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TABLE OF CONTENTS

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VOLCANIC ASH FROM MOUNT MALINDANG, NORTHEASTERN ZAMBOANGA DEL SUR PROVINCE, PHILIPPINES

by

C. F. PAIN[1]

Volcanic ash is an important soil parent material in many parts of southeast Asia. In the Papua New Guinea highlands, for example, soils formed on Quaternary volcanic ash occur over large areas, and support considerable numbers of people. The importance of volcanic ash has been stressed by work on the chronology and stratigraphy of the volcanic ash layers (eg. Pain & Blong, 1979).

In the Philippines there are many volcanoes of Quaternary age, some of them still active (Bureau of Mines, 1963). However, a recent literature search, carried out by the author, found only two papers on stratigraphy of volcanic ash and volcanic ash soils in the Philippines (Mariano, 1964; Mathisen and Vondra, 1983). Although other papers may have been published, there is clearly room for more work on volcanic ash stratigraphy, and volcanic ash soils, in the Philippines.

During a visit to the Philippine Australian Development Assistance Programme (PADAP) in Pagadian City, Zamboanga del Sur Province, Mindanao Island, fieldwork was carried out to assess the importance of volcanic ash in the province. It was found that widespread volcanic ash deposits are restricted to the northeastern part of the province. These deposits are derived from Mount Malindang, a large stratovolcano with a diameter of more than 50 km. Most of the volcano lies in Misamis Occidental Province, while the western third is in Zamboanga del Sur Province (Fig. 1).

This paper describes the stratigraphy and distribution of volcanic ash in Zamboanga del Sur, and comments briefly on the implications for soils in the area.

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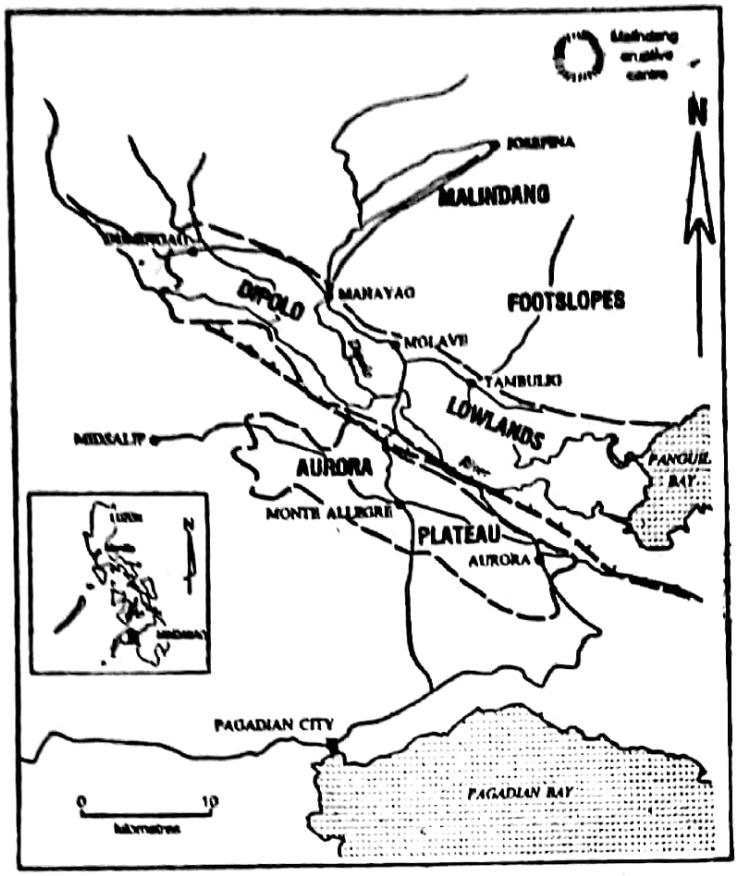

Figure 1. The area of the study, showing the main physiographic features. The broken line with the ticks gives the location of the Dipolo fault zone.

VOLCANIC ASH STRATIGRAPHY

Four volcanic ash units are distinctive enough to be mapped in the field. Following geological practice, these are given informal geographic names. They are described below. Various units of undifferentiated ash are also briefly described. Figure 2 presents correlation sections which show the thicknesses and stratigraphic relationships of the various volcanic ash units recognised. The stratigraphy is summarized in Table 1.

Undifferentiated Volcanic Ash

Most volcanic ash sections examined have undifferentiated volcanic ash units at depths below 1-5 m, in one case totalling 21 m. These ashes are well-bedded, and generally have clay textures, although original particle sizes were up to blocks of 10 cm or more. Most, however, were deposited as fine lapilli or ash grades.

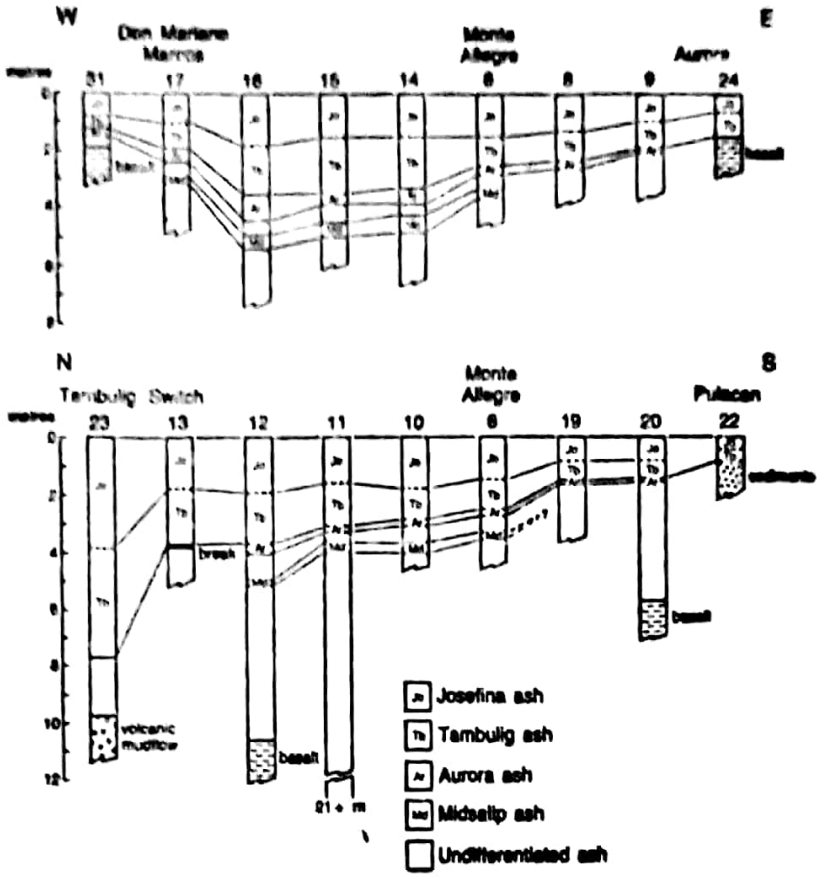

Figure 2. Correlation sections showing the stratigraphy of volcanic ash layers south of Malindang volcano. For location of sections see Figure 4.

TABLE 1. STRATIGRAPHY OF VOLCANIC ASH FROM MALINDANG

Volcanic Ash unit	Symbol
Josefina ash	Jo
Tambulig ash	Tb
erosion break	
Aurora ash	Ar
undifferentiated ash	
Midsalif ash	Md
undifferentiated ash	

Several undifferentiated volcanic ash beds also lie between the lower two named beds, but are not distinct enough to be consistently recognised.

Midsalip (ash).

This ash layer, named from Midsalip settlement, never exceeds 60 cm in thickness. At Monte Alegre road junction, the type site, it consists of 25 cm of reddish brown to orange brown clay. It has a slight tendency to weather out of the road cutting (Fig. 3) and in places is layered. Upper and lower boundaries are both distinct, and in both cases Midsalip ash contacts undifferentiated layers of volcanic ash.

Towards the north, Midsalip ash tends to thicken slightly, while to the south it merges with the undifferentiated ashes, and becomes indistinguishable from them. Midsalip ash also merges with other ashes both east and west of Monte Allegre. At some sites it is present as a row of reddish nodules rather than a layer.

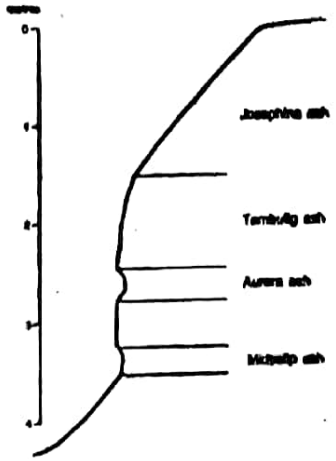

Figure 3. Profile of road cutting at Monte Allegre, showing the relationship between road cutting shape and volcanic ash unit.

Aurora ash (Ar).

This ash unit is named from Aurora township, and like Midsalip ash, is not very thick for the most part. Its maximum thickness of 90 cm was found near Don Mariano Marcos. At the type site, Monte Allegre road junction, Aurora ash consists of 25 cm of orange-brown clay. It occurs as a consistent and distinctive layer along the cutting about 2.5 m below the surface. At this site, as at others, it weathers out from the cutting, a feature that helps in its identification (Fig. 2).

Over most of its distribution, Aurora ash is orange-brown to reddish-brown in colour, and always has a clay texture. South of Monte Allegre it has occasional yellow mottles. Both its upper and lower boundaries are generally distinct. It lies conformably on older undifferentiated ashes at most sites. Its upper boundary with Tambulig ash is conformable on stable sites, but along the Dipolo fault zone and on some steeper valley sides there is a distinct break between Aurora ash and Tambulig ash. This break indicates movement of the Dipolo fault, and a period of erosion, between the deposition of Aurora ash and Tambulig ash.

Tambulig ash (Tb).

Tambulig municipality, on the northern side of the Dipolo lowlands, provides the name for Tambulig ash. At Monte Allegre road junction, the type site, the unit consists of 100 cm of reddish brown clay, with some lighter coloured inclusions that are probably weathered sand-sized minerals. There are also rare black concentrations of manganese along cracks. Tambulig ash is massive, and is smooth along the Monte Allegre road junction exposure, contrasting with the broken appearance of the overlying Josefina ash.

The characteristics described for the Monte Allegre site generally apply to Tambulig ash all over its distribution in Zamboanga del Sur. Colour ranges from yellow brown to greyish and reddish brown, while the black inclusions of manganese are almost always present.

The lower boundary of Tambulig ash is usually conformable on Aurora ash, although there is often a break between the two (see above). At Tambulig it rests on undifferentiated ashes which in turn overlie a volcanic mudflow deposit. At all exposures seen, Tambulig ash is conformably overlain by Josefina ash.

Josefina ash (Jo).

This ash unit is named from Josefina municipality, in the extreme northeast of the province, on the slopes of Malindang volcano. At the type site, Monte Allegre road junction, Josefina ash is a 150 cm thick deposit of light reddish brown clay. It is friable, and has an uneven surface on the exposure, where aggregates have fallen away. This contrasts with the underlying Tambulig ash, which remains smooth and massive.

These characteristics persist over the area of the present study. North from Monte Allegre, and on the slopes with Malindang volcano, there is a tendency for Josefina ash to have a red colour, but elsewhere, the reddish brown colours dominate. At most exposures Josefina ash is redder than Tambulig ash, the latter tending more towards brownish colours. However, the boundary between the two units is often not

clear, being indistinct or diffuse. It is always conformable. Josefina ash is the upper most volcanic ash unit and therefore always lies at the surface, with a generally well developed soil profile in the upper part.

VOLCANIC ASH DISTRIBUTION

With sufficient data on thickness covering a wide area, it is usually possible to construct isopach maps for individual volcanic ash units. In the present case, however, only a small part of the total distribution of ash was studied, so conclusions must be tentative. The following discussion considers the original distribution of the ash, and then its present day distribution.

Original Distribution

Neither Midsalip ash nor Aurora ash are sufficiently well known to allow plotting of isopachs. However, because there is a tendency for them to thin away from Malindang volcano, it is thought that they were probably erupted from there.

Josefina and Tambulig ashes are well enough exposed to allow some conclusions about their original distribution. Figure 2 shows that they both rapidly decrease in thickness away from Malindang volcano (the north-south section), while along the west-east section they form a lens thick in the middle, and thin at both ends. These thickness changes indicate that the source of both volcanic ash units is Malindang volcano.

Using the data available, an isopach map was prepared showing the combined thicknesses of Tambulig and Josefina ashes (Fig. 4). The 100 cm isopach, drawn more firmly than the others in Figure 4, describes the arc of a circle centered on Malindang volcano. This distribution on the southwest side of volcano, and the fact that the prevailing winds in the area blow from the southwest, suggests that the distribution shown in Figure 4 is the upwind part of an eliptical deposit around Malindang volcano. The downwind and much longer part of the elipse probably extends out over the Mindanao Sea (Fig. 4, inset).

Present Distribution.

Although more than 1 m of Tambulig ash and Josefina ash was deposited within the elipse shown on Figure 4, not all of it remains today. Erosion and deposition have considerably altered the original deposition. Two kinds of areas in particular no longer have a cover of volcanic ash. First, areas of active alluvial sedimentation have no cover because the volcanic ash is older than the land surface. Second, steep slopes and areas of unstable rock have lost their volcanic ash cover because of subsequent erosion.

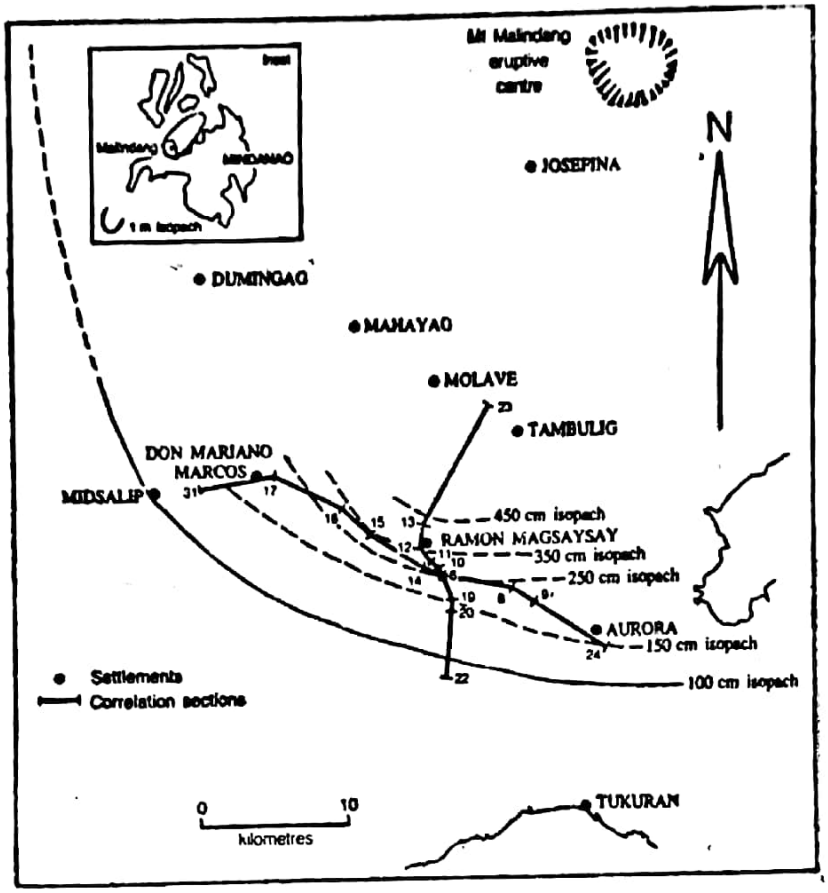

Figure 4. Isopach map of Tambulig and Josefina ashes.

The following generalizations can therefore be made about the area covered with more than 1 m of Josefina ash plus Tambulig ash.

1. On steep slopes (more than about 25 degrees), volcanic ash is restricted to small pockets where erosion has been minimal.
2. Only the higher parts of alluvial lowlands have a volcanic ash cover. The rest consists of deposits that are younger than the volcanic ash, although they may be derived in part from volcanic ash.
3. The remaining areas, consisting of the Aurora plateau and the foot-slopes of Malindang volcano (Fig. 1), have a more-or-less complete cover of the upper two volcanic ash units.

