this country there has never been any formal arrangement for periodic research review. Such changes as have been brought about in content or direction of research have resulted from *ad hoc* measures such as legislation or reorganisation. For example, responsibility for research in coffee and kola was given

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to the Cocoa Research Institute of Nigeria by an Act of Parliament following the dissolution of its predecessor, the West African Cocoa Research Institute, which was concerned exclusively with cocoa research. Similarly, in recent years, the creation of new research institutes has been brought about through the reorganisation of research administration resulting in the establishment of the Agricultural Research Council of Nigeria, and later the National Science and Technology Development Agency. Such <u>ad hoc</u> changes are likely to be haphazard since they originate from unrelated events and are therefore likely to be injurious to research in the long run.

The existence of a periodic review machinery, say every five years, should go a long way in eliminating much of the instability in research organisation that has been witnessed over the last few years. Such review could evaluate research in terms of its achievements, problems, resource constraints, and the relevance of its programmes in the light of current government policies. Furthermore such review would be done on sub-sectoral basis. Thus food crops research would be reviewed, so that all institutes dealing with food crops would be evaluated for their effectiveness in raising productivity in food production.

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The report of the review should then form the basis for changes in research re-organisation, be it in administration, funding,training of research personnel or the creation of new research institutes as may be necessary.

7.4.2 Research information utilization: The utilization of research information is the fundamental objective of applied research. In view of its crucial role in raising returns to investments in agricultural research, this item will be discussed in some detail. In Nigeria the utilization of agricultural research information has been generally poor. It is often claimed that there is a wide gap between available research knowledge and its application at the farmer's level, such gap being attributed to a whole range of factors among which are farmers' resistance to change and poor performance by the extension services. Yet,as we have found in this study, the utilization of research knowledge in cocoa production (as evidenced by the high rate of return) has taken place within the same social and institutional framework. If so, it is here suggested that the gap between available research information and farmers' practice has a more fundamental cause than the reasons that are usually advanced. In a recent

study

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study,[9] for instance, it has been found that the Western Nigeria Cotton Scheme - a scheme with an integrated research and extension set-up - failed largely because its research findings were irrelevant to the farmers' resource situation. Furthermore such findings were usually so rigidly prescribed as to leave the farmer with only two options: to accept the findings in its entirety, or to reject. Since the findings were normally out of tune with farmers resource situation, they were invariably rejected.

How can the utilization of research information be enhanced so as to raise the returns to investments in agricultural research? First, research policy must take cognisance of the criteria of relevance. Thus research work directed at the traditional farmers must come to grips with the issue of farming systems as a framework for introducing improved practices, rather than the present preoccupation with sole-cropping. Secondly, agricultural research in this country has for long been the exclusive preserve of the technical scientists. With increasing realisation of the need for a multi-disciplinary approach

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9 Abidogun, A., Agricultural Research in Nigeria: towards greater relevance for the farm-firm. Journal of Rural Economics and Development 11(1), 1977 (in press)

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to the problems of agricultural production, the economist has recently gained entry. Whilst he is beginning to contribute towards rationalizing research recommendations, for instance by the estimation of production functions from the results of completed experiments,[10] he has participated very little todate in experimental design itself. Yet this is an area in which his involvement could yield the highest dividends in terms of greater acceptability of research recommendations. The usual approach to experimental design is to select a few observations (treatments) with many replicates on which functional analysis of variance is then applied to test "significant differences". Such an approach of course results in the kind of all-or-nothing recommendations highlighted above. Analysis based on economic criteria on the other hand requires a good spread of observations to describe a production function surface. This implies a change of emphasis from the traditional question of "which of the factors" to "how much of each factor".

Thirdly, no matter the criteria for its design, results from experimental research, by its controlled nature, are

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10 Olayide, S.O. and O. Ogunfowora, Economics of maize response to NPK application. Bulletin of Rural Economics and Sociology, 5(1) pp. 95-121.

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seldom applicable to work-a-day farming situations. Davidson and Martin[11] in an analysis of Australian crop and livestock data have shown that farm yields tend to approach experimental yield the more intensive the use of labour in production. For a country like Nigeria in which farm labour is limiting and with little capital employed in production, this clearly means that the discrepancy between experimental and farm yields would be very high. Erbynn's study on fertilizer experiments in Ghana - with largely similar conditions as in Nigeria - showed, for instance that yields were three and four times higher than those found in practice (even with fertilizer).[12] Given a difference of such magnitude it is difficult to ignore Candler's suggestion that unadjusted research recommendations can only be regarded as untested hypotheses that have every chance of being inadequate.[13]

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11 Davidson, B.R. and B.R. Martin, The relationship between farm and experimental yields. University of Western Australia Press, Nedlands. 1967.

12 Erbynn, K.C. Maize response surfaces and economic optima in fertilizer use in Volta Region of Ghana. Crops Research Institute, Council for Scientific and Industrial Research, Kumasi. Ghana. 1970.

13 Candler, W.V., Production economics and problems of animal production. Proceedings of New Zealand Society of Animal Production, 22; 1962. 142-58.

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Research recommendations could be made less hypothetical by subjecting experimental results to a more rigorous down-to-earth test and assessment. In this regard the use of "demonstration farms" as a means of "proving" to the farmers that they could obtain identical results as those of experimental findings is naively question-begging. This is because such demonstration farms tend to simulate the factor proportions of experimental plots in a single-minded pursuit of "demonstrating recommended practices". Besides, since they are usually based on sole cropping, they reveal nothing of the effects of new practices on existing farming systems and even less of the real opportunity costs of new inputs.

These difficulties need not arise if the testing of experimental research findings is recognised as being only another link in the cycle of formulating relevant research priorities, appropriate experimental programmes and design, and the need to establish a reliable basis for an unbiased feed-back. This recognition implies that no experiment is in fact completed until it has reached the local farm stage. Thus research programmes should include the siting of field trials on a number of representative farms within identifiable farming systems. Ideally such

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trials should be run with the operations involved being carried out by the farmer himself as part of his farming routine, research personnel supervising only the technical details in respect of the practices under investigation. The results obtained from such trials will inevitably be less spectacular than those claimed under current arrangements, but will obviously provide a set of recommendations far more relevant.

7.4.3 Research economics and extension: Some previous workers in the field of agricultural research economics have treated research exclusively as a process of generating new knowledge, presumably on the assumption that once such knowledge becomes available it would automatically be utilized by farmers.[14] For developing countries at least this assumption seems unrealistic, given poor transportation facilities, inadequate communication network and mass illiteracy among the generality of farmers. In the event, the costs of extending research information to farmers are specific costs to research. Hence the approach in this study has been to treat research and extension as a system.

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14 See for example Griliches, Zvi, Research costs and social returns, hybrid corn and related innovations, Journal of Political Economy, 66, October 1958.

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Failure to see extension as part of the research system is in part responsible for the generally held notion that output in research is unquantifiable. One effect of this is that allocation of research funds are usually based on non-economic criteria, like the size of establishment, the amount of funds received in the past, or the ability of the representative of the research institution to sway finance administrators at budget meetings. This of course results in misallocation of resources. Surprisingly, some economists seem to lend weight to such misallocations, themselves treating research expenditure as sunk costs.[15]

Given the need to rationalize investment programmes in terms of benefit-costs criteria, research output will need to be specified and quantified. Certainly for applied agricultural research the logical yardstick for measuring output is the shift in the supply function of farm output attributable to the introduction of new varieties, cultivation practices, etc. There is thus a need to adopt a systems approach to the treatment of research in terms of allocation of resources as well as evaluation. This means

15 Purvis, M.J., Report on a survey of oil palm rehabilitation in Eastern Nigeria. CSNRD report No. 10, Michigan State University, 1968

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that the existing arrangement under which resource allocations are made separately to research and extension as if both have nothing in common should be reviewed so that any particular research project has its extension aspects incorporated into it. This will require a reorganisation of existing framework, resulting in some form of integration of extension and research activities. In this regard it should be noted that a number of agricultural research institutes have already established an extension arm, usually referred to as Agricultural Extension Research Liaison Services. This seems to have reached its highest development at the Institute of Agricultural Research, Ahmadu Bello University which has pioneered this innovation right from its inception as an institute. Having been in existence for over fifteen years now an evaluation of its role in enhancing returns to investment in agricultural research may be of great interest to research administrators and policy makers.

7.5 Summary

This chapter has been concerned with highlighting certain policy implications and prescriptions emanating from our findings. These include the need for reform in

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the areas of research administration, funding, and training of research personnel. Among the policy prescriptions made are the establishment of a machinery for periodic research review, the need for a new orientation in the formulation, design and execution of research projects with a view to raising the degree of utilization of research information. Finally, in the context of development planning and resource allocation, a systems approach to the financing of research is advocated such that research and extension are regarded as being related processes in the overall objective of raising agricultural productivity, rather than as separate activities to be financed independently as seems the case at present.

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CHAPTER VIII

SUMMARY AND CONCLUSIONS

8.1 Summary of findings and recommendations

The gap between developed and developing countries remains as wide as ever in spite of almost two decades of United Nations effort to close the gap through "aid" and "technical assistance." The hopes of bringing about a rapid rise in the standard of living of these countries have not materialised for a variety of reasons. An attempt was made to highlight some of these in chapter one, and the conclusion is reached that development in the final analysis has to be internally generated. Furthermore, for many developing countries agriculture represents the Achile's heel of economic development. It was suggested that substantial increases in agricultural productivity can only be brought about through technological change. The essential ingredients of technological change in terms of policy prescriptions for developing countries were then explored through various studies, among which were those of Solow, Johnson, Griliches

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and Schultz. The connection between research and technological change in developing countries is examined with particular reference to adaptive aspects of agricultural research.

In chapter two agricultural research in Nigeria was critically reviewed through the various stages of its development, starting with the colonial era, through internal self-government and national independence periods, to the present post-independence military administration period. Against this background certain key factors that are crucial to an effecient research organisation were highlighted. These include research personnel and administration, research funding and infrastructure, and research information dissemination. A general evaluation of research impact was attempted and it was concluded that research has made virtually no impact on general farming practices, especially in the food farming sector. A number of reasons were identified for the lack of research impact on food production. First, the relative abundance and availability of land favours the continuation of the traditional shifting cultivation, leaving no incentive for the adoption of improved practices. Secondly, the communal land tenure system is unsuited to present-day requirements for cash crops production since

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the occupier of agricultural land has no incentive to improve the fertility of the land he is cultivating. Thirdly, agricultural research has not always progressed evenly on all fronts so that the adoption of an improvement in one area of farming may be handicapped by a lack of corresponding innovation in other complementary areas. Fourthly research is frequently directed to problems that may be irrelevant from the farmer's standpoint.

Amidst the low productivity level of agricultural research in general, cocoa research seems to stand out as an exception. In chapter three cocoa research in Nigeria was reviewed with particular reference to the organisational framework of the West African Cocoa Research Institute and its successor, the Cocoa Research Institute of Nigeria. Some of the factors found to be crucial to the success of cocoa research are the type of organisational set-up, the funding arrangements which guaranteed generous income on a long-term basis, and a virile staff training policy. The impact of research on cocoa production was examined in terms of development of new cocoa varieties, especially the Amazon and the hybrids, and control of cocoa pests and diseases.

In chapter four, the peculiarities of agricultural research as a public good and the problems of pricing

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from the standpoint of economic welfare theory were highlighted. In the light of this the conclusion is reached that it is justifiable to run agricultural research on the public account. This was followed by a review of literature on studies dealing with estimates of agricultural research productivity. Among these are the studies by Peterson, Evenson and Kislev, and Griliches. Peterson employed the production function approach, including research expenditures as an explanatory variable, in a study of returns to poultry research in the United States. Evenson and Kislev also using the production function approach adopted paper publications as a measure of research output. One major weakness of the latter study is that for applied agricultural research the use of paper publications as output is inappropriate since it assumes that potential users are capable of understanding and adopting the findings published in learned journals. Griliches model using the investment evaluation approach provides a more appropriate technique for estimating returns to research. Peterson also used the same approach in his study. The main weakness of these studies is that extension expenditures were not included as part of the costs of research. This was rectified in the model used in this study by regarding expenditures on cocoa

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extension as specific costs to cocoa research. Following the review of literature, our index-number model under the investment evaluation approach was developed. This consists of a formula for measuring the long-term shifts in the cocoa supply function arising from the adoption of improved cocoa varieties. Next, another model was developed under the production function approach, with cocoa output as the independent variable, while the explanatory variables include area of improved cocoa in production, weather, disease control, ~~price~~ and research-plus-extension expenditures (suitably lagged).

In chapter five our index-number model was employed in the empirical estimation of the internal rate of return to cocoa research, using time series data from 1944/45 to 1976/77. This resulted in an estimate of 37 per cent, indicating that between 1944 and 1977 the annual returns to cocoa research has been 37 per cent on the average. As a sensitivity test, the yield difference between improved and unimproved varieties was discounted by half and the internal rate of return on this estimated. A value of 34 per cent was obtained. We therefore concluded that returns to investment in cocoa research is very high when compared with many development projects.

