Pedologists’ approach to agro-technology transfer: Case study of Ikwuano, Abia State, Nigeria


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Soil resource illiteracy and a weak link between agricultural research and farmers are major problems limiting agricultural development in Nigeria. Pedologists provide interpretative soil maps (land capability classification and soil fertility maps) that will enable potential land users to appreciate the advantages and limitations of the soil resource base that is utilized for agricultural production. Such maps are visual aids to facilitate effective communication between extensionists and farmers, in an effort to (1) adopt appropriate land and agronomic management practices, (2) increase productivity and (3) enhance the efficiency of resource use in agricultural production. This approach was illustrated using Ikwuano Local Government Area (LGA) of Abia State, Nigeria, as a case study.

Key words: Pedologists, interpretative soil maps, agro-technology transfer, Ikwuano LGA, Nigeria.

INTRODUCTION

Nigerian agriculture, and indeed African agriculture, has failed to meet the continuously changing needs of the citizenry. Persistent food insecurity and failure of agriculture to supply adequate quantities of raw materials to industries are stark realities. This is attributed to many factors, among which is soil resource illiteracy. OFAR (1984, 1985) identified poor knowledge of soil as a major problem hindering agricultural development in Umuahia Agricultural Zone. This is not a surprise as similar observations have been made in most parts of Nigeria and Africa. Some of the reasons for this situation are related to lack of soil survey reports of most rural communities and Local Government Areas (LGAs) where food and fiber production take place. Also, the scales of most national soil surveys are so coarse (at reconnaissance level) that pedological information about rural communities is virtually non-existent. Similarly, in these communities, soils where most agricultural research and production take place are not characterized. All these reasons and perhaps more contribute to the widespread problems of soil resource illiteracy. This in turn hinders effective agro-technology transfer between areas with similar and/or different soils. There is a clear need for linking soil (pedological) science with extension education.

The term pedology, in its restricted sense, is the science of identification, formation and distribution of soils, which covers soil classification, soil genesis and survey (Dudal, 1987). Pedology has the fundamental task of identifying and characterizing the soil body, determining its distribution, establishing relationships, facilitating international communication and guiding the development of new technologies and their applications.

Agricultural development is hindered by a weak link between agricultural research and farmers (Osborn, 1995) and the extension sector is expected to strengthen this linkage. Extension, though an informal education, has been described by Christoplos (1996), as communication. Visual aids are communication channels and vital tools to facilitate the transfer of ideas from a source to a receiver. Interpretive soil maps could be excellent visual aids for extension education. This is because they could show the productive capacity of the land, its suitability to specific land uses (crop options, fishery, irrigation, etc), and guide resource use (such as quantity of fertilizers to apply) and land management (such as erosion control). These advantages, probably

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prompted Fagbemi (1987), to suggest the production of soil fertility capability maps of LGAs as a new dimension towards efficient use of land and fertilizers in Nigeria. In response to this call, FMANR (1990) produced soil fertility maps of North East, North West, South East, South West and Middle Belt agro-ecological zones of Nigeria, Sobulo and Adepetu (1987) had produced similar maps for South West agro-eco zone.

What are interpretive soil maps?

The use of interpretative soil maps at rural level in extension education should be seen as a novel approach to achieving the food security initiative of Nigerian Government. It is also a road map to achieve the Millennium Development Goals on hunger and poverty, as well as reverse natural resources depletion through agriculture. Interpretive soil maps are simplified cartographic representations of the soil or part of it in a specific area or location. Such maps are non-existent in Ikwuano LGA of Abia State, Nigeria. Soil fertility classification maps are attempts to interpret soil test for fertilizer predictions for cassava and yam, which are crops commonly grown in the area, based on critical soil levels of N, P and K as determined from field trials. A good interpretive soil map should be able to address all or some of these problems:

1. It should have a purpose – what does the map show?
2. It should be able to provide basic information about an area in a simplified manner.
3. It should be able to assist potential land users to solve soil-related problems in an area with less difficulty.
4. It should guide input procurement and site selection, in relation to a particular land use, or an agricultural project. Examples include choice of crops, fertilizer type and quantity to apply, erosion control, etc.
5. It should provide information on the nature and distribution of a particular soil problem or sets of problems.
6. It should enhance the predictability of soil attributes in an area covered by the map by a potential user. It should, therefore, facilitate dissemination and adoption of agricultural innovations within a recommendation domain.

The objective of this study was to improve soil resource literacy by providing interpretive soil maps as visual aids for extension education. This is illustrated, using Ikwuano LGA in Abia State, Nigeria, as a case study.

MATERIALS AND METHODS

The study area

Ikwuano LGA is a major food-producing area in Abia State. It is located between 5°24’ to 5°30’ N latitudes and 7°31’N to 7°37’E longitudes covering an area of 31,000 ha. The area represents the typical degraded humid forest ecology in the southeast agro-ecological zone of Nigeria. The area is characterized by bi-modal annual precipitation totaling over 2000 mm, air temperature ranging from 22 to 31°C, and high relative humidity (77%) during the wet season. The soils are characterized by differences in topography (toposequence) and parent materials (lithosequence) (Chukwu and Ifenkw, 1996) due to uplands and inland valleys within the rural landscape. As a result, there is an enhanced potential for a diversity of land use options, spanning from arable crop and tree crop production to forestry, animal husbandry and fishery.