AGE AND NATURE OF THE ERUPTIONS

The Bureau of Mines and Geosciences (1963) allots a Pliocene-Quaternary age to volcanic rocks in the area, including Malindang volcano. A Quaternary age is supported by two Potassium-Argon (K-Ar) ages obtained from basalts near Midsalip (site 31) and south of Monte Allegre (site 20) (Figs. 2 and 4).

These ages are as follows:

Site 31 1.36 ± 0.05 million years
Site 20 1.63 ± 0.03 million years

The volcanic ashes are younger than these rocks.

The degree of dissection of Malindang is similar to that of volcanoes in Papua New Guinea that have ages within the last 1 million years (Loffler *et al.*, 1980). On the other hand, the lower footslopes of Malindang are truncated. This truncation almost certainly happened during a lower sea level, perhaps about 20,000 years ago, which places a minimum age on the footslope-forming volcanism. The strong weathering of Josefina and Tambulig ashes, and their general appearance, compares with ashes in Papua New Guinea which have ages in excess of 50,000 years, but less than 200,000 years (Pain and Blong, 1979). The youngest Malindang ashes probably fall in this same age range.

The lower ash units, including Aurora ash, appear in part to have been deposited as lappili-sized material, with fragments more than 2 mm in diameter. Many individual shower beds can still be recognised. This suggests rapid deposition from explosive volcanism. Josefina and Tambulig ashes, on the other hand, show no obvious breaks, and contain no evidence that they were ever more than fine ash size. This is true even for exposures where the two units total more than 7 m. This suggests that the two units consist of fine ash that was deposited intermittently, and was rapidly weathered and incorporated into the top of existing soil profiles.

Deposition of the older ashes may therefore have occurred over a fairly short period, while the accumulation of Tambulig and Josefina ashes may have taken several thousand years.

IMPLICATIONS FOR SOIL FORMATION

Because volcanic ash mantles the landscape on which it falls, it cuts off the underlying rocks from the soil. This means that areas covered with volcanic ash will have the same kinds of soils, regardless of underlying geology. In northeastern Zamboanga del Sur, volcanic ash soils are found on the Aurora plateau and on the footslopes of Malindang volcano. They are also found in small pockets elsewhere, where erosion has been slow. At the western end of the Aurora plateau, Josefina ash overlies river terraces, giving them a shallow volcanic ash soil.

Outside the 1 m isopach (Fig. 4), volcanic ash will be retained on some surfaces, and will influence the soils even if it is not recognisable in the field. This may give anomalous chemical and crop-yield data for the soils that are affected. The rate of thinning of the ash suggested

by the N-S section (Fig. 2) indicates that the influence of the ash may extend only a few kilometres outside the 1 m isopach.

CONCLUSIONS

A glance at the 1:1,000,000 geological map of the Philippines (Bureau of Mines, 1963) indicates that Malindang is one of more than 30 volcanoes that have probably spread ash over the Philippines landscape. This has important implications for soil distributions, and also suggests that volcanic ashes have a considerable potential in the study of geomorphic history in the Philippines. Certainly in Zamboanga del Sur it is possible to present a chronology of landform development on the basis of volcanic ash stratigraphy. This work will be reported separately.

ACKNOWLEDGEMENTS

This report was written while I was Visiting Research Associate at the Institute of Environmental Planning, University of the Philippines, Diliman, Quezon City. Logistical support in Zamboanga del Sur was provided by the Philippine Australian Development Assistance Programme. John Owen, School of Geography, University of New South Wales, drew the figures, and Jenny Pursell typed the manuscript. The Australian Mineral Development Laboratories (Dr. A. Webb) carried out the Potassium-Argon dating.

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GEOGRAPHY: TRENDS AND ISSUES

by

MELITON B. JUANICO*

In the Philippines, it used to be that geography was taught as a separate subject in the grades. Many can still remember that up to the 1950's geography was still taught in schools and pupils learned about the names and locations upon the earth of countries, capitals, cities, rivers, mountains, etc. They appeared to have an enjoyable time then participating in contests involving locating certain cultural and physical features of places on the map.

Presently, social studies is taught instead of geography, especially in the grades. Although it still implicitly includes geography in its scope and sequence, social studies may be criticized for its inclusion in the teaching process of all the social sciences and their subject matter which even the teachers find difficult to integrate. There is, however, a new policy at the Ministry of Education, Culture and Sports (MECS) to put back geography in schools following the reemphasis on basic subjects.

That there is now a reawakening to the importance of studying geography has been expressed by no less than former Minister of the MECS Onofre D. Corpuz when he said, ". . . I have already instructed my Ministry staff . . . to reintroduce geography as a separate subject in the school curricula. But they are still fighting where to place it but I insist that it will be in the elementary and also [be] in the high school."[1] However, the type of geography that will be taught in schools this time will no longer be the same as that mainly taught before. What was taught before was the type of geography called *place geography* which is very descriptive and less meaningful since it involves mainly the memorization of trivia. It is still, however, an essential part of geography which one can use as a stepping stone for analysis or which one can simply use for practical purposes. One can imagine how embarrassing a situation it would be if a tourist asks a Filipino what the present capital of the Philippines is and his answer is still Quezon City! Or one can imagine if another is asked where Iloilo City is located and his answer is Ilocos Norte!

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[1] Onofre D. Corpuz, "Geography and Its Development in the 80's: A Challenge," Philippine Geographical Journal, Vol. 25, No. 1 (Jan.-March, 1981), p. 7.

The Nature of the "New" Geography

It is the purpose of this paper to present the nature, importance, influences in, content and subdivisions of geography. These aspects will all include the trends in geography today although they may already indicate the current issues concerning the discipline. Towards the end the paper will mention the issues concerning the image of geography and the role of the discipline in Philippine socio-economic development and education. Why study the "new" geography indeed? And, at the outset, what is its nature?

The study of geography today includes not only place geography but a good amount of what is called *nomothetic*[2] geography, or geography that basically asks the question "why," not only the "what" and the "where," and tries to arrive at generalizations from the answers. In this sense, geography then is a science since its central focus is problem-solving and whose end products are explanation and prediction. For example, to know where Mount Mayon is located, its height and its shape, is to possess some interesting knowledge, but one should not stop there. He should ask the question, "Why is Mount Mayon located where it is?" and he finds the answer in vulcanism, a phase of geology. Or he may ask, "Why is it the most perfectly symmetrical volcano in the world?" and the answer lies in the endogenous process of vulcanism as well as in the exogenous process of weathering and erosion. These physical questions should lead one to cultural ones and he may ask, "What crops are grown around the mountain slopes and why are they raised there?" and the explanation is found in the volcanic soil, in the Type 2 climate or in the crop preferences of Albay farmers. But one should not just stop there. He should ask, "Why are the spatial distribution of crops, settlements, etc. structured the way they are?" and he comes to the heart of the "new" geography — seeking answers to questions about variations in spatial patterns (e.g., crop and settlement distributions) and the processes which generate them (e.g., vulcanism, erosion, migration, etc.) and cause them to change over time.[3]

Thus emphasized in the above example is the question *"why"* as a major characteristic of the scientific, problem-solving or inquiry-oriented geography. And also emphasized is the *spatial* dimension (and the different physical and cultural patterns created) as the *point of view* by which geography should be distinguished from its sister science geology and the other sciences. Any phenomenon, therefore, that has variation in terrestial space is of interest to the geographer.[4] Other academic

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[2] Michael Eliot Hurst, **A Geography of Economic Behavior** (North Scituate, Mass.: Duxbury Press, 1972), p. 5.

[3] James C. Stovall, **Introductory Geography Syllabus** (Bound mimeographed copy at the National Institute of Geological Sciences and Department of Geography Library, University of the Philippines, Diliman, Quezon City), p. 2.

[4] Richard Ulack, "Geography in the Philippines," **Philippine Geographical Journal** (1983).

disciplines like sociology, economics and political science also ask spatial questions, but, according to Prof. Richard Morril, "it is only geography which realizes that the fact of space is not just an awkward inconvenience in our theories but a basic organizing principle of existence."[5]

To recapitulate, this brings the discussion to this oft-quoted question which embodies the objectives and the nature of geography as a whole: "What is, where and why, and what difference does it make?"[6] The words "what" and "where" refer to the "old" geography, i.e., descriptive geography. This also refers to what is called the *idiographic approach* in geography that characterizes place geography. The term comes from the Greek root word *idios,* meaning "unique," hence the approach merely describes the uniqueness of places and does not go into the causes of areal differentiation which is characteristic of the nomothetic approach.[7] "What" and "where" then only refer to the first objective of geography: *"to picture man's habitat at a specific point in time through the study of the arrangement of natural and human elements over the earth's surface.* Here the effect of the past in creating the present is recognized and the effect of the present on the outcome of the future is implied.[8]

Going back again to the sentence, the words "why" and what difference does it make" are concerned with the "new" geography, i.e., with analytical geography. Whereas the "old" geography is interested mostly in processes, activities or events and their location, the new geography is concerned with causative explanation and areal differentiation. Following the nomothetic approach which tries to arrive at generalizations, geography uses the inquiry method to come up with hypothesis, theories and laws that try to order disparate bits of data and provide them an intellectually satisfying meaning. This also leads to the second objective of geography: *to interpret man's habitat and show his relationship to it.*[9] This stresses the current nomothetic orientation in geography that pursues the nature of the dynamic coexistence and interaction between the operational (cultural) and phenomenal (physical) milieu over the earth's surface. This shows how man operates over the earth's surface by adapting to or modifying the phenomena presented to him by nature and/or the Divine Creator, just as he cannot help being influenced by nature that circumscribes his actions.

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[5] Malcolm G. Scully, "Academic Geography: Few Students, Closed Departments, Fuzzy Image," The Chronicle of Higher Education, Vol. 24 (May 26, 1982), pp. 1, 12.
[6] Henry M. Kendall, Robert M. Glendinning and Clifford MacFadden, Introduction to Geography (2nd ed.; New York: Harcourt Brace and World, Inc., 1967), p. 9.
[7] Hurst, op. cit., p. 5.
[8] Kendall, et al., op. cit., p. 9.
[9] Ibid., p. 11.

Importance of the Geographic Discipline

From the above discussion, one can infer the importance of geography and that is to give the idea that many processes in a place are interrelated or that places themselves are interconnected by different processes and are *dependent* on each other. The concept of *interdependence* deals a blow to the related ideas of regionalism, provincialism and destructive rivalry of regions and countries among each other. Places actually intertwine in their functions and needs, despite their differences. Indeed, no man is an island! Thus consciousness of interdependence should create cooperation and understanding and avoid wars and disunity, be it among a country's regions or among countries of the world. Aside from the cultural systems like the economic subsystem that create interdependence, the physical processes also interconnect them. The moving wind and oceanic systems, for example, connect countries such that whatever happens in one part of the world can affect the other parts. One can imagine the grim effects of spraying the tropical atmosphere with lethal amounts of bacteria in the event of a biological warfare. The trade winds will carry these around the tropical belt and outward to the other latitudinal zones of the earth.

Another importance of the geographic discipline lies in its role of *counteracting the undesirable tendency towards specialization in human knowledge*. The different branches of learning have become so specialized in their content and methodology that they barely understand each other. Specialization can be carried too far. There might even come a time when there will be specialists for each nostril! People no longer know the inter-relationships among the different disciplines, unlike in olden times and up to the period of global explorations when men were ambivalent in what Sir Charles Percy Snow calls the "two cultures"[10] and could claim expertise in many fields with the likes of Michelangelo and Leonardo da Vinci. Admittedly, times are different now and specialization is an inevitable result of the "knowledge explosion" but it does not mean that educated people have to close their understanding even to related or sister disciplines. Allowing his will abet the operation of what philosopher José Ortega y Gasset calls the "barbarism of specialization"[11] in the different fields of knowledge today that often leaves the layman bewildered if not confused. Geography offers the vantage point of allowing one to integrate the different branches of human knowledge. It allows him to avoid the pitfall of mistaking the tree for the forest, so to say. How satisfying it is indeed to be able to find one's intellectual bearings! And it is no small boast that it can even perform better the integrative function of the social studies!

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[10] C. P. Snow, **The Two Cultures and a Second Look** (2nd ed.; Cambridge: Cambridge University Press, 1964).

[11] José Ortega y Gasset, "The Barbarism of Specialization," **Great Essays in Science**, ed. Martin Gardner (New York: Washinton Square Press, 1957), pp. 117-125

As a corollary to the above ideas, especially to the concept of interdependence, geography would foster what is called *ecological consciousness* or an awareness of the need to maintain the delicate balance of the local as well as global ecosystems. If people know that their actions have repercussions in other places and in other times, they would be more circumspect in their decisions. For instance, if one knows that by cutting the trees without replacing them in the watershed or catchment areas in the mountains he will create a host of ecological imbalances like soil erosion, siltation of dams, destruction of wildlife, wastage of water, spoilage of recreation areas, microclimatic change, flooding and power failure, then he would be more careful in his actions that could cause these ecological backlashes. Again, in the atmosphere, there are so many systems or cycles whose equilibrium have to be maintained such as the water cycle, oxygen cycle, carbon dioxide cycle, or the nitrogen cycle. So too, on the land and in the sea — the world is a delicate functioning spaceship in outer space that carries its own life-support systems. If men destroy their self-contained celestial vehicle that the Divine Creator has made for them, then the human race is doomed! Once the ecological imbalances become irreversible, not all man's piety nor his wit, not all his sciences and technologies, can stem the onrushing tide of global destruction.

The discussion now shifts to the cross-currents of disciplinary thought that have influenced the "new" geography in terms of the characteristics cited above.

Influences in Geographic Study

Since 1945, *probabilistic* ideas have slowly seeped into the social sciences from such fields as physics where the indeterminacy principle was born. It was not, however, until the late 1950's that their influence was felt in geography mainly through the indirect influence of the social sciences. The development of the doctrine of probabilism in geography may be mentioned as an outcome of and as the latest reaction to the previous deterministic orientation of the field. Probabilism states that man is the active agent in the total environment and that although nature is the passive agent which does not control or determine human action or economic development (as posited by environmental determinism), it does make certain modes of action probable and others less probable. Up to the mid-20th century, geography's orientation was deterministic, i.e., geographers believed that physical geographic characteristics had a determinative or controlling effect on man's actions and economic development. The geographic (climatic) determinist Ellsworth Huntington, for instance, believed that temperate zone countries are more progressive than tropical ones because of the benign climatic

conditions in the middle latitudes![12] On that count the Philippines would be doomed to underdevelopment and mediocrity!

The incorporation of the uncertainty principle via the behavioral sciences into geography is known as *behavioralism*, which sees man's role as more active and his behavior as resulting from his perception of his environment. His perception is molded by his individual and group values, his biological inheritance, his education and training and by his experiences. His characteristically free behavior is also indeterminate or unpredictable, i.e., cannot be predicted or described with certainty. His actions are subjective and can only be explained in terms of bounded rationality, meaning his decisions follow a preference scale. Along this scale, he chooses as it were certain courses of action that will benefit him or will satisfy certain particular sets of needs. He will not necessarily select the optimum or the best but only those that are good enough for him.[13]

Geography was also affected by the popularity of the *systems approach* or the notion of a complex inter-related whole which became firmly established in the last 20 years in such fields as engineering, transportation and communications technology. But the influence of the systems approach on geography was more direct from biology, starting from the formulation by A. G. Tansley in 1935 of the concept of ecosystem and the discipline of ecology which studies it.[14] Simply stated, ecology means a study of the ecosystem, i.e., it is a study of the animate or biotic and the inanimate or abiotic components of the total environment and how these components interact with each other, are organized, and function in a balanced and dynamic manner.

There is even a study called human ecology which studies man and his relationships with the biotic and abiotic components of the earth's surface. This study, in fact, bears close resemblance to cultural geography. Thus geography has also employed systems analysis to understand particularly the nature and causes of the spatial arrangement of human and physical elements over the earth's surface. Further, geography, therefore, studies types of inputs and outputs, stimuli and responses, and the feedback systems between these relationships.

