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STATE OF SOIL RESEARCH IN SOUTHWESTERN NIGERIA: THE ACHIEVEMENTS, CHALLENGES AND WAY FORWARD

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ABSTRACT

Soil is the bedrock for food, fibre, fuel, raw materials, foundation for most engineering constructions, sink for industrial pollution, determinant of land quality and habitat to millions of micro-organisms useful in medicine, biodegradation and recycling of wastes. In spite of its huge life-support services, it has not been given adequate attention, thus resulting in the dearth and uncoordinated information about soils in Nigeria, leading to abuse and misuse of soil resources. To reposition soil research in transforming agriculture in Nigeria, regional assessment of the state of soil research in different geopolitical zones of the country becomes desirable. The objectives of this paper were to review the state of soil research in southwestern Nigeria, identify the salient achievements so far recorded, emphasize the challenges militating against sustainable soil research efforts in southwestern Nigeria and suggest possible ways forward.

Keywords: ***Soil research, soil research achievements, soil research challenges, Southwest Nigeria***

INTRODUCTION

Research is a systematic investigation, including development, testing and evaluation, designed to develop or contribute to generalizable knowledge. It is a curiosity-driven activity that has the purpose of discovery and advancement of knowledge (Fawole *et al.*, 2006). It is the process of creating new knowledge or new insights on knowledge, or unlocking knowledge (Ibidapo-Obe, 2010). The scope of research could be an event, a process, a social institution, a biological condition, etc. Irrespective of the subject, research seeks to understand what is being researched, through observation, experimentation and analysis to arrive at a better understanding or a definite conclusion on the subject matter (Adebola, 2009). Therefore, soil research is a way of acquiring dependable and useful information and data about soils as well as the analysis of the data collected in order to arrive at a valid conclusion.

In light of Nigeria's current economic challenges, its poverty situation and its unimpressive rate of economic growth, soil research should be given the utmost attention in a bid to enhance sustainable economic development. Soil is an important natural resource. Therefore, the survival of man on the planet Earth depends on soil and it is certain that without the soil, there will be no life (Areola, 1990). Soil is a medium for plant growth, provides food, fodder, raw materials and fuel for basic human and animal needs, and serves as a sink for all forms of waste. It plays a key role in modifying and ameliorating the adverse effects of climate change and provides a foundation for buildings, roads and other structures. It is the determinant of land quality and habitat to millions of micro-organisms useful in medicine, bio-degradation and recycling of wastes. Though soil covers most lands of the earth, regarding its service for humans, it is a limited and largely non-renewable resource (Blum,

2006). On the globe, about 3.2 billion hectares are used as arable land, which is about a quarter of the total land area (Davis and Masten, 2003). Total agricultural land covers about 40–50% of the global land area (Scherr, 1999). Feeding about 10 billion people is one of the greatest challenges of our century (Borlaug, 2007). In SW Nigeria, the mainstay of the economy is agribusiness of which low-input farming engages almost 70% of the population. In agribusiness, soil is a major factor of production. However, despite its huge life support services, the soil has not been given adequate attention, thus resulting in the dearth and uncoordinated information about soils in Nigeria and some parts of West Africa (Ande *et al*., 2017). This has impacted negatively on policy decisions for regional and national planning, resource allocation, economic development, preservation of the environment, soil suitability for crops, regulation of the use of natural resources and general under-development of the SW region in particular and Nigeria, in general (Olaniyan and Ogunkunle, 2008).

Consequently, an array of challenges confronts development which needs urgent attention. Some of these challenges include but are not limited to, low agricultural productivity, infrastructural failures, environmental pollution and land use-induced hazards (floods, landslides, gully erosion and global warming). The dearth of soil information for urban planning, evaluation of construction materials and site selection has resulted in severe hazards ranging from road failures, landslides, sinking of buildings and various infrastructure failures. There is therefore an increased need for cross and multidisciplinary soil information-gathering approaches to address the critical demands coming from different end-users.

