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THE SPATIAL
DIMENSION
IN NIGERIAN
AGRICULTURAL
DEVELOPMENT

by S. Akin Agboola



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SINCE ANCIENT TIMES, man's fear of starvation has been persistent and real. The Lord's prayer, "Give us this day our daily bread" uttered by millions of christians around the world every day, gives a vivid illustration of this fear and uncertainty. Should such a prayer not be heard and favourably answered, the dire and unpleasant consequences are in no doubt. In like manner, planners and administrators in both the developed and developing world can almost be heard to audibly repeat annually with religious fervour and expectation "Give us this year a bountiful harvest for the sake of our economy and the welfare of our people". The Psalms indicate in such awful clarity the hurdles to be jumped and the anxieties to be overcome before such laudable goals can be achieved. Psalm 127 cautions,

"It is in vain you rise early, to go late to rest, eating the bread of anxious toil"

This is partly because, as Psalm 78 puts it,

He gave their crops to the caterpillar, and the fruit of their labour to the locust. He destroyed their vines with hail and their sycamores with frost".

The opening section of this lecture is not meant to portray world agriculture in pessimistic or gloomy terms or present God as an unrelenting force frustrating human agricultural efforts. Rather, the intention is to underline the significance of agriculture for the majority of the world's population, and to stress the importance of food and other crops to man's survival and social and economic well being. It is also to emphasize that although the prospects of an agricultural paradise are ever present, yet its attainment is subject to God's injunction "in the sweat of your face you shall eat bread". This is interpreted here to mean man's obligation to mobilise all the physical, human, and technological resources at his disposal to achieve the goals of agricultural production.

Of all the resources man is capable of harnessing for the purpose of satisfying his most basic wants, land space is probably the most fundamental. Viewed within the context of agriculture, land space is important in terms of its extent relative to population distribution and densities, its quality measured in terms of soil structure, fertility and moisture status, its locational characteristics, especially with regard to accessibility to markets and major transport routes, the inter-regional and intra-regional variations in the intensity and profitability of its use, and its complex relationships with the ecological and human environments. It is because of the significant place occupied by the spatial dimension in agricul-

tural development that it has been chosen as the topic for this inaugural lecture. It seems to me that it is the independent variable around which many important dependent variables in agriculture revolve. Without it, man has no place under the sun to stand, how much less of having the opportunity to sweat from his brows and bringing forth agricultural returns, be it food or other crops and live-stock.

In the light of the foregoing, the objectives of this inaugural lecture are as follows:

- (a) to show that agriculture permeates all aspects of national life in Nigeria to an extent that only a multi-disciplinary approach can cope with its multi-faceted problems and that geography has a contribution to make to the solution of these problems;
- (b) to emphasize the significance of the spatial dimension in agricultural development;
- (c) to draw attention to the lack of justice done to the spatial theme in Nigerian agricultural studies;
- (d) to assess geographical contributions to the spatial analysis of Nigerian agriculture, and to highlight the gaps which remain to be filled; and
- (e) to suggest guidelines for space-oriented research in Nigerian agriculture.

AGRICULTURE IS COMPLEX to the extent that not just biological processes, economic activities or diffusion processes are involved, rather it is a whole way of life, especially within the African setting. In Nigeria, over 70 per cent of the population is engaged in agricultural activities, and it is the main pivot around which rural life—socio-economic, cultural, technological and sometimes even religious and political—revolves. It is also the most conspicuous user of land and the most important source of food-stuffs for the population and raw materials for local and overseas industries. In such a situation, the complexity of agriculture inevitably attracts the attention of a host of disciplines stretching across agricultural, biological, physical, technological and social sciences. While useful contributions to our understanding of Nigerian agricultural problems from these different specializations have not been lacking, a synthesis of findings in a way to make theory formulation possible, to sharpen techniques of analysis and to pose issues of spatial significance to policy makers have not always been available. I humbly submit that by the nature of

his training, the geographer is one of the useful candidates for this type of undertaking.

The complexity of agriculture and the relevance of geography can be viewed from another angle. Agriculture has as its main components—farmers, crops, and livestock. All interact with the environment and are influenced by specific cultures and technologies. Whether we are concerned with the real components of agriculture or the factors which influence their operations, they all vary in space and are subject to spatial analysis. Let me illustrate with the example of farmers. Of particular interest in the spatial analysis of farmers are population distribution patterns in rural areas, the man-land relationships expressed in agricultural population densities, the rural communities in which farmers live indicated as rural settlements patterns, the short-term and long-term movements of farmers shown in commuting and migration patterns, and the variations in cultural and technological practices as exemplified by cultivation and storage techniques, to mention only a few of the topics of spatial significance. In fact, viewed in its correct perspective, the spatial aspects of agriculture alone are so complex that geographical research has to rely on collaboration with other social scientists in covering the ever-widening horizons involved.