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An attempt was made in chapter six to estimate the returns to cocoa research using the production function model described above. The marginal return to cocoa research was found to be about ₦20. Converting this to an internal rate of return a value of 42 per cent was obtained. This compares very well with the estimate of 37 per cent obtained through the index-number model, showing that empirical results from the two approaches are very close.

Certain policy implications arising from the study were examined in relation to stimulating greater productivity in agricultural research, especially food crops research. These include new dimensions in research administration, new approach to research funding and a more dynamic staff training policy. Beyond these, certain policy prescriptions were made, which if adopted could result in greater effectiveness in the organisation and conduct of agricultural research. Among these are the need for periodic research review, the need to treat research and extension as a system, in terms of resource use and planning as well as evaluation.

8.2. Limitations of study

The limitations of this study derive from two main sources. The first is in respect of the data. This has

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already been dealt with in details under the various items of data in chapters five and six. In general the limitations due to data are such as to lead to underestimation of the returns both under the index-number approach and the production function model. This is because whenever there was an option between equally reasonable alternatives, the choice was invariably in favour of the alternative that would result in lower estimate of return. To that extent our estimate of internal rate of return to investment in cocoa research can be regarded as a lower bound.

The other source of limitations relates to the assumptions of the production function model in particular vis-a-vis what obtains in practice. First, the assumption of a smooth continuous mathematical function is not applicable, since output of research knowledge resulting from research expenditure is a discontinuous process. Thus instead of a smooth continuous curve we have a series of "jumps". Nevertheless, on a conceptual plane, the locus of these jumps over a suffeciently long period will form a smooth curve, with the outer vertices formed by the "steps" representing the points on the curve. To that extent the approach is not inappropriate. Secondly, the production function assumes an instantaneous relationship

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between input and output, whereas empirically the relationship had to be measured over time. This is particularly so in this study where the lag between expenditures and research output (in terms of increase in production resulting from adoption of research findings) is quite considerable. An attempt to meet this shortcoming was made by lagging the research variable as explained in chapter six.

All in all, these discrepancies between the assumptions of the production function and our empirical situation do not seem to be so serious as to render the model unsatisfactory, considering that the internal rate of return obtained through this model is 42 per cent compared with 37 per cent by the index-number model which is a more appropriate approach to investment evaluation problems.

8.3 Areas of further research

This study has been concerned with the estimation of returns to investments in cocoa research which is possibly the most successful venture in the whole field of agricultural research in Nigeria. As a pioneering work in the area of economics of agricultural research in Nigeria, the study has inevitably raised more questions than it has attempted to answer. There is thus an urgent

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need for more research in this area before a distinct picture of the entire agricultural research situation can begin to emerge. It is suggested that on basis of priority the questions that require urgent answers are those of an organisational and administrative nature. In this connection the following questions are considered to merit urgent attention as areas for further research.

What should be the optimum number of agricultural research institutes at this stage of Nigeria's socio-economic development?

Should agricultural research institutes specialize along commodity lines or on ecological basis?

What should be the upper limit in the size of an institute in terms of staffing, considering that many existing research institutes in the tradition of the civil service tend to be heavily overstaffed?

How best can research activities in relevant university faculties be coordinated with institutes research programmes?

Are university-affiliated agricultural research institutes necessary, or should all research institutes maintain a semi-autonomous status under the National Science and Technology Development Agency?

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How far should research in food crops go? Should an institute dealing with food crops carry out research in all the fields affecting the crops, including the fields of engineering, food technology, industrial uses, etc.?

What are the real constraints to research in food crops?

Has the Agricultural Extension Research Liaison Services (AERLS) approach merits over current extension arrangements under the various state ministries of agriculture?

What should be the role of the ministries of agriculture in the dissemination of agricultural research findings?

8.4 Conclusions

The focus on this study is to establish the need for an evaluation of investments in agricultural research on the same basis as those of other economic ventures. As has been found in the study the returns to past investments in cocoa research has been very high. Such high returns suggest gross underinvestment in cocoa research, and possibly in other areas of agricultural research. The need to correct such an anomaly can only be taken seriously on the strength of empirical studies of this nature.

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Beyond fulfilling the need to rationalize a general impression about the contribution of research to cocoa production by providing quantitative empirical evidence, this study has also attempted to contribute to methodology of investment analysis in the special area of agricultural research, with a view to providing the necessary tool for decision-making in resource use and allocation within the agricultural research sector as well as between it and other sectors. Lack of such tool has in the past probably contributed to the use of rather arbitrary criteria for allocating resources to agricultural research, more so as its output unlike those of development projects appears intangible.

Given the need to increase resource allocation to agricultural research (as established by the high returns to cocoa research), an effecient organisational framework will become increasingly important if further investments, particularly in food crop research, are to be beneficial. Yet we are at present ignorant on many questions regarding this aspect of agricultural research. Initiating investigations into such areas may well prove invaluable in enhancing the productivity of agricultural research in general.

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APPENDIX I

NIGERIAN RESEARCH INSTITUTE ACT, 1964

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NIGERIAN RESEARCH INSTITUTES ACT, 1964

ARRANGEMENT OF SECTIONS

Section

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1964, No. 33

AN ACT TO ESTABLISH RESEARCH INSTITUTES IN RESPECT OF COCOA, COFFEE AND COLA, IN RESPECT OF THE OIL PALM, IN RESPECT OF RUBBER, AND IN RESPECT OF TRYPANOSOMIASIS; TO PROVIDE FOR THE TRANSFER TO THOSE INSTITUTES OF CERTAIN ASSETS AND LIABILITIES OF EXISTING BODIES (IF ANY) ESTABLISHED FOR SIMILAR PURPOSES AND FOR THE WINDING UP OF THOSE BODIES; AND FOR PURPOSES CONNECTED WITH THE MATTERS AFORESAID.

[*See section* 9 (2)] Commencement.

BE IT ENACTED by the Legislature of the Federation of Nigeria in this present Parliament assembled and by the authority of the same as follows :—

Establishment and functions of research institutes.

1.—(1) There shall be established four bodies corporate by the following names, that is to say—

(*a*) the Cocoa Research Institute of Nigeria;

(*b*) the Nigerian Institute for Oil Palm Research;

(*c*) the Rubber Research Institute of Nigeria; and

(*d*) the Nigerian Institute for Trypanosomiasis Research,

which bodies are hereafter in this Act referred to collectively as "the institutes" and severally as "the Cocoa Institute", "the Oil Palm Institute", "the Rubber Institute" and "the Trypanosomiasis Institute" respectively.

(2) The institutes shall be charged with the general duty of undertaking research into and providing information and advice relating to—

(*a*) the production and products of cocoa, coffee and cola in the case of the Cocoa Institute;

(*b*) the production and products of oil palm and of such other palms as the Minister may determine in the case of the Oil Palm Institute;

(*c*) the production and products of rubber; and

(*d*) trypanosomiasis in the case of the Trypanosomiasis Institute.

(3) subject to the following provisions of this section, each of the institutes shall have power to do anything which, in the opinion of the institute, is calculated to facilitate the carrying on of the activities of the institute.

(4) Except with the prior approval in writing of the Minister, an institute shall not have power—

(*a*) to incur expenditure outside approved estimates under this Act; or

(*b*) to borrow money.

(5) The Minister may from time to time give to an institute directions of a general nature in writing with respect to the performance of its functions; and it shall be the duty of the institute to comply with the directions.

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Management of affairs of institutes.

2.—(1) There shall be established for each institute a governing council (hereafter in this Act referred to, in relation to the relevant institute, as "the council"), and the provisions of the Schedule to this Act shall have effect, so far as applicable, with respect to the constitutions of the councils and the other matters there mentioned.

(2) The affairs of each institute shall be managed by the council, and references in this Act to the institutes shall be construed accordingly; and without prejudice to the generality of the foregoing provisions of this subsection—

(*a*) anything falling to be done by or to an institute shall be done by or to the council on behalf of the institute, or by or to such person acting as the representative of the council as the council may determine; and

(*b*) in particular, any contract or instrument which, if made or executed by a person not being a body corporate, would not be required to be under seal may be made or executed on behalf of the institute by any person generally or specially authorised to act for that purpose by the council.

(3) It shall be the duty of the council of each institute—

(*a*) to prepare a programme of research within the field for which that institute is responsible for such periods of not less than three years as the board may, with the approval of the Minister determine, together with detailed estimates of the expenditure which will be required to carry out the programme;

(*b*) each year to review, and if necessary revise, the programme approved under paragraph (*a*) for the following year, together with the estimates of expenditure for that year;

(*c*) to submit the programmes and estimates of expenditure, and any annual revisions, for approval by the Minister;

(*d*) to carry out the programmes of research approved by the Minister.

(4) There shall be a director for each institute, who shall be appointed by the Minister on the advice of the council and shall be a person with wide experience of the matters with which the relevant institute is concerned; and the director shall—

(*a*) be charged with the day to day management of the affairs of the institute in accordance with such instructions as may from time to time be given to him by the council; and

(*b*) hold office, subject to the provisions of section five of this Act, in accordance with the terms of the instrument by which he is appointed (including terms as to the payment of his remuneration by the council).

Financial provisions.

3.—(1) Each of the institutes shall establish and maintain a fund from which there shall be defrayed all expenditure incurred by the institute.

(2) There shall be paid or credited to the fund—

(*a*) such sums out of moneys provided by Parliament as Parliament may from time to time determine;

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(*b*) in the case of any institute other than the Trypanosomiasis Institute, such sums out of moneys to be provided by the legislature of each Region or by the appropriate statutory agency of each Region, in accordance with a formula agreed by the several governments and the government of the Federation ;

(*c*) such assets of the relevant institute and committee mentioned in section eight of this Act as are transferred to the institute in pursuance of that section ; and

(*d*) all other assets from time to time accruing to the institute.

(3) The fund shall be managed in accordance with rules made by the Minister and the Minister of the government of the Federation responsibile for finance, acting jointly ; and, without prejudice to the generality of the power to make rules conferred by this subsection, the rules shall in particular include provision—

(*a*) specifying the manner in which the assets of the fund are to be held and regulating the making of payments to and from the fund ;

(*b*) requiring the keeping of proper accounts and records for the purposes of the fund in such form as may be specified by the rules ;

(*c*) for securing that the accounts are audited periodically by an auditor appointed by the Ministers aforesaid, acting jointly ;

(*d*) requiring copies of the accounts and of the auditor's report on them to be furnished to the Minister as soon as may be after the end of the period to which the accounts relate ; and

(*e*) requiring the Minister to lay before each House of Parliament copies of all accounts and reports received by him in pursuance of the last foregoing paragraph and, in the case of accounts or reports relating to the Cocoa Institute, the Oil Palm Institute, or the Rubber Institute, to send a copy to the Governor of each Region.

Compulsory acquisition of land for institutes. Cap. 167.

4.—(1) For the purposes of the Public Lands Acquisition Act, the purposes of each of the institutes shall be public purposes of the Federation within the meaning of that Act.

(2) The Chief Federal Land Officer may, by an instrument under his hand and seal, vest in the relevant institute any property acquired by the President by virtue of subsection (1) of this section ; and the institute shall pay to the Minister of the government of the Federation responsible for finance a sum equal to the aggregate amount of any expenses (including compensation) incurred on behalf of the President by virtue of the said subsection in respect of any property vested in the institute by such an instrument.

Application of Pensions Act to employment in the service of institutes etc.

5.—(1) The Minister of the government of the Federation responsible for pensions may by order declare that the office of the director of an institute or of any person employed by an institute shall be a pensionable office for the purposes of the Pensions Act ; and any order made under an enactment repealed by virtue of this Act declaring that an office under an institute or committee abolished by virtue of this Act is a pensionable office for the purposes of that Act, or of pensions enactments superseded by that Act, shall be deemed to have been duly made in pursuance of this subsection, with effect from the date (if any) specified by the order, in respect of any corresponding office in the service of an institute established by this Act.

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(2) The Pensions Act shall, in its application by virtue of the foregoing subsection to any office, have effect as if—

(*a*) the office were an office in the public service of the Federation within the meaning of the Constitution of the Federation ;

(*b*) the references to the Minister of the government of the Federation responsible for pensions in paragraph (1) of section seven of that Act were references—

(i) in the case of the office of director of an institute, to the Minister ; and

(ii) in any other case, to the council of the relevant institute ; and

(*c*) section nine of that Act (which relates to compulsory retirement) were omitted.

(3) Nothing in the foregoing provisions of this section shall prevent the appointment of a person to any office on terms which preclude the grant of a pension or gratuity in respect of service in that office.

(4) So much of section seven of the Pensions Act as prevents the grant of benefits under that Act in respect of a person retiring before a specified age shall not apply in relation to the retirement of an expatriate officer within the meaning of that Act who—

(*a*) retires, either before or after the commencement of this Act, from an office which was or is a pensionable office by virtue of any such order as is mentioned in subsection (1) of this section ; and

(*b*) held, on or before the first day of October, nineteen hundred and sixty-two, any such office as is mentioned in paragraph (*a*) of this subsection.

Annual report.

6. It shall be the duty of each of the institutes to furnish to the Minister, as soon as may be after the end of each year, a report on the activities of the institute during that year ; and the Minister shall—

(*a*) lay before each House of Parliament a copy of each report received by him in pursuance of this section ; and

(*b*) send a copy of each report to the Governor of each Region.