The concept of a system as a set of identified elements so related that together they form a complex whole and which is within the purview of geographic study, is also related to another influence — that of the *convergence* or *interdisciplinary approach* which many sciences are trying to employ. Thus geography considers the boundaries of disciplines as artificial and instead tries to use their theories and methodologies

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[12] Gordon R. Lewthwaite, "Environmentalism and Determinism: A Search for Clarification," Annals of the Association of American Geographers, Vol. 56, No. 1 (March, 1966), pp. 23-24, 7, 9.

[13] Hurst, op. cit., p. 8.

[14] Hurst, op. cit., p. 42.

in the analysis of certain problems and in so doing gain more meaning and insight. Geography, by its historical orientation, is broad and, therefore, multidisciplinary; but more than this at present, it tries to see the interrelationships of the different disciplines to come up with an interdisciplinary understanding of various phenomena over the earth's surface. It is a difficult task, for sure, and one which others criticize as tending towards superficiality in understanding. What it may lack in depth, however, is compensated for by the holistic and eclectic picture it gives which is intellectually satisfying.[15]

Another important change in geography is the use of what is called the nomothetic approach as opposed to the idiographic one, concepts which were mentioned earlier. The idiographic approach emphasizes description and the uniqueness of the qualities of particular places. It draws its conclusions by induction, i.e., by starting from particulars and ending in generalizations. This old descriptive approach is criticized as being preoccupied with merely collecting data or piling fact upon fact. The nomothetic approach, on the other hand, is analytical and uses the deductive method, i.e., by starting first with generalizations or hypothesis and then going on to particular to either support or disprove such generalizations. This new approach in geography looks for repeated patterns, particularly for spatial patterns and analyzes their causes in order to develop principles, generalizations and concepts. Like the use of probabilism, the systems approach, convergence principle, quantification and models, the nomothetic approach is another tool of geography for understanding the complexities of the real world.

Definition of Geography

How then should geography be defined today based on the above influences amidst the cross-currents of ideas that have come about in the first half of the 20th century? Geography may be defined then as *the study dealing with man and his interrelationships with his natural environment, how such interrelationships are spatially distributed over the earth's surface, and why the resulting spatial distributions are patterned the way they are.* How far indeed has this definition of geography advanced from that which defines it as "description of the earth" as derived from the Greek root words *geo* (the earth) and *graphein* (to write).

Thus based on the influence of behavioralism and probabilism, man is made the focus and not the physical component of the total environment. And based on the influence of models, the systemic approach, convergence principle and the nomothetic approach, focus is made on the aspects of interrelatedness and interactions. Being dealt with is

[15] Hurst, op. cit., p. 7.

the systemic ineraction between man and his physical environment — how man influences his environment in turn affects him. Here, following the nomothetic orientation, geography does not focus on description but on analysis and problem-solving as a scientific discipline, where the end products are explanation and prediction.

As indicated earlier, the tendency of geographers before was to describe the things that occurred and where they where located. They gave less emphasis to explaining *why* and *how* things were distributed as they were. Today the geographer asks the question: *"Why are spatial distributions patterned they way they are?"* Thus he also gives emphasis to the explanation of spatial distributions and to the comprehension of the processes by which spatial patterns change through time. Geographers are not excited so much by the distributions per se which refer to the frequency with which something occurs in space. *What excites them is the effort to understand why and how spatial distributions vary in pattern and in intensity from one place to another.* The *spatial context or point of view,* therefore, distinguishes geography from the other disciplines, just as the psychological context identifies psychology and the cultural context identifies anthropology. To reiterate, *geography is not defined then by the topics it studies but by this point of view which deals with the questions of spatial differentiation, location and circulation (interaction).*

From the definition above and the previous discussions on the nature of geography, two topical things also stand out — the *physical (natural)* and *cultural (human)* components of the earth's surface. These two components make up what are called the basic elements of geography which will now be examined briefly.

The Basic Elements of Geography

An examination of the human habitat indicates that its nature results from the dynamic interaction of two groups of elements — the *physical or natural* and the *cultural or human.* Though the two elements are combined in a systemic framework, their combinations are in no wise constant, varying from place to place and from time to time. The physical elements form the base upon which man depends for his livelihood. He has learned either to control or modify some of them, yet he has to accept certain other physical characteristics as limitations upon his activities. And the things that he uses to change the physical milieu to serve his needs make up what are called the cultural elements or the elements that result from his presence.

Table 1 shows the basic elements that constitute the geographic study.[16] Under physical (natural) elements, there are the hydrosphere, lithosphere, atmosphere and biosphere. Under cultural (human) elements, there are population, cultural inheritance, major occupations and

[16] Kendall, op. cit., pp. 4-5.

major works or accomplishments. A component of the physical elements is the hydrosphere or water world which makes up 75 percent of the earth's surface. This great proportion perhaps should necessitate renaming Planet Earth properly into "Planet Sea." The hydrosphere may be classified into major and minor water bodies. The lithosphere or solid portion includes landforms, soils and minerals. Although the solid portion is only 25 percent of the earth's surface, it is important to man, for man is a "land lubber," i.e., an animal adapted to walk on land. Climate and weather are studied under atmosphere or the gaseous portion of the earth. The biosphere or the world of living things comprises natural vegetation and wild animal life. The biosphere also includes man and the domesticated crops and animals that he raises, but these elements are cultural rather than physical.

Table 1. The Basic Elements of Geography

Physical (Natural) Elements	*Cultural (Human) Elements*
1. Water features	1. Population — numbers, densities, patterns of distribution
a. Major bodies — oceans, seas, big lakes and rivers, soil water, underground water	2. Cultural inheritance
b. Minor bodies — small lakes and rivers, bays and gulfs, ponds, canals, sheet flows	a. Material culture — tools, ornaments, utensils, dwellings, clothing
2. Landforms	b. Non-material culture — customs and traditions, values, ideas and beliefs
a. Major — mountains, plains, hills, plateaus	3. Major occupations
b. Minor — mesa, delta, hill, coastal bars	a. Primary — hunting, gathering, fishing, mining, lumbering, agriculture, animal husbandry
3. Soils — zonal, intrazonal, azonal	b. Secondary (manufacturing)
4. Minerals — actual and potential	c. Tertiary — trade, services
5. Climate and weather — long-term and short-term conditions of the atmosphere	4. Major works or accomplishments — infrastructures, rural and urban settlements, networks and modes of transportation and communication
6. Natural vegetation — trees, grasses, desert plants	
7. Wild animal life — first, second, third level consumers	

Among the cultural elements studied by geography is population — its number, density and distribution patterns over space. Cultural heritage is included next and this includes man's material and non-material culture, i.e., the tangible (tools, weapons, etc.) and intangible (customs, values, etc.) aspects of his culture. Geography is likewise interested in man's economic activities — primary, secondary, tertiary and even quarternary occupations. Man's major works like infrastructures, settlements and flows and structures of transportation and communication constitute the last interest of geography. Geography may be said then to be interested in the above topics whose vertical range is about 300 miles high up in the atmosphere where man's satellites and spaceships roam and about 3 miles below the earth's surface, the greatest depth reached by man so far with his mining drills. It should be pointed out that geographic interest in these topics is different from those of other disciplines. Geography is interested more in the distribution of these phenomena over terrestrial space and in the causes of the patterns they create.

The discussion of the basic elements in geographic study logically turns to the geographic subdisciplines that try to study such topics. In short, the discussion will now touch on the subdivisions of geography.

Subdivisions of the Geographic Field

Geography is aptly called by the eminent British planner Sir Patrick Geddes "the synthesis and mother of all sciences." Salita, a well-known Filipino geographer, calls it "the core in the unity of knowledge and the queen of the sciences."[17] Geography has its feet and hands, so to speak, in all the branches of human knowledge. It has connections with the 1) *natural sciences*, 2) *social sciences* and 3) *humanities*. Geography as natural science studies nature — the waters, landforms, minerals, soils, climate and flora and fauna over or close to the earth's surface. As a social science, geography deals with the structure and function of society and its subsystems. It studies man's political system, economic system, religious system, educational system, population, the family, man's cultural values, folkways and beliefs, as well as his technology. As a humanistic discipline, geography studies artistic works, and is involved with the arts like painting, sculpture, music, literature and the dance, particularly in terms of their spatial distribution and differentiation.

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[17] Domingo C. Salita, **Geography and Natural Resources of the Philippines (Quezon City: College of Arts and Sciences, University of the Philippines, Diliman, Q.C., 1974)**, p. 3.

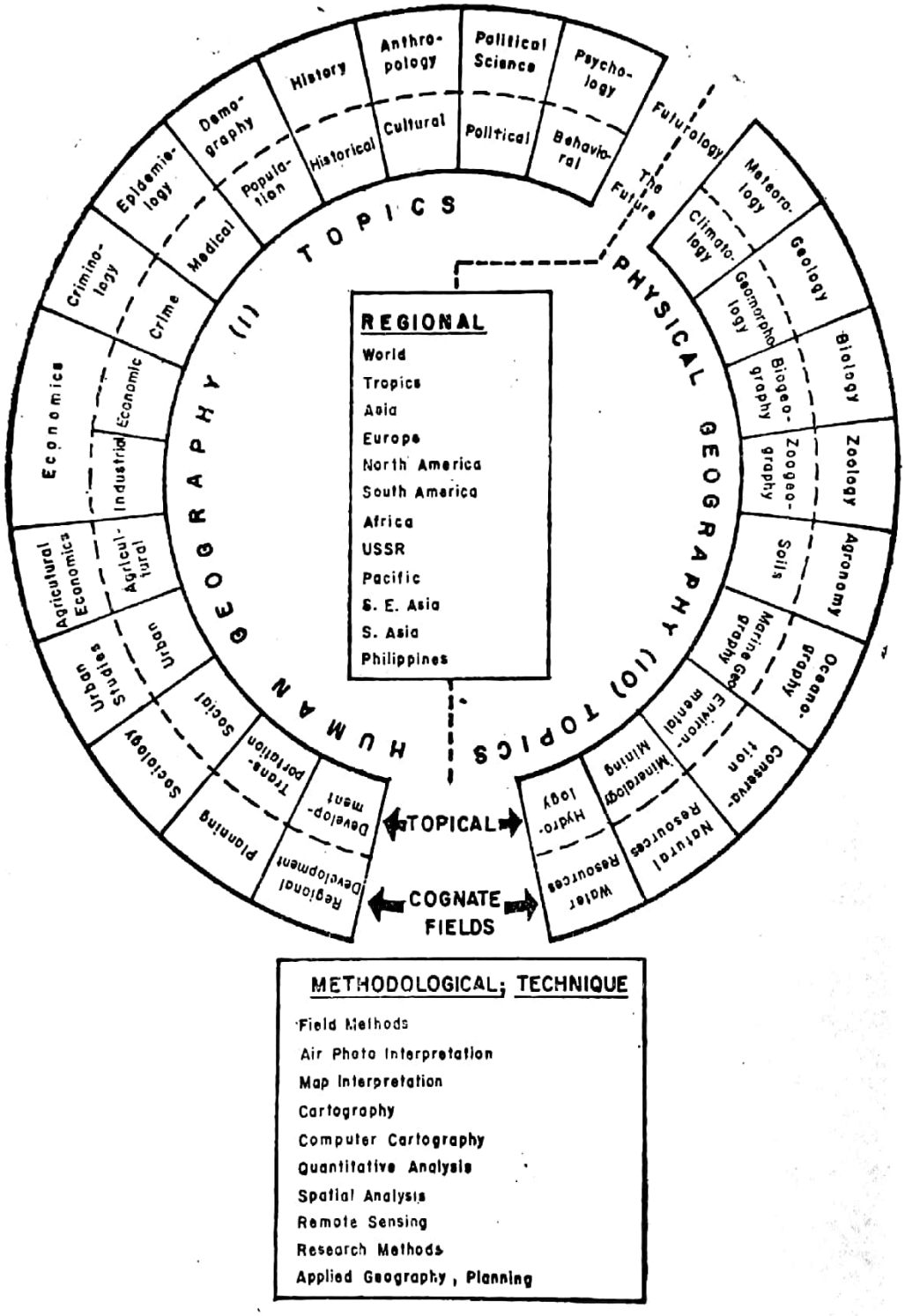

Fig. 1. Major Topical, Methodological and Regional Specialties in Geography (after Ulack, 1983).

As shown in Fig. 1,[18] geography is holistic and interdisciplinary for it jointly studies most academic disciplines. Geography's interdisciplinary orientation that gives one a vantage point constitutes its virtue but the resulting superficiality from preoccupation with too many topics could be its failing. This *superficiality, however, can be counteracted by specializing only in one disciplinary orientation while maintaining a broad understanding of the ramifications of the other branches of man's exploding knowledge.*

Thus geography is seen as being divided into two broad fields: 1) physical geography and 2) human geography. Under physical geography, geography has a tie-up with oceanography in marine geography, with geology in geomorphology, with agronomy in soil geography, with natural resource studies in mineralogy or mining, with meteorology in climatology, and with biology in biogeography. Under human geography, it has a tie-up with demography in population geography, with anthropology in cultural geography, with history in historical geography, with psychology in behavioral geography, with sociology in social geography, with economics in industrial geography and economic geography, with political science in political geography and with planning in transportation geography. All the subject matter studied by these disciplines have variation in earth space and are, therefore, "fair game" for geographic investigation. This is the basic reason for the variety of topics studied and taught by geographers.

Topical (systematic) and regional geography. As Fig. 1 also shows, geography can be studied through both the topical and the regional approaches. The different mergers of geography with other disciplines described above follow what is called the topical or systematic approach in geographic study. Systematic geography is concerned with the geographic aspects of particular phenomena, i.e., with the distribution of a phenomenon as it relates to other areally distributed phenomena in a systemic, dynamic framework and as it contributes to an understanding of areal differences in human organization. This concern is not the same as one which motivates the specialist in a systematic science like soil science or botany.

For instance, to explain the preceding statement, the soil scientist may study soils like the geographer in terms of the distribution of many soil varieties over the earth. The soil scientist, however, is interested primarily in the distributional study not as a means of understanding *areal differentiation* in general, but as a means of understanding the

[18] Adapted from Ulack, op. cit., p. 6.

nature of soils. The soil geographer, on the other hand, investigates soil distributions in terms of the role they play in differentiating one area of human activity from another, in their relation to agricultural, forestry and transportation patterns. While the soil geographer seeks data from the soil scientist concerning the nature of soils, he at the same time aims to generalize about the relations that particular groupings of soils have to other areally distributed phenomena.

Regional geography attempts to organize knowledge concerning differences from place to place in the ways men have occupied the earth's surface and established areally defined systems of organization. Or to define it simply, regional geography is the study of an area or *region* of the earth's surface that is *homogeneous* in terms of aspects like location, manufacturing, physical geographic features, economic activity, cultural trait or ethnic origin. For example, the Cagayan Valley of Luzon is a region because it is made homogeneous or whole by the valley topography. Western Visayas is a region because it is made homogeneous by one ethno-linguistic trait — the people belong to the Ilongo subculture and they speak the Hiligaynon dialect. Thus the regional geographer is a systematizer and integrater of a given data into an area of relative homogeneity, i.e., a region.

As the chart indicates, one can also study bigger regions such as the regions of the world like the tropics, Asia, Europe, North America, South America, Africa, USSR, Pacific, Southeast Asia, and South Asia. In studying these regions, however, topical geography is also used, i.e., the different subfields of geography are employed to study the region, with the emphasis depending on the goals of the investigator. The two approaches are, therefore, related and topical geography in turn may employ regional geography as analytical support or for illustrative purposes.

The chart further indicates the techniques and/or methodologies of geography which include field methods, air photo interpretation, map interpretation, cartography (map-making), computer cartography, quantitative analysis, spatial analysis,remote sensing, research methods and applied geography/planning. These are the varied tools for gathering data and for analyzing such data as guided by the hypothesis and theoretical frameworks furnished by topical or systematic geography. They can also be specializations in geographic work as in the case, for instance, of cartography which is involved with the making of *the basic tool of the geographer — maps.*

Despite the above discussion on geography's importance and usefulness, still, in the Philippines, it may be asked why geography is so

little known and has a low image. For instance, why is it that only the U.P. College of Social Sciences and Philosophy offers undergraduate and graduate degrees in geography while in the United States over 400 schools have departments? This leads to a brief discussion of why this discipline, which promises to offer much, has a relatively *low status* and *exposure* in the Philippines.