Production of interpretive soil maps

As a guide to the production of interpretive soil maps, available literatures on technical soil classification of the area were reviewed. They included studies on soil-plant relations (edaphological) approach to biodiversity conservation rice-fish culture (riripisciculture) potential of inland valleys, land capability for agricultural development, land resources problems in rural development and agricultural land use (Chukwu and Chinaka, 2001). Results of these reviews were synthesized, simplified and delineated on maps (Figures 1 and 2) that are less technical for extension agents to use as teaching aids (visuals) and literate farmers to understand and use.

Interpretation of soil tests for fertilizer predictions for cassava and yam, which are crops commonly grown in the area, based on critical levels of N, P and K (SPFS, 2004) involved soil fertility classification mapping. The soil fertility classes were rated low, medium and high, as in Sobulo and Adepetu (1987) with their associated fertilizer application recommendations being: (1) full fertilizer dose for low fertility (500 to 600 kg/ha N P K fertilizer 15:15:15); (2) 1/3 to 1/2 dose for medium fertility and (3) no fertilizer for high fertility.

RESULTS AND DISCUSSION

Land capability classification map

The land capability map is a cartographic interpretation of soil survey reports in the area, indicating in practical terms, the potentialities and limitations of the land for alternative uses.

Two land capability classes (Figure 1) represented by Roman numerals (II and VII) and three capability sub-classes or groups of capability units (IIw, Ilen and VIIes) were delineated. A capability unit combines the capability class and the limitations (w, e, n and s) inherent in that class. These limitations or problems found in each capability unit are represented by subscripts defined as:

\[ \text{w = wetness or poor drainage; e = soil erosion; n = low nutrient retention; s = slope} \]

Capability unit IIw represents arable land occupying 15.0% of the area (4,650 ha). The physiographic surface is nearly level to concave plain. The area is characterized by medium to fine loamy surfaces (sandy clay loam to clay loam textural classes at the epipedon (topsoil) underlain by clay endopedon (subsoil). The soils are
somewhat poorly drained because of high clay contents. Consequently, access could be very difficult at the peak of rainy season. Most of the cocoa producing communities: Umuokwo, Amuro, Iberenta, elemaga, Isiala Ibere and part of Umuariaga, belong to this unit (Chukwu and Chinaka, 2001). Some of the areas like Oburo, Amuro and Nkalanta could be flooded at the peak of the rainy season. It also has a high potential for rice, fishery, rice-fish culture (rizipisciculture) and sugarcane (Chukwu and Ifenkwe, 1996).

Capability unit Ilen is the most extensive arable land in Ikwuano (23,250 ha), equivalent to 75.0% of the area. The unit represents well-drained coarse loamy to sandy soils. The topography encompasses gently undulating to concave or nearly level plains. It is prone to sheet erosion and has low nutrient retention capacity for sustainable crop production. The sandiness increases as one traverse from the proximal end (Umudike) to the distal end (Ariam). Aggradations of colluvial sand from upper elevation are common. Among the communities in the capability unit Ilen are Amaba, Amawom, Ndoro, Aro Iyama, Isiala, Ekebedi, Awomukwu, Oloko, Umuigwu, and Ogbuebule.

Capability unit Vles comprises well-drained sandy to coarse loamy soils occupying 10.0% of the area or 3100 ha. Generally, the area is a non-arable land because of morpho-erosion (gulling and land sliding) (Chukwu and Ifenkwe, 1996). This unit is a strip of land meandering from Umuariaga community through Ihim, iyila, Ngwugwo, Obohia Ibere to Ogbuebula. At the Ogbuebula end, clay is extracted at the foot of the gully for industrial purposes. The physiography is a highly undulating plain with wide, deep and frightening gullies that are susceptible to land sliding. However, a minor strip of land
Figure 2. Soil fertility class map of Ikwuano. A represents medium fertility soils that are low-medium in N, P and K (4.650ha); B represents low-fertility soils that are low in N and K and medium-high in P (26,350ha).

at the valley bottom, endowed with perennial streams has potential for crop production. Appropriate land management for this unit is forestry and slopping agricultural land technology (Chukwu and Chinaka, 2001)) to stabilize the soil and improve its potentialities for arable crop production.

Soil fertility mapping

Figure 2 shows that two soil fertility classes (A and B) could be delineated in the area. Mapping unit A represents soils of medium fertility, where N, P and K could range from low to medium. Total N varies from 0.08 to 0.16%. Available P (Bray 2P) ranges from <5 to 20 mg/kg, while exchangeable K ranges from 0.06 to 0.30 cmol/kg.

The soil fertility mapping unit B represents soils that suffer from multi-nutrient deficiencies (Chukwu and Asawalam, 2001) of two primary nutrients (N and K). Total N, available P and exchangeable K in this unit could vary from 0.05 to 0.12%, 10 to 30 mg/kg and 0.04 to 0.11 cmol/kg.

Fertility map unit A for cassava and yam production based on the recommendations of SPFS (2004) and (Sobulo and Adepetu, 1987), is medium. Application of 200 to 300 kg/ha (4 to 6 bags) of NPK fertilizer 15:15:15 is economic fertilizer rate to maximize cassava and yam production on Unit A. However, unit B has low fertility and requires about 500 to 600 kg/ha (10 to 12 bags) of NPK fertilizer 15:15:15 to sustain cassava and yam production.

Conclusion

A proposed pragmatic approach to effective agro-technology transfer in Nigeria, resulted in delineating Ikwuano LGA, Abia State, into three land capability
classification maps and two soil fertility maps. These maps will enhance understanding of the physical environment on which agricultural land utilization type or types will be sited and guide judicious management of resources (labour, fertilizer input, soil, water etc.) within a recommendation domain, to enhance and sustain higher agricultural productivity.

REFERENCES