Regulations.

7.—(1) The council of each institute may make regulations generally for its purposes under this Act ; and without prejudice to the generality of the foregoing, regulations may provide for the disciplinary control over the staff of the institute concerned.

(2) Regulations made under the foregoing subsection shall not have effect until they are approved by the Minister and have thereafter been published in the gazette.

Winding up of existing research institutes and their committees. Caps. 218 and 219.

8.—(1) The Minister shall by order provide for—

(*a*) the winding up of the affairs of the institutes and committees established by the West African Institute for Oil Palm Research Act and the West African Institute for Trypanosomiasis Research Act respectively ; and

No. 6 of 1950.

(*b*) the winding up as respects Nigeria of the affairs of the institute and committee regulated by the West African Cocoa Research Institute (Nigerian Status) Act, 1950,

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and for the transfer of the assets and liabilities of each such institute and committee as aforesaid to the corresponding institute established by this Act; but nothing in this subsection shall be construed as affecting the assets or liabilities of the institute or committee regulated by the said Act of 1950 except to the extent that they arise within Nigeria or by reason of activities carried on or formerly carried on within Nigeria.

(2) An order made in pursuance of subsection (1) of this section may contain such incidental and supplementary provisions as the Minister considers expedient for the purposes of the order.

(3) When it appears to the Minister that the affairs of any institute mentioned in paragraph (*a*) or (*b*) of subsection (1) of this section and its committee have been wound up, he shall by order declare the institute and committee to be dissolved on such day as may be specified by the order; and the order—

(*a*) shall include provision repealing on that day the enactments mentioned in subsection (1) of this section so far as they relate to the institute and committee dissolved by the order; and

(*b*) may include provision repealing or modifying any other enactment relating to that institute or committee to such extent as the Minister considers expedient in consequence of any other provision made by an order under this section.

Short title, extent, commencement and interpretation.

9.—(1) This Act may be cited as the Nigerian Research Institutes Act, 1964, and shall apply throughout the Federation.

(2) This Act shall come into force on such day as the Minister may by order appoint, and a different day may be appointed in pursuance of this subsection in relation to each of the institutes.

(3) In this Act "the Minister" means—

(*a*) in relation to institutes other than the Trypanosomiasis Institute, the Minister of the government of the Federation responsible for agricultural research; and

(*b*) in relation to the Trypanosomiasis Institute, the Minister of the government of the Federation responsible for veterinary research.

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Section 2

SCHEDULE

Constitutions etc. of the councils

Membership of the councils

1.—(1) Subject to the provisions of this Schedule, the council of the Cocoa Institute shall consist of eleven members and comprise—

(*a*) two persons appointed by the Minister.
(*b*) the director of the institute;
(*c*) five persons appointed by the Government of Western Nigeria;
(*d*) one person appointed by the Government of Eastern Nigeria;
(*e*) one person appointed by the Government of Northern Nigeria;
(*f*) one person appointed by the Government of Mid-Western Nigeria;

(2) Subject to the provisions of this Schedule, the council of the Oil Palm Institute shall consist of ten members and comprise—

(*a*) two persons appointed by the Minister.
(*b*) the director of the institute;
(*c*) one person appointed by the Government of Western Nigeria;
(*d*) four persons appointed by the Government of Eastern Nigeria;
(*e*) one person appointed by the Government of Northern Nigeria;
(*f*) one person appointed by the Government of Mid-Western Nigeria.

(3) Subject to the provisions of this Schedule, the council of the Rubber Institute shall consist of ten members and comprise—

(*a*) two persons appointed by the Minister.
(*b*) the director of the institute;
(*c*) one person appointed by the Government of Western Nigeria;
(*d*) one person appointed by the Government of Eastern Nigeria;
(*e*) one person appointed by the Government of Northern Nigeria;
(*f*) four persons appointed by the Government of Mid-Western Nigeria.

(4) Subject to the provisions of this Schedule, the council of the Trypanosomiasis Institute shall consist of eleven members and comprise—

(*a*) five persons appointed by the Minister.
(*b*) the director of the institute;
(*c*) one person appointed by the Government of Western Nigeria;
(*d*) one person appointed by the Government of Eastern Nigeria;
(*e*) two persons appointed by the Government of Northern Nigeria;
(*f*) one person appointed by the Government of Mid-Western Nigeria.

(5) If the Minister responsible for a particular institute is satisfied that persons who are not members ought, by reason of their experience or professional competence to be admitted to membership he may, by notice in the Gazette, appoint as additional members not more than five persons so qualified; and any person so appointed under this sub-paragraph may attend all meetings and take part in any deliberations of the council, but shall not be entitled to vote thereat.

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Tenure of office of members

2.—(1) Subject to the provisions of this paragraph, a member of a council shall hold office for the period of five years beginning—

(*a*) in the case of a member appointed to fill a vacancy which has not previously been filled, with the day when this Act comes into force as respects the relevant institute;

(*b*) in any other case, with the day next following that on which the term of office of his predecessor expires by the efluxion of time or, where the predecessor has previously vacated office, on which it would have so expired.

(2) With a view to securing the retirement in rotation of members appointed as additional members of each council, the Minister may by order provide that the term of office of any three of such members shall be such shorter period as the Minister may from time to time approve, but not less in any particular case than three years.

(3) Where a member ceases to hold office at a time when more than three months of his term of office remain unexpired, the authority who appointed him shall as soon as may be appoint a successor who shall, subject to the following provisions of this paragraph, hold office for the residue of that term.

(4) Without prejudice to the provisions of section eleven of the Interpretation Act, 1964 (which, among other things, provides for the removal of appointees by the persons who appointed them), a member of the council shall cease to hold office if he resigns his office by a notice in writing signed by him and served on the Minister. 1964, No. 1.

(5) A person who ceases to hold office as a member of a council shall be eligible for reappointment as such a member.

(6) References in the foregoing provisions of this paragraph to members of a council do not include references to the director of the relevant institute.

Proceedings of councils

3. Subject to the provisions of this Act and of section twenty-six of the Interpretation Act, 1964 (which provides for decisions of a statutory body to be taken by a majority of its members and for the chairman to have a second or casting vote), each council may make standing orders regulating the proceedings of the council or any committee thereof.

4. The quorum of the council shall be five provided that at the meeting there are at least two members present to represent other governments on the council; and the quorum of any committee of a council shall be determined by the council.

5.—(1) The Minister after consultation with the Regional Governments shall appoint the chairman of a council from among its members and every council of its own motion shall elect some other member to be the deputy chairman of the council; so however that notwithstanding the period for which the appointment or election is to have effect, if a chairman or deputy chairman ceases to be a member of the council he shall cease to hold the office to which he was so appointed or elected as the case may be.

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(2) At any time while the office of chairman is vacant or the chairman is in the opinion of the council permanently or temporarily unable to perform the functions of his office, the deputy-chairman shall perform those functions, and references in this Schedule to the chairman shall be construed accordingly.

6.—(1) Subject to the provisions of its standing orders, a council shall meet whenever it is summoned by the chairman ; and if the chairman is required so to do by notice given to him by not less than four members of the council he shall summon a meeting of the council to be held within twenty-eight days from the date on which the notice is given. If the chairman fails to summon any meeting when so required, the Minister in his discretion may exercise such power.

(2) At any meeting of a council the chairman or in his absence the deputy-chairman shall preside, but if both are absent the members present at the meeting shall elect one of their number to preside at that meeting.

(3) Where a council desires to obtain the advice of any person on a particular matter the council may co-opt him as a member for such period as it thinks fit ; but a person who is a member by virtue of this subparagraph shall not be entitled to vote at any meeting of the council and shall not count towards a quorum.

(4) Notwithstanding anything in the foregoing provisions of this paragraph, the first meeting of each council shall be summoned by the Minister, who may give such directions as he thinks fit as to the member who shall preside and the procedure which shall be followed at that meeting.

Committees

7.—(1) Each council may appoint one or more committees to carry out, on behalf of the council, such of its functions as the council may determine.

(2) A committee appointed under this paragraph shall consist of the number of persons determined by the council, and a person other than a member of the council shall hold office on the committee in accordance with the terms of the instrument by which he is appointed.

(3) A decision of a committee appointed under this paragraph shall be of no effect until it is confirmed by the council.

Officers and servants

8. Without prejudice to the generality of subsection (3) of section one of this Act but subject to subsections (4) and (5) of that section, each council shall have power—

(*a*) to appoint such officers and servants of the institute as the council may determine ; and

(*b*) to pay to any officers and servants of the institute such remuneration as the council may determine.

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Miscellaneous

9. Standing orders made by a council may provide for the payment to any member of the council or other person appointed to a committee of the council of such travelling and subsistence allowances in respect of any periods spent on the business of the council as the council may determine; but, notwithstanding anything in section one of this Act, no other remuneration shall be paid by the council to any such member or other person.

10.—(1) The fixing of the seal of each institute shall be authenticated by the signature of the director or of some other member of the council authorised generally or specially by the council to act for that purpose.

(2) Any document purporting to be a document duly executed under the seal of an institute shall be received in evidence and shall, unless the contrary is proved, be deemed to be so executed.

11. The validity of any proceedings of a council or a committee thereof shall not be affected by any vacancy in the membership of the council or committee, or by any defect in the appointment of a member of the council or of a person to serve on the committee, or by reason that a person not entitled to do so took part in the proceedings.

12 Any member of a council or of a committee of a council who has a personal interest in any contract or arrangement entered into or proposed to be considered by the council or a committee thereof shall forthwith disclose his interest to the council and shall not vote on any question relating to the contract or arrangement.

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APPENDIX II

THE AGRICULTURAL RESEARCH COUNCIL

OF NIGERIA DECREE 1971

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THE AGRICULTURAL RESEARCH COUNCIL OF NIGERIA DECREE 1971

ARRANGEMENT OF SECTIONS

Decree No. 25

[*See section* 19(2)] Commencement.

THE FEDERAL MILITARY GOVERNMENT hereby decrees as follows :—

1.—(1) There is hereby established a body to be known as the Agricultural Research Council of Nigeria (in this Decree referred to as "the Council") which shall have the functions assigned to it by this Decree and which shall be a Research Council for the purposes of the Nigerian Council for Science and Technology Decree 1970.

Establishment of the Agricultural Research Council of Nigeria. 1970 No. 6.

(2) The Council shall be a body corporate with perpetual succession and a common seal.

2. The functions of the Council shall be—

Functions of the Council.

(*a*) to advise the Nigerian Council for Science and Technology and through it the Federal Military Government and the State governments on national science policy and financial requirements for the implementation of such policy in respect of research and training in the agricultural sciences and the application of the results of such research and training to promote the national economy ;

(*b*) to ensure the implementation of national science policy laid down by the Nigerian Council for Science and Technology in respect of research and training in the agricultural sciences ;

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(*c*) to survey and maintain an up-to-date record of all the existing facilities and personnel for research and training in the agricultural sciences throughout Nigeria and advise the Nigerian Council for Science and Technology and through it the Federal Military Government and the State governments on their adequacy and efficient utilization in the interest of the national economy;

(*d*) to co-ordinate the research and training carried on by institutions mentioned in paragraph (*c*) above and to allocate priorities to them in accordance with the policy laid down by the Nigerian Council for Science and Technology;

(*e*) to advise the Nigerian Council for Science and Technology, and through it the Federal Military Government and the State Governments on such organisational changes, including the establishment of institutes, as are required to implement or further the efficiency of research in the agricultural sciences, and to bring under the aegis of the Council such institutes as may from time to time be agreed by the Federal Military Government or, as the case may be, the State Governments;

(*f*) to encourage general education in the agricultural sciences and to sponsor the training of post-graduate students for research work;

(*g*) to publish or sponsor the publication of the results of research and training in the agricultural sciences particularly in relation to Nigerian problems and to popularise such results where their general recognition is, in the Council's opinion, of national importance;

(*h*) to encourage and promote collaboration between those engaged in research in the agricultural sciences in Nigeria and those so engaged in other countries;

(*i*) to carry out such other activities as may, in the opinion of the Council, further the advancement of research and training in the agricultural sciences.

Membership of the Council.

3.—(1) The Council shall, subject to subsection (4) below consist of twenty-two members as follows—

(*a*) a Chairman who must be a person of distinction in one or more of the agricultural sciences and who shall be appointed by the Federal Executive Council on the recommendation of the Commissioner;

(*b*) one member chosen from amongst the Directors of the Federal Departments of Agriculture, Livestock, Forestry, Fisheries and Meteorology;

(*c*) one member representing each State in the Federation such member being an Agriculturist, Veterinarian or Forester in the service of the government of the State concerned;

(*d*) six scientists from the universities in Nigeria chosen from the faculties of Agriculture, Veterinary Science and Forestry of such universities; and

(*e*) two persons with extensive technical knowledge of and close association with the development of the agricultural sciences.

(2) All appointments under paragraphs (*b*) to (*e*) of subsection (1) above shall be made by the Commissioner.

(3) The Commissioner shall, in appointing members under paragraph (*c*) of subsection (1) above, give preference to the most senior Agriculturist, Veterinarian or Forester in the service of the government of the State concerned but may appoint another person who is not the most senior (but who is

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otherwise qualified under paragraph (*c*) as aforesaid) if the Commissioner is satisfied that it is necessary to do so in order to maintain a proper balance of the different professions on the Council.