The Image of Geography

One reason for geography's low profile and relative obscurity in the country is the prevalent perception that geography is a new discipline. It is actually an old subject, dating back to the Greeks whose studies on the cosmos, the earth and regions were subsumed under geography. It is true, however, that geography's current conception is new, following the "scientific revolution" which emphasized problem-solving or the scientific approach. Its adherents are still to some extent pioneers in the "new" geography and their struggle towards delimiting the concerns of their holistic discipline has resulted to its "fuzzy image"[19] or to the confusion on what its content and methodology should be. Nevertheless, as already mentioned, geography is finding its intellectual bearings now by its adoption of the point of view based on *spatial variation.*

A second reason for the low image of geography in the country is the limited opportunity for specializing in or pursuing degrees in geography. As mentioned above, only the University of the Philippines in Diliman offers complete geography courses at the undergraduate and masteral levels. A number of the big schools in Metro Manila offer only one or two college geography subjects like economic or political geography as requirements or electives of other courses. While the discipline is strong in European countries, North America and former colonies of Great Britain, in the Philippines it has been neglected. Surely, in the Philippines with over 50 million people a market for geographers can exist if only local schools would help create them by offering geography degrees in all pedagogical levels and by propagating its role in the public and private sectors of national life.

A third reason for the low profile of geography lies in the perceived lack of employment opportunities and limited chances for advancement. Students would rather go to such practical courses as business administration, engineering, statistics or economics which would offer supposedly more remuneration. Little do students know, however,

[19] Malcolm G. Scully, "Academic Geography: Few Students, Closed Departments, Fuzzy Image," **The Chronicle of Higher Education, Vol. 24 (May 26, 1982).**

that the employment field in geography is vast — in *government, teaching, research, business* and the *military.* In the government, for instance, knowledgeable agency managers are realizing the usefulness of geography and right now there is a call for geographers particularly in agencies involved in socio-economic and spatial planning. Also, with the eventual inclusion of geography subjects in the elementary and high school curricula, there is a need for more teachers trained in the "new" geography. In fact, all geography graduates from U.P. Diliman have well-paying jobs, since being few, they enjoy the luxury of wide employment choices.

A fourth reason for the discipline's poor image is the fact that it is still considered by the uninitiated as a descriptive and taxonomic discipline, i.e., it still uses the idiographic approach which merely compiles vast amounts of incoherent trivia. Many picture geographers as sadists who force their pupils to memorize all the provinces and their capitals or who sense that the geographer's intellectual curiosity stems from pictures of natives in the pages of the *National Geographic Magazine.* As discussed earlier, it is now known that geography has progressed from this simplistic approach and embraced the nomothetic one that mainly asks the questions, "why" and "how" instead of "what" and "where" and tries to use theories and generalizations to introduce meaning to an otherwise incoherent mass of gathered data.

A fifth reason for the geographic field's poor standing among the disciplines is the perception that geography has become so interdisciplinary that it appears to lack a coherent center. That is, it appears to many as a discipline composed of a loosely knit group of specializations that do not have much in common. But as noted earlier, geography's interdisciplinary nature could also be its strength since the practitioner is given a chance of interrelating the seemingly disparate contents of the different disciplines. The geographer has a relatively clearer grasp of reality since he is trained to have a wider compass of perception. And if a need for specialization arises, he can always specialize in one of the different subdisciplines indicated in Fig. 1. The aspect of broadness or superficiality that geography is often criticized about can actually be circumvented by adopting the spatial point of view on which the different capabilities of other disciplines can be brought to bear.

The last reason for the discipline's inferior status lies in the criticism that it is not a rigorous field of study, i.e., it is not a "hard" course like physics, chemistry or even biology. This idea stems from the newness of the approach and from one of the major subject matters of geography — people. Spatial or territorial behavior of humans could be subjective and hard to measure, unlike the characteristics of the

inanimate components of the environment like minerals and soils which are exact and constant. But it must be pointed out that one of the influences in modern geography is quantification — statistical measurement not only in physical geography but even in the more unpredictable realm of human geography. Statistics, calculus, mathematics and computer programming are now standard tools in geography. But quantification and computerization are only means, not ends, toward effective analysis. If one is turned off by numbers he can always resort to verbal analysis and description in geography — this constitutes the beauty of geography — an ambivalent discipline!

The Relevance of Geography to Philippine Development and Education

Mentioned earlier was the importance of geography in the political, epistemological and ecological fields. Worthy of mention, too, is its relevance to the economic and educational fields. Today, geography has established a strong record of creditable performance in the development planning efforts of countries like the USSR, the United Kingdom, most other European countries, India, Malaysia and Singapore. In Russia, which by its sheer size is very conscious of the role of geography in national development, the discipline is at the forefront of activities involving sophisticated environmental monitoring systems. In the United States, professional geographers played vital roles in the planning of the word's most complex transportation network located in the congested corridor between Boston and Washington, D.C. In the Philippines, geography can play an active role in regional development, industrial location, environmental assessment, land use planning, resource management and conservation or in the general idea of planning the spatial component of the economic development of the Philippines. The Ministry of Human Settlements, for instance, has prepared the ***National Multi-Year Human Settlements Plan, 1978-2000*** and the ***Regional Multi-Year Human Settlements Plans***[20] as spatial plans to complement the economic development plans of the NEDA. This was done by the Ministry based on the findings of the then Task Force on Human Settlements that ". . . the prevailing spatial distribution of infrastructures and services, housing, cities, and urbanized centers, reflect the lack of attention to the integration of spatial elements of development . . ."[21]

Geography should also be introduced in the elementary and high school curricula since from experience even the "old" geography that

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[20] **National Multi-Year Human Settlements Plan, 1978-2000 (Manila: Human Settlements** Commission, December, 1977); **Regional Multi-Year Human Settlements Plans** (Manila: Human Settements Commission, December, 1977).

[21] **Human Settlements: The View of a New Society (Manila: Task Force on Human** Settlements, 1975).

emphasized place geography had its indispensable place in Filipino learning. Now foreign tourists even know more about the basic facts on the country than Filipino pupils and students. How can one love the Philippines indeed if he is not familiar with her vital statistics? People may not become "Mr. Know-It-Alls" by studying geography but it will immensely help them become well-informed and well-rounded individuals following the idealistic tradition of gentlemen-scholars that flourished in the Middle Ages and the Renaissance. In the United States, mentors are even teaching ninth and tenth grades how to use geography in selecting an optimum location for a new industry as part of their exercises under the "new" geography curricula.

At the Ministry of Education, Culture and Sports, it is heartening to note that a new policy was issued providing for the reintroduction of geography in the elementary and secondary levels following the general decision to emphasize basic subjects. In the new elementary curriculum, Civics and Culture will be the new learning area in Grades I and II and in Grade III the content of Civics and Culture will be expanded to include Geography, History and Work Ethic. In Grades IV to VI, Geography, History and Civics will replace Civics and Culture and will be taught as separate subjects.[22] In high school, geography is presently offered as an academic elective subject from Second Year to Fourth Year. Secondary schools usually offer Philippine Geography in the Second Year, Economic Geography in the Third Year and World Geography in the Fourth Year. The plan on the revision of the secondary curriculum is to offer geography as separate required subjects in the different levels.[23]

This paper has belabored itself enough pointing out the relevance and importance of geography as an academic discipline. In closing, it is appropriate and interesting to note this supportive quotation from a famous non-geographer, economist Kenneth Boulding:

> Geography is in a state of great intellectual ferment, busy absorbing new methods, specially quantitative methods, on all sides, and quite self-consciously aware of its role as an integrator of many social sciences and natural sciences besides. Of all the disciplines, geography is the one that has caught the vision of study of the earth as a total system, and it has strong claims to be the queen of the human sciences.[24]

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[22] "The New Elementary School Curriculum (NESC)," MECS Order No. 6, s. 1982, issued January 29, 1982.

[23] "The Revised Secondary Education Program, 1973," MECS Department Order No. 20, s. 1973, issued May 30, 1973.

[24] Douglas Amedeo and Reginald G. Golledge, An Introduction to Scientific Reasoning in Geography (New York: John Wiley and Sons, Inc., 1975), p. 3.

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SMALL SCALE POLYCULTURE: AN ALTERNATIVE DEVELOPMENT MODEL[1]

by

DAVID L. CLAWSON[2]

INTRODUCTION

Traditional small scale tropical agriculturists are identified by numerous names throughout the world. In Latin America they are known as *campesinos, milperos,* and *conuqueros.*[3] Two of the more categorical terms in use worldwide are peasants and slash and burn farmers, the latter being known as *kaingineros* in the Philippines. Numerous attempts have been made to classify small scale agriculturists on the basis of technological and tenurial characteristics.[4] Regardless of the precise name or category assigned by individual researchers, however, the small scale traditional farmer has been almost universally viewed by scholars as technologically backward and unproductive. This perception has been strengthened by a general reluctance on the part of the farmers to adopt new, so-called modern or scientific, agricultural products and technologies. The resistance of the traditional farmer to change has proven to be a source of seemingly endless frustration to third world development personnel who have debated extensively the causes of peasant conservatism.

Attempts to explain the reluctance of small scale farmers to innovate tend to fall into two broad interpretive groupings.[5] The first

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[1] An earlier draft of the study, entitled "The Productivity of Small-Scale Filipino Agriculture and Its Relevance to National Development," was presented at the 6th National Conference on Local-National History held at the University of the Philippines, Diliman, on December 11-14, 1984.

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The author acknowledges the financial support of the Philippine-American Educational Foundation (Fulbright-Hays). All opinions and conclusions, however, are his own.

[3] See David L. Clawson and Raymond E. Crist, "Evolution of Land-Use Patterns and Agricultural Systems (Northern Andes)," **Mountain Research and Development,** 2 (1982), pp. 265-272; also Robert C. West and John P. Augelli, **Middle America: Its Lands and Peoples,** 2nd ed. (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1976), pp. 229-237.

[4] An excellent recent analysis of Philippine agrarian class distinctions based on land tenure status is Antonio J. Ledesma, **Landless Workers and Rice Farmers: Peasant Subclasses under Agrarian Reform in two Philippine Villages** (Los Baños: International Rice Research Institute, 1982).

[5] The cognitive-risk controversy is analyzed in John Kunkel, "Opportunity, Economics, and Behavior: A Comment on Acheson and Foster," **American Anthropologist,** 78 (1976), p. 327. An empirical test of the theories in a Mexican peasant village is presented in David L. Clawson, "Intravillage Wealth and Peasant Agricultural Innovation," **The Journal of Developing Areas,** 12 (1978), pp. 323-336.

viewpoint, frequently advocated by social scientists, holds that peasant conservatism is a by-product of limiting socio-cultural factors. This interpretation is exemplified by Foster's Image of Limited Good model.[6] Foster hypothesized that traditional villagers view all desirable things in life, be they material substances such as land, food, or wealth or be they immaterial attributes such as friendship, honor or security, as existing perpetually in limited, rather than infinite supply. Furthermore, according to Foster's model, the peasant farmers perceive themselves as being incapable of doing anything to increase the quantity of these limited goods. It follows, then, that if an individual farmer should improve significantly the level of his possessions through the adoption of improved agricultural technologies, that his peers will feel envy owing to their belief that the innovator's increased share of the limited goods will inevitably result in a reduction in their own shares. In order to avoid a breakdown of the traditional shared poverty of the community, the noninnovators will, according to the theory, exert sufficient social pressure to force the innovator to terminate his productive behavior.

Erasmus's cognition model also supported the hypothesis that peasant society is, by nature, intrinsically non-innovative.[7] In this model, villagers strongly discourage innovation and individual achievement. In order to perpetuate the prevailing order, peasants are said to exercise "invidious sanction," toward high achievers by permitting them to display their wealth only through religious ceremonies and other community celebrations as a form of "conspicuous giving." Such rituals act as leveling mechanisms, reducing wealth levels between the rich and the poor. Peasant or rural society, according to these and similar cognitive theories, is inherently incapable of innovative or progressive behavior without benign outside intervention or assistance. Whether it is recognized or not, this viewpoint has provided a philosophical justification for many foreign and domestic rural assistance programs in the Philippines and other developing nations.

A second viewpoint of peasant conservatism, advanced by many economists and social scientists, holds that the lack of innovative farmer behavior is attributable to the extreme poverty of rural life itself.[8] Small

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[6] George Foster, "Peasant Society and the Image of Limited Good," **American Anthropologist**, 67 (1965), p. 296. See also George Foster, **Tzintzuntzan** (Boston: Little, Brown, 1967), pp. 122-152.

[7] Charles Erasmus, **Man Takes Control** (Minneapolis: University of Minnesota Press, 1961), pp. 113-120.

[8] Theodore Schultz, **Transforming Traditional Agriculture** (New Haven: Yale University Press, 1964); John Mellor, **The Economics of Agricultural Development** (Ithaca, N.Y.: Cornell University Press, 1966); Clifton Wharton, Jr., "Risk, Uncertainty, and the Subsistence Farmer," in **Economic Development and Social Change**, ed. George Dalton (Garden City, N.Y.: Natural History Press, 1971), pp. 566-574; and James Acheson, "Limited Good or Limited Goods? Response to Economic Opportunity in a Tarascan Pueblo," **American Anthropologist**, 74 (1972), pp. 1152-1169.

scale farmers are viewed as intellectually willing and capable of modernization but prevented from innovating by fear of even a single crop failure. In other words, the farmers are believed to be living so close to the margin of survival that they cannot afford the risks of experimentation. The key to rural development, according exponents of this position, is simply to minimize farmer risks through the provision of a financial security package that usually includes generous credit terms, crop insurance policies, and liberal amounts of advice from extension agents.

Regardless of which, or to what degree, either or both of the viewpoints is correct, it is unfortunate that both have reinforced public perception of traditional farmers as essentially inefficient, outdated vestiges of an unproductive past that should be transformed or removed. The small farmer in the Philippines and elsewhere is constantly encouraged by well-intentioned, but perhaps not fully informed, political and development leaders to modernize and to become more scientific in his agricultural practices. In November, 1984, for example, a provincial governor was reported by the *Bulletin Today* newspaper as having urged farmers under his jurisdiction "to break tradition and start making full use of modern farming technology instead of raising crops 'through the crude way and leaving everything to God.' "[9]

It is hoped that this study will demonstrate that the traditional tropical farmer, far from leaving everything to diety, is a most creative and successful agriculturist whose production strategies, refined through centuries of experience, offer a pattern worthy of emulation and capable of contributing significantly to Philippine agricultural development.

SMALL SCALE CROPPING SYSTEMS AND THEIR PRODUCTIVITY

There exist, among small scale Filipino farmers today, three general forms of agriculture. The first two involve a heavy, and often total, reliance upon monoculture, or the raising of only one crop in a given area of land at a given time. The third entails polyculture, or the simultaneous intercropping of multiple crops in a given piece of land. Care must be exercised to not confuse relay cropping, which is simply an intensive form of monoculture with polycultural multiple cropping. By planting one crop soon after the previous crop is harvested, relay farming can result in multiple harvests of a field in the course of a year. Yet, it is still monocultural because only one crop is grown in an area at a time. Even if the field is divided into several sections, each utilized for relay cropping so that many crops are harvested each year, unless several different crops are growing together in shared space it is simply intensive monoculture. A general rule to distinguish between

[9] As quoted in The Bulletin Today, 29 November 1984.

monoculture and polyculture is to observe whether the crops occupy different spatial niches; if the crops are multi-layered or storied, it is polyculture.