Soil is the solid material on the earth's surface that results from the interactions among the various factors and processes forming the soil. The combined effects of the factors and processes over a period of time give rise to distinct soil types (Buol *et al*., 2011). These factors have been grouped into parent material, relief, climate, organisms, and time, while the common tropical pedogenetic processes include decomposition, mineralization, leaching, phytocycling, pedoturbation, eluviation, illuviation, braunification, plinthization and gleization amongst several others. Since these factors and processes differ from place to place, therefore, soils formed from their interactions also vary from one environment to the other. The objectives of this paper, therefore, were to review the state of soil research in southwestern Nigeria, identify the salient achievements so far recorded, emphasize the challenges militating against sustainable soil research efforts in southwestern Nigeria and suggest possible ways forward.

SOIL RESEARCH ACHIEVEMENTS IN SOUTHWESTERN (SW) NIGERIA

Parent rocks/parent materials of soils in SW Nigeria

Most parts of SW Nigeria are underlain by the basement complex rocks with undulating topography (Makinde *et al*., 2009). The rocks show a great variation in grain size and mineral composition ranging from very coarse-grained pegmatite to fine-grained schists, and from acid quartzite to basic rocks (Smyth and Montgomery, 1962). Ojanuga (1978) described the bedrock geology of soils of SW Nigeria as presenting a complex pattern of pre-Cambrian metamorphic (dominant) and igneous rocks, common among which are gneisses, schists and granites. The older granites are widespread and resistant rocks, giving rise to smoothly doomed hills – the inselberg. The variation in grain size, mineral

composition and the nature of the parent rock is a major factor that determines the morphology of soils in the region. The southern part of the region is underlain by sedimentary rocks of varying ages. The stratigraphy of the sedimentary region of SW Nigeria based on Jones and Hockey (1964) and Omatsola and Adegoke (1981) is indicated in Table 1. Elueze (1982) opined that the basement complex rocks, in central SW Nigeria formed predominantly from coarse-grained granite and gneiss. Migmatite-gneiss form the most widespread rock type in the basement covering about 50% of the Nigeria Precambrian domain (Ajibade *et al*., 1988).

Table 1: The stratigraphy of the sedimentary zone of SW Nigeria

	Geologic Age	Jones and Hockey (1964)	Omatsola andAdegoke (1981)
Quaternary	Recent Oligocene to Pleistocene	Alluvium coastal Plain Sands	Alluvium coastal Plain Sands
Tertiary	Eocene Paleocene-Lower Ecocene	Ilaro formation Ewekoro formation	Ilaro formation Oshosun formation Akinbo formation Ewekoro formation
Cretaceous	Cretaceous	Abeokuta Formation	Araromi formation Aofowo formation

Sources: Jones and Hockey (1964); Omatsola Adegoke (1981)

Benchmark soils of upland SW Nigeria

In SW Nigeria, soil studies had been geared toward the immediate needs of agricultural development while fundamental pedological research had been minimal. Superficial deposits on the pediments have been described in detail by Nye (1954, 1955), Smyth and Montgomery (1962), Folster and Ladeinde (1967), Folster (1969), Ojanuga *et al*. (1976), and Murdoch *et al*. (1976). They revealed that stratified slope deposits are present, which could not have been laid down under the present climatic conditions. Folster (1969) and Burke and Durotoye (1970) described three distinct erosional surfaces in SW Nigeria. These indicated that the post-African landscapes have been modified by periodic denudational processes during the Pleistocene-holocene period. It was concluded that periods of humid and arid climates have alternated in the area. Later, with the growing government interest in natural resources, efforts were made to examine individual profiles. These were grouped based on environmental characteristics and profile morphology. The soils were grouped at the lower category of classification, such as the 'series' and the 'associations'. At the higher level, D'Hoore (1964) grouped the soils of the area as Tropical Ferruginous soils, while those within the sedimentary area were mapped and classified as Tropical Ferrallitic.