(4) The Federal Executive Council may by notice in the Gazette increase or reduce the membership of the Council.

Tenure of office of Chairman and members.

4.—(1) Subject to the provisions of this section, a person appointed as Chairman of the Council or as a member thereof shall hold office for a period of three years from the date of his appointment and shall be eligible for re-appointment for one further period of three years; thereafter he shall no longer be eligible for re-appointment:

Provided that nothing in this subsection shall be construed as entitling any person who has held office as Chairman for a term and who is being re-appointed under this section to be appointed again as Chairman.

(2) The Federal Executive Council may at any time remove the Chairman from his office and if so removed the Chairman shall cease to be a member of the Council.

(3) The Chairman may resign his appointment by a letter addressed to the Secretary to the Federal Military Government and the resignation shall have effect from the date of the receipt of the letter by the Secretary to the Federal Military Government.

(4) A member other than the Chairman may resign his office by a letter addressed to the Commissioner and that member's resignation shall have effect as from the date of the receipt of the letter by the Commissioner.

(5) The foregoing provisions of this section shall be without prejudice to the provisions of section 11 of the Interpretation Act 1964 relating to appointment. 1964 No. 1.

Travelling and subsistence allowances.

5. There shall be paid to every member of the Council, out of the moneys at the disposal of the Council, such travelling and subsistence allowances in respect of any periods spent on the business of the Council as the Commissioner may determine, but no other remuneration shall be paid to any member of the Council.

Temporary appointments.

6.—(1) The Federal Executive Council may, on the recommendation of the Commissioner, appoint a person to act in the place of the Chairman during a long absence or during the temporary incapacity from illness of the Chairman; and that person while so acting may exercise all the functions of the Chairman under this Decree.

(2) The Commissioner may appoint any person to be a temporary member during a long absence or during the temporary incapacity from illness of any member; and that person, while the appointment subsists, may exercise all the functions of a member under this Decree.

Power of certain persons to attend meetings of Council.

7. The following persons, that is to say—

(*a*) the Permanent Secretary, Federal Ministry of Agriculture and Natural Resources, or his representative,

(*b*) not more than two members of the Nigerian Council for Science and Technology, and

(*c*) any of the Directors of Federal Departments of Agriculture, Livestock, Forestry, Fisheries and Meteorology not appointed a member of the Council under paragraph (*b*) of section 3 (1) of this Decree,

may attend any meeting of the Council and may take part in its deliberations but shall not be entitled to vote.

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Proceedings of the Council.
1964 No. 1.

8.—(1) Subject to the provisions of section 26 of the Interpretation Act 1964 (which provides for decisions of a statutory body to be taken by a majority of its members and for the chairman to have a second or casting vote), the Council may make standing orders regulating the proceedings of the Council or any committee thereof.

(2) The quorum of the Council shall be ten, and the quorum of any committee of the Council shall be determined by the Council.

(3) The validity of any proceedings of the Council or of its committees shall not be affected—

(*a*) by any vacancy in the membership of the Council or any such committee;

(*b*) by any defect in the appointment of any such member;

(*c*) by reason of the fact that any person not entitled to do so took part in the proceedings.

(4) Any member of the Council or any committee thereof who has a personal interest in any contract or arrangement entered into or proposed to be considered by the Council or any committee thereof shall forthwith declare his interest to the Council and shall not vote on any question relating to the contract or arrangement.

(5) The Council shall meet not less than twice in each year and on such other occasions as may be necessary.

(6) The secretary shall attend meetings of the Council but shall not be entitled to vote.

Committees of the Council.

9.—(1) The Council shall appoint a committee each for agriculture, veterinary science, forestry, fisheries and manpower training; and, without prejudice to the foregoing, the Council may appoint such other standing, steering and ad hoc committees as the Council thinks fit to carry out, consider and report on any matter with which the Council is concerned.

(2) The Council shall appoint one of its members to be chairman of any committee appointed under this section.

(3) A committee appointed under this section may include persons who are not members of the Council; and if such members are appointed or co-opted on the committee, they may take part in the deliberations thereof but shall not be entitled to vote thereon.

Secretary and other officers of the Council.

10.—(1) The Council shall appoint a secretary to manage the affairs of the Council under its direction.

(2) The Council may appoint such other persons to be officers and servants of the Council as the Council may determine to assist the secretary in the exercise of his functions.

(3) The remuneration and tenure of office and conditions of service of the secretary and other officers and servants of the Council shall be as determined by the Council with the approval of the Federal Commissioner for Establishments.

Application of Pensions Act to officers of the Council.
Cap. 147.

11.—(1) The Federal Commissioner for Establishments may by order published in the Gazette declare the office of the secretary of the Council or of any person employed by the Council to be a pensionable office for the purposes of the Pensions Act.

1963 No. 20.

(2) Subject to subsections (3) and (4) below, the Pensions Act shall, in its application by virtue of the foregoing subsection to any office, have effect as if the office were in the public service of the Federation within the meaning of the Constitution of the Federation.

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(3) For the purposes of the application of the provisions of the Pensions Act in accordance with subsection (2) above—

(*a*) paragraph (1) of section 7 of that Act (which confers on the Commissioner power to waive the requirement to give notice of desire to retire at the age of forty-five) shall have effect as if for the references to the Commissioner there were substituted references to the Council ; and

(*b*) the power under section 9 (1) of the Act to require an officer to retire at any time after attaining the age of forty-five shall be exercisable by the Council and not by any other authority.

(4) Nothing in the foregoing provisions shall prevent the appointment of a person to any office on terms which preclude the grant of a pension or gratuity in respect of service in that office.

Offices and premises.

12.—(1) For the purpose of providing offices and premises necessary for the performance of its functions, the Council may—

(*a*) purchase or take on lease any land, and

(*b*) build, equip and maintain offices and premises.

(2) The Council may sell or lease any land, offices or premises held by it and no longer required for the performance of its functions.

Power to accept gifts.

13.—(1) The Council may accept gifts of land, money or other property, upon such trusts and conditions, if any, as may be specified by the person making the gift.

(2) The Council shall not accept any gift if the conditions attached by the person making the gift to the acceptance thereof are inconsistent with the functions of the Council.

Financial provisions.

14.—(1) The Council shall establish and maintain a fund from which there shall be defrayed all expenditure incurred by the Council.

(2) There shall be paid and credited to the fund established pursuant to subsection (1) above—

(*a*) such moneys as may be supplied to the Council by the Federal Military Government or the government of a State ;

(*b*) all moneys as may be raised for the purposes of the Council by way of gift, loan, grants in aid, testamentary disposition or otherwise ;

(*c*) all interests received in respect of moneys invested by the Council ; and

(*d*) all other assets from time to time accruing to the Council.

(3) The fund shall be managed in accordance with rules made by the Federal Executive Council ; and without prejudice to the generality of the power to make rules under this subsection, the rules shall in particular contain provisions—

(*a*) specifying the manner in which the assets of the fund are to be held, and regulating the making of payments into and out of the fund ;

(*b*) requiring the keeping of proper accounts and records for the purposes of the fund in such form as may be specified in the rules ;

(*c*) for securing that the accounts are audited periodically by an auditor appointed from a panel approved by the Federal Executive Council ; and

(*d*) requiring copies of the accounts and of the auditor's report on them to be furnished to the Federal Ministry of Finance and the Federal Ministry of Agriculture and Natural Resources.

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Report on the activities of the Council.

15. The Council shall as soon as possible after the end of each year submit to the Federal Executive Council and to the Nigerian Council for Science and Technology a report on the activities of the Council and any research institute under its administration during the last preceding year.

Compulsory acquisition of land.
Cap 167.

16. (1) For the purposes of the Public Lands Acquisition Act the purposes of the Council shall be public purposes of the Federation within the meaning of that Act.

(2) The Chief Federal Land Officer may, by an instrument under his hand and seal, vest in the Council any property acquired pursuant to subsection (1) above; and the Council shall pay into the Consolidated Revenue Fund of the Federation a sum equal to the aggregate amount of any expenses (including compensation) incurred on behalf of the Federal Military Government by virtue of that subsection in respect of any property vested in the Council by such an instrument.

Regulations.

17. The Council may make regulations generally for its purposes under this Decree; and without prejudice to the generality of the foregoing, regulations may provide for—

(*a*) the functions and responsibilities of the secretary, and

(*b*) the disciplinary control of all officers and servants of the Council.

Interpretation.

18. In this Decree, unless the context otherwise requires,—

"agricultural sciences" includes agrometeorology, fisheries, forestry and veterinary sciences;

"the Chairman" means the chairman of the Council;

"the Commissioner" means the Federal Commissioner for Agriculture and Natural Resources;

"the Council" means the Agricultural Research Council of Nigeria;

"the secretary" means the secretary appointed under section 10 of this Decree.

Citation, extent and commencement

19.—(1) This Decree may be cited as the Agricultural Research Council of Nigeria Decree 1971 and shall apply throughout the Federation.

(2) This Decree shall be deemed to have come into force on 1st May 1971.

MADE at Lagos this 3rd day of May 1971.

MAJOR-GENERAL Y. GOWON,
Head of the Federal Military Government,
Commander-in-Chief of the Armed Forces,
Federal Republic of Nigeria

EXPLANATORY NOTE

(This note does not form part of the above Decree but is intended to explain its purpose)

The Decree establishes the Agricultural Research Council as a body corporate with the general duty of advising on, promoting, supervising and co-ordinating research in the agricultural sciences. The Council is to be one of the major Research Councils under the general surveillance of the Nigerian Council for Science and Technology.

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APPENDIX III

AGRICULTURAL RESEARCH INSTITUTES DECREE 1973

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AGRICULTURAL RESEARCH INSTITUTES DECREE 1973

ARRANGEMENT OF SECTIONS

Decree No. 35

[27th *August* 1973] Commencement.

THE FEDERAL MILITARY GOVERNMENT hereby decrees as follows :—

Establishment and Management of Research Institutes

1.—(1) The Commissioner may, on the advice of the Agricultural Research Council of Nigeria (in this Decree hereafter referred to as "the Council") and the Nigerian Council for Science and Technology, by order establish institutes to conduct research and training in any field of— Power to establish research institutes.

(*a*) Agriculture,

(*b*) Veterinary Science,

(*c*) Fisheries,

(*d*) Forestry, and

(*e*) Agro-meteorology and water resources,

for the purposes of the Agricultural Research Council of Nigeria Decree 1971. 1971 No. 25.

(2) An order establishing an institute under this section shall not come into force until it has been approved by the Federal Executive Council.

(3) An order establishing an institute under this section may contain supplementary or incidental provisions consistent with this Decree relating to the establishment of the institute, including, without prejudice to the generality of the foregoing powers, provisions for—

(*a*) the designation of the institute ;

(*b*) the matter on which the institute is to conduct research, including training where appropriate ;

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(*c*) the transfer to the institute of any existing Federal or State Research Station or other assets belonging to any existing Federal or State research department or institute ;

(*d*) the establishment, constitution, and proceedings of a governing board to manage the affairs of the institute ;

(*e*) a suitable association or other form of relationship of the institute with any university or institution of higher learning in Nigeria ; and

964 No. 33. (*f*) the repeal of the Nigerian Research Institutes Act of 1964 in respect of any institute established under that Act, if the assets of such institutes are transferred to a new institute in pursuance of paragraph (*c*) of this subsection.

Status of institutes, etc.

2.—(1) Any institute shall be a body corporate with perpetual succession and a common seal and may sue or be sued in its corporate name.

(2) The application of the seal of each of the institutes shall be authenticated by two signatures, namely—

(*a*) the signature of the Chairman or some other member of the board authorised by the institute to authenticate the application of the seal ; and

(*b*) the director of the institute or officer authorised by the institute to act in his place for this purpose.

(3) Any instrument or contract which, if executed or entered into by a person other than a body corporate, would not require to be under seal, may be executed or entered into on behalf of an institute by the Chairman or by the director or such other members or servants of the institute as may be appointed to act in their place.

Duties of boards.

3. It shall be the duty of the board of each institute—

(*a*) to prepare a programme of research within the field for which the institute is responsible for such periods, not less than three years, as the board, with the approval of the Council, may determine, together with detailed estimates of the expenditure which will be required to carry out the programme ;

(*b*) to review, and if necessary revise, each year the programme approved under paragraph (*a*) above for the following year, together with the estimates of expenditure for that year ;

(*c*) to submit the programme and estimates of expenditure and any annual revisions for approval by the Council ;

(*d*) to carry out the programme of research approved by the Council ;

(*e*) to arrange for the preparation of annual reports on the progress of the work of the institute and the submission of such reports to the Council ; and

(*f*) to make suitable arrangements for the application of the results of the work of the institute by the extension services of those States in which such results can be applied.

Powers of Institutes.

4.—(1) Subject to the provisions of this Decree, any such institute shall have power to do anything and to enter into any transaction which in its opinion ought to be done in the proper discharge of its functions.

(2) Each of the institutes shall, in particular, and without prejudice to the generality of the foregoing power, have power to acquire and hold land and property.

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(3) For the purpose of the Public Lands Acquisition Act the purposes of an institute shall be public purposes of the Federation within the meaning of that Act. Cap. 167.

