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Ghana Soil Management Policy: Relevance, Concepts And Processes For Its Attainment.

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Abstract: Ghana's soils are described as low productive soils whose productivity continues to decline rapidly as a result of the adopted unsustainable crops production systems. In addition, prime agricultural lands are also being permanently lost as a result of urbanization to other land use sectors thereby affecting sustainable crops production. However, there is currently no existing policy framework that seeks to guide the holistic exploitation of Ghana's soil resources for the current and future needs. This paper therefore discusses the relevance, ideas and concept for attaining a soil management policy to drive Ghana's agricultural development and food security programs.

Index Terms **- Food Security, Land Degradation, Soil Organic Carbon, Soil Policy, Sustainable Soil Management.**

Introduction: The need for a Ghana soil policy The soil is the basic natural resource that provides critical environmental services needed for the continuous survival of the human civilization. At the foundation of the agricultural sector of every country is the soil, on which the following important agricultural and ecosystem services relies:

- Provision of food and nutrition security, fresh water, pharmaceuticals, industrial products, hydropower and biomass.
- Protecting human and animal health through mineral nutrient supply.
- Supporting the purification of water and air, nutrient cycles, crop pollination, seed dispersal and disease control.
- Preserving the genetic and species diversity for current and future use.

In addition, the soil has been described by Lal (2008) as the most important element in the current global debates around climate change, such as carbon sequestration and climate regulation. He quantifies the amount of Carbon (C) in soil to represent a substantial portion of the C found in terrestrial ecosystems of the planet, to be approximately 3170 gigatons (GT; 1 GT = 1 petagram = 1 billion metric tons) of which, nearly 80% (2500 GT) is found in soil. This means that any anthropogenic activity that can lead to the release of soil C into the atmosphere can create a soil carbon deficit relative to the levels of carbon that previously existed in the soil as well as have a significant impact on the global climate. For example, the conversion of natural ecosystems to agricultural use has resulted in the depletion of Soil Organic Carbon (SOC) levels, releasing 50 to 100 GT of carbon from soil into the atmosphere (Lal, 2009). This has been described as the combined result of reductions in the amount of plant roots and residues returned to the soil, increased decomposition from soil tillage, and increased soil erosion (Lemus & Lal, 2005). Soil organic carbon is also a vital soil component with important effects on the functioning of terrestrial ecosystems. Storage of SOC results from interactions among the dynamic ecological processes of photosynthesis, decomposition, and soil respiration. Human activities over the last 150 years have led to changes in these processes and consequently to the depletion of SOC and the exacerbation of global climate change. However restoration of degraded lands and croplands productivity enhancement activities such as reforestation or grassland restoration on a former crop field can reduce the carbon deficit caused from years of agricultural production and sequester carbon through higher root productivity compared to crops. Likewise, the creation of wetlands and ponds can sequester large amounts of carbon because decomposition is greatly reduced in waterlogged soils from lack of oxygen; this can actually result in carbon gains that exceed the deficits resulting from past land use. Other management practices such as irrigation of pasture or rangelands as well as reduced tillage of agricultural lands may also increase carbon levels beyond historic SOC stocks if carbon inputs under new management greatly exceed levels under natural conditions. Additionally, the processes of erosion and deposition act to redistribute soil carbon according to the topography of the landscape, with low-lying areas such as floodplains often having increased SOC relative to upslope positions (Ontl & Schulte, 2012). In Ghana, the agricultural sector has been described as the backbone of the economy, contributing about 18.9% to GDP in 2016 (MOFA, 2017). The sector has regained its position as the largest employer (after dropping second to the Service's Sector in 2010), employing 44.7% of the labor force in 2013 (GLSS6, 2014). All successive Governments have attempted to rally financial and political support for the promotion of agriculture for food security, environmental sanity and poverty reduction consideration, yet these efforts have failed to attain the desired expectations over the long term due to several factors including: lack of consistent policy direction; inadequate financial support; non-focused education of our farmers on modern trends in farming; poor integration of technology into agriculture and low crops yields due to low soil fertility (FAO, 2015). Out of the total national land area 23.8 million ha, agricultural lands constitutes about 13.6 million ha (57.1%). However, most of the soils are of low inherent fertility, and therefore rapidly becomes degraded when converted to croplands without the adoption of appropriate soil conservation measures. Of the existing agricultural lands, only about 26 % is currently under cultivation, leaving almost half of agricultural lands for possible further agricultural development. Unfortunately, large portions of the remaining lands are currently under forest reserves and other conservation or protection regimes. There is therefore the need to sustainably manage the existing croplands for the provision of food and nutritional security for the current and future population, with the objective of preventing and controlling erosion, increasing their organic matter content, and replacing the increasing plant nutrients lost through erosion and crop uptake (MOFA, 2015) However, soils of Ghana's agricultural lands are threatened by two basic issues. The first threat concerns the severe decline soil productivity leading to decline in factor productivity, low nutrient content in the food, poor health of the crops predisposing them to severe pest and diseases and ultimately resulting in poor