A well-documented early study in soils of SW Nigeria was that of Smyth and Montgomery (1962). The primary objective of the soil studies was to solve the problems posed by poor cocoa yields (Vine, 1951). The purpose was essentially to survey, identify, characterize, demarcate and map areas in Central Western Nigeria suitable for cacao production. It was the first

commissioned soil survey effort by the then Western Nigeria Regional Government. Smyth and Montgomery (1962) found a close relationship between the nature of the parent material and the type of soil which formed the basis of their classification of the soils of central SW Nigeria and reported that the entire area of the central SW-Nigeria overlies metamorphic rocks of the basement complex, the great majority of which are very ancient being of Pre-Cambrian age. The rocks varied greatly in grain size and mineralogical composition, ranging from very coarse-grained pegmatite to fine-grained schist, and from acid quartzite to basic rocks consisting largely of amphibole. The soils were characterized with undulating topography (Obi *et al.*, 2009).

Smyth and Montgomery (1962) classified the soils of central western Nigeria into 'associations' and 'fascs' using geographical and taxonomic criteria. Drainage was the first criterion used in the identification of the soil series. Although other criteria were considered along with drainage, morphological features were used mainly in classifying the soils into series. However, their descriptions were highly subjective as observed by Ojanuga (1978) and Okusami and Oyediran (1985) to the extent that some of the soil series described were difficult to identify on the field. Ojanuga (1978) described the bedrock geology of the soils to present a complex pattern of pre-Cambrian metamorphic (dominant) and igneous rocks, common among which are gneisses, schists and granites. Some soil scientists and geomorphologists have indicated that soil development in SW Nigeria had been considerably influenced by past climatic conditions, especially those of the three erosional phases (Nye, 1954; 1955; Smyth and Montgomery, 1962; Ojanuga *et al.*, 1976). Others (Ojanuga, 1978; Banjoko and Ogunwale, 1980; Amusan and Ashaye, 1991) were of the opinion that soil development in this part of the country can be ascribed to the interaction of geomorphic and pedogenic processes.

Specifically, Smyth and Montgomery (1962) used the relationship between soil morphology and the nature of the underlying rock to group the soils of central SW Nigeria into eight associations thus:

- Iwo: well-drained, coarse-textured soils from coarse-grained granite and gneisses;
- Ondo: well-drained, medium to fine textured soils from medium-grained granite and gneisses;
- Egbeda: well-drained fine-grained soils from biotite gneiss and schist;
- Itagunmodi: well-drained fine-textured soils derived from amphibolites;
- Okemesi: well-drained coarse textured very gravelly soils from quartz schist and massive quartzites;
- Mamu: well-drained medium textured soils from sericite schists;
- Jago: soils of various textures in low topography sites derived from alluvium and local colluviums; and
- Origo: fine-textured soils with impeded drainage from diorite gneisses.

In all, within the forest region of SW Nigeria, 46 soil series were identified and mapped based on drainage, parent rock, forms of parent material and profile morphology. Previous efforts at understanding the genesis, chemical and mineralogical properties of soil formed in the basement complex of SW Nigeria have been directed at the study of veneer of pedi-sediment over saprolite. Amusan and Ashaye (1991) suggested that a consideration of the interaction between episodic landscape erosion and pedo-genesis was required to explain soil genesis. In the basement complex area, there is a strong relationship between topographic position and soil genesis. Landscape position

influences runoff, drainage and soil erosion, hence affecting soil genesis. Further studies by Okusami and Oyediran (1985), Amusan (1991), Amusan and Ashaye (1991), Amusan *et al*. (1993) and several other workers grouped most of the upland soils in SW Nigeria as Ultisols with Inceptisols at the lower slope areas. Basically, the soil temperature regime in the region is isohyperthermic (Okusami and Oyediran, 1985; Amusan, 1991) with a ustic soil moisture regime.