Committees of boards.

5. The board of each of the institutes may appoint Committees and delegate to them any of its functions other than any function affecting the constitution of the board and its committees.

Directors of institutes.

6. There shall be as director for each of the institutes such person appointed by the Council, who shall be a person with wide experience of the matters with which the relevant institute is concerned ; and the director shall—

(*a*) be charged with the day to day management of the affairs of the institute in accordance with such instructions as may from time to time be given to him by the institute ; and

(*b*) hold office on such terms and conditions as the Council may determine.

Staff

Employment of officers and servants.

7. The Council may appoint such officers and servants as are deemed necessary for the proper discharge of the functions of an institute under this Decree upon such terms and conditions of service as the Council may determine :

Provided that the rates and scales of salary and other emoluments relating to any such appointment or employment shall be comparable with those prevailing in Nigerian universities.

Power of delegation by Council.

8. The Council may delegate to the board of the institute its power under section 7 of this Decree to appoint officers and servants of the institute, subject to such conditions and restrictions as it may deem fit to impose.

Regulations.

9.—(1) The board of each of the institutes may make regulations for its purposes under this Decree ; and, without prejudice to the generality of the foregoing, the regulations may provide for the disciplinary control over the staff of the institute concerned.

(2) The regulations made under the foregoing subsection shall not have effect until they have been approved by the Council.

Financial Provisions

Financial provisions.

10.—(1) Each of the institutes shall establish and maintain a fund from which there shall be defrayed all expenditure incurred by the institute.

(2) There shall be paid or credited to the fund—

(*a*) such sums of money provided by the Federal and State Governments and their agencies as the Council may allocate to the institute ;

(*b*) such assets of the relevant research departments and institutes as may be transferred to the institute in pursuance of this Decree ; and

(*c*) all other assets from time to time accruing to the institute.

(3) The fund shall be managed in accordance with rules made by the Council with the joint approval of the Commissioner and the Federal Commissioner for Finance ; and without prejudice to the generality of the power to make rules conferred by this subsection, the rules shall, in particular, include provisions—

(*a*) specifying the manner in which the assets of the fund are to be held and regulating the making of payments to and from the fund ;

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(*b*) requiring the keeping of proper accounts and records for the purpose of the fund in such form as may be specified by the rules;

(*c*) for securing that the accounts are audited annually by an auditor approved by the Council;

(*d*) requiring copies of the accounts and of the audit report on them to be forwarded to the Council not later than three months following the end of the period to which the accounts relate.

Power to borrow money.

11. Each of the institutes may borrow or lend money only with the approval of the Council.

Miscellaneous

Disposal of fund, etc. of an institute on dissolution.

12. Where an institute is dissolved by reason of the revocation of an order establishing such institute, any balance of the fund of the institute and all other property of the institute remaining at the date of the revocation shall be disposed of and applied as may be approved by the Commissioner.

Inter-pretation.

13. In this Decree, unless the context otherwise requires, the following expressions have the meanings hereby assigned to them respectively, that is to say—

'board' in relation to an institute means the board established to manage the institute in accordance with any order made under section 1 of this Decree establishing such institute;

'Commissioner' means the Federal Commissioner for Agriculture and Natural Resources;

'Council' means the Agricultural Research Council of Nigeria;

'institute' means an institute established by an order made under section 1 of this Decree.

Citation.

14. This Decree may be cited as the Agricultural Research Institutes Decree 1973.

MADE at Lagos this 27th day of August 1973.

GENERAL Y. GOWON,
Head of the Federal Military Government,
Commander-in-Chief of the Armed Forces,
Federal Republic of Nigeria

EXPLANATORY NOTE

(*This note does not form part of the above Decree but is intended to explain its purport*)

The Decree empowers the Federal Commissioner for Agriculture and Natural Resources, on the advice of the Agricultural Research Council of Nigeria and the Nigerian Council for Science and Technology, to establish institutes to conduct research and training into the fields of agriculture, veterinary science, fisheries, forestry, agro-meteorology and water resources by order.

PUBLISHED BY AUTHORITY OF THE FEDERAL MILITARY GOVERNMENT OF NIGERIA AND PRINTED BY THE MINISTRY OF INFORMATION, PRINTING DIVISION, LAGOS

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APPENDIX IV

AGRICULTURAL RESEARCH INSTITUTES DECREE 1973

Research Institutes (Establishment, etc.) Order 1975

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L.N. 107 of 1975

AGRICULTURAL RESEARCH INSTITUTES DECREE 1973 (1973 No. 35)

Research Institutes (Establishment, etc.) Order 1975

Commencement : 1st *November* 1975

In exercise of the powers conferred on me by section 1 of the Agricultural Research Institutes Decree 1973, and of all other powers enabling me in that behalf, I, Bernard Oghenekome William Mafeni, Federal Commissioner for Agriculture and Rural Development, hereby make the following Order :--

1. --(1) There are hereby established Research Institutes (hereinafter in this Order referred to as "the institutes") designated as follows :— Establishment of the Research Institutes.

(*a*) The Cocoa Research Institute of Nigeria,

(*b*) The Forestry Research Institute of Nigeria,

(*c*) The Kainji Lake Research Institute,

(*d*) The Lake Chad Research Institute,

(*e*) The Leather Research Institute of Nigeria,

(*f*) The National Animal Production Research Institute,

(*g*) The National Cereals Research Institute,

(*h*) The National Horticultural Research Institute,

(*i*) The National Root Crops Research Institute,

(*j*) The National Veterinary Research Institute,

(*k*) The Nigerian Institute for Oceanography and Marine Research,

(*l*) The Nigerian Institute for Oil Palm Research,

(*m*) The Nigerian Institute for Trypanosomiasis Research, and

(*n*) The Rubber Research Institute of Nigeria.

(2) The institutes shall be research institutes for the purposes of the Agricultural Research Institutes Decree 1973 and shall, except in the case of the National Animal Production Research Institute, be subject to the control of the Agricultural Research Council of Nigeria (hereinafter referred to in this Order as "the Council") established by the Agricultural Research Council of Nigeria Decree 1971. 1973 No. 35. 1971 No. 25.

(3) The National Animal Production Research Institute shall be subject to the control of the Ahmadu Bello University.

2. The Cocoa Research Institute of Nigeria shall conduct research into cocoa, coffee, tea, kola and cashew and shall, in particular, undertake research into-- Field of research of the Cocoa Research Institute of Nigeria.

(*a*) the improvement of the genetic potentials of the specified crops,

(*b*) the improvement of agronomic and husbandry practices,

(*c*) the mechanisation and improvement of the methods of cultivating, harvesting, processing and storage of the specified crops,

(*d*) the improvement of the utilization of by-products,

(*e*) the ecology of pests and diseases of the specified crops and improved methods of their control,

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(*f*) the integration of the cultivation of the specified crops into farming systems in different ecological zones and its socio-economic effects on the rural populations, and

(*g*) any other problems related to the specified crops.

Field of research of the Forestry Research Institute of Nigeria.

3. The Forestry Research Institute of Nigeria shall conduct research into forestry and the conservation of wild flora and fauna and shall, in particular, undertake research into—

(*a*) the improvement of the genetic potentials of forest trees of economic importance,

(*b*) the improvement of silvicultural practices relating to forest trees of economic importance,

(*c*) the mechanisation and improvement of the methods of cultivating, harvesting and processing of forest trees of economic importance,

(*d*) the improvement of the utilisation of by-products,

(*e*) the ecology of pests and diseases of forest trees of economic importance and improved methods of their control,

(*f*) the integration of the cultivation of forest trees of economic importance into the farming systems in different ecological zones and its socio-economic effects on the rural populations, and

(*g*) any other problems relating to forestry, wild flora and fauna.

Field of research of the Kainji Lake Research Institute.

4. The Kainji Lake Research Institute shall conduct research into—

(*a*) the limnological behaviour and characteristics of the Kainji and other man-made lakes and their effects on the fish and other aquatic life,

(*b*) the abundance, distribution and other biological characteristics of species of fish and practical methods of their rational exploitation in the said lakes and the major rivers of Nigeria,

(*c*) the behaviour and characteristics of wild life and their conservation as well as range ecology in the Kainji lake area,

(*d*) the public health problems arising from the construction of dams and the resettlement of people around the Kainji and other man-made lakes,

(*e*) the development of irrigated crops around the Kainji lake,

(*f*) the socio-economic effects of the construction of the Kainji and other man-made lakes on rural populations, and

(*g*) any other related matters.

Field of research of the Lake Chad Research Institute.

5. The Lake Chad Research Institute shall conduct research into—

(*a*) the hydrological behaviour and characteristics of the Lake Chad and the limnology of the associated surface and ground waters,

(*b*) the abundance, distribution and other biological characteristics of species of fish and other aquatic forms of life in the lake and practical methods of their rational exploitation,

(*c*) the behaviour and characteristics of the wild fauna and flora associated with the lake and their conservation,

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(*d*) the ecology and methods of control of crop pests and diseases of economic importance,

(*e*) the improvement of the methods of control of dry farming and livestock husbandry in the severe environmental condition around the lake,

(*f*) the improvement of the cultivation of wheat, barley and other crops by irrigation around the lake,

(*g*) the socio-economic and public health effects of the introduction of large-scale irrigation schemes and improved methods of animal husbandry and fishing on the rural populations around the lake, and

(*h*) any other matters related to the lake.

6. The Leather Research Institute of Nigeria shall conduct research into all aspects of the production and products of leather and the utilisation of local tanning materials. Field of research of the Leather Research Institute of Nigeria.

7. The National Animal Production Research Institute shall conduct research into animal production and animal products generally, and in particular— Field of research of the National Animal Production Research Institute.

(*a*) the genetic and nutritional improvement of cattle, sheep, goats and other livestock of economic importance,

(*b*) the improvement of livestock management and husbandry practices,

(*c*) the economics of meat production,

(*d*) nomadism and the socio-economic effects of the settlement of nomads,

(*e*) the integration of livestock into the farming systems and its socio-economic effects on the rural populations,

(*f*) the improvement and management of natural range for the grazing of livestock,

(*g*) the improvement, establishment and management of sown pastures, and

(*h*) any other problems related to animal production.

8. The National Cereals Research Institute shall conduct research into the production and products of rice, maize and grains and legumes of economic importance and shall, in particular, undertake research into— Field of research of the National Cereals Research Institute.

(*a*) the improvement of the genetic potentials of the specified crops.

(*b*) the improvement of agronomic and husbandry practices,

(*c*) the mechanisation and improvement of the methods of cultivating, harvesting, processing and storage of the specified crops,

(*d*) the improvement of the utilisation of by-products,

(*e*) the ecology of pests and diseases of the specified crops and improved methods of their control,

(*f*) the integration of the cultivation of the specified crops into farming systems in different ecological zones and its socio-economic effects on the rural populations, and

(*g*) any other problems related to the specified crops.

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Field of research of the National Horticultural Research Institute.

9. The National Horticultural Research Institute shall conduct research into fruit trees and vegetables of economic importance generally and shall, in particular, undertake research into -

(a) the improvement of the genetic potentials of the specified crops,

(b) the improvement of agronomic and husbandry practices,

(c) the mechanisation and improvement of the methods of cultivating, harvesting, processing and storage of the specified crops,

(d) the improvement of the utilisation of by-products,

(e) the ecology of pests and diseases of the specified crops and improved methods of their control,

(f) the integration of the cultivation of the specified crops into farming systems in different ecological zones and its socio-economic effects on the rural populations, and

(g) any other matters related to the specified crops.

Field of research of the National Root Crops Research Institute.

10. The National Root Crops Research Institute shall conduct research into the production and products of yams, cocoa-yams, cassava, sweet potatoes, Irish potatoes and other root and tuber crops of economic importance and shall, in particular, undertake research into—

(a) the improvement of the genetic potentials of the specified crops,

(b) the improvement of agronomic and husbandry practices,

(c) the mechanisation and improvement of the methods of cultivating, harvesting, processing and storage of the specified crops,

(d) the improvement of the utilisation of by-products,

(e) the ecology of pests and diseases of the specified crops and improved methods of their control,

(f) the integration of the cultivation of the specified crops into farming systems in different ecological zones and its socio-economic effects on the rural populations, and

(g) any other matters related to the specified crops.

Field of research of the National Veterinary Research Institute.

11. The National Veterinary Research Institute shall conduct research into—

(a) all aspects of animal diseases and their treatment and control,

(b) all aspects of animal nutrition,

(c) the production of vaccines and sera,

(d) the introduction of exotic stock to improve meat, milk and egg production,

(e) the standardisation and quantity control of manufactured animal feeds, and

(f) any other related matters.

Field of research of the Nigerian Institute for Oceanography and Marine Research.

12. The Nigerian Institute for Oceanography and Marine Research shall conduct research into the resources and physical characteristics of the Nigerian territorial waters and the high seas beyond, and in particular-

(a) the abundance, distribution and other biological characteristics of species of fishes and other marine forms of life and practical methods of their rational exploitation and utilisation,

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(*b*) the improvement of brackish water fishing and fishculture,

(*c*) the socio-economic problems of exploiting the resources of the sea and brackish waters,

(*d*) the effects of pollution on Nigerian coastal waters and its prevention,

(*e*) the nature of the marine environment, including weather forecasting and the topography of the seabed and the deposits on or under the seabed, and

(*f*) any other related matters.