The last aspect of the complexity of Nigerian agriculture and the necessity for geographical involvement I want to deal with at this stage arise from the problems at present being experienced in the agricultural sector. The *Third National Development Plan 1975-80* has drawn attention to the declining contribution of agriculture to the Gross Domestic Product (GDP). It is of the opinion that “the performance of the sector in recent years clearly underlies the need for much greater mobilization of resources at all relevant levels of the economy than has hitherto been done” (Federal Ministry of Economic Development, 1975). Some of the obvious agricultural problems include declining export and food crop production during a period of increasing demand, consequent steep increases in food imports and lowered contribution to the balance of payments position, rising food prices in internal markets, deteriorating morale among farmers and the steady drift of population from agricultural activities, a systematic deterioration of the ecological environment, accompanied by declining productivity and quantitative and qualitative under-utilization of land and other resources. There are also serious imbalances in the scale and intensity of agricultural land use leading to dangerous regional disparities in agricultural development. The solutions to these multifarious problems depend a great deal on careful physical, economic, and social planning at national and regional levels. Because such planning has to rely

heavily on the collection and presentation of facts on existing agricultural conditions, the role of the geographer is indispensable and crucial.

II

IN TURNING TO the second objective of this lecture, we have to be clear about the definitions of two terms, *spatial dimension* and *agricultural development*. The emphasis on spatial analysis in geography dates back to the 1960s. The spatial point of view generated then was accompanied by strong doses of quantification and theory formulations—developments which brought the subject closer to the other sciences. Also, as a side development, the need to make the meanings of terms clear and accurate or operational contributed to a clearer understanding of what 'spatial' actually connotes. According to Taaffe (1974), spatial analysis involves the study of spatial distributions and space relations or of spatial organization expressed as both pattern and process.

This definition implies the following

- (a) that there is organized use of space by man;
- (b) that such organized use leads to the emergence of orderly distributions or patterns of specific phenomena on the earth's surface, and
- (c) that specific relationships or processes can be used or established to explain the patterns.

Such a procedure is capable of throwing useful light on man-environmental systems and relationships, a fundamental problem also studied by other sciences.

Recent developments in geography throw further light on the structural and dynamic aspects of spatial analysis. These have to do, in particular, with the cultivation of the frontier areas between the subject and some other social sciences—especially economics, sociology and psychology. Regional economists and economic geographers have collaborated, for example, in rendering linear programming more spatial through the construction of regional allocation models and maps showing optimal or least-cost allocation of resources and attempting a comparative analysis of why the actual pattern in a given region does not conform to the optimal pattern. Such analysis throws light on both the structural and spatial patterns of regional economy.

The dynamic component of spatial analysis has been introduced by casting diffusion theory, widely used in sociology, into a regional mould by geographers. In establishing the validity of diffusion as a field of geographic interest, Brown and Moore (1969) observed

that "the spread of a phenomenon, idea, or technique throughout a population or region incorporates basic geographic elements of distance, direction and spatial variation . . .". Diffusion-oriented research has been used by geographers to identify the tendency towards spatial regularity in the spread of innovations, and to throw light on how the processes involved—information flow, social communication, and the resistance attributes of the population concerned—to mention only a few—take place within a spatial context (Hagerstrand, 1953).

The two remaining components of spatial analysis worth mentioning briefly at this point are perception of the environment and systems theory. One of the most important questions to which an answer is sought in perception studies is the extent to which spatial behaviour is conditioned by variations in perception of the environment (Chisholm 1971). This is particularly relevant within the context of this lecture, as the use of land by farmers for agricultural purposes is largely due to their assessment of environmental quality, hazards and potentialities.

Owing to its integrative nature, perhaps, it is appropriate that the application of systems thinking to spatial analysis should be discussed last. The approach focusses attention on the structure, function, equilibrium and change of the basic components of spatial structures (Harris 1969). It also emphasizes the "relationships between different groups of organisms, and between the organisms and the environment they occupy" (Moss and Morgan 1967). Within an agricultural setting, the ecological relationships are crucial as they provide the means of understanding the actual transformation of matter and energy to useful organic products, and of relating these to spatial changes in climatic and pedological conditions. Thus, crop and animal husbandry can be viewed as an attempt to control and direct the energy of ecological systems towards the production of economic materials.

In a nutshell therefore, spatial analysis involves the identification of static and dynamic structures on the earth's surface, the processes and perceptions which explain them, and the establishment of the systems of relationships which integrate, and energise them towards productive goals. The spatial theme also involves an assessment of the qualities of space and environment for specific agricultural uses, and an appreciation of the changes in the ecological environment under the impact of man's use.

Agricultural development is usually considered a process of change in the direction of improved land and labour productivity, increased per capital incomes, and a rise in the general standards of living. These are made possible through improved efficiency in the use of land and labour resources, decline in the importance

of traditional inputs, increase in the quality and quantity of external inputs, improved technical and managerial efficiency, and the availability of an array of supporting services (Johnston and Kilby 1975). Schultz (1966) has also stressed the importance of introducing relatively cheap sources of additional agricultural production, investing on high pay-off new inputs and improving the state of the arts both in human and material terms.