In the savanna zone of SW Nigeria, substantial soil studies had been carried out on the characterization, genesis and mineralogy of tropical savanna soils by Ojo-Atere and Ogunwale (1982a and 1982b), Ojanuga (1979) and Ojo-Atere and Oladimeji (1983). Upland soils in the region were grouped as Typic Haplustalf (Alfisol with ustic moisture regime) while soils in the lowland areas were mapped as Typic Ustropept (an Inceptisol). It had long been established that the predominant clay mineral in upland soils of SW Nigeria is kaolinite (typically, low-activity clay -LAC) with traces of smectites (mostly montmorillonite and vermiculite) in some inland valley soils in the region. Olayinka (2009) once remarked that tropical soils, unlike temperate ones, are highly weathered, leached and acidic with a high rate of organic matter decomposition and mineralization which deplete the inherent soil fertility. The soils are fragile and characterized by low-activity clay, low cation exchange capacity and low base saturation resulting in low productivity. Moss (1954) undertook detailed characterization and mapping of soils in the sedimentary zone of SW Nigeria. Based on drainage, nature of parent material and soil morphology, 60 soil series were recognized. The most widespread of these in SW are the well-drained soils that developed in sandstone (e.g. Alagba, Agege, Owode series) and the seasonally swampy soils formed in shale (e.g. Ogun series). The former soils are ferruginized, ferrallitic and strongly acidic while the latter have vertic properties. The government bodies responsible for soil research and mapping (e.g. IAR&T) and some Universities with Soil Science Departments in the region have also carried out soil resource inventories for specific single or multipurpose problem-solving soil characterization for sustainable land use or soil fertility/suitability evaluation activities (Ande *et al.*, 2015; FMARD Report, 2014). It is noteworthy that the Institute of Agricultural Research and Training (IAR&T), Moore Plantation, Ibadan, with the national mandate for soil research, has conducted soil surveys in the region since its inception as the Research Division of the Ministry of Agriculture and Natural Resources (MANR) of the old Western Region of Nigeria.

Modern agriculture requires that farmers have sufficient knowledge of the capability and nutrient status of the soils to be utilized. Such information, when available, enables the farmer to make informed choices of crops and/or livestock to be raised that are technically feasible (Harrison, 1981; Beets, 1992). This has given rise to the need for soil surveys and soil evaluation studies before crop cultivation and other agricultural land uses. Detailed morphological, physical, chemical and mineralogical data are needed to put the soils in the taxonomic groups and fertility capability classes according to their potentials and limitations to develop improved management practices/strategies for them to ensure their sustainable productivity. Some other studies have led to the establishment of critical levels of some soil properties within the SW agroecological zone (Table 2). Critical level or concentration is a term that is common in both soil and plant analyses. It is a threshold of nutrient concentration above which crop

yield may be optimum and below which the crop will be deficient.

Table 2: Critical levels of some soil parameters and plant nutrients for arable crops in SW Nigeria

Nutrient	Critical level	Author	Year
Gravel	25%	Babalola	1977
Bulk density	1.63 g/cm^3	De Geus	1973
N	0.1%	Adepetu	1986
P	8-15 mg/kg	Adepetu *et al*	2014
K	0.18-0.2 meq/100g	Agboola and Obigbesan	1974
	0.24 meq/100g	Agboola and Ayodele	1987
Ca	2.0-2.6 meq/100g	Agboola and Corey	1973
	3.8meq/100g	Adepetu	1986
Mg	0.4 meq/100g	Adepetu	1986
	1.9 meq/100g	Agboola and Ayodele	1987
Fe	5-9 mg/kg	Sillampaa	1972
Mn	25 mg/kg	Adeoye and Agboola	1985
Cu	1.06 mg/kg	Sillampaa	1972
	1.2-2.0 mg/kg	Agboola and Corey	1973
Zn	1.0-7.5 mg/kg	Cox and Kamprath	1972
	3.0-3.45 mg/kg	Sobulo and Osiname	1981
B	0.1-0.7 mg/kg	Cox and Kamprath	1972
Mo	0.04-0.2mg/kg	Cox and Kamprath	1972