Field of research of the Nigerian Institute for Oil Palm Research.

13. The Nigerian Institute for Oil Palm Research shall conduct research into the production and products of oil palm and other palms of economic importance and shall, in particular, undertake research into —

(*a*) the improvement of the genetic potentials of the specified crops,

(*b*) the improvement of agronomic and husbandry practices relating to the specified crops,

(*c*) the mechanisation and improvement of the methods of cultivating, harvesting, processing and storage of the specified crops,

(*d*) the improvement of the utilization of by-products,

(*e*) the ecology of pests and diseases of the specified crops and improved methods of their control,

(*f*) the integration of the cultivation of the specified crops into farming systems in different ecological zones and its socio-economic effects on the rural populations, and

(*g*) any other matters related to the specified crops.

Field of research of the Nigerian Institute for Trypanosomiasis Research.

14. The Nigerian Institute for Trypanosomiasis Research shall conduct research into trypanosomiasis and onchocerciasis generally and, in particular—

(*a*) the pathology, immunology and methods of treatment of the diseases,

(*b*) the ecology and life-cycle of the vectors and the mode of transmission of the disease,

(*c*) chemical, biological and other methods of vector control,

(*d*) the socio-economic effects of the disease on the rural populations, and

(*e*) any other matters related to the diseases.

Field of research of the Rubber Research Institute of Nigeria.

15. The Rubber Research Institute of Nigeria shall conduct research into the production and products of rubber and other latex producing plants of economic importance and shall, in particular, undertake research into —

(*a*) the improvement of the genetic potentials of the specified crops,

(*b*) the improvement of agronomic and husbandry practices relating to the specified crops,

(*c*) the mechanisation and improvement of the methods of cultivating, harvesting, processing and storage of the specified crops,

(*d*) the improvement of the utilization of by-products,

(*e*) the ecology of pests and diseases of the specified crops and improved methods of their control,

(*f*) the integration of the cultivation of the specified crops into farming systems in different ecological zones and its socio-economic effects on the rural populations, and

(*g*) any other matters related to the specified crops.

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Non-research functions of the institutes.

16.—(1) The institutes where applicable may, at the written request of any government agency, local government authority or private body, and if the institutes concerned have resources to meet such request, train laboratory, extension and other categories or descriptions of workers relative to their specified fields of research for such government agency, local government authority or private body.

(2) Without prejudice to the specified research functions of the institutes, the institutes concerned shall produce improved seed and other planting materials primarily for their research and experimental programmes but may, for the purposes of advancing or disseminating the results of their researches, make available for distribution to farmers the improved seed and planting materials.

(3) All the institutes shall, when so requested by any government in the Federation, government agency, local government authority or any authorised body, provide information or give advice relating to their specified fields of research to such government, government agency, local government authority or authorised body.

Vesting of assets, etc.

17.—(1) On the coming into effect of this Order, all the assets, properties and rights hereinbefore vested in and exercised by the specified Federal research stations or departments shall without further assurance apart from this Order vest in the respective institutes specified hereunder, being institutes established under this Order, that is to say—

1964 No. 33

(a) in the case of the Cocoa Research Institute of Nigeria, the Nigerian Institute for Oil Palm Research, the Rubber Research Institute of Nigeria and the Nigerian Institute for Trypanosomiasis Research, being institutes established under the Nigerian Research Institutes Act 1964, the assets, properties and rights shall vest respectively in—

(i) the Cocoa Research Institute of Nigeria,
(ii) the Nigerian Institute for Oil Palm Research,
(iii) the Rubber Research Institute of Nigeria, and
(iv) the Nigerian Institute for Trypanosomiasis Research.

(b) in the case of the Federal Department of Agricultural Research, the assets, properties and rights shall vest in the National Cereals Research Institute,

(c) in the case of Umudike Agricultural Research and Training Station, the assets, properties and rights shall vest in the National Root Crops Research Institute,

(d) in the case of the Federal Department of Forestry Research, the assets, properties and rights shall vest in the Forestry Research Institute of Nigeria,

(e) in the case of the Federal Department of Veterinary Research, the assets, properties and rights shall vest in the National Veterinary Research Institute,

(f) in the case of the Federal Hides, Skins and Leather Institute of the Federal Livestock Department, the assets, properties and rights shall vest in the Leather Research Institute of Nigeria,

(g) in the case of Kainji Lake Research Project, the assets, properties and rights shall vest in the Kainji Lake Research Institute,

(h) in the case of the Federal Department of Fisheries—

(i) the assets, properties and rights held in respect of the research functions of the Department on the Lake Chad shall vest in the Lake Chad Research Institute, and

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(ii) the assets, properties and rights held in respect of the oceanographic and marine research functions of that Department shall vest in the Nigerian Institute for Oceanography and Marine Research.

(2) The Ahmadu Bello University shall transfer to and vest in the National Animal Production Research Institute such assets and powers as the University shall deem expedient for the proper functioning of the institute.

Constitution, etc. of Governing Boards of Institutes. 1973 No. 35.

18.—(1) Subject to the relevant provisions of Agricultural Research Institutes Decree 1973, the affairs of each institute shall be managed by a Board (in this Order referred to as "the Board").

(2) Each Board shall consist of seven persons who shall be persons with wide knowledge of and experience in the field of research of the institute.

(3) Members of the Boards, with the exception of the Governing Board of the National Animal Production Research Institute (who shall be appointed by the Council of the Ahmadu Bello University) shall be appointed by the Commissioner on the nomination of the Council.

(4) There shall be a Chairman of the Board of each institute who shall be appointed by the Commissioner and designated as such from among the members of the Board.

(5) The Chairman and every member of the Board shall hold office for a term of five years from the date of their appointment and may be eligible for appointment for one further term of three years.

(6) Without prejudice to the foregoing provisions, the Commissioner may appoint any person to act as temporary Chairman or member of the Board of any institute during long absence or temporary incapacity by illness or other cause of the Chairman or a member; and a person so appointed shall, while the appointment subsists, have the same powers as are exercisable by the Chairman or the member.

(7) Any member of the Board including the Chairman may resign his appointment by a letter addressed to the Commissioner, and if accepted, the resignation shall take effect from the date the Commissioner received the letter of resignation.

Co-opted members.

19. Notwithstanding the provisions of section 18 (2) above, where the Board desires to obtain the advice of any person on any matter, the Board may co-opt that person as a member of the Board for such period as it may deem necessary so however that such a co-opted member shall not be entitled to vote nor count towards a quorum.

Proceedings of the Board

20.—(1) The Board of each institute may make standing orders regulating the proceedings of the Board or any committee thereof.

(2) The quorum of the Board shall be four and the quorum of any of its committees shall be determined by the Board.

(3) The validity of any proceedings of the Board or any of its committees shall not be affected—

(a) by any vacancy in the membership, or

(b) by any defect in the appointment of a member, or

(c) by reason of the presence or participation in the proceedings of the Board by a person who is not a member of the Board.

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(4) The Director of each institute and the Secretary of the Council or their representatives shall be entitled to attend meetings of the Board of an institute and take part in its deliberations, but shall not be entitled to vote on any matter or issue.

Construction of some provisions of this Order. 1964 No.1.

21. The provisions of sections 18, 19 and 20 above shall have effect without prejudice to the Interpretation Act 1964.

Special disclosure by a member

22. Any member of the Board of any institute or any committee thereof who has a personal interest in any contract or arrangement being entered into or proposed to be considered by the Board or any committee thereof, shall forthwith declare and disclose his interest in such contract or arrangement to the Board and shall be disqualified to vote on any question relating to such contract or arrangement.

Board meetings.

23. The Board of an institute shall meet not less than twice in each year, and the Board may meet on such other occasions as it may deem necessary.

Association of institutes with universities, etc.

24. The Board of an institute may with the approval of the Council enter into association agreement with the competent authorities of any university or other institution of higher learning or recognised international institutions for the purposes of promoting or furthering mutual co-operation in the field of scientific research in respect of which the Board has responsibility under this Order.

Citation, etc.

25.—(1) This Order may be cited as the Research Institutes (Establishment, etc.) Order 1975 and shall be deemed to have come into operation on 1st November 1975.

1964 No. 33

(2) The Nigerian Research Institutes Act, 1964 is hereby repealed.

MADE at Lagos this 29th day of November 1975.

B. O. W. MAFENI,
Federal Commissioner for Agriculture and Rural Development

EXPLANATORY NOTE

(This note does not form part of the above Order but is intended to explain its purpose)

The Order establishes Research Institutes and provides for their constitution, functions and relationship with the Agricultural Research Council of Nigeria, and in one case, with the Ahmadu Bello University. The Order provides for the transfer of property, and other rights now vested in specified Federal agencies or departments to the institutes established by this Order. Further provisions are made in the Order for the facilitation of mutual co-operation in research and teaching between the institutes and universities or other institutions of higher learning or research, whether in Nigeria or elsewhere.

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APPENDIX V

NATIONAL SCIENCE AND TECHNOLOGY DEVELOPMENT AGENCY DECREE 1977

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NATIONAL SCIENCE AND TECHNOLOGY DEVELOPMENT AGENCY DECREE 1977

Decree No. 5

[20th January 1977] Commencement.

THE FEDERAL MILITARY GOVERNMENT hereby decrees as follows :—

Establishment of the National Science and Technology Development Agency.

1. There is hereby established a body to be known as the National Science and Technology Development Agency (hereafter in this Decree referred to as "the Agency") which under that name shall be a body corporate with perpetual succession and a common seal, and may sue and be sued in its corporate name.

Functions of the agency.

2. The Agency shall, subject to this Decree, have executive responsibility for the promotion and development of science and technology, including initiation of policy in relation to scientific research and technology ; and, without prejudice to the generality of the foregoing, it shall be the duty of the Agency —

(a) to advise the Federal Military Government on national science policies and priorities and on scientific and technological activities generally ;

(b) to prepare periodic master plans for the development of science and technology and advise the Federal Military Government on the financial requirements for the implementation of such plans ;

(c) to prepare annual budgets for scientific research development and receive grants for allocation to research institutions and special research projects conducted by universities under the aegis of the Agency ;

(d) to advise the Federal Military Government on the creation of new research institutes and centres and the reorganisation of existing ones to meet national needs ;

(e) to supervise and co-ordinate the activities of research institutes and centres established under this Decree ;

(f) to allocate special research projects to the universities after consultation with the National Universities Commission ;

(g) to take such steps as it may deem necessary to facilitate the application of the results of scientific and technological research by Federal and State ministries and their agencies ;

(h) to advise on scientific and technical manpower requirements of Nigeria and to promote manpower training for research ;

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(*i*) to advise on science education not only at the advanced level in respect of scientific manpower training, but also at lower levels in respect of science education in schools and general science education for the public ;

(*j*) to establish and maintain a National Science and Technology Library, Documentation and Conference Centre ;

(*k*) to publish or sponsor the publication of scientific research journals as it may consider desirable ;

(*l*) to channel external aid meant for the development of science and technology to Government research establishments ;

(*m*) to promote co-operation in science and technology with similar bodies in other countries and with international bodies connected with science and technology ; and

(*n*) to carry out such other activities as are necessary or expedient for the full discharge of any of the functions of the Agency under this Decree.

Power of Commissioner to establish research institutes.

3.—(1) The Commissioner may, with the approval of the Federal Executive Council, by order published in the *Gazette* establish research institutes ; and the provisions of Schedule 1 to this Decree shall apply in relation to any institute so established.

(2) An order establishing a research institute under this Decree may contain supplementary or incidental provisions, including provisions for—

(*a*) the designation of the institute ;

(*b*) the matter or matters on which the institute is to conduct research, including training where appropriate ;

(*c*) the transfer to the institute of the assets and liabilities of any existing Federal or State research establishments ;

(*d*) the establishment, constitution and proceedings of a governing board to manage the affairs of the institute ;

(*e*) a suitable association or other forms of relationship of the institute with any university or institution of higher learning in Nigeria.

Membership, etc.

4.—(1) The Agency shall consist of the following members —

(*a*) the Commissioner who shall be the Chairman ;

(*b*) seven distinguished scientists to be appointed by the Federal Executive Council to represent the following scientific fields —

(*i*) agricultural sciences ;

(*ii*) biological sciences ;

(*iii*) engineering and technology ;

(*iv*) medical sciences ;

(*v*) physical sciences ;

(*vi*) social sciences ; and

(*vii*) military science and technology ;

(*c*) six other persons to be appointed by the Federal Executive Council to represent interests not otherwise represented ;

(*d*) the Executive Secretary of the Agency who shall be an ex-officio member with no voting rights.

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(2) Subject to section 5 of this Decree, a member (other than the Chairman) who is not a public officer—

(*a*) shall hold office for a period of three years from the date of his appointment and shall be eligible for reappointment for one futher term of three years only;

(*b*) shall be paid such remuneration and allowances as the Federal Executive Council may determine.

Removal from office of member of the Agency.