It is evident from the foregoing that many of the structural aspects of agricultural development have significant spatial implications, which account for our interest in it in this lecture. Owing to its static and dynamic nature, agricultural development is peculiarly amenable to spatial analysis. The use of improved seeds, modern techniques of production and general increases in agricultural output usually involves an expansion of land use and have implications for the theoretical and practical aspects of space economies. The competition for land use, for example, which emerges, leads to spatial variations in land use intensity and cropping patterns, phenomena understood better by reference to the von Thunen model.

Other explanatory spatial models found useful under conditions of agricultural development include North's export base theory, which focusses attention on the mechanisms of economic growth within the regional setting, and the Myrdal hypothesis of cumulative causation which seeks to explain inter-regional inequalities during the process of national development. The other approaches to spatial analysis already discussed above help to throw light on the complex inter-relationships which exist between space, environment and land use, the various influences which are relevant to the farmer in his design of land use strategies, the significance of the modelling of change to future agricultural planning and the cumulative impact of agricultural development on environmental quality.

We have thus far, through definitive statements on spatial analysis and agricultural development, thrown light on the significance of the spatial theme in agricultural development. It is now necessary for us to turn our attention to the use of the spatial dimension in agricultural studies in Nigeria.

III

THE LEADING AGRICULTURAL books on Nigeria whose spatial contents have been examined for use in this lecture are Oluwasanmi's, *Agriculture and Nigerian Economic Development* (1966), Oyenuga's *Agriculture in Nigeria* (1967), F. A. O.'s, *Agricultural Development in Nigeria 1965-1980* (1966), the CSNRD'S, *Strategies*

and recommendations for Nigerian rural development 1969-1985 (1969), and the Federal Ministry of Agriculture's, *Agricultural Development in Nigeria 1973-1985* (1974). These are eminent books in their own rights, with specific objectives and designed to solve specific problems. In fact, most of them are landmarks in Nigerian agricultural studies, and nothing said here is calculated to detract from the invaluable contributions they have made.

In recognition of the fact that land provides the main base for agricultural enterprises, all the authors emphasize the significance of the land element in their books. Some, like Oyenuga and FAO, pay particular attention to the distribution, productivity and potentialities of soil types in the country, while others are more interested in the tenurial and economic aspects. They also all recognise the fundamental impact of environmental factors, especially climate and ecological zones on agricultural production. In addition, most of the books gave some consideration to land use and what they refer to as crop production patterns. Only a few, notably, Oluwasanmi, the Consortium and the Federal Ministry of Agriculture attempted to give spatial expression to the numerous human variables of relevance to agriculture. Whatever their shortcomings, all these contributions are considered to be on the credit side.

An assessment of the spatial context of these books has to be related to their objectives. One of them is meant to be an introductory text for agricultural education at the professional and academic levels. All the others emphasize the development theme, such as the role of agriculture in Nigerian economic development, trends in agricultural development and the need for further planning, and rural development strategies.

Given these broad objectives, the role of the farmer as the cornerstone of any agricultural development effort ought to have been recognized. Only one of the books under review emphasized the role of the population factor in agriculture in some details and only in respect of population densities does one obtain some idea of spatial distribution. The best of the others was content in offering estimates of the number of farmers in the country. When questions touching upon the location of the farmers, their concentrations, the types of communities in which they live, their accessibility to lines of communication and the man-land ratios are asked, satisfactory answers are not always forth-coming from these books. Surely, if we are to improve the lot of farmers in rural environments, we have to know where they are, in what numbers and how they can be reached. I do not imply from these comments that agricultural scientists are not interested in farmers, or that a lot of useful works have not been done on aspects of their rural sociology and

response to extension programmes. Rather I am only trying to emphasize that much of the area dealing with spatial behaviour by farmers have been sadly neglected in many agricultural studies for too long. Because of their importance to an understanding of the processes of inter-regional development, it is also unfortunate that only limited attention has been given to migration, rural-urban relationships and the commuting patterns of farmers.

The situation is even more serious with regard to crop distribution patterns throughout the country. Students at least require to have an accurate idea of the location and extent of crop zones in the country together with the environmental relationships. Academic staff and research scientists, interested in the theme of agricultural development, need in addition to have some idea about the spatial variations in land use within the different crop zones at particular points in time, and the changes taking place in the emphasis on different crops over time. Out of such considerations should emerge useful base maps capable of promoting meaningful agricultural planning at the national and regional levels.