CHALLENGES TO SOIL RESEARCH IN SW NIGERIA

Lack of effective national and/or regional research policy focus and collaboration

Soil information system (SIS) is an organized system that promotes effective and sustainable utilization and management of soils and related natural resources by the provision of appropriate information to decision-makers. Adequate soil information can inform long-term policies to facilitate productive, optimal and sustainable use of available land and stem the tide of migration which has been the single cause of major inter-ethnic conflicts. Nationally and within the SW geo-political zone, such information is lacking. There is no national and or regional research policy thrust to guide the scientists in the conception, design and implementation of their research activities. Although some research institutes have specific national mandates on their research policy, this is not so for higher institutions. In higher institutions, soil research is geared towards the personal upliftment and promotion of the researcher rather than focusing on national soil research needs. Further is a lack of research collaboration between the research institutes in SW Nigeria and the various higher institutions in the region.

Lack of effective national coordinating and regulatory body for soil research in Nigeria

Except for the recently established Nigeria Institute of Soil Science (NISS), there are limited national and or regional soil research coordinating centres and regulatory bodies which make studies in soils a job for all. Zoologists, Botanists, Geographers and several other people of diverse backgrounds do regularly engage in soil investigations, sampling, analyses and thereafter try to interpret the data without any formal training in the field of soil science. Yet,

sustainable use of soil resources calls for an adequate understanding of their properties, potentials, capabilities, suitability and constraints to specific land use types.

Political and industrial instability

Since independence, until recent years, there have been frequent changes of political power in Nigeria and the attendant instability, inconsistency and incoherence in governmental policies and programs, the practitioners in the education/research industry, including soil researchers, are left confused. Before the researcher concludes an evaluative study of a particular program or policy, it is either discarded or replaced with a different, sometimes completely divergent policy or program. Political instability has also taken its toll on the educational and research institutes in SW Nigeria. The academic calendar is frequently disrupted: there are strikes, lockouts, closures and general social upheavals by various staff unions in higher institutions and research institutes, and all these influence the orientation, timing, process and quality of any research activity in the field of soil. Yet, the politician or policy maker out there is waiting, with his characteristic suspicion of, and impatience with the researchers.

Incessant power failure

The prevalent epileptic power supply cannot support meaningful soil research activities in higher institutions and research institutes in SW Nigeria. Available statistics have shown that poor electricity supply in the country is endangering the growth of the critical sectors of the economy which the education sector is not singled out. In the education sector, only a trickle of daily electricity production reportedly goes into the country's higher institutions of learning (Odiegwu, 2009). There are 170 universities in Nigeria as of 2023, 79 are private, federal universities amount to 43, while state universities are 48. Some of Nigeria's oldest universities in the SW are the University of Ibadan, Ibadan, the Obafemi Awolowo University, Ile-Ife, the University of Lagos, Lagos and the Federal University of Technology, Akure. The epileptic power supply situation is still the same today and has no doubt, rendered research equipment dysfunctional. The results and effects are that some tertiary institutions resort to diesel-propelled generators which on their own, are expensive and environmentally unfriendly. Also, research processes are disrupted as they only work for a limited period.

Inadequate funding for research project

Insufficient funding is one of the major problems confronting the education and research system in Nigeria. As observed by Nwoye (2002), federal and state governments turn deaf ears to the financing and supply of essential scientific materials or facilities needed in higher institutions and secondary schools for effective teaching and learning. Research funding is critical to the ability of tertiary institutions to conduct cutting-edge research in the first place and ultimately to the quality of the research. Most research activities in Nigeria are sponsored by the government through government funding agencies like the National Science and Technology Fund (NSTF), the Education Trust Fund (ETF), now Tertiary Education Fund (TetFund) etc., as well as several federal/state ministries, boards and parastatals which directly fund researching institutions or research projects under them. In addition, research projects are occasionally funded by international and philanthropic organizations by way of sponsored research support, endowment funds, foreign aid, fellowships, donations, grants, etc. Unfortunately, there is virtually no industry involvement in funding academic research in Nigeria (Donwa, 2006); or very few. Research in