5. The office of a member who is not a public officer shall become vacant if he resigns his office by a letter addressed by him to the Commissioner, or the Commissioner is satisfied that it is not in the interest of the Agency for the person appointed to continue in office as member and with the approval of the Federal Executive Council, the Commissioner shall notify the member in writing to that effect.

Funds.

6.—(1) There shall be established by the Agency a fund to be known as the National Science and Technology Development Fund.

(2) There shall be paid into the fund such sums as may be made available to the Agency by the Federal Military Government for allocation for research in pursuance of paragraph (*c*) of section 2 of this Decree.

(3) The Agency shall establish and maintain a separate fund from which shall be defrayed all expenditure incurred by the Agency otherwise than in pursuance of subsection (2) above.

(4) There shall be paid into the fund established in pursuance of subsection (3) above—

(*a*) such sums as may be made available by the Federal Military Government for the running expenses of the Agency; and

(*b*) such other sums as may accrue to the Agency from any other source.

Executive Secretary and other staff of the Agency.

7.—(1) There shall be appointed by the Federal Executive Council an Executive Secretary to the Agency, who shall be an eminent scientist with wide experience in the field of science administration.

(2) The Executive Secretary who shall be the chief executive officer of the Agency shall hold office on such terms and conditions as may be specified in his letter of appointment or on such other terms and conditions as may be determined from time to time.

(3) The Agency may appoint such other persons to be employees of the Agency as it may deem fit.

(4) The remuneration and tenure of office of employees (other than the Executive Secretary) of the Agency shall be determined by the Agency after consultation with the Federal Commissioner for Establishments.

(5) The Agency shall have the power to make, with the approval of the Federal Executive Council, regulations governing conditions of service of its employees.

(6) The Agency may grant loans to its employees for purposes approved by the Federal Military Government.

Accounts and audit.

8.—(1) The Agency shall keep proper accounts and proper records in relation thereto and shall prepare in respect of each financial year a statement of accounts in such form as it may direct.

(2) The Agency shall as soon as may be after the end of the financial year to which the accounts relate cause its accounts to be audited by auditors approved by the Federal Commissioner for Finance.

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(3) The auditors shall on completion of the audit of the accounts of the Agency for each financial year prepare and submit to the Agency the following two reports, that is to say—

(*a*) a general report setting out the observations and recommendations of the auditors on the financial affairs of the Agency generally for that year and on any important matters which the auditors may consider necessary to bring to the notice of the Agency ; and

(*b*) a detailed report containing the observations and recommendations of the auditors in detail on all aspects of the operation of the Agency for that year.

Annual report.

9. The Agency shall prepare and submit to the Federal Executive Council through the Commissioner a report on the activities of the Agency during the preceeding financial year and a projection for the following year, and shall include in such report a copy of the audited accounts of the Agency.

Proceedings of the Agency.

10.—(1) The quorum for meetings of the Agency shall be six of whom at least two shall be persons appointed under section 4 (1) (*b*) above.

(2) The Agency shall meet not less than three times in each year and on such other occasions as may be necessary.

(3) If the Agency desires to obtain the advice of any person on any particular matter, the Agency may co-opt that person to be a member for as many meetings as may be necessary, but he shall not be entitled to vote.

(4) The validity of any proceedings of the Agency shall not be affected by any vacancy in the membership of the Agency, or by any defect in the appointment of a member of the Agency or by reason that any person not entitled to do so took part in the proceedings.

Repeal, savings and transfer of assets and liabilities.

11.—(1) The enactments specified in Schedule 3 to this Decree are hereby repealed to the extent specified in the third column of that Schedule.

(2) The transitional and saving provisions in Schedule 2 to this Decree shall have effect in relation to assets and liabilities of the Councils specified therein.

L.N. 107 of 1975.

(3) Notwithstanding subsection (1) above, the research institutes established by the Research Institutes (Establishment, etc.) Order 1975 shall be deemed to have been established under this Decree and references in that Order to "Council" shall be construed as references to the Agency established under this Decree, and references to the Commissioner shall be construed as references to the Commissioner as defined by section 13 of this Decree.

Committees.

12.—(1) The Agency may appoint Research Committees in any field of science and technology as the Agency may consider appropriate to assist the Agency in its activities.

(2) The Agency may appoint such other standing and ad hoc committees as the Agency thinks fit to consider and report on any matter with which the Agency is concerned.

(3) Every committee appointed under the foregoing provisions shall be presided over by such person as the Agency may appoint and shall be made up of such number of persons, all of whom need not be members of the Agency, as the Agency may determine in each case.

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13. In this Decree, unless the context otherwise requires— Interpretation.

"the Agency" means the National Science and Technology Development Agency established under section 1 of this Decree ;

"the Chairman" means the person appointed as Chairman pursuant to section 4 of this Decree ;

"the Commissioner" means the Federal Commissioner charged with responsibility for science and technology ;

"Executive Secretary" means the Executive Secretary appointed pursuant to section 7 of this Decree.

14. This Decree may be cited as the National Science and Technology Development Agency Decree 1977. Citation.

SCHEDULES

SCHEDULE 1

Section 3 (1)

ESTABLISHMENT OF RESEARCH INSTITUTES

1. Any research institute established under this Decree shall have a governing board and shall be a body corporate with perpetual succession and a common seal and may sue and be sued in its corporate name and it shall have power—

(*a*) to prepare a programme of research within the field for which the institute is responsible, for such periods, not less than three years, as the board, with the approval of the Agency, may determine, together with detailed estimates of the expenditure which will be required for carrying out the programme ;

(*b*) to review, and if necessary revise, each year the programme approved under paragraph (*a*) above for the following year, together with the estimated budget for that year ;

(*c*) to carry out the programme of research approved by the Agency ; and

(*d*) to make suitable arrangements for the application of the results of the work of the institute by Federal and State Ministries and their agencies to development activities.

2. The members of the governing board of each institute shall be appointed by the Commissioner with the approval of the Federal Executive Council.

3. Subject to the provisions of this Decree, each institute shall have power to do anything and to enter into any transaction which in its opinion ought to be done in the proper discharge of its functions.

4. Each institute shall, in particular, and without prejudice to the generality of the foregoing power, have power to acquire and hold land and property.

5. For the purpose of the Public Lands Acquisition Act the purposes of an institute shall be public purposes of the Federation within the meaning of that Act. Cap. 167.

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6. The board of each institute may appoint such number of standing and ad hoc committees as it thinks fit to consider and report on any matter with which the board is concerned.

7. There shall be a Director for each institute appointed by the Commissioner on the advice of the board of the institute concerned, who shall be a person with wide experience of the matters with which the relevant institute is concerned ; and the Director shall—

(*a*) be charged with the day to day management of the affairs of the institute in accordance with such instructions as may from time to time be given to him by the board of the institute ; and

(*b*) be appointed in accordance with the regulations and conditions of service approved by the Agency.

8. The board of each institute may appoint such employees as are deemed necessary for the proper discharge of the functions of the institute under this Decree and pay such employees such remuneration and allowances as are payable to persons of equivalent grades in the public service of the Federation.

9. The board of each institute shall prepare and submit to the Agency an annual report on the activities of the institute.

Financial Provisions

10. Each institute shall establish and maintain a fund from which shall be defrayed all expenditure incurred by the institute.

11. There shall be paid into the fund such sums as may be made available to the institute by the Agency, and such other assets as may accrue to the institute from time to time.

12. The fund shall be managed in accordance with rules made by the Federal Commissioner for Finance ; and without prejudice to the generality of the power to make rules conferred by this section, the rules shall, in particular, include provisions—

(*a*) specifying the manner in which the assets and the fund are to be held and regulating the making of payments to and from the fund ;

(*b*) requiring the keeping of proper accounts and records for the purpose of the fund in such form as may be specified by the rules ;

(*c*) for securing that the accounts are audited annually by an auditor approved by the Agency ;

(*d*) requiring copies of the accounts and of the audit report on them to be forwarded to the Agency not later than three months following the end of the period to which the accounts relate.

13. Each institute may borrow or lend money only with the approval of the Agency.

14. Each institute may grant loans to its employees for purposes approved by the Agency.

15. Each institute shall prepare and submit its programme and estimated budget and any annual revision for approval by the Agency.

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SCHEDULE 2

Section 11 (2)

TRANSITIONAL PROVISIONS RELATING TO TAKE-OVER OF ASSETS AND LIABILITIES OF COUNCILS PREVIOUSLY RESPONSIBLE FOR SCIENCE AND TECHNOLOGY

1. The functions, and assets and liabilities of any of the Councils specified hereunder (hereinafter referred to as the "affected council") shall as from the commencement of this Decree be disposed of in accordance with the following provisions of this Schedule.

2. Upon the commencement of this Decree —

(*a*) the rights, interests and obligations in respect of assets and liabilities of any affected council subsisting immediately before the commencement of this Decree, under any contract or instrument shall by virtue of this Decree be assigned to and vested in the Agency ;

(*b*) any such contract or instrument as is mentioned in paragraph (*a*) above shall be of the same force and effect against or in favour of the Agency and shall be enforceable as fully and effectively as if instead of the affected council the Agency had been a party thereto ; and

(*c*) the Agency shall be subject to all the obligations and liabilities to which the affected council was subject immediately before the commencement of this Decree and all other persons shall as from the said commencement have the same rights, powers and remedies against the Agency as they had against the relevant affected council.

3. Any proceeding or cause of action pending or existing immediately before the commencement of this Decree by or against an affected council in respect of any right, interest, obligation or liability of such affected council may be commenced, continued or enforced by or against the Agency as it might have been by or against an affected council if this Decree had not been made.

4. In this Schedule, "affected council" means any of the following Councils, that is —

(*a*) the Nigerian Council for Science and Technology established under the Nigerian Council for Science and Technology Decree 1970 ; 1970 No. 6.

(*b*) the Agricultural Research Council of Nigeria established under the Agricultural Research Council of Nigeria Decree 1971, ; 1971 No. 25.

(*c*) the Industrial Research Council of Nigeria established under the Industrial Research Council of Nigeria Decree 1971 ; 1971 No. 33.

(*d*) the Medical Research Council of Nigeria established under the Medical Research Council of Nigeria Decree 1972 ; 1972 No. 1.

(*e*) the Natural Sciences Research Council of Nigeria established under the Natural Sciences Research Council of Nigeria Decree 1973. 1973 No 9.

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SCHEDULE 3 *Section 11 (1)*

REPEALS

Number	*Title*	*Extent of Repeal*
1970 No. 6	Nigerian Council for Science and Technology Decree 1970	The whole Decree
1971 No. 25	Agricultural Research Council of Nigeria Decree 1971	The whole Decree
1971 No. 33	Industrial Research Council of Nigeria Decree 1971	The whole Decree
1972 No. 1	Medical Research Council of Nigeria Decree 1972	The whole Decree
1973 No. 9	Natural Sciences Research Council of Nigeria Decree 1973	The whole Decree
1973 No. 35	Agricultural Research Institutes Decree 1973	The whole Decree

MADE at Lagos this 20th day of January 1977

LT.-GENERAL O. OBASANJO,
Head of the Federal Military Government,
Commander-in-Chief of the Armed Forces,
Federal Republic of Nigeria

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EXPLANATORY NOTE

(This note does not form part of the above Decree but is intended to explain its purpose)

The Decree establishes the National Science and Technology Development Agency as a body corporate and confers on it, among other things, executive responsibility for the promotion and development of science and technology, including initiation of policy relating to scientific research and technology. The Agency takes over the functions of the various existing statutorily established research councils which are now dissolved.

PUBLISHED BY AUTHORITY OF THE FEDERAL MILITARY GOVERNMENT OF NIGERIA AND PRINTED BY THE MINISTRY OF INFORMATOION, PRINTING DIVISION, LAGOS

BIBLIOGRAPHY

UNIVERSITY OF IBADAN LIBRARY

I BOOKS

Baldwin, K.D.S., The marketing of cocoa in Western Nigeria. Oxford. Oxford University Press, 1954.

_______ The Niger agricultural project. Oxford. Basil Blackwell, 1957.

Bauer, P. T., West African Trade, London. Routledge and Kegan Paul Ltd. 1963.

Blase, Melvin G. (ed), Institutions in agricultural development. Ames, Iowa. Iowa State University Press, 1971.

Caine, S., Prices for primary producers Hobart. Paper No. 24. London. 1963.

Clayton, E. S., Agrarian development in peasant economies. London. Pergamon Press, 1964.

Dillon, John, The analysis of response in crop and livestock production. London. Pergamon Press, 1968

Eicher, Carl K. and Carl Liedholm (ed), Growth and development in the Nigerian economy. Lansing. Michigan State University Press, 1970.

_______ and Lawrence W. Witt (ed), Agriculture in economic development. McGraw Hill, 1964.

Enke, Stephen, Economics for development. Englewood Cliffs. Prentice Hall Inc., 1963.

UNIVERSITY OF IBADAN LIBRARY

Evenson, Robert and Yoav Kislev, Agricultural research productivity. New Haven. Yale University Press, 1975.

Ezekiel, M. and K. Fox, Methods of correlation analysis (third edition). New York. John Wiley and Sons. 1959.

Fishel, Walter L. (ed), Resource allocation in agricultural research. Minneapolis. University of Minnesota Press, 1971.

Galleti, R., K.D.S. Baldwin and I. O. Dina, Nigerian cocoa farmers. London. Oxford University Press, 1956.