human health (FAO, 2005). Moreover, Ghana's agricultural lands have low inherent fertility status developed on thoroughly weathered parent materials. They are old and have been leached over a long period of time with the two most deficient nutrients being nitrogen and phosphorus particularly because of the very low organic matter content (Bationo, 2015). The coarse nature of the soils has an impact on their physical properties and water stress is common during the growing season. The soil nutrient depletion rates in Ghana is estimated at 35 kg N, 4 kg P and 20 kg K ha^{-1} (FAO, 2005) leading to a steady decline in crop yield levels with severe implications on sustainable agriculture and food security. These levels of nutrient loss are similar to the trend in sub-Saharan Africa sub region with estimated minus 22 – 26 kg N, 5.83 – 6.87 kg P_2O_5, and 18 – 23 kg K_2O ha-1 from 1983 – 2000 (Stoorvogel and Smaling, 1990). The average yields of most of the crops are therefore 20–60% below their achievable yields, indicating that there is significant potential for improvement (Tetteh et. al., 2017). Meanwhile, extensive areas of country's land area particularly the Interior savannah zone continue to suffer from severe soil erosion and land degradation in various forms. Soil erosion caused by rainfall and water runoff continue to cause potent degradation processes affecting soil productivity. Large tracts of land in Ghana have been destroyed by water erosion (Quansah et al., 2000) with the most vulnerable zone being the northern savannah (Guinea and Sudan Savannah zones) which covers nearly 50% of Ghana with the Upper East Region being the most degraded area of the country. A model of land degradation assessment in Ghana predicts that land degradation reduced agricultural income in Ghana by a total of US$4.2 billion over the period 2006–2015, which is approximately five percent of total agricultural GDP in this ten-year period (Diao and Sarpong, 2011). Soils management research effort to generate technologies and innovations for sustainable management of the already fragile soil conditions, is similarly fragmented, under-resourced and lacks the capacity to be generating the knowledge needed to improve the management of soils in even more challenging climatic conditions.

The other threat comes from the permanent loss of agricultural lands to other land use sectors such as real estate, construction activities, compaction, mining and other resource extraction or exhaustive cultivation (MLF, 1999). For example the land area occupied by most cities and towns and even villages have expanded many folds and this expansion has come at the cost of permanent loss of prime agricultural lands. In recent times, Accra, the capital city of Ghana, has expanded beyond the Greater Accra region into the Central region, whilst Kumasi, Takoradi and Tamale are also expanding, with real estate and industrial structures taking over previously existing parcels of farmlands and plantations in between peri-urban communities especially along the major trunk roads.

These factors, accompanied by population growth, increasing average income and changing dietary patterns, have led to the fact that cropland per capita has fallen by more than half since 1960 (MOFA, 2015) leading to enhanced exploitation of soil resources for crops production with the attendant soil degradation. In addition, as Ghana continues to exploit economic opportunities associated with the increased export of fresh fruits and other non-traditional export crops, more demand is exerted on the current soil resources leading to accelerated soil degradation that threatens food security and reduces the provision of associated environmental services. In view of this global megatrends, particularly for global supply of food and bioenergy, there is the increasing need of additional land resources that also puts more pressure on the desire to convert existing forest lands as well as marginal lands into croplands, with its attendant environmental consequences.