Our present knowledge about the spatial distribution of crops is too scanty, hazy and inaccurate for us to be proud of as a nation. Even in respect of export crops, whose production levels are well documented, our ideas of the location and extent of the production zones are hazy and conflicting. Compare, for example, the location of the cocoa zone as contained in Galletti and others with that in Smyth and Montgomery, and the maps you see in our Ministries of Agriculture and experience the amount of confusion that results from the exercise. Despite the obvious conflicts in these different sources, many authors forget that all the maps were compiled over two decades ago, and that the changes which have taken place within the zone are such that these maps are now so out-of-date that attempts should be made to prepare new ones. Yet in all the books under reference, much of the description of crop distributions are based on such obsolete maps and those prepared by Buchanan and Pugh in the early 1950s. There are no references to even simple locations such as grading stations at different points in time to serve as illustrations of the expansion or contraction of crop zones. There are no descriptive accounts on the distribution of new inputs at the spatial level to serve to educate us about the adoption of new practices and seeds at national and regional levels.

If in such simple matters of distribution, we grope in the dark, we should be expecting too much if we attempt to find out from our standard agricultural texts about the variations in land-use in the different crop regions, the spatial dynamics of crop zones over time, and the spatial patterns of land use at the national level.

Of course, all the picture of land use you get from the books are the broad categories, such as tree or root crops within our former over-large regions. Only the Consortium broke the broad categories down to individual crop levels and within ecological zones which still cover thousands of square kilometres. Because these simpler spatial distributions are not forthcoming, one looks in vain for any discussion of inter-relationships between land-use structures, producer-consumer dichotomies, inter-regional land use models and the systems or integrative approach to crop studies.

One wonders why conditions have remained like that for so long. Is it that the authors of these books have some special aversion to the use of maps to illustrate their different descriptions? I don't think so, for most of the books under reference use distribution maps which are available. The fact is that I doubt if agricultural scientists, with the exception of soil scientists and applied climatologists among them, regard spatial analysis with the inevitable preparation of maps, as central to their discipline. The attitude seems to me to be, if others attempt spatial analysis and prepare maps of **relevance** to their interests, these are used with relish; if not, it is **just too bad**, but there is the usual structural format of **agricultural texts** to turn to.

Secondly, it appears that studies carried out at the local or regional level or at the level of the individual crop are not always accorded adequate significance to qualify for insertion in such general textbooks. It is true that publications at the **national level** involve such a synthesis of material that local or regional studies are smothered in the process. But there is such a staggering **amount of** land use and resource survey materials available in Ministries or Institutes of Agriculture that one wonders why some of these **have** not been used at least to throw light on variations in **land use** patterns in different parts of the country.

Another explanation is that the frontier area between **agriculture** and geography has not been sufficiently exploited to the **mutual** benefit of both subjects. When this is done, agricultural **scientists** will appreciate more the importance of the spatial dimension in their analysis and geographers will be able to obtain a clearer insight into the structural components of the agricultural business and how these operate within the spatial setting. Such co-operation can only result in a fuller and **more satisfactory appraisal of the** agricultural scene than has **hitherto been the case**.

If we are critical of the limited **amount of spatial analysis** contained in Nigerian agricultural studies, could we not imply that the reason lies with the failure of geographers to give a useful lead in this direction? If recent geographical contributions have had limited impact, what are the factors responsible? What case

can geographers make anyway for the continued significance of the spatial dimension in agricultural development and how convincing are their arguments with other scholars and policy makers? These and other questions arise in one's attempt to assess the contributions to the spatial analysis of agriculture and the gaps which remain to be filled.

Geographical contributions to agricultural studies were first made through the publication of Buchanan and Pugh's *Land and People in Nigeria* (1955). The impact of the book on the agricultural scene was immediate and profound for the following reasons. Firstly, it contained a highly penetrating analysis of the environmental setting relevant to an understanding of agricultural activities in the country. Secondly, it was copiously illustrated with maps of crop and livestock distributions whose instant appeal derived from their originality and imaginative nature. Since they were the first of such maps to be published in Nigeria, they were and are still widely quoted in books with agricultural, economic and regional interests. Lastly, the book had an enthusiastic reception because of the interesting and deep insight into Nigerian agriculture it provides by concentrating attention not only on farming but on farmers as well, not only on crops but on their consumers and not only on cattle but also on the herders. In these and other ways, the book shows clearly how the socio-economic and cultural organization of society have relevance for agriculture.

The publication of the Buchanan and Pugh book was followed by a period of comparative lull along the geographical front for Nigerian agricultural studies. It was not so much that there were no relevant studies, but that the few publications in the immediate post-Buchanan/Pugh period were either amplifications of themes already covered or of too limited scopes to command attention. However, useful extensions of the environment/population/agriculture relationship themes were pursued by Grove (1961) with regard to Northern Nigeria, Ojo (1968) in respect of critical population densities, and Adejuwon (1962) on the climatic parameter in Western Nigerian cocoa cultivation. The foundations of other themes were laid by Morgan (1959) concerning the delimitation of agricultural regions in Southern Nigeria, and Mabogunje and Gleave (1964) on the evolution of agricultural landscapes using historical evidence.