The first type of monocultural small scale farming common to the Philippines is traditional grain farming, usually focusing on rice or maize. Practitioners of this form of agriculture prefer to rely on the cultivation of multiple native or indigenous varieties or cultivars of the staple grain crop. These varieties often vary in color, length of growing season, resistance to environmental stresses, and yield. They are site-specific, having been adapted over time to the unique physical characteristics of a small area. These adaptations may include length of daylight, temperature and precipitation, pests and diseases, and soil texture and fertility. Their greatest asset is their hardiness and their ability to assure a high degree of harvest security. Because they are adapted to local, naturally-occurring conditions, they respond poorly to modern technological inputs such as fertilizer. This has led many agricultural development personnel to belittle the traditional varieties as unproductive and to advocate their replacement with allegedly high yielding hybrids. We shall see later, however, that the hybrids, when forced to produce under common natural conditions, are not nearly so productive as is often claimed.

The second type of monocultural small scale farming now widely practiced in the country is so-called Green Revolution grain farming.[10] It entails the use of hybrid seeds developed specifically to respond to massive amounts of fertilizer and water. Owing to the lack of adaptation to local environmental stresses, however, the new varieties almost always require heavy inputs of insecticides, pesticides, and herbicides in order to yield a respective harvest. Because these inputs can be applied more efficiently by mechanical means, mechanization and its attendant high energy costs are frequently utilized. Because mechanized equipment is more profitably used on a large scale, cooperative or collective organization of the farmers is encouraged which is contrary to their natural preference for individual labor. In order to encourage farmer cooperation, financial credit to pay for the package of inputs is often channeled through rural cooperatives or other collective organizations.

Advocates of Green Revolution technologies and strategies often justify their efforts on the basis of comparative yield data which suggest that the new or modern crop varieties are more productive. Initial International Rice Research Institute (IRRI) tests of the hybrid

[10] For a sample of Green Revolution literature, see D.J. Greenland, "Bringing the Green Revolution to the Shifting Cultivator," Science 190 (1975), pp. 841-844; Clifton R. Wharton, Jr., "The Green Revolution: Cornucopia or Pandora's Box," Foreign Affairs 47 (1969), pp. 464-476; and Stanley Johnson, The Green Revolution (London: Hamish Hamilton Ltd., 1972).

rice variety IR-8 led development personnel in the mid-to-late 1960s to forecast yields of 8 to 10 tons/ha throughout the Philippines which, had they been realized, would have resulted not only in national self-sufficiency but also in a significant export capacity as well.[11]

These extraordinary yields, however, can be achieved only under equally extraordinary field conditions in which the supply and balance of the environmental and technological inputs essential to success are controlled and managed as intensively as a chemist's laboratory. Crucial variables such as solar insolation, water supply, atmospheric temperature and winds, soil texture and nutrients, and weed, insect, and disease control must all blend in ideal proportions in order for the "miracle" yields to be achieved. Such a level of control, regretably, can seldom if ever be realized under actual field conditions.

To the extent that the necessary controls can be implemented, the modern Green Revolution seed varieties generally result in yields considerably higher than those obtained from the traditional varieties. At Pangasinan, for instance, Green Revolution rice-mungbean monocultural systems yielded 4.99 tons/ha/year while traditional monocultural farmers planting the same crops managed only 1.90 tons/ha/year, or only 38 percent of the former. Similarly, in Iloilo, rice-mungbean farming yielded 9.22 tons/ha/year using Green Revolution technologies compared to only 2.16 tons/ha/year under traditional management. Also at Iloilo, rice and cowpeas yielded 6.05 tons/ha/year among Green Revolution farmers compared to only 2.31 tons/ha/year in the absence of the new inputs (Table 1).

Table 1. Comparative Yields of Similar Crops Grown at Identical Sites in the Philippines under Different Technological Levels.

Site	Crop/s	Technology	Yield in tons/hectare 1st Crop	2nd Crop	3rd Crop	Annual Total
Pangasinan	Rice/Mungbean	Green Rev.	4.17	0.82	none	4.99
	Rice/Mungbean	Traditional	1.65	0.25	none	1.90
Iloilo	Rice/Mungbean	Green Rev.	5.48	3.44	.30	9.22
	Rice/Mungbean	Traditional	2.10	.06	none	2.16
Iloilo	Rice/Cowpea	Green Rev.	5.30	.75	none	6.05
	Rice/Cowpea	Traditional	2.10	.21	none	2.31

Source: S. Jayasuriya and C. Maranan, "Economics of upland crops in rice-based cropping systems" in **Cropping Systems Research in Asia** (Los Baños: International Rice Research Institute, 1982), pp. 69-74.

These figures, regretably, are not representative of the country as a whole which, in recent years, has averaged approximately 1.8 tons/ha in irrigated areas utilizing traditional rice varieties compared to yields of only 2.1 tons/ha for the modern irrigated varieties. Without irrigation, the productivity differential is almost non-existent, with the

[11] R.W. Herdt and T.H. Wickham, "Explaining the gap between potential and actual rice yields: the Philippine case," in **Economic Consequences of the New Rice Technology** (Los Baños: International Rice Research Institute, 1978), p. 4.

rainfed lowland traditional varieties averaging 1.3 tons/ha compared to a yield of 1.4 tons/ha for rainfed lowland hybrid cultivars.[12]

The huge gap between the optimal trial yields of 8.0 or more tons/ha and the overall national average of the Philippines of 1.8 tons/ha of rice has frequently been cited as evidence of the alleged backwardness of the small farmer. Advocates of this position argue that as soon as the farmer changes, i.e. "modernizes," by adopting the Green Revolution technologies, national output will surge upward. The inadequacy of this simplistic interpretation was demonstrated, however, in Herdt and Wickham's landmark quantitative analysis of the factors contributing to the potential-actual yield gap (Table 2). Physical factors alone, including the lower insolation levels characteristic of the wet season when most of the nation's rice is produced, imperfect water control, and annual fluctuations in rainfall, sunlight, diseases, and insects, accounted for 3.9 tons/ha or 63 percent of the 6.2 tons/ha gap. Unfavorable economic returns, in which lower yielding production packages actually resulted in greater net profitability to the farmer owing to the excessive costs of inputs associated with the highest yielding packages, were responsible for a further actual yield decline of 1.0 ton/ha or 16 percent of the gap. Only 1.3 tons/ha, or 21 percent of the gap, was attributable to inadequate farmer management practices and only part of this was traced to the continued widespread use of the traditional varieties.

The modest actual increases in productivity generated by the new rice technologies have required major increases in cash expenditures to cover the costs of additional fertilizer, the net economic impact on the small farmer of the Green Revolution packages has frequently been decidedly negative.[13] In other words, even though the farmer's yield using the new technologies is usually slightly higher than the output obtained from the traditional varieties, the production costs of the former are so much greater than the latter that the farmer is financially better off producing less. Those farmers who persist in using the new technologies incur almost insurmountable indebtedness but are reassured by development personnel that profitability is just around the corner if the farmers will only become more efficient by incorporating more fully the modern strategies. The tragic consequence of this vicious cycle has been what Griffin has called the "pauperization" of the small farmer.[14] In Laguna, the very heart of the modern rice development

[12] Ibid., p. 5.

[13] Ibid., p. 15. Herdt and Wickham noted that for experiments conducted in Nueva Ecija utilizing eleven crop treatments for analysis, "seven of the eleven were uneconomic because they gave either a lower yield at a higher cost or the same yield at a higher cost."

[14] K. Griffin, "Comments on labor utilization in rice production," in Economic Consequences of the New Rice Technology (Los Baños: International Rice Research Institute, 1978), p. 141.

effort, the number of landless households increased from 30 to 45 percent of the total population between 1966 and 1974.[15] Ruttan has observed that, with the possible exceptions of Taiwan and Malaysia, "there are substantial areas in almost every country in Asia where the rural poor... are worse off both relatively and absolutely than two decades ago."[16]

Table 2. Analysis of the Gap between Potential and Actual Philippine Rice Yields

Item	Yield reduction due to this factor (tons/ha)	Adjusted yield (tons/ha)
Physical Factors		
IRRI trials, Los Baños, modern varieties, dry season with irrigation	—	8.0
Field tests away from Los Baños, modern varieties, dry season with irrigation	1.6	6.4
Field tests away from Los Baños, modern varieties weighed wet and dry seasons	.8	5.6
Rainfed, no irrigation on 58 percent of rice lands	1.0	4.6
Environmental fluctuations in levels of precipitation, sunlight, diseases, insects	.5	4.1
Cultural Factors		
Unfavorable economic returns for highest yielding production packages	1.0	3.1
Inadequate farmer management including use of traditional varieties and poor weed, insect and disease control	1.3	1.8

Source: Modified from R.W. Herdt and T.H. Wickham, "Exploring the gap between potential and actual rice yields: the Philippine case," in **Economic Consequences of the New Rice Technology** (Los Baños, International Rice Research Institute, 1978), pp. 3-24.

[15] Ibid., p. 140-142.

[16] V.W. Ruttan, "New rice technology and agricultural development policy," in **Economic Consequences of the New Rice Technology** (Los Baños: International Rice Research Institute, 1978), p. 373.

An additional aspect of the deteriorating condition of the small farmer is that the new rice technologies actually have resulted in increased rather than decreased labor requirements. Barker and Cordova found that the average number of man-days of labor per hectare of rice farmers of Central Luzon increased from 60.2 under the traditional systems to 81.6 under the Green Revolution packages. Given the negligible increases in yield of the hybrid varieties, the so-called progressive farmer had to labor 37.1 days to produce a ton of rice compared to 26.2 days for his traditional neighbors.[17]

In addition to the negative economic consequencies of the new technologies, Climacosa has documented numerous "nightmarish" social consequences including a loss of a sense of community and belonging, reduced social interaction, increased demographic mobility, and the breakdown of traditional moral principles.[18] To these ills, we might add a loss of independence of farmer decision making and a degradation of the quality of the physical environment.

THE POLYCULTURAL ALTERNATIVE

Having reviewed the productivity of the two monocultural systems practiced by small scale Filipino farmers, we turn lastly to an assessment of tropical polyculture which involves the simultaneous cultivation in the same field of multiple crops and crop varieties.[19] One widely documented advantage of peasant polyculture is the exceptionally high level of harvest security it provides the farmer.[20] By utilizing both slow maturing crops such as cassava, taro, sweet potatoes and other tubers along with perennials such as bananas and papaya, as well as fast maturing grains and vegetables, the small scale polycultural farmer virtually assures himself of a diverse harvest throughout the year. By growing plants that differ in their height above the ground, the polycultural farmer utilizes more efficiently the available solar energy while at the

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[17] R. Barker and V.G. Cordova, "Labor utilization in rice production," in **Economic Consequences of the New Rice Technology** (Los Baños: International Rice Research Institute, 1978), pp. 113-136.

[18] D. Climacosa. "A Contemporary Historian's View on Socio-Economic Changes Brought About by the New Rice Technology." Paper presented at the Sixth National Conference on Local-National History, 11-14 December, 1984, University of the Philippines, Diliman.

[19] The distinction between interspecific and intraspecific diversity in tropical agriculture is analyzed in David L. Clawson, "Harvest Security and Intraspecific Diversity in Traditional Tropical Agriculture," **Economic Botany 39 (1985)**, pp. 56-67.

[20] J.H. Chang, "Tropical Agriculture: crop diversity and crop yields," **Economic Geography 53 (1977)**, 241-254; E. Colson, "In good years and in bad: food strategies of self-reliant societies," **Journal of Anthropological Research 35 (1979)**, 18-29; M.U. Igbozurike, "Ecological balance in tropical agriculture," **Geographical Review 61 (1971)**, 519-529; C.L. Johannessen, "Domestication process of maize continues in Guatemala," **Econmic Botany 36 (1982)**, 84-99; David L. Clawson, "Nealtican, Mexico: A peasant community that rejected the 'Green Revolution,'" **American Journal of Economics and Sociology 38 (1979)**, 371-387.

same time, the diversity of root systems beneath the ground surface results in a more complete capture of soil nutrients and soil moisture thereby reducing the fertilizer and supplemental water requirements of the farmer.[21] The need for spraying to control disease and insects is minimized by the diversity of crops which limits excessive buildups of destructive agents and also by the reliance of the farmer on native insect- and disease-resistant varieties adapted to his specific locale. Labor for weeding is also reduced in comparison to monocultural farming since weeds have difficulty in establishing themselves against the competition of the multitude of useful crops. Finally, the need for expensive tractors is eliminated and, indeed, their use would be most destructive of the finely balanced system.

The minimal mechanical and other technological requirements of small-scale tropical polycultural systems have tended to mask their extremely high harvest potential which is achieved through multiple vegetative layering. This strategy permits, in effect, the simultaneous cultivation of three, four or, in some cases, even five crops in the same space. Consider, for example, a farm in which banana and papaya share the highest vegetative layer, with maize, sugar cane, and cassava next, followed by taro and chile pepper, and finally sweet potato vines running along the ground floor. While such crop space-sharing tends generally to lower individual crop yields, owing to crowding and to competition for available sunlight and nutrients, its *cumulative* production when measured over the course of a year, is most impressive. In other words, when comparing the yields of a crop grown under monocultural conditions to the same crop which forms only one part of a polycultural complex, the monocultural productivity will invariably be greater. To assess agricultural productivity in this manner, however, is inaccurate. A better method of measurement is to compare the total output per hectare of all crops produced.

POLYCULTURAL FARMING IN QUEZON CITY: A CASE STUDY

In order to assess the productivity of small scale Philippine polyculture, an analysis was undertaken in 1984 of a 416 square meter farm plot worked on vacant land in Teachers Village, Quezon City. The lot is dry farmed by a squatter named Jaime.

[21] For detailed analyses of the superior biological efficiency of tropical polyculture, see Donald Q. Innis, "The Future of Traditional Agriculture," **Focus** 30 (1980), pp. 1-8 and Peterr E. Hildebrand, "Multiple Cropping Systems are Dollars and 'Sense' Agronomy," **Multiple Cropping** (Madison: American Society of Agronomy Special Publication Number 27, 1976, 1976), pp. 348-371. An extremely useful booklet full of helpful suggestions for small scale tropical polycultural farmers is Paul Sommers, **Low cost farming in the humid tropics: an illustrated handbook** (Manila: Island Publishing House, Inc., 1983).

The uppermost vegetative layer of Jaime's plot contained 31 banana plants which yielded approximately 186 kilos of fruit and 14 papaya plants which generated 195 kilos of produce. The next highest layer consisted of 92 cassava plants, 2 okra plants, 24 clusters of sugar cane and 300 maize plants. The okra and maize are sown twice annually and the others once annually resulting in combined yields of 543 kilos of food. The next vegetative story consisted of taro, arrowroot, and hot chile peppers which produced a total yield of 258 kilos. The ground layer was comprised of swamp cabbage or *kangkong* in a poorly drained section and sweet potatoes and squash on the higher ground. These three crops generated a combined yield of 875 kilos. Jaime's total 1984 harvest of 2057 kilos of food, which was derived from just .0416 or 1/24 of a hectare of land, was the equivalent of 49,447.12 kilos or 54.39 tons of food per hectare (Table 3). Furthermore, all of this was accomplished without the use of any insecticides, hybrid seeds, irrigation, or mechanized farm implements. In addition, the only fertilizer

Table 3. The Productivity of a Polyculture Plot in Quezon City, Philippines, 1984

Crop	Annual Yields, kgs., 416 M² plot	Equivalent Yields, kgs. per hectare
Upper Story		
Banana *(Musa paradisiaca)*	186	4,471.15
Papaya *(Carica papaya* L.*)*	195	4,687.50
Third Story		
Cassava *(Manihot esculenta* C.*)*	184	4,423.08
Maize *(Zea mays)*	125	3,004.81
Sugar cane *(Saccarum officinarum)*	210	5,048.08
Okra *(Hibiscus esculentus* L.*)*	24	576.92
2nd Story		
Taro *(Colocasia esculenta* S.*)*	200	4,807.69
Arrowroot *(Marantha arudinacea)*	50	1,201.92
Chile Pepper *(Capsicum annuum)*	8	192.31
Ground Layer		
Swamp Cabbage *(kangkong) (Ipomoea aquatica)*	200	4,807.69
Sweet Potato *(Ipomoea batatas)*	600	14,423.08
Squash *)Cucurbita maxima* D.*)*	75	1,802.88
T O T A L	2,057	49,447.12

Source: Author field data.

applied was a very small amount of home-generated chicken manure. Jaime incurred no debts in the management of his tiny farm and, had he desired to sell his produce rather than consume most of it within the family the *net* income, when converted to pesos per hectare, would have placed him in a very favorable position relative to most of the nation's small scale rice or maize farmers.