Federal Universities, Polytechnics and Colleges of Education is routinely funded through some relevant supervisory bodies namely, the National Universities Commission (NUC), the National Board for Technical Education (NBTE) and the National Commission for Colleges of Education (NCCE), respectively. It should be emphasized that the funding of research in these institutions has been generally poor and irregular. The federal institutions of higher learning are better funded and more autonomous than state government-owned institutions (Clark and Sedgwick, 2004). In Nigeria, the traditional funding method for higher education research is formula funding based on inputs – staff size, enrolment etc (Salami and Hauptman, 2006). However, given the expenditure dynamics of higher education research against scarce state resources in a dwindling global economy, many countries around the world are now adopting the innovative, performance-based funding mechanism among others on peer-reviewed outputs or outcomes, rather than inputs (Akintoye, 2008; OECD, 2010). Funding has always been a major constraint to research development and implementation. The replacement of old, unserviceable equipment, infrastructure, tools, and machines and the recruitment of qualified staff that can make research work meaningful and relevant to the needs of modern-day Nigeria all need money which is not always available. Grants are also difficult to come by.

Dilapidated infrastructure and equipment

One of the consequences of poor funding of education is dilapidated infrastructure. Research infrastructure in institutions of higher learning is grossly inadequate and generally weak. There is a dearth of modern equipment, the old ones when available, are no longer serviceable because the manufacturers have long phased them out of their production lines. Workshops, libraries and laboratories are all ill-equipped, and obsolete educational facilities are difficult to replace if not impossible. These hinder research activities and findings.

Poor quality Scientists and Technical Staff

There is a general shortage of skilled manpower to manage equipment/facilities effectively in the nation's higher institutions and research centres to gear up and aid research. Without experts to handle these facilities, some of them will be rendered redundant and this obviously, can jeopardize the efforts of researchers. In some cases, where equipment is available, the technicians to handle them are either not available or incompetent to operate them. Training and re-training of the academic and supportive staff are not regularly carried out to update their knowledge. Also, resistance to change by some scientists/researchers is a great problem for research development. According to Braimoh (2008), the ever-present problem with Nigerian teachers is their resistance to change. Despite the change in the educational systems all over the world, some Nigerian lecturers/researchers still prefer to hold on to their crude traditional methods of doing things. Their failure to embrace the latest skills, methods and techniques for carrying out research work, negatively impacts their research capability.

Non-prioritization of research activities by the government

The general social, economic and political environments prevalent in society seriously militate against research development. The government does not consider education a priority or pay adequate attention to research findings. This explains why funds are not generously released to the education sector to engage in breakthrough research activities. While the tertiary institutions in the country are still grappling with obsolete equipment in this period of very rapid

change, the government takes delight in squandering money on politics. Neither the government nor the society cares to find out research discoveries not to talk of making use of them. A visit to most of the institutions of higher learning will show many research works that have been done over the years rotting away. Due to the low level of scientific culture and interest, the general public and politicians prefer not to invest in research activities but in politics which is their main area of interest. This attitude does not encourage soil researchers to continue with good research work.

Corruption and mismanagement

Nigeria's problem of funding research is not a result of a lack of sufficient money but of too much money wasted through mismanagement and fraudulent practices. According to Lamido (2013), the level of corruption in the country has assumed a threatening dimension that is also disastrous and destructive to the economy. This definitely has negative effects on education and research. Corruption has eaten so deep into the fabric of national life that even the education and research sector is not spared. Ultimately, this has affected the quality and quantity of scientific findings, up-to-date equipment and infrastructural facilities for good research. The removal of these constraints will bring a glorious future to Nigeria.

Lack of awareness of the role of Soil in food security and national development by the general public

Soil research in SW Nigeria is in a very pitiable state. Little or no recognition has been given to the need for soil studies and research in soils in Nigeria. This is clearly manifested in the non-choice of soil studies by candidates seeking admission to higher institutions in Nigeria. This has also resulted in a very wide disparity between soil scientists and other personnel in agriculture and other fields of science. Indeed, it is rare for candidates to choose Soil Science as their course of first choice while seeking admission to higher institutions in the field of agriculture.