The use of modern approaches for the spatial analysis of Nigerian agriculture was spear-headed by Coppock (1965). In a keynote article published in the *Nigerian Geographical Journal*, he discussed the problems of data in Nigerian agricultural studies, the mapping and other analytical purposes to which what was available could be put, and provided general guidelines on research scope, content,

and direction in the country's agricultural geography. He also showed the need for careful documentation and objective analysis of agricultural data used in throwing light on spatial patterns.

The analysis of the competitive spatial relationships existing between yams and cassava attracted the attention of Agboola in Western Nigeria (1968) and Uzozie for Eastern Nigeria (1971) and provided useful opportunities for following Coppock's lead. Crop distribution patterns were based on village sample data obtained from the Rural Economic Surveys of the early 1960s. It was also possible to show a comparative picture of the proportion of farmers growing each of the two crops and the crop combinations which emerge on the agricultural landscape. More generalized studies of cropping trends were also carried out in the Tiv area by Vermeer (1970) and of land use patterns in the Kano area by Mortimore (1963) during the same period. Similarly, more precise techniques of analysis were used in agro-climatological studies of sugar cane, cotton and cocoa by Oguntoyinbo during the 1960s. Many of these latter studies had considerable impact in agricultural circles.

As if the 1960s were preparatory years, spatial analysis of Nigerian agriculture blossomed considerably in the 1970s. It was a period of co-operation among geographers and between geographers and other scientists; it also brought into limelight the emergence of the masqueraders i.e. geographers turned agricultural scientists, and the introduction of greater complexity into Nigerian agricultural studies. These fruitful collaborations led to the testing and perfection of additional methodological approaches to the spatial analysis of Nigerian agriculture.

That the interpretation of aerial photographs can be used to throw useful light on land use has been amply demonstrated by Adejuwon and Jeje (1975) in the Ife Region. The land use map produced by them has provided interesting insights into cropping patterns, the changes in land use structures with increasing distance from Ile-Ife, and the relationships of these to settlement patterns. Since their land resource survey also involved geomorphological and soil mapping, they succeeded in correlating soil types and slope forms with broad cropping patterns. This type of work shows what can be accomplished over areas of limited extent, the results of which can be used to illustrate major trends in agricultural land use in different parts of the country. Their desire to make use of satellite imagery for such interpretations in the near future may make it possible for wider areas to be covered and perhaps more accurate results obtained.

Another interesting study which results from fruitful collaboration among geographers is Faniran and Ajaegbu's (1971) attempt

to examine the relationship between land slopes and farm sizes in the Vom area of the Jos Plateau. Significant observations made by them include the tendency for farm sizes to decrease with increasing slope and the fact that landslopes could explain 40 per cent of the variations in farm sizes. There is no doubt that if this type of work is extended, light could be thrown on the relationship between slope and cropping patterns. Comparative yield figures, and observations on relative erosion can then be used as a basis for advising farmers on cropping strategies in areas of marked relief. This type of study commands attention owing to its establishment of spatial covariation between two agricultural parameters through statistical analysis.

Co-operation between geographers and other scientists have helped to throw light on problems of drought, the transfer of technology, and rural migration, all topics of outstanding relevance to agricultural development. Perhaps, no other gathering showed the increased collaboration between geographers and other scientists better than the 1973 Symposium in London on *Drought in Africa*, which discussed the causes, nature and effects of recent droughts in the continent and how to alleviate these. The contributions of the Nigerian contingent to the Symposium were later published in *Savanna* Vol. 2 No. 2. What is remarkable about this publication is that although contributors were from widely-separated fields of human nutrition, soil science, crop physiology, extension studies and rural development, apart from geography, the spatial implications of the drought were clearly demonstrated. Some of the geographical contributions, such as those of James (1973) in respect of North-Eastern Nigeria and Mortimore (1973) on Kano, showed remarkable insights into patterns of agricultural production, while the studies of Kowal, Adeoye and Kassam (1973), all agricultural scientists, were very stimulating in terms of spatial analysis. This outstanding example of a meeting of minds has shed a great deal of light on the impact of the drought such as settlement dynamics, remarkable decline in crop yields, and spectacular latitudinal shifts of isohyets with the attendant effects on cultivation limits. The emphasis on the spatial dimension in drought occurrence now puts us in a position to know the possible areas where serious consequences may be expected and render planning to combat future drought hazards feasible.

Attracted by the remarkable role that migrant farmers have been playing in the expansion of cocoa in the north-eastern cocoa zone, Agboola, in collaboration with a sociologist (Dr. Olusanya) and an agricultural economist (Dr Ilori) have attempted to throw light on the spatial interaction issues involved, the demographic characteristics and processes at play, and the agricultural develop-

ment consequences. Our analysis have shown that (a) distance and location from the cocoa zone affect the volume, character and direction of migration flow; (b) a remarkable socio-economic transformation characterised by farmers on the move seeking better opportunities at destination, which are unavailable at their points of origin has occurred; (c) a rural-urban migration process has been set in motion by land-owners who, enjoying rents from their farms, attempt to establish themselves in the urban environment and (d) a group of enterprising and prosperous tenants have emerged with all the social and economic implications for this part of the cocoa zone. This type of study draws attention to an aspect of social history with far-reaching consequences for the socio-economic development of the region concerned. It also raises many questions, which the study was not designed to answer. What happens to the system of land ownership after the present generation of tenant farmers would have disappeared? What are the consequences for the agricultural prosperity of the region when the yield of cocoa trees decline? Will cocoa cultivation be replaced by food crop production or will the children of original migrants return home in disappointment leaving the agricultural landscape of the area desolate? What measures can government contemplate beforehand to prevent this state of affairs?