The demand for land is also implicit in the individual Sustainable Development Goals (SDGs), which Ghana has committed itself to pursue towards the attainment of a higher middle income economic outlay in the near term (NDPC, 2017). The effort to attain the SDGs in Ghana will be affected by the future availability of land and thereby potentially impede the achievement of the goals. Twelve of the 17 SDGs are underpinned by the use of natural resources, some of which directly relate to requiring additional land resources or over exploitation of existing lands, such as the goals on food security (SDG 2), energy supply (SDG 7), production and consumption (SDG 12) and the use of ecosystems (SDG 15).

Unfortunately, the governance of agricultural productivity and ecosystem services provided by the soil is almost left to no one's concern. Ghana currently has no coherent national policy on soil management to guide the sustainable exploitation of this important natural resource for current and future needs. There is no approach in place for protection of soil quality and productivity as well as for the planning and management of the soil resources for Ghana's socio-economic development. Ghana has over the years failed to even initiate any consistent policy debate towards the planning, development and implementation of any policy to guide the management of its soil resources for the attainment of food and nutritional security, bioenergy as well as all the above ecosystem services.

Moreover, the country's has no nationally developed standards and benchmarks to determine whether the current status of our soils can support the provision of the required soil management services, as well as the projections for its improvement towards future demands from the same or even reduced piece of agricultural lands. As a result Ghana has no basis to determine in a nationally consistent manner with any authority, whether the current condition of our soils is improving or deteriorating to support the socio economic aspirations of the country towards the attainment of self-sufficiency in food production as a component the "Ghana without aids" Agenda.

The paper is purely a desk study, and all findings are descriptively presented based on extracts from published materials, public documents and other secondary information, and seeks to contribute to the current debate on the need for a National Soil Management Policy to guide the sustainable management of this important natural resource.

2. INADEQUACIES OF OTHER RELATED POLICIES TO ADDRESS SOIL AND LAND USE CHALLENGES

Ghana's 1992 constitution recognizes the necessity that a long term development plan is required for growth and development of the country. Article 87 (2) of the constitution calls for the need to develop plans characterized by monitoring, evaluation and coordination of development policies, programs and projects whilst Act 479 (1994) has also mandated the need for the formulation of comprehensive national development planning strategies and to ensure that strategies including consequential policies and programs are effectively carried out.

In the 40 year Long-term National Development Plan of Ghana (2018-2057) document, two out of the five strategic goals were agriculture and food security related. Goal Two focused on "creation of an equitable, healthy and prosperous society" with a major consideration under the Sectoral Issues in Social Development was the attainment of Food and Nutrition Security. In addition, Goal Three also focused on the building of a well-planned and safe communities while protecting the natural environment, under which developmental issues in Rural Development, Natural Environment Management and Climate Variability, Change and Management have direct bearing on the judicious exploitation of the soil and environmental resources for the attainment of plan's aspirations (NDPC, 2017). Yet no sustainable soil management consideration for the successful roll out of the plan was mentioned in the entire document.

In the area of land resources utilization in support of Ghana's socio economic development, the National Land Policy (1999) has attempted to address some of the fundamental problems associated with land management in the country. These include general indiscipline in the land market, characterized by land encroachments, multiple land sales, use of unapproved development schemes, haphazard development, indeterminate boundaries of customary-owned, resulting from lack of reliable maps and plans, compulsory acquisition by government of large tracts of land, which have not been utilized; a weak land administration system and conflicting land uses, such as, the activities of mining companies, which leave large tracts of land denuded as against farming, which is the mainstay of the rural economy, and the time-consuming land litigation, which have crowded out other cases in our courts (NLP, 1999). Issues of avoiding (and conscious protection) of prime agricultural lands for the siting of other competing land uses were never considered.