It is recognized that the majority of the crops cultivated under most tropical polycultural systems are high in starch content, low in protein content, and of relatively low market value. Nevertheless, it is precisely those crops which constitute the bulk of the dietary intake of most Filipinos. Any increase in the supplies of the staple foods would thus benefit directly and quickly the most needy segment of the population. Furthermore, it would appear to be much more realistic to focus our extension efforts on the incorporation of more leguminous crops into the highly productive polycultural complexes rather than attempting to eliminate the complexes altogether in favor of newer but far less productive production systems.

CONCLUSIONS AND RECOMMENDATIONS

Traditional tropical polyculture offers a low-cost environmentally-balanced alternative to monocultural Green Revolution farming in the Philippines. It is a sophisticated, highly specialized, culturally compatible adaptation to the tropical environment which, under intensive management, can result in extremely high yields of foodstuffs per hectare.

The yields achieved by Jaime should not be taken as necessarily representative of those achieved by other polycultural farmers. The exact yields of each farmer will be determined by the unique mix of crop combinations, by the site-specific physical conditions of each plot each year in such aspects as precipitation, drainage, temperature, and soil fertility, and by the level of care and management provided by the farmer. Jaime's yields could be increased considerably, for example, by better control of the grass that chokes his *kangkong* patch most of the year and by the addition of supplemental irrigation during the long, stressful dry season. He could also raise his yields by utilizing more intensively the first three or so meters of space along the side of his plot which faces the street and which is presently utilized primarily for a mound of earth which serves to limit access to the garden but which produces almost no foodstuffs. What is more significant than Jaime's specific yields, therefore, is the principle that tropical polyculture greatly outproduces its monocultural counterparts, even those with

Green Revolution inputs. As such, it has the potential to contribute significantly to increased domestic food supplies and to national agricultural development.

As the population of Manila and the provincial urban centers continues to expand at a pace almost beyond control, it is easy to overlook the fact that approximately 65 percent of the population of the country is still classified as rural. Indeed, the agrarian population has expanded over the past fifty years at an average well in excess of 2.00 percent per year and today exceeds 32 million compared to just 19 million in 1960.[22] To be successful, it is imperative that national development policy strengthen rather than weaken what Critchfield has aptly called the "universal village culture."[23] Yet, in attempting to establish new agricultural technologies, whose benefits ironically appear to have been considerably overrated, we have contributed to a serious deterioration of the economic and cultural stability of many small farmers. Guided by the premise that the rural sector will continue to comprise a significant proportion of the Philippine population whose well-being is essential to national development, it is recommended that the established development agencies or perhaps a new "Center for the Development of Traditional Agriculture" be funded to expand significantly research support for the following:

1) analysis of the productivity of varying traditional polycultural crop complexes
2) incorporation of more legumes into the traditional complexes in order to increase protein production levels
3) development of higher yielding, open-polinated crop varieties which perpetuate disease and insect-resistant properties
4) development of crop varieties with lower water requirements
5) development of higher yielding crop varieties with low fertilizer requirements.

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[22] Domingo C. Salita and Emerson M. Lorenzo, "Urbanization and National Policies in the Philippines," **Philippine Geographical Journal** 27 (1983), pp. 103-112.

[23] Robert Critchfield, "Science and the Villager: The Last Sleeper Awakes," **Foreign Affairs** 60 (1982), p. 23.

HUMAN POPULATION GROWTH AND FOOD RESOURCES PROBLEM IN NIGERIA

by

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Phylogenists do place man at the pinnacle of the animal kingdom because of his ability to assess a problem and devise a solution and to put that solution into operation (Owen, 1971:518-550). However, at this crucial period in human history, man has as yet not effectively applied his talents to solving the problem of his exploding population. It was on the basis of this that the Reverend Thomas Malthus presented to humanity a cruel future of a world dominated by spectres of famine, pestilence, plague, disease and war (Weaver and Wisman, 1978:93-104). Malthus had envisioned a world driven by uncontrollable forces and thus offered a theory of human failure which he adduced two main reasons to explain:

(a) People are simply wicked and therefore it would be preposterous to expect a positive outcome from their interaction.

(b) The "Frankensteinian Monster Thesis" — humanity is at the mercy of forces which it has set in motion, people simply do not possess sufficient awareness and strength to control their creations.

While disagreeing with Malthusian Theory of uncontrollable forces driving the world, and of the utter wickedness of man as not to produce positive outcome from their interaction, the author partly shares his pessimism or at least shows some concern as regards to the Frankensteinian Monster Thesis. Malthus had predicted in 1798 that humanity will breed until its teeming millions die off from war, disease and hunger.

In Nigeria, the rate of population increase has been phenomenal. The population issue as a whole has brought about many crises already and may, if unresolved, throw the nation into a cataclysm, because population increase means reduction in per capita space, and increases in per capita demands on the nation's resources which are not infinite. With careful planning established on the principles of "fairness" and "equal" distribution of the nation's resources and wealth, Nigeria can and will be able to avert civil strife. With improved health technology,

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she is also able to reduce the incidence of disease and pestilence, but she is not yet able to avert hunger. Today, Nigeria is a hungry nation. She cannot produce enough to feed her teeming millions. Something must be done to avoid this disaster spelt by Malthusian Hypothesis, and, which is staring the nation in the face.

The main objective of this study is to examine critically the attempts adopted by Nigeria to produce enough food to feed her population. In specific terms, the study will discuss the development of agriculture in colonial Nigeria, post independence era, and agriculture today in the attempt to find out why Nigeria has not been successful to produce enough to feed her millions. It will offer some policy suggestions which may, if judiciously applied, help to boost agricultural development and productivity in Nigeria and thereby provide the population with enough food.

THE GENERAL PROBLEM

Nigeria extends from about latitude 4°N to 14°N and from longitude 3°E to about 15°E. The entire nation covers an area of about 913,072.64 square kilometres. The greatest North to South extension is about 1040 km while the East to West extension is about 1120 km (Handbook, 1973:9).

The coastline is fairly irregular and is intersected by an intricate network of creeks, lagoons and rivers. The most important river is River Niger which is fed by many tributaries including River Sokoto, Kaduna, Anambra, Imo and others. Towards the coast there are many sand bars, and these are backed by a belt of mangrove forest, which in most cases are very inhospitable and sometimes infertile. Beyond this belt is the tropical forest which stretches for about 129 km to the north, after this is a region of undulating country and some isolated hills and open parkland grading into the savannah which covers about 717,040 sq. km. Though the northern extremities do stretch towards the arid Sahara desert, the Southern frontiers do receive some summer rains.

The above description intends to reveal that, of the 913,072.64 sq. km. area of Nigeria, part has been taken up by rivers, creeks and marshes. There are unhealthy wet or dry regions too, thus reducing the hospitable and habitable area. This is the land area which Nigeria house her millions of people.

Between 1932 and 1978, Nigeria has experienced some phenomenal rise in her population. A close study of Table 1 shows that between 1932 and 1947 the general population increase in Nigeria was about 100,000 people each year. But beginning 1950, population increased by 1,000,000 or over each year. In 1977, Nigeria's population was estimated at 85 million. This estimation had made Nigeria the most populous nation in Africa (Best and Bliji, 1977:145). In 1982 the

population of Nigeria (estimate) was 89,117,500 (Nigeria Year Book, 1981:14). At 3.2% rate of natural increase annually, there would be about 108 million Nigerians in Nigeria by the year 2000.

Table 1 — Population of Nigeria 1932-77 (Selected Years)

Year	Population	Year	Population	Year	Population	Year	Population
1932	19,300	1950	34.33m	1959	41.91m	1970	55.07m
1933	19,489	1951	35.02m	1960	42.95m	1975	62.93m
1939	20,601	1952	35.75m	1965	48.68m	1976	64.34m
1940	20,800	1955	35.34m	1966	49.89m	1977	85m
1945	21,790	1956	39.12m	1968	52.42m		
1947	23,745	1957	40.01m	1969	53.73m		

Source: United Nations Demographic Year Book
United Nations Publishing Service, New York.

Table 2 shows the main characteristics of the population of Nigeria compared with other countries of West Africa.

Table 2 — 1980: Population Characteristics of Selected Countries of West Africa.

Country	Birth Rate %	Death Rate %	Infant Mortality %	Natural Increase %
*Nigeria	50 (High)	18 (Low)	157 (High)	3.2 (High)
Mali	49	22	190	2.1
Sierra Leone	46	19	136	2.6
Benin	49	19	149	3.0
Ghana	48	17	115	3.1

Source: 1980 World Population Data Sheet
Population Reference Bureau, Washington, D.C.

*Comments By Author: High or Low considering other West African Countries.

Perhaps, the data in Table 2 can answer partly why there is a phenomenal rise in the population of Nigeria. There is low or declining death rate. The birth rate on the other hand is high. Although infant mortality rate is high, the percentage of natural increase is also high. Improved medical facilities and the general awareness of education for good health in Nigeria, and the inability or unwillingness of Nigerians to control human population growth are among the reasons responsible for the high rise in population. This spurting trend in population in Nigeria has had serious repercussions for the well being of the nation. If "development" entails the improvement in people's levels of living — their homes, health, education and general well being — and if "development" also encompasses their self esteem, respect, dignity and freedom to choose, then the really important question about the population in Nigeria is: How does the contemporary population situation in Nigeria contribute to or detract from the attempt to achieve sustained economic development and growth, not only for the current generation,

but also for future generations? Among the major questions to be answered by Nigeria are:

(a) Will Nigeria be capable of raising the levels of living of her people with the current and anticipated population growth? To what extent will this rapid population increase make it more difficult to provide essential social services including housing, transportation, sanitation, and to fight environmental problems posed by urbanization and provide adequate security for all?

(b) How will Nigeria be able to cope with the vast increases of the labour forces over the next decades? Seeing, the current percent of population under 15 is between 45 and 50.

(c) Will Nigerian food supply and its distribution be sufficient not only to feed the anticipated population increase in the decades ahead but also to improve their nutritional levels to a point where all Nigerians can have adequate diet?

(d) Will Nigeria be able to extend the coverage and improve the quality of the health and educational systems so that everyone can at least have a chance to secure adequate health care and a basic education?

(e) Since land area in Nigeria cannot be expanded and since increases in population means reduction in her per capita space, and increase generally in per capita demands, how will Nigeria reconcile these?

Certainly, these are the problems that stare Nigeria in the face because of her bustling population increase, and one of them that requires spontaneous answer is the "Food Problem".

THE FOOD PROBLEM

The problem of feeding the teemings millions in Nigeria and providing for the future generations will be solved by Nigeria being able to develop and utilize her agricultural resource base.

Nigeria has a wealth of agricultural resources. There is vast area of arable land on which almost all tropical crops can grow. Out of the country's total land area of about 913,072.64 sq. km just about 304,357.6 sq. km or roughly a third, constitute arable land and land under permanent pastures cover about 56 per cent of the land area. Since only about 10 per cent of the land comes under forest reserves and allowing about 15 per cent of the land area for permanent pastures, it follows that about 31 per cent of the land constitute agricultural land. With 9 per cent of the total Nigerian land mass presently not used for any specific purpose, the percentage of land that can be utilised for agricultural purposes goes up to 40 per cent, that is, about 365,229.056

sq. km. Thus more than half the potential agricultural land in the country is at present not utilized (Second National Development Plan: 103).

With about 70 per cent of Nigerian labour force in agriculture, Nigeria can be called an agricultural country. At Independence, the sector contributed about 70 per cent to the GNP. In 1966, it declined to 55 per cent and still continued to decline because of the emergence of oil as a dominant source of revenue (Nigeria/American Economic Relations, 1978:36). In 1975, the agricultural sector only contributed 23 per cent to the GNP (Bacheller, 1978:592). Because of this apparent neglect of agriculture, Nigeria for some time now has been importing a large proportion of her food requirements. This means that Nigeria cannot as yet feed her population. The solution to this problem lies with development of agriculture.

AGRICULTURE IN NIGERIA

Nigeria is unique among African nations in that she has been growing rapidly without a major dependence on large scale foreign investment in the production of agricultural, mining or manufacturing products. The dynamics of Nigerian agricultural development has been small, indigenous farmers who have produced export crops on a major scale since World War I (Oluwasanni, 1966). Since 1950, output of agricultural products for domestic use is believed to have increased approximately in line with population growth and agricultural exports have grown by about 4.5 per cent as shown in Table 3, as a result of the accomplishment of small holders.

Table 3 — Value of Nigerian Exports of Principal Agricultural Products, 1950-67 in Million Naira

Item	1950		1960		1962		1964		1966		1967	
		%		%		%		%		%		%
Cocoa	38.0	21.0	73.6	21.7	66.6	19.8	80.2	18.7	56.6	9.9	109.4	22.6
Oil Palm Products	57.6	31.9	80.0	23.6	51.6	15.3	63.4	14.8	75.6	13.3	27.6	5.7
Groundnut Products	31.0	17.2	57.8	17.5	82.0	24.3	94.0	21.9	111.0	19.5	93.8	19.4
Rubber	5.6	3.1	28.4	8.3	22.8	6.7	22.0	5.1	23.0	4.1	12.6	2.6
Other Agricultural Products	17.6	9.8	20.4	6.0	14.4	4.3	12.8	3.0	19.4	3.4	n.a.	n.a.
Sub-Total Agriculture	149.8	83.0	260.2	77.1	237.4	70.4	272.4	63.5	285.6	50.2	243.4	50.3
Petroleum	—	—	8.8	2.6	33.4	9.9	64.2	14.9	184.0	32.4	144.2	29.8
Other Non-Agricultural Exports	30.6	17.0	70.4	20.3	66.2	19.7	92.2	21.6	98.6	17.4	95.8	19.9
Total	180.4	100.0	339.4	100.0	337.0	100.0	428.8	100.0	568.2	100.0	483.4	100.0

Source: Helleiner, Gerald, op. cit., Federal Office of Statistics and Economic Indicators.

Agriculture in the Colonial Era: 1900 - 1960

Colonial agricultural policy had three main emphasis, and these were only on export crops:

(a) Around 1910, the government encouraged farmers to increase their production per hectare. These, it used to feed British industries and to flood international markets.

(b) Marketing Boards were established in 1947 mainly to stabilize prices.

(c) In 1949, the government began to involve herself in the productive processes, hence, direct investments were made by various regional governments to establish farm plantations and settlements.

In sum, Government engaged in research and education (teaching how to increase output) and the individual farmers received high yielding seed varieties. Emphasis at this time was on rubber, groundnut products, cocoa, oil palm produce, cotton and other agricultural exports.

Marketing Boards were formed and they controlled 69 per cent by value of all the Nigeria exports and 78 per cent of all non-mineral exports. Table 3 also shows the value of Nigerian principal agricultural products from 1950-1967. For these export crops, prices were generally kept between $\frac{2}{5}$ and $\frac{3}{5}$ of the World Market Prices (Johnson *et al.*, 1969). The Colonial Government was not really interested in the development and production of food crops in Nigeria hence there was no official policy enunciated.

Post Independence Period:

After Independence in 1960, the Federal Nigerian Government was involved in direct agricultural projects, and like its colonial predecessor, emphasis was on export crops. The country's infrastructural facilities to agriculture were expanded. Planners correctly knew that for effective development, agricultural and industrial expansion must be complementary and integrated, and so, priority was said to be given to agricultural, industrial and technical education. Sadly enough, the increase in food supplies was handled in a 'vague' manner mostly because of lack of knowledge and the inability to influence output. In fact, the situation then was well summarized by Iqbousurike (1971:519-520) when he concluded:

> . . . rather high powered institutions have been established for export crops such as oil palm, cocoa and rubber, yams, a central item of food and internal commerce have been left to tag along as best they could virtually without benefit of concerted scientific study. Indeed, in their occasional experiments with yams, the Ministries of Agriculture have usually handled the crop as if it were a temperate latitude crop.