The participation of a geographer in a project involving the consequences of transfer of technology into a part of Nigeria indicates that the significance of the spatial dimension in agricultural development is becoming increasingly recognized. When I turned my attention to the spatial analysis of yam and cassava cultivation in Western Nigeria, I little appreciated the potentialities of the two crops for the transfer of technology into the country. But when it became necessary for an academic group to study the likely socio-economic consequences of the introduction of the gari-processing plant into parts of southern Nigeria, I found myself inevitably drawn into increased dialogue with other scientists covering the areas of Food Science and Technology, Agricultural Engineering, Agricultural Economics and Sociology. The results of my earlier spatial analysis were found useful in differentiating between the different cassava-producing areas of Western Nigeria and in drawing up a sample framework for the survey which was to follow. It was found that the consequences of such a project would be most severe in the important producing areas, where most of the women may be thrown out of job. Before the location of gari-processing machines, it is necessary to carry out land use surveys to throw light on the capacity of specific areas for cassava production to feed the plants established. Spatial analysis, therefore, will appear to be crucial in the process of taking viable decisions on

certain types of technology transfer into parts of the Third World.

The main shortcoming of the spatial contributions reviewed so far is that their impact is confined to the local and regional scales of consideration. Two recent developments in spatial analysis are likely to rectify this weakness. The first relates to the series of extensive resource surveys being carried out in northern Nigeria by the Land Resources Division of the Directorate of Overseas Surveys. So far, the greater part of the former North-Eastern State has been covered, while the results of surveys in large parts of Kano, Kaduna and Niger States may soon be published. The main objective of these surveys is an assessment of the physical environment as a basis for sound national planning. It is therefore not surprising that many of the participants were geographers/soil scientists/resource specialists, who I referred to above as the masqueraders. The volumes of these resource surveys published so far provide a wealth of information on the environmental parameters in resource development and on spatial aspects of cropping patterns and livestock movements.

Just over two decades after Buchanan and Pugh's book, a renewed attempt is being made to present the spatial structure and dynamics of Nigerian agriculture on a national canvass. Through my forthcoming book, *An Agricultural Atlas of Nigeria*, it is hoped that considerable light will be shed on the spatial organization of the country's agriculture. Apart from the human and environmental backgrounds to agriculture, the book concentrates attention on the following themes: (a) the spatial distribution of crops and livestock; (b) processes, factors, theories and models, which explain the distribution patterns; (c) agricultural dynamics and development within the context of new concepts of agricultural organization, modern ideas of technological and other inputs and improved techniques of water management in agriculture. Copiously illustrated by maps based on the Rural Economic Surveys, it is hoped the book will up-date our knowledge of crop land use patterns, processes, and spatial relationships.

The basic question to answer at this stage is how spatial strategies contribute to agricultural development. Only some of the answers can be provided here:

- (i) The emphasis on space allocation for crop and livestock use is crucial to agricultural planning and development. This is because a clear insight into the location of agricultural resources at present could provide a useful background for determining the feasibility of crop expansion, and the necessity for crop intensification programmes in different parts of the country in the future.

- (ii) On the diagnostic level, rational agricultural development planning leans heavily on land and water resource evaluations which highlight the spatial variations in the capability of land surfaces for differential agricultural development. A strict adherence to the land use recommendations following such surveys could ensure optimum productivity levels in crop production and range development.
- (iii) Basing cropping strategies on ecological zones could enhance agricultural development efforts. This is particularly the case if a deliberate attempt is made to understand the internal workings of the natural ecosystems, and the density, variety index and composition aspects of these are closely imitated in cropping and range patterns. This is to ensure the survival for long periods of the domesticated plants and animals species, which are made to replace the natural ones.
- (iv) As we have shown, space-oriented agro-climatological research is indispensable to agricultural development. The main emphasis here include the demarcation of cropping limits, soil moisture and temperature conditions conducive to crop production, the complex relationships between soil temperature, weed growth, control and crop yields, conservation of soil moisture levels in areas of high run-off and poor infiltration properties, the synchronization of cropping and rainfall regimes in the determination of planting, weeding and harvesting sequences, weather effects on crop and animal physiological responses, climatic regimes favourable to specific types of range development, and climatic strategies suitable in marginal areas for specific crop development. Appropriate emphasis on these geographical areas could stimulate agricultural productivity and development.
- (v) Different regional planning strategies could enhance the achievement of agricultural development goals. On the one hand, delimitation procedures could indicate the extent to which available environmental resources are appropriately used. The judicious application of growth pole locational strategies, spatial interaction procedures and spatial behavioural models could be manipulated in favour of agricultural development. The careful planning and location of agro-industrial growth poles in agriculturally backward areas, by stimulating demand, could increase agricultural output. The free movement of labour is useful in the identification of regional inequalities in development,

and if appropriate measures are taken, could systematically lead to the narrowing of development gaps. One of the ways of achieving this is through the establishment of linkages between producers and consumers, and improvement of accessibility between export producers, ports and industrial sites.