Admittedly, poor motivation, poor and irregular funding, obsolete research infrastructure, inadequacy of qualified research personnel, general lack of national research focus and poor linkage between researchers and the industrial sector are yawning gaps in Nigeria's higher education research. These constraints constitute serious limitations to the soil research capacity and capability of the various research institutes.

THE WAY FORWARD

Adequate training of Soil Scientists and Technical Staff

Research is an indispensable avenue for finding solutions to Nigeria's social, economic and technology-related problems. There should be adequate training for academic staff to equip them with the necessary training to plan and implement research projects. Capacity building for researchers in the areas of research and development should be organized regularly. In addition, there is a need for a Reference Soil Laboratory Network for the standardization of procedures and methods' harmonization. The standardization will ensure that the quality of soil data generated and being used for prediction is good and thus can enhance the credibility of the results. The availability of soil data from which scientifically valid decisions are generated is essential, hence the need for a reference laboratory. There is also the need for training of staff in soil information generation and management for effective land use monitoring and planning.

Proper funding of research works in soil studies

There is a need to make more visible the importance of soil science to national development and economic growth to attract better funding from the Government. The government should generously release funds to tertiary institutions and research stations for research purposes. The funds released for research projects should be seriously monitored to avoid diversion. Provision of adequate research grants should be made to enable the researchers to carry out relevant qualitative research. The government should endeavour to provide functional physical infrastructural facilities for research institutes. Provision and access to facilities for qualitative soil research should be supplied to all higher institutions of learning and research institutes.

Checking corruption, promoting transparency and accountability in research institutes

The Nigerian research and educational system has over time been exposed to large-scale corruption and several inefficiencies including a faulty headship selection process. As part of the advocacy geared toward efficiency in the system is a need to give more autonomy to financial management in public education and research institutions. For instance, through autonomy, higher institutions of learning could improve their financial situation by improving the efficiency and effectiveness of resource generation, and use and cutting costs. Besides, public educational/research institutions should be encouraged to develop resource mobilization strategies, to generate revenue by themselves. For this purpose, educational foundations can be set up to mobilize financial support from private donations.

Establishment of soil research regulatory body

A philosophy of national development must be evolved and everything must be done to give appropriate legal backing to bodies concerned with research and research-related activities. Policy-making bodies should be set up to guide research activities. Appropriate government agencies should also ensure that research activities are backed up by adequate infrastructure, adequate personnel and adequate funding. The recently established Nigeria Institute of Soil Science (NISS) should be up and doing in its responsibility. Future generation researchers/academia in Nigeria look forward to seeing the present trend of poor infrastructure and lack of up-to-date learning/research facilities replaced with cutting-edge/sophisticated equipment to be able to compete favourably with their peers elsewhere in the world. These aspirations are what the government and relevant stakeholders must respond to if the future development goals of the nation must be attained.

Popularizing soil research works and their relevance to national development

There has to be more awareness of the need and importance of soil testing as a measure of the quality of the soil before anything is carried out on it. The discipline of soil science as a course in the nation's Universities should be given adequate publicity and possibly incentivized so that young and upcoming Scientists could embrace soil science as a chosen course of study.

CONCLUSION

The thrust of this review paper is that, besides assuaging the obvious inadequacies in soil research, such as poor funding and decaying infrastructures/facilities, authorities concerned must create the needed incentives and ambience conducive to qualitative research/scholarship in soil science. Provision of subsidies for higher degree training of researchers, protection of purposive/creative researchers, adoption and

utilization of findings, and funding the mass production of invented products by researchers should be encouraged. Establishing a compelling synergy among the research institutions, the industries and the market as a way of creating a sense of fulfilment among researchers as well as raising the productivity profile of the nation are considered the panacea for sustained soil research activities for food security and national development.

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