The 1962-1968 period allocated 13.5 per cent of funds proposed for development to agriculture as compared with 3.5 to 5.6 of the total allocations in Federal plus Regional Capital and recurrent budgets over 1949-1962 period. As Wells (1966:38) noted, and as shown in Table 4, one third of the resources allocated to agriculture went to "Government Directed Projects" which included farm settlements, plantations, irrigation schemes and others which in truth could not be said to be in any way successful. It can be sadly mentioned that up to this point the government was not directly and sufficiently involved in the food production business. In fact, the staff correspondent in the Nigerian-American Economic Relations (1978:36) paints the picture in its true perspective when he says:

> Owing to the emergence of oil as a dominant source of revenue, agriculture seems to have suffered a major set-back in the country to a point where the country had to be importing a large proportion of its food requirements.

This means that every attention was turned to oil which then produced about 90 per cent of Nigeria's revenue, and the proceeds from oil were spent in procuring for Nigerians some basic food items by importing them no matter at what cost. Nigeria at this time continued to dish out "generalized and vague" objectives of agriculture without any qualification (Oluwasanni, 1971:144). The Federal Government however laid special emphasis on soil fertility and fertilizer studies and the breeding of improved seeds.

The Northern Nigeria Government Plan was to increase agricultural output per worker and per hectare, to increase beef and other meat production, and to exploit to a much greater extent the fishes in the rivers and lakes (Development Plan 1962-1968:206).

In Western Nigeria, the Government was to increase productivity both of food and export crops through the efficient use and management of land, labour and capital as well as efficient marketing of the products (Development Plan 1962-1968:287).

All these were sound and welcome proposals, but in reality there was no planned or anticipated percentage increase in agricultural production, employment or income. Table 5 clearly shows that real agricultural productivity increased from N1610 million in 1962 to N1739 million in 1967 (that is, about 7.4 per cent in six years). One may then ask: What is this increase compared with the population increase in these decades? Similarly, the percentage of agricultural contribution to the economy during these years continued to dwindle from 61.2 in 1962 to 54.9 in 1967 but Nigeria refused to read the hand writing on the wall. Truly, this grim picture continued into the first quarter of

Table 4 — Development Plan Allocations To Agriculture Federation of Nigeria, 1962-68 in Million Naira

Government	Government Directed Projects	Extension	Credit	Research	Education and Training	Processing and Distribution	Others	Total
Federal	2.000	—	6.000	14.932	—	—	20.000[1]	40.932
North	9.718	21.984	5.700	3.420	1.458	1.336	1.382	44.998
East	36.228	11.970	2.800	.800	3.522	—	5.692	60.958
West	17.354	8.406	10.000	.798	.320	—	—	36.878
Total	63.300	42.306	24.500	19.950	5.300	1.336	27.074	183.766[2]
Percent	34.4	23.0	13.3	10.9	2.9	0.7	14.7	99.9

[1] Grants to Regions for unspecified uses.
[2] Total does not add to that in Plan because of slight disparity in Eastern Region figures.
Source: Wells, J.C., Government Investment in Nigerian Agriculture; Some Unsettled Issues. Nigerian Jour. Soc. and Econ. Studies, Vol. III, March, 1966, p. 47.

Table 5 — Gross Domestic Product at 1962 Factor Cost (in Million Naira)

		1962-63	1963-64	1964-65	1965-66	1966-67
1	Agriculture, Forestry and Fishing	1609.60	1714.00	1733.40	1741.80	1739.00
	a. Agriculture	1299.20	1408.00	1372.80	1372.60	1351.00
	b. Livestock	143.60	140.60	161.20	156.60	161.00
	c. Forestry	122.80	140.60	132.40	138.00	131.80
	d. Fishing	44.00	44.40	67.00	74.60	95.20
2	Mining	53.60	62.60	95.00	164.80	228.80
3	Manufacturing and Crafts	151.80	153.60	157.60	183.40	186.20
4	Transport and Communications	121.80	136.20	134.40	129.60	125.40
5	Others	694.00	757.40	806.40	866.40	886.80
	Total	2630.80	2851.40	2926.80	3086.00	3116.20
	Percentage of Agric. Contribution	61.2	61.1	59.2	56.4	54.9

Source: Federal Office of Statistics, Lagos.

the seventies without being adequately briddled and Nigeria continued to spend the oil money unwisely in importing the nation's principal items of food as shown in Table 6. Nigeria could not produce enough food for her hungry millions.

Agriculture Today:

Nigeria is placing much emphasis on the use of modern agricultural techniques and equipment such as biological research and mechanization, settlement and plantation schemes. Such schemes include: General Gowon's National Accelerated Food Production Programme of the early 1970's; the Mutala-Obasanjo Operation Feed the Nation (OFN) of late 1970's; the Shagari's Green Revolution of the 1980's. All these policies have subsidized credit schemes to rehabilitate failing cash and food crops in the nation as a whole. They by-pass small scale farmers in favour of large scale or state run plantation or settlement schemes like the River Basin Development Authorities. These Projects are collosal failures inspite of huge public or governmental investments (Madunagu, 1984: 115).

The staple food of Nigeria consists of roots, tubers, pulses and cereals. Available results from the limited nutrition surveys conducted in various parts of the country is given in Table 7. These total calorie intake by region are much lower than the average intake of 3,200 recorded for some industrialized countries (Development Plan 1970-1974

Table 6 — Imports of Principal Items of Foods by Quantity and Value (00 Weight) (00 Naira)

Period	Sugar		Confectionery		Flour Wheaten		Biscuits and Cakes		Fish		Milk		Total Import
	Kilo	Naira	Kilo	Naira	Kilo	Naira	Kilo	Naira	Kilo	Naira	Kilo	Naira	Value
1962	78287	6778	1837	1310	59033	5903	2185	958	40846	15980	14377	4568	35497
1963	52124	6898	977	500	3099	266	813	446	46485	15262	15241	4762	28154
1964	40795	6096	1136	636	2083	340	508	292	36629	12806	19661	5966	26136
1965	62843	5280	1589	792	1676	168	508	312	33784	14640	22810	7272	28464
1966	60201	5352	446	792	3709	312	508	262	31295	14928	24538	8040	29686
1967	78997	6048	1377	912	1473	120	610	262	20270	9792	23776	7224	24358

Source: Federal Office of Statistics, Lagos.

103). Nutritionally therefore, the available protein in the average Nigerian diet is also very inadequate at the estimated level of 62 grams per head per day, compared with the indicated minimum requirement of 70 grams. The yield in protein-nutrient crops is low and just a small portion of the protein comes from animals. So far, there has been some development in fishing and poultry industries since the Food and Agriculture Organization (FAO) study in 1965 but still not enough (Development Plan 1970-74:104). It will be recalled that in the 1960's, Nigeria was capable of producing and did produce almost all the essential food requirements she required. But by 1971, food imported into the country accounted for about 10 per cent of total imports. By 1979, the figure rose to about 20 per cent. The figure today stands at 50 per cent or more — (Madunagu, 1984:115). It can be estimated that food demand in Nigeria today is growing three times as food production. The above in effect shows that there are two main problems in the production of domestic food items:

(a) ensuring that supplies keep pace with the growth of population;
(b) increasing the protein and calorie intake of the population.

Table 7: Calories Intake Per Day By Region (1963/64)

Item	Northern Nigeria	Western Nigeria	Eastern Nigeria
Cereals	1,751	415	163
Roots	467	1,018	1,212
Pulses and Nuts	258	98	37
Vegetables	22	3	12
Fruits	3	5	7
Sugar	8	40	21
Meat	30	45	30
Fish	1	25	14
Eggs	1	4	2
Milk	34	4	2
Oils and Fats	124	252	274
Total	2,719	1,909	1,774

Source: Agricultural Development in Nigeria, 1965-1980, p. 397.

Effective agricultural policies must therefore revolve around these two problems, but to set the stage, vital constraints and needs have to be tackled:

(a) *Land Tenure:* The prevailing land tenure system in Nigeria whereby land is largely under the control of families, villages and clans hinder agricultural development and must be drastically changed. Effective

mechanization of agriculture in Nigeria may depend on how soon this is done. Fortunately, in a broadcast on March 29, 1978 — (Quarterly Economic Review of Nigeria, Third Quarter, 1978:10), the Federal Government announced the introduction of a new land tenure system in Nigeria. 'Henceforth, land will be held in trust by the State Governments on behalf of the people, to protect and preserve the rights of members of the community to use land and enjoy its fruits.' The main aim of the decree was to prevent any undeveloped land from being gobbled up by a few wealthy individuals. This should mark the beginning of an organized land use planning and husbandry in Nigeria. The main benefit of this decree to the government is that it should enable the government to acquire large areas of undeveloped land for purposes of development. Today, the Federal Government of Nigeria has attempted to acquire enough land for each of the River Basin Development Authorities in Nigeria. There are altogether 11 such authorities and each is a multiple scheme for the development of agriculture, fishing, irrigation, tourism and power.

Unfortunately, either because there are flaws in the instrument of the Land Acquisition Decree itself or in its implementation the Federal Government and/or the State Governments in Nigeria may not acquire land for development without protests and riots. Thus, to protest against a forcible eviction from and dispossession of their land, invited police brutality where more than 200 peasants were killed in Bakalori-Sokoto State (Madunagu, 1984:115). In the Cross River State, the Ika and Utu Etim Ekpo Projects of the Cross River Basin Development Authority have been abandoned because of similar protests and litigations. Other River Basin Development Authorities may not find it easy also. If the government wants to succeed in its land acquisition policy, the decree should be reviewed. Checks and balances should be built into the system to ensure that the dispossessed landowners are effectively resettled and compensated to avoid unnecessary riots and protests.

Presently, the degree of land utilization in Nigeria is low. Cropped area represents 25-35 per cent of the suitable 207.48 million hectares and only 11-16 per cent of land potentially suitable for agriculture. (Nigeria: World Bank Country Economic Report, 1975:129).

There is serious population pressure in the tree crop belts in the South mostly in parts of Imo, Anambra and Cross River States to the East and Ibadan in Oyo State and parts of Ondo State to the West. In the North, Kano State and part of Kaduna State to the North have received the same impact such that groundnut and coconut belts have been reduced. Attempts to extend areas of cultivation have reduced grazing areas resulting in over grazing and erosion.

An area which is still underpopulated and underfarmed is the middle belt covering an area of about 185.25 million hectares. Not enough has

been done yet to develop this belt. If the tsetse fly menace could be effectively eliminated, and with planned irrigation, this area would form the nation's most successful cattle region and bread basket.

(b) *Irrigation and Soil Conservation Schemes:*

In more than three quarters of the Northern part of the country, rainfall is not more than five months duration. Sometimes the rainfall is rather erratic and undependable. Cattle and crops are always badly affected during this time and the farmers usually lose millions of Naira. For successful agricultural development, irrigation from many developed water and soil conservation schemes is a *sine qua non.* Such water works include Sokoto River Authority, Chad Basin Authority, Niger and Kaduna River Basin Authorities. The Federal Government has already made huge investments in these projects and only time will tell. To supplement the Federal Government projects are such FAO projects like: Water Resources in Lake Chad, Hydraulic Development of Pastoral Areas and many others.

In addition to the problem of land acquisition already discussed above, it seems the major problem in expanding irrigation scheme is the absence of basic data to plan projects. Hydrologic data are meagre or non-existent, topographic and soil surveys are yet to be accomplished together with crop soil acceptance. All these will require considerable time. By 1985, it was estimated that about 20,243 hectares could be brought under irrigation leading to an increase in agricultural output of only 3 per cent (Nigeria World Bank Country Economic Report, 1975:130). Today, we are already in 1985, attainment of the estimated 3 per cent increase is a mirage.

Attention should be given to the collection and provision of these basic data, because no successful agricultural planning could be done without facts.

(c) *Agricultural Credits:* So far, Nigerian agriculture has progressed with uncertain reliance on traditional sources of lending — the private commercial banks. Rapid growth in output which the country needs now requires new lending institutions. The establishment of a National Credit Bank is today an advantage. In addition State Governments have initiated agricultural loan schemes. With all these lending institutions, farmers should be able to have enough capital for the development of their farms. But whenever the loan is available, the issue of credit worthiness makes it almost impossible for the farmers to utilize them. Certainly, to protect agricultural loans, the lending bodies require sureties and guarantees, which are difficult to secure. Consequently, most peasant or small scale farmers, do not derive the benefits of agricultural loans and are therefore not able to make meaningful production.

Individuals should be organized into effective co-operatives or other co-operate bodies which should embark on large scale agricultural production. Vast hectares of land should be made available to them. These co-operatives should be given agricultural loans which should be supervised regularly to ensure maximum productivity.

It is common practice in Nigeria, that farmers who may qualify for agricultural loans may, upon receipt of such loan, divert part of it to 'more prestigious and self promoting' ventures like purchasing luxurious saloon cars, marrying new wives and or building status oriented houses. Very little of the loan may be put into agricultural use itself.

Even in government sponsored agricultural projects, it is not uncommon to see that some unscrupulous and unpatriotic Nigerians divert agricultural funds into private use. One is not surprise that within a short time after appointment, such officers become 'mini millionaires' possessing many cars and buildings and pose as 'important' Nigerians while the common people are suffering the pangs of unceasing hunger. This is one of the reasons why government sponsored agricultural projects may record heavy governmental investments in Development Plans without substantial or equivalent returns. Here again, there is need to create in the system enough checks and balances as already mentioned above so that loans and funds meant for agricultural development and productivity may not be diverted into personal or unproductive ventures. Fraudulent officers should receive enough punishment under the law to deter others.

(d) *Agricultural Education and Research:*

Inadequate overall planning is an impediment to agricultural development. Until quite recently the principal responsibility of the Federal Ministry of Agriculture was limited to research. The links between the Federal and the State Ministries are weak and makes it difficult to monitor implementation of planned projects or the application of research results and recommendations. Regional specialization based on comparative advantage is not sufficiently encouraged. There is a general shortage of qualified personnel mostly at state level for planning and project preparation. Although many Nigerian Universities have Departments of Agriculture, present training facilities are inadequate. Efforts should be made to improve training facilities to produce the much needed manpower for agricultural development. On the job training should also be encouraged.

With such needed manpower provided, attention will be given to research work. Before now export crops such as cocoa, oil palm, cotton,

ground nuts had received the main emphasis in research while food and feed crops had been comparatively neglected. Today, there is however, some signs that high yielding varieties of sorghum, maize, rice are available and in no distant future disease resistant varieties of yams and cassava will arrive. Much is and will be the product of research, but research efforts today lacks overall direction. Luckily, the Agricultural Research Council has been formed to remedy this. There is also another drawback — no research has been done on the total farming system and on integrating improvements within the system. Wihout this, the technical optima sought for individual crops will be meaningless. There is also inadequate agro-economic data on basic economic limitations such as the shortage of labour at key periods in the cropping year, to provide complete guidance for re-orientation of technical research programmes. There is therefore, an urgent need for all the Universities in Nigeria offering Agriculture, the Nigeria Research Centres and Federal and State Ministries of Agriculture and the Agricultural Research Council to work in close collaboration to solve these problems and also monitor progress in agricultural development and output.

In general however, the young educated Nigerian wears a "snobbish" attitude towards farming. This attitude stems from the 'elitist' type of education that was brought to Nigeria by the Colonial Masters and which after independence, Nigeria could not shake off. The average school leaver in Nigeria today develops aversion to agriculture. Rather than go into agriculture, the young and unemployed is attracted by the magnetism of the city to roam the cities in search of jobs. There is therefore a general drain of able bodied young men and women to the cities leaving the job of farming to the old and uneducated who are unable to increase production to meet the increase in population.

The solution to this problem is with effective re-ordering of Nigerian educational needs and programme and effective rural development. Schools should be made more environmental and dignity of labour fostered. The realism of farming should be shown in the school farm. All students should take active interest in farming as one of their examination subjects. They should be taught right in the school that improved agriculture can also bring as much money and is also rewarding as other lucrative occupations. If infrastructure for development is taken into the rural areas, rural development will foster agricultural development.