Gittinger, J. Price, Economic analysis of agricultural projects. The John Hopkins University Press, 1972.

Hawkins, C. J. and D. W. Pearce. Capital investment in appraisal. London. Macmillan Economic Studies. The Macmillan Press Ltd., 1971.

Hayami, Y. and V. W. Ruttan, Agricultural development: an international perspective. Baltimore. John Hopkins Press, 1971.

Heady, E. O. and J. L. Dillon, Agricultural production functions. Iowa State University Press, 1961.

Helleiner, G. K. Peasant agriculture, government and economic growth in Nigeria. Homewood, Illinois. Richard D. Irwin Inc., 1966.

Higgins, Benjamin, Economic development. Principles, problems and policies. London. Constable and Company Ltd., 1959.

UNIVERSITY OF IBADAN LIBRARY

Hill, Poly, The Gold Coast farmer: a preliminary survey. London. Oxford University Press, 1956.

_______ The migrant cocoa farmers of southern Ghana. Cambridge. Cambridge University Press, 1963.

Hirschman, Albert O., The strategy of economic development. New Haven. Yale University Press, 1958.

Johnson, J., Econometric methods. New York. McGraw-Hill Inc., 1963.

Lewis, Arthur W., Theory of economic growth. London. Urwin University Books, 1955.

Marshal, Alred, Principles of economics. 8th edition. London. MacMillan, 1930.

McCormick, B.J. <u>et al</u>. Introducing economics. Penguin Education 1974.

Mynt, Hla, The economics of developing countries. London. Hutchinson and Co. Ltd., 1968.

Oluwasanmi, H.A., Agriculture and Nigerian development. London. Oxford University Press, 1966.

Peston, Maurice, Public goods and the public sector. London. Macmillan economic studies. Macmillan Press, 1972.

Samuelson, Paul A., Economics, tenth edition. McGraw Hill, Kogakusha Ltd., 1976

UNIVERSITY OF IBADAN LIBRARY

Schultz, T. W., Transforming traditional agriculture. New Haven. Yale University Press, 1964.

Seers, D. and L. Joy (ed.), Development in a divided world. Penguin Books. 1970.

Stewart, I. G. and H. W. Ord (ed), African primary products and international trade. Edinburgh. 1964.

Stopler, W.F., Planning without facts: lessons in resource allocation from Nigeria's development. Cambridge. Harvard University Press, 1966.

Wells, Jerome C., Agricultural policy and economic growth in Nigeria, 1962-1968. London. Oxford University Press, 1974.

II JOURNAL ARTICLES

Abaelu, J. N., Building the foundations for Nigeria's agricultural growth: public expenditures on agricultural research. Bulletin of Rural Economics and Sociology, 8 (1); 1973.

______ The Nigerian oil palm sector revisited. The Nigerian Journal of Economics and Social Studies, 13 (3); 1971, 285-298.

Anon., Research and development in Nigeria - Federal Government research institutions. Nigerian Trade Journal, 15 (1); 1967, 9-18.

UNIVERSITY OF IBADAN LIBRARY

Anthonio, Q.B.O., Agriculture and economic development: Some misconceptions in research policy. The Nigerian of Economic and Social Studies, March 1972.

Ashton, J. and S. J. Rogers, Agricultural adjustment - a challenge to economists. Journal of Agricultural Economics, 18(20); 1967.

Cash, W. C., A critique of manpower planning and educational change in Africa. Economic Development and Cultural change, October 1965.

Clayton, E.S., Freedom and welfare in developing countries. Farm Economist 10(6); 1963.

Griliches, Zvi, Hybrid corn: an exploration in the economics of technological change. Econometrica, 25; 501-22, 1957.

_______ Research costs and social returns: hybrid corn and related innovations. Journal of Political Economy. 66: 419-31, 1958.

_______ The sources of measured productivity growth, U.S. agriculture, 1940-1960. Journal of Political Economy, 71: 331-46, 1962.

Essang, S.M. and S. O. Olayide, Pattern of estimated agricultural expenditures in the 1975-80. Nigerian plan: some implications. The Nigerian Journal of Economic and Social Studies, 17(3): 245-62, 1975.

UNIVERSITY OF IBADAN LIBRARY

Evenson, Robert and Yoav Kislev, Research and productivity in wheat and maize. Journal of Political Economy 81: 1309-29, 1973.

_______ Investment in agricultural research and extension: an international survey. Economic Development and Cultural Change

Fogg, C.D., Economic and social factors affecting the development of small-holder agriculture in Eastern Nigeria. Economic and Social Change, 13(3): 1965.

Latimer, R. and D. Paarlburg, Geographic distribution of research costs and benefits. Journal of Farm Ecoomics 47: 234-41, 1965.

Mohan, R., D. Jha and R. E. Evenson, The Indian agricultural research system. Economics and Politics Weekly; March 31, 1973.

Nelson, R. R. and E. S. Phelps, Investment in humans, technological diffusion and economic growth. American Economic Review, 56: 69-75, 1966.

Olayemi, J. K., Some economic characteristics of peasant agriculture in the cocoa belt of Western Nigeria. Bulletin of Rural Economics and Sociology, 7(2), 1972.

Olayide, S.O. and O. Ogunfowora, Economics of maize response to NPK applications. Bulletin of Rural Economics and Sociology, 5 (1): 95-122, 1970.

UNIVERSITY OF IBADAN LIBRARY

Peterson, Willis L., Return to poultry research in the United States. Journal of Farm Economics, 49 (3): 656-669, 1967.

Prest, A.R. and R. Turvey, Benefit-cost analysis: a survey. Economic Journal, December 1965.

Ruttan, Vernon W., Research institutions: questions of organisation. In Institutions in agricultural development. Edited by Melvin G. Blase, Ames, Iowa. Iowa State University Press, 1971.

Solow, Robert M., Technical change and the aggregate production function. Review of Economics and Statistics, 39: 312-19, August 1957.

______ Technical progress, capital formation and economic growth. American Economic Review, 52; 76-86, May 1962.

Stigler, G.J., The economics of information. Journal of Political Economy, 69: 213-25, 1961.

Tang, A., Research and education in Japanese agricultural development. Economic Studies Quarterly, 13:27-41.

Tweenten, Luther G. and Fred H. Tyner, Towards an optimum rate of technological change. Journal of Farm Economics, 46: 1075-84, December 1964.

Ugoh, S. U., Prospects of some Nigerian agricultural products in the world market. The Nigerian Journal of Economic and Social Studies, November 1965.

UNIVERSITY OF IBADAN LIBRARY

Wickizer, V.D., The plantation system in the development of tropical economies. Journal of Farm Economics, 40 (1), 1958.

______ The small-holder in tropical export crop production. Food Research Institute Studies, February 1960.

Wood, G.A.R., Cocoa research in Ghana. World Agriculture, 19:88, 1967

Yotopoulos, P.A., From stock to flow capital inputs for agricultural production function: a microanalytical approach. Journal of Farm Economics, 49 (2): 1967.

III THESES, RESEARCH PAPERS AND REPORTS

Abidogun, A., The role of export crops in economic development with special reference to Nigeria. Unpublished M.Sc. thesis, University of London, 1965.

Ardito-Barletta, N., Costs and returns of agricultural research in Mexico. Unpublished Ph.D thesis, University of Chicago, 1970.

Ayer, H., The costs, returns and effects of agricultural research in a developing country. The case of cotton seed research in Sao Paulo, Brazil. Unpublished Ph.D thesis, Purdue University. 1970.

UNIVERSITY OF IBADAN LIBRARY

Gill and Duffus, Cocoa market report (series).

Glendiffing, E.R., The performance of the introductions and hybrid in WACRI trials. Report of the cocoa conference. London. The Cocoa, Chocolate and Confectionery Alliance, 1957.

Hines, J., The utilization of research for development: two case studies in rural modernization and agriculture in Peru. Unpublished Ph.D thesis, Princeton University, 1972.

International Institute for Tropical Agriculture, The NAFPP: a new dimension for Nigerian agriculture. Ibadan, 1977.

Lewis, Arthur W., Reflections on Nigeria's economic growth. Development Centre Studies, O.E.C.D., Paris, 1967.

McFarlane, D. and Martin Oworen, Investment in oil palm plantation: a financial and economic appraisal. Economic Development Institute, Enugu. 1966.

McKelvie, A.D., The relationship between rainfall and main crop yield. Report of the cocoa conference, 1957.

Norman, D.W., Crop mixtures under indigenous conditions in northern Nigeria. Conference on factors of economic growth in West Africa. ISSER, University of Ghana, Legon. 1971.

________ and E. B. Simmons, Relevant research priorities for farm development in West Africa. Conference on

UNIVERSITY OF IBADAN LIBRARY

factors of economic growth in West Africa. ISSER, University of Ghana, Legon. 1971.

Okurume, Godwin, The food crop economy in Nigerian agricultural policy. CSNRD report No. 31, 1969.

Olatunbosun, Dupe. Nigerian farm settlements and school leavers farm - profitability, resource use and social-psychological considerations. Unpublished Ph.D thesis, Michigan State University, East Lansing, 1967.

______ Nigerian government policies affecting investment in agriculture. CSNRD report No. 16, 1968.

______ and S. O. Olayide, Effects of the marketing boards on the output and income of primary producers. International conference on marketing board system, NISER, Ibadan 1971.

______ Pricing policy and supply response in cocoa production: the Nigerian case. Proceedings of cocoa economic research, University of Ghana, Legon. April 1973.

Olayemi, J. K., Peasant cocoa production in Western Nigeria: an economic analysis. Unpublished Ph.D thesis, McGill University, 1970.

Oluwasanmi, H.A., West African development in the 60's. Conference on factors of agricultural growth in West Africa. ISSER, University of Ghana, Legon, 1971.

UNIVERSITY OF IBADAN LIBRARY

Oni, S. A., A statistical analysis of the demand for Nigerian cocoa. Department of Agricultural Economics and Extension, University of Ibadan, March 1970. Mimeographed.

______ An econometric analysis of the provincial and aggregate responses among Western Nigerian cocoa farmers. Unpublished Ph.D thesis, University of Ibadan, 1972.

Purvis, M.J., Report on a survey of the oil palm rehabilitation scheme. CSNRD report No. 10, Michigan State University, 1968.

Salter, W. E. G., Productivity and technical change. Monograph 6 of the Department of Applied Economics, University of Cambridge, Cambridge University Press, 1960.

Saylor, R. G., A study of obstacles to investments in oil palm and rubber plantations. CSNRD report No. 15, Michigan State University, 1968.

Teriba, R. O., Western Nigeria public sector and economic development, 1948-1962. Unpublished Ph.D thesis, University of Manchester, 1961.

Toxopeus, F., Amazon cocoa in Nigeria. Annual report of the West African Cocoa Research Institute (Nigeria) 1963-64.

UNIVERSITY OF IBADAN LIBRARY

United Africa Company, Economic and statistical report (various issues)

United Nations, F.A.O, Processing of raw cocoa for the market. Agricultural studies No. 60, Rome, 1963.

______ F.A.O, The international organisation of commodity trade: case study of cocoa. New York, 1966.

______ F.A.O., Agricultural development in Nigeria 1965-1980. Rome, 1966.

IV NIGERIAN OFFICIAL PUBLICATIONS

Agricultural Research Council of Nigeria, Report on national seminar on manpower planning for agricultural development in Nigeria. Ibadan, 1977.

Cocoa Research Institute of Nigeria, Annual reports, several issues.

Engledow, F.L., Report on the federal organisations for agricultural, veterinary, forestry and fisheries research. Sessional paper No. 4 of 1959. Federal Government Printer, Lagos, 1959.

Department of Agriculture, Annual reports, several issues.

Federal Government of Nigeria, Digest of statistics, Federal Office of Statistics, Lagos several issues.

UNIVERSITY OF IBADAN LIBRARY

________ 1962-1968 Development Plan, Government Printer, Lagos. 1962.

________ The four-year development plan 1970-74. Federal Ministry of Economic Planning and Reconstruction. Lagos, 1970.

________ Agricultural development in Nigeria 1973-85. Federal Ministry of Agriculture and Natural Resources. Lagos, 1974.

________ Third national development plan 1975-80, volumes 1 and 2. Central Planning Office, Federal Ministry of Economic Development, Lagos, 1975.

________ Economic indicator, several issues. Federal Office of Statistics, Lagos.

Smythe, A. J. and F. Montgomery, Soils and land use in central Western Nigeria. Ibadan. Government Printer, 1962.

West African Cocoa Research Institute, Annual reports, several issues.

Western Nigeria Government, Tree crop planting projects, Ibadan. Government Printer, 1964.

________ The Western State special cocoa development scheme, Ibadan, 1970. Mimeographed

________ Statistical Bulletin, several issues. Ministry of Economic Planning, Ibadan. Government Printer.

UNIVERSITY OF IBADAN LIBRARY

__________ Western State programme of the third national development plan 1975-80. Ibadan. Government Printer, 1975.

Western Nigeria Marketing Board, Annual reports, several issues.

__________ Statistical information on Western State of Nigeria controlled produce. Ibadan. Several issues.

UNIVERSITY OF IBADAN LIBRARY