V

WE HAVE SO far discussed our expectations with regard to the spatial dimension in agricultural development, and what have been achieved so far. The gaps which remain are bound to influence the design of research strategies in this area in the years ahead. Space-oriented research in agriculture can be based upon the land, which provides the base for farming activities, the crops and livestock which depend on land or its products for their sustenance and the farmers, who are the prime movers of agricultural activities.

One of the greatest problems confronting planners in Nigeria today is the absence of accurate information on agricultural land use. We require, as a matter of urgency, facts on the amounts of our land surface which are cultivable, non-cultivable, suitable for grazing and marginal for agricultural purposes. We are not only interested in the extent of these different categories of land use, we also require information about their location at local government, state, regional and national levels. These broad categories will also have to be broken down into the crop and livestock components. Background information on land quality, capability, and potentialities should open the way to a realistic appraisal of the appropriateness of existing land use practices.

It is in such a setting that national land use strategies can be formulated, its implementation in details mapped out beforehand and necessary adjustments at different scales of consideration made. Armed with such a wealth of data, the design of land use strategies can be used as an instrument of agricultural development. This implies emphasizing more those crops and livestock, which yield high pay offs in terms of returns at particular times and in specific areas of the country adjudged suitable. In the light of the above, I should like to support the call on the Federal Government to set up as a matter of urgency a Nigerian Land Use Commission charged with the responsibility for collecting, collating, analysing and publishing data and maps on the country's land use trends and advising on strategies which should govern its use.

Before the work of such a Commission can succeed, a lot of research effort on methodology, theory and content from a host of

academic disciplines will be required. For example, decisions have to be taken on whether to use satellite imagery or aerial photographs in land use interpretation, and on whether analysis should be made through the use of simple, sophisticated or computerized systems. Geological, geomorphological, soil, crop and livestock mapping will also certainly engage the attention of many specialists. Whichever way one looks at it, an appraisal of the land surface of Nigeria in terms of capability and potentiality will entail a great deal of inter-disciplinary research effort, but the spatial aspects will prove to be of fundamental importance.

Another important area which commands research attention is the spatial relationships and linkages between producing regions. This type of research should take account of the relative location of producing and consuming regions, raw materials production and the site of industries, export crop producing areas and ports. Surely, a suitable balance should be struck between each of these opposite pairs if both farmers and consumers are to receive and pay fair prices for agricultural products. The type, quality, and ease of accessibility between the producer and the consumer are crucial to the achievement of a just solution. Research work on transport media within crop zones and links among them are very crucial to our understanding of these relationships. Equally important is the role of distance in the pricing policies of commodities, a type of study which can show Government in which areas to intervene in order to have salutary influences on prices. By virtue of their training, such studies have to be undertaken by geographers.

There is growing realization that the fundamental key to agricultural development in the Third World is the direction of increased attention towards traditional agriculture in such a manner that more knowledge is accumulated about its internal workings and use made of these to upgrade rather than replace it. As an example, there is speculation about our ignorance of the old yam civilization of West Africa, which provided adequate food for the population in the past. It is now feared that its degradation and replacement by other crops constitute one of the root causes of food supply problems in the region today. It is necessary for the spatial theme in agricultural studies to throw light on the location and extent of the yam-producing areas in Nigeria today, examine the most favourable environmental conditions found in them, consider the distances of these to areas of conspicuous consumption, and suggest production and marketing strategies designed to boost the yam economy by ensuring adequate demand and reasonable price levels for the crop. It will also be necessary to examine the extent to which traditional production, storage, processing and marketing devices are still practised and can be improved, against physical.

social and economic backgrounds. An inter-disciplinary approach will ensure that reliable and realistic results are obtained.

Another aspect of traditional agriculture worth researching into is the capacity of different food crops and species to support population. The cultural and environmental setting in which such crops and their species have performed well should be carefully studied with a view to finding out whether such conditions obtain in other parts of the country and whether such successful practices can be diffused.

So far, we have done little to understand Nigerian farmers, particularly their processes of decision making. A great deal of research effort is required to throw light on the perception of the environment by farmers and how such perception influences their land use strategies and cropping patterns. The experience of farmers in the use of certain types of soils and vegetation in Western Nigeria has been known to influence their cropping strategies. Similarly, weather uncertainties and seasonality tend to affect the scale of agricultural operations. Perception studies have to be pursued further so that farmers' reactions to specific environmental conditions can be forecast beforehand.