(e) *Agricultural Techniques and Inputs:*

Agricultural production in Nigeria is carried out almost entirely by small or peasant farmers with holding not more than 3.2 hectares. Here, they cultivate a variety of crops some for export and others for their subsistence needs. About ninety per cent of output of palm oil

comes from small semi wild groves. The same is true of other crops. Farming implements are hoes, cutlasses and other locally made equipment, though the use of power equipment and machinery is showing up gradually, and more particularly in the northern plantations and the River Basin Authorities.

The use of chemical fertilizers as agricultural inputs is minimal. Since there is no local production of fertilizer, it is imported in bulk and then distributed through extension services and local agents. Adequate supplies are not usually available when farmers need them. Suitable planting materials are seriously dificient. Insecticides and other farm chemicals are very necessary and increased output needs an improved system of supply which is still unattainable in Nigeria. If Nigeria can only boast of one petro-chemical industry these set backs will become a matter of history and with sufficient education and practice, food production will be boosted.

(f) *Transport and Marketing:*

Transport is one of the most imporant component of marketing costs. The transport network in Nigeria is anything but efficient. The main arterial roads are always in poor condition because of vehicle overloading and inadequate maintenance. Feeder roads are unsurfaced and generally ill maintained. Under such conditions output levels frequently remain static because there is no way to move production out of rural areas or they are moved at very high costs. Perishable farm products cannot wait upon roads that are bogged down with pot holes in dry season or impassable from mud in the rainy season. This reminds us that in Nigeria, most rural areas are not accessible and so cannot effectively interact in the space economy of the nation. For increased agricultural production, road network should be expanded. Such roads should be well maintained for prompt circulation of agricultural inputs and products.

Apart from rubber and food crops, all other major crops are controlled and marketed by various State Marketing Boards. These Boards were established to stabilize prices and improve marketing organisation. Unfortunately, the Boards beginning in the sixties turned their attention to raising revenues. As already mentioned, producer prices were fixed at almost half the world export values only to offer disincentives to the local farmers. Consequently, production of export crops is low. Although the producer prices have risen considerably in recent years, the harm had been done as there still remains some criticisms on the system of licensed buying agents. The marketing board system should realize that it is trying to kill the "goose that lays the golden egg" by their unpatriotic policies. They should give the producer his free share of the world prices to offer enough incentive for increased production.

(g) *Attitude of Nigerians:*

One of the most important factors that militate agalnst agricultural development and productivity is the psychology bordering the average Nigerian's choice and selection. To the Nigerian, locally manufactured food items or even clothings are just not good enough. It must be an imported commodity in order to suit his choice. Malaysia, for instance, produces palm oil, vegetable oil and other derivatives. Nigeria also produces these items. The average Nigerian has without any justifiable reason chosen the imported items from Malaysia because it is imported. Rice is produced almost everywhere in Nigeria. Today, rice mills in Ogoja and Abakiliki are almost deserted or abandoned because many Nigerians loath locally processed rice which they nick-name "Abakiliki" and run after 'Uncle Bens' which is imported. Because the products of the local mills see no substantive markets within the country, they must fold up or close down temporarily with many adverse spiral effects on the economy. Since the oil money was handy, the nation did not see anything wrong yet. Importation at any cost was the order of the day. Today, the oil boom is gone, but since Nigeria must feed her millions at all cost, and since the available local production is just a drop in the bucket, Nigeria must continue to import at all cost. Certainly, Nigeria cannot produce enough to feed her teeming millions. As long as Nigeria depends on imported food items the economy will continue its downward trend with all the attendant multiplier effects. It is therefore, high time that Nigerians changed their minds and attitude in favour of their locally produced items. Nigeria should stop importation of rice forth-with. Incentives should be given to local farmers to produce enough to go around.

(h) *Government Policy:*

Although no scientific investigation has as yet been conducted into the failure of government agricultural projects, the author strongly holds that for now, government should not embark on actual food production. In Nigeria, as in most Third World Countries, 'Government Work in no man's work'. 'Government work is not to be finished in one day'. This mentality permeates the agricultural production machinery. Workers refuse to put in their maximum effort in production because their salaries are not determined by their inputs. They come from votes. As long as this is allowed to go on unbriddled, government agricultural projects will continue to be a failure. Government should establish good, well equipped and satisfactorily managed 'model' farms in all countries for demonstration. Manned by well qualified and trained agricultural experts, the centres should act as training depots for individual and cooperate farmers. The use of modern techniques like fertilizers, insecticides, new crops, equipment and other farm inputs may be demonstrated

here. Many field extension staffs should be employed to carry research findings and innovations to the peasant farmers in the community and the many periodic markets in Nigeria and many other assemblies could form successful demonstration grounds.

Rather than go into active farming, the government should encourage successful individuals to invest in farming. Co-operative farming should be encouraged. With sufficient government supervision, good and efficient infrastructure, such farms might develop into 'Agropolitan'[1] centres which will attract agro-allied industries and stimulate increased productivity in agriculture.

The above suggestions will bring radical improvement in the techniques and methods of agricultural production. Thus increase in agricultural productivity will mean plenty of food for all, more income for farmers and the provision of sound raw material base for an industrial take-off.

(i) *The Issue of Population Increase:*

It is extremely important to note that the population problem is much more than the food problem. It has wider ramifications that make it a severe developmental problem. Some of these problems have been put in the form of questions earlier in this study. It will also be remembered that a high rate of population growth such as Nigeria has, not only has an adverse effect on improvement in food supplies, it also intensifies the constraints on the development of savings, foreign exchange and human resources. Savings per capita is depressed and growth of physical capital per worker is retarded. The need for social infrastructure is also broadened and public expenditure must be absorbed in providing productive assets. The health of the generality of the people will always be impaired. Nigeria should begin to cut down her population increase as to be able to feed them effectively and bring about reduction in unemployment and inequality.

She can do this in many ways:

1. The foremost is to institute a rapid change in the climate of opinion regarding family planning. This might not be easily achieved in an atmosphere of both over and covert institutional hostility towards birth control. The process will be gradual because it requires positive private decisions by individuals to limit their family size in the face of public criticisms, religious oppositions and cultural traditions.

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[1] Agropolitan Centre is a sort of Growth Pole or Growth Centre Strategy. Here agro-based projects are established to grow leading to the development of such rural areas. For more discussion on Agropolitan Strategy, see John Friedmann and Mike Douglass 'Agropolitan Strategy — Towards a New Strategy for Regional Planning in Asia', in Fu-Chen et al., (eds)**Growth Pole Strategy and Regional Development Policy — Asian Experiences and Alternative Approaches.** New York: Pergamon Press, Inc. (1978) pp. 243-269.

2. The government should import both chemical and mechanical methods of contraceptives derived by intensive research for circulation. The acceptance of such contraceptives will however depend on how successful they prevent unwanted pregnancies and without any harmful side effects.

3. The government may want to legalize abortion.

4. Family planning education should be enhanced. Here couples are taught how to use rhythm method to avoid unwanted pregnancy.

5. Sterilization is another method, whereby couples may be cut away from producing, but still neither the sexual drive nor gratification from intercourse is diminished. This may be introduced in Nigeria, but since the individual's consent may be the basis, its acceptance in Nigeria is rather remote. This notwithstanding, there is the need for Nigeria to cut down on its population by any means. Family planning may be the best means.

Conclusion

As things are, it appears Nigeria has moved from the era of 'vague and generalized' agro-policy into one of action and commitment of the people towards providing more food for more people. The programmes outlined above are quite good and they show a knowledge of careful study and planning. For instance, programmes such as 'Operation Feed the Nation, Green or Agricultural Revolution, Operation Grow More Food' and other Government sponsored projects have been launched. There is an attempt to educate and support the individual farmer by way of granting loans and other incentives yet, presently, Nigeria cannot produce enough to feed her millions. For a long time now agriculture had been ignored because of the appearance of oil in the economy as a major foreign exchange earner. Projects planned and implemented now may therefore take sometime to mature and produce. But Nigeria has to fight against unpatriotic and unscrupulous Nigerians who reject everything Nigerian in favour of imported food-items by either reducing food importation to the minimum or completely stopping importation of certain items like rice. Fraudulent practices whereby agricultural funds are not fully utilized but are diverted to individual and private use should receive enough punishment under the law to deter others. Rather than go into direct food production, the government should encourage successful individuals and co-operate bodies to develop agriculture in Nigeria. The government will provide agricultural loans, inputs and incentives and supervise. It should also provide the necessary infrastructure for agricultural development. These done, Nigeria's attempt to increase pro-

duction will yield sufficient returns in the long run. But these attempts to produce enough to feed the teeming millions may only be palliative. Even if the Nigerian technology should develop to a point for her to embark on hydroponics, algal culture, food synthesis and yeast culture which are other scientific methods of food production, they would still not offer a panacea to the impending woes associated with hunger that Malthus predicted. The secret to Nigeria's success lies in the heart of effective control of human population growth which Nigeria should adopt. The time to begin is now.

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FERTILIZER USAGE

by

AURORA S. TOLENTINO[1]

INTRODUCTION

Plants like other living organisms need the right kind of food to sustain their growth and development. Adequate and proper balance of the plant foods are essential for a rapid growth and maximum yield of crops. These plant foods are derived from the air, water and soil. In crop production, the plant nutrients supplied by the soil are most often lacking or in many cases are in forms not readily available for immediate use of the growing crop.

The main purpose of the use of fertilizer is to apply the essential plant nutrients necessary for increasing crop production, and it must be clearly understood that the addition is principally intended to supplement the available but insufficient nutrients in the soil. The use of fertilizer is never to constitute the only source of supply for the plant.

Why do we use Fertilizer?

A farmer is interested in the growth of his crops since it is the nature of crop growth that determines the quantity and quality of the yield he expects to get. One of the major factors that govern crop growth is the supply of nutrients or plant foods available to the growing crops. Most soils are not adequately supplied with nutrients to produce a beautiful crop that brings profit to farmers.

The following effects of proper fertilization are:

1. Increase growth and vigor of plants: leaves are green and increase in leaf area, stalks are healthy, better tillering in the case of rice, plants develop good root system.
2. Increase in yield which means bountiful harvest.
3. Improves the quality or the nutritional value of the crop of foods and feeds.
4. In many cases, fertilizer increases the resistance of plants to certain pests and diseases.
5. Fertilizers enable the plant to utilize soil moisture efficiently or increases the plants resistance to drought.

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When fertilizers are properly used, yields may double or even triple. Fertilizer application may substitute for limited land resources. For example, a farmer employing traditional farming practice used to harvest 0.7t/ha. With the use of fertilizer he harvesed 2.1t/ha. This means that fertilizer use increased the yield thrice, or a farmer could harvest in one hectare what he could get in three hectares without fertilization.

What kinds of fertilizer to use?

Farmers can often minimize their costs by careful attention to the kinds of fertilizers they buy. Each of the major plant nutrients elements can be obtained from a variety of products. Even if there are no significant differences in the response characteristics of alternative materials one may be substantially cheaper to another. For example under certain conditions, such as high cost of transportation, concentrated phosphorus and nitrogen are less expensive sources of nutrients. However, the factors that effect fertilizer costs are complex, but what is important to a farmer is how much he pays.

Where there are differences both in costs and in crop responses it may be particularly difficult for farmers to decide what fertilizer materials are their "best buy". In places where farm technician's advice is available, this would ease the problem. Soil test and or plant tissue analysis when properly calibrated againsts crop response would also help. Such testing is usually carried on as a part of the program of agricultural research of advisory agencies. There is a continuous need for such testing because of the development of new fertilizer materials and of new strains of crops in addition to changing soil fertility conditions.

The ultimate cost of a bag of fertilizer paid by the farmer end-user depends on various factors, such as the available plant nutrients supplied (NPK content), the market forces of supply and demand, including handling and transportation cost to the farm-gate. Farmers associations or cooperatives are often organized to reduce cost.

Principles involved in Fertilizer use

Certain principles, involving the characters of the soil, the crop and the fertilizer materials, influence the choice of methods of application of fertilizer to soil. Some of the more important factors concerned with their complicated relationships are summarized below.

1. Adequate quantities of plant nutrients in correct balance within the root zones, in addition to optimum moisture, proper aeration, and other favorable condition are necessary for maximum yields.

2. Irregular distribution can lower fertilizer efficiency if some plants or plants roots are given too much and others too little amount of fertilizers.

3. Early stimulation of the seedling is usually advantageous. At least a part of the plant food should be placed within reach of the young seedling's roots.

4. Soluble salt go into solution in moist soil and move to some extent. The rate and distance of movement depend upon the chemical nature of the solution salts and upon the character of the soil. They move upward during dry periods or are carried downward by rain or irrigation water.

5. Nutrient elements when in dry soil are of little or no benefit to the plant. Such conditions may exist in the surface soil during prolonged dry periods.

6. Excessive concentration of soluble materials in contact with either seed or roots causes injurious effects. Crops, however, vary in their tolerance of soluble salt concentration.

7. Water-soluble fertilizers of relatively high plant food content have a higher salt concentration per unit of plant food and a greater tendency to produce salt inquiry than do equal amount of plant food in the less concentrated fertilizers.

8. In commonly used fertilizers, because the nitrogen and protash carriers are more readily soluble than the phosphate materials, they can not be safely concentrated in large amount near the seed or roots.

9. Reduction of soil moisture increases the concentration of the soil solution, therefore, relatively large amounts of fertilizer placed too near the seed or seedling roots are most likely to cause injury during usually dry periods, particularly when such periods occur soon after fertilizer application. Concentration also depends upon the water-holding capacity of the soil.

10. Fertilizers applied on the soil surface and plant nutrients moved to the soil surface during dry weather are subject to washout by surface runoff water of a sudden intense rain.

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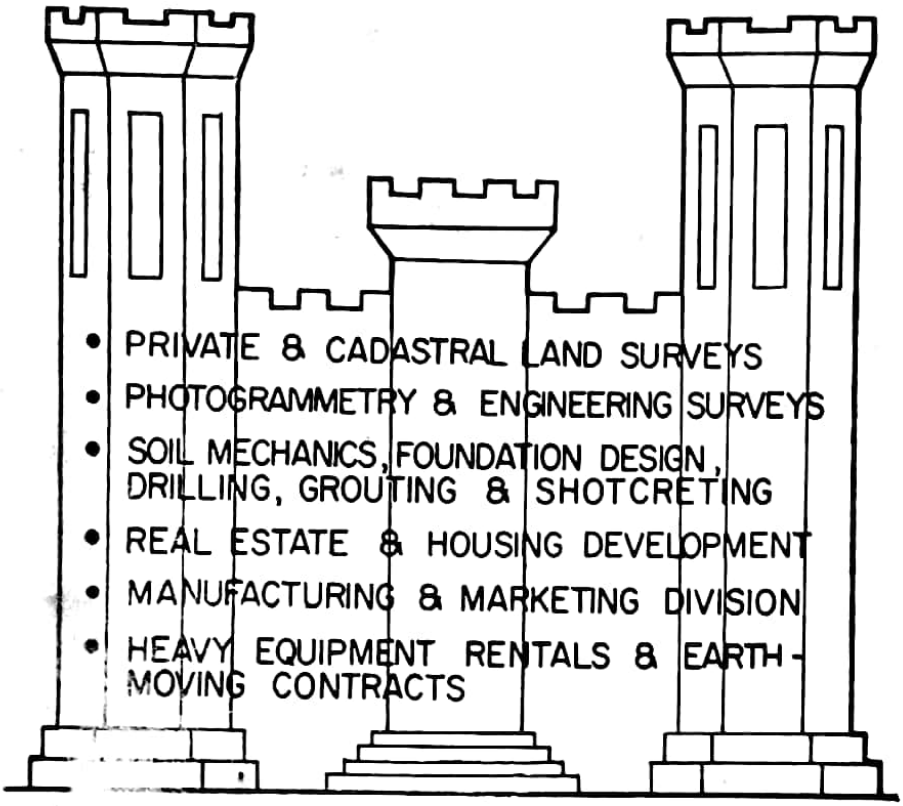

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