Predictive studies in Nigerian agriculture is further rendered difficult by the lack of time series data or analysis of land use at specific points in time. These conditions have almost made impossible the study of agricultural dynamics. As the data situation improves, this is an area of research worth pursuing actively. As it throws light on crop trends and structural changes in agriculture, it paves the way to a clearer understanding of the relevant processes.

Apart from the absence of land use survey maps, another important constraint on agricultural studies in Nigeria is imposed by relevant data. Yet it is not so much that there are no data at all, but the problem lies with the multiplicity of Ministries and Agencies keeping these data, the great complexity of the spatial units used, most of which are not comparable, and the variations in the time scales covered. As a result, a consistent spatial analysis of land use is extremely difficult to provide.

What is required at the national level is the setting up of a data bank by the Federal Government, with all Government and private agencies compelled by law to supply data to such a bank in conformity with specified formats. As a starting point, permanent administrative units within which data should be collected should be clearly defined. The present Local Government Council areas could serve such a purpose. The second step is to oblige all data-collecting organizations to use these spatial units as frameworks for their exercise and analysis of data in respect of such units.

The third step is for the Federal Government to ensure that data are made available on the minutest details of the social and economic organization of society. Lastly, all data collected should be sent to the National Data Bank, which should have the duty of collating, analysing and publishing the data annually in a form which makes spatial comparability possible. Until such an idea is put into practice, it will be difficult to delineate the important aspects of the spatial dimension of Nigerian agricultural development.

A final bottleneck to Nigerian agricultural development discussed here concerns the planning process. Although *The Third National Development Plan 1975-80* has a section on Regional Development, yet a great deal remains to be done to translate the agricultural objectives of the plan into spatial realities. At the national level, the target rate of growth of food crops between 1974/75 and 1979/80 is 4.8 per cent per annum, while the plan is silent on export and industrial crops, which are in any case declining in importance. Projected food crop expansion at the state level is expressed in hectares. What is lacking is the failure to appraise the capacity of different areas within States for crop expansion. This implies that the principles of physical planning have not been integrated with economic planning in the plan document. Physical planning is concerned with the sets of rules and regulations which have to be fulfilled by the spatial arrangement of the physical element in order to make maximum contribution to the well-being of society. What is required in Nigeria is that economic planning should recognize that a proper spatial arrangement of investments may contribute to the national objective of the welfare of society.

The other planning problem has to do with the failure of government to recognize that agricultural development is a systems process which requires a variety of talents to plan and implement. It is high time that the Federal Ministry of Agriculture ensures that an inter-disciplinary approach to planning and research is adopted in order to bring agricultural development within the reach of the masses. As this lecture has emphasized, technologists, social scientists, engineers, biological, physical and agricultural scientists should all be involved in a determined effort to modernize agriculture, increase its productivity, and radically improve the prosperity of millions of Nigerian farmers. Ministries of Agriculture, the Agricultural Research Council of Nigeria, Crop Research Institutes, River and Lake Basin Development Commissions, and the International Institute of Tropical Agriculture and other Agencies, all have a duty to ensure that the processes of decision taking, planning and policy formulations in the agricultural sector are based on the fullest consultation and collaboration with all scholars with relevant interests and expertise in Nigerian agriculture.

CONCLUSION

IN CONCLUDING, I should like to emphasize the need to cultivate the frontier zone between spatial and agricultural disciplines. For our own part, in geography, apart from designing some courses on Spatial Organization of Society and Spatial Processes and Diffusion, we shall start offering from next year full final year specializations in Water Resource Evaluation and Land Resource Evaluation. There is also a final year course on Spatial Aspects of Rural Development. For those interested in the techniques of land surface analysis, there is also a full-fledged option on mapping techniques covering the areas of land surface analysis, vegetation mapping, advanced aerial photo interpretation, surveying and photogrammetry. There are extensions of these courses into the postgraduate levels. It is with great pleasure that we stretch our hands of fellowship to all scholars interested in agricultural studies to come forward and take part in some of these courses which should contribute immensely to our analysis of the spatial dimension in agricultural development. Fortunately, responses have been forthcoming from Soil Science and Agricultural Economics at the postgraduate level. We are equally enthusiastic in collaborating with other Faculties on topics dealing with plant or crop-water relations, soil moisture/temperature influences on crop growth and pest control, the fertility status of Nigerian soils, crop species selection in relation to ecological conditions, physiological and ecological relationships in livestock rearing, and the varying status of the ecological environment under conditions of cultivation and livestock rearing. This is a challenge for interested scholars in the agricultural, biological, social and nutrition sciences to take up and contribute to the agricultural development of Nigeria. If the spatial dimension requires so much collaborative effort in accomplishing, then it should be clear to all concerned that agricultural development can only be brought about through painstaking, analytical, and realistic multi-disciplinary research efforts.

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