Out of the over 86 Statute Laws in Ghana on Land and Natural Resource listed in the National Land Policy (1999), only one (1), the Farm Lands (Protection) Act. 1962 (Act 107) had a direct consideration on soil management for agriculture and ecosystem services. However, a major limitation of the current Farm Lands (Protection) Act. 1962 (Act 107) is that it does not provide any conscious and long-term protection of prime agricultural lands from being converted into other non-agricultural land-use. It prescribes that "where a person acquires land after the commencement of this Act for the purposes of farming and does not farm a part or the whole of that land for a period of eight years from the date of the acquisition, the title to the whole of the land of that person or the portion that has not been farmed is, for all purposes, extinguished".

Currently, there is no single coherent multi-sectorial approach being followed across all sectors of the country on soil resources management for sustainable ecosystem services and socio-economic development. Various land related sectors at the central level such as urban planning, rural development, industry, transport, mining, agriculture etc. follow their own approaches towards land resource management. This lack of coordination and effective regulatory standards invariable affect the agricultural sector in terms of encroachment as well as sometimes forceful takeover of some prime agricultural lands by the other sectors, affecting food security and causing disenchantment among farmers.

There is therefore the need for common efforts towards sustainable management of soil resources for food security, ecosystem services, as well as climate change adaptation and mitigation considerations. This should encompass enhanced and applied knowledge of soil resources as well as improved governance and standardization by a recognized body empowered to enforce all regulations.

Within the agricultural sector, various Governments have since the 1980s initiated some policy reforms in the agricultural sector like removal of subsidies, liberalization of the marketing of fertilizers, elimination of guaranteed minimum prices and withdrawal of government involvement from direct production and distribution of agricultural inputs and products, as well as promotion of private sector involvement with a view to improving agricultural production.

In addition, several recent Government policy initiatives and programs have also been developed and implemented over the years with the ultimate aim of enhancing agricultural productivity for food security and poverty reduction. Some of the major programs implemented by MOFA at national level include: the Planting for Food and Jobs (PFJ); Planting for Expert and Rural Development (PERD); One Village, One Dam (1D1F); Fertilizer Subsidy Program; the Block Farming Program, Agricultural Mechanization Centers and the Irrigation Development Program.

Similar other national agricultural development policy initiative such as the Food and Agriculture Sector Development Policy (FASDEP II, 2007) emphasized on the modernization of agriculture and increased productivity of Ghanaian farmers. It must be emphasized that various discussion of Modernization of Agriculture in Ghana have unfortunately, centered mainly on the mechanization of land tillage practices, which require a more in depth consideration of soil health and degradation consideration for its successful implementation to offset adverse ecological catastrophe that have been associated with similar programs in other parts of the world. The Medium Term Agriculture Sector Investment Plan (METASIP 2010-2015) which served as the implementation plan of FASDEP II comprised of six programs which represented Ghana's priorities with Food Security and Emergency Preparedness, as well as Increased Growth in Incomes being the major areas for investment in the agricultural sector, did not also consider soil health and associated sustainability issues.

It is worth mentioning that the sustainability of all the above policy initiatives are depended upon the potential of the soil resource base as well as the ability of the farmer to sustainably manage soil resources for successful agriculture. Despite the laudable policy aspirations of such programs, little effort have been dedicated towards the implementation of these programs in line with soil fertility and ecological considerations that will guarantee the sustainability of such programs in the long term. For example, the inappropriate siting of such major programs on unsuitable soils and ecological settings, will not only require more investment in the production cycle to achieve the program objectives, but will also accelerate the rate of land and environmental resources degradation associated with the particular program.

In addition, inconsistencies between overall policy objectives, measures adopted to achieve these objectives and the effects they generate have been observed (FAO, 2015). Recent analyses demonstrate that despite the introduction of producer support programs such as the fertilizer subsidy, buffer stock program and waver of import duties to protect the agriculture sector, Ghanaian producers received lower prices than they could have received if policy and market distortions were removed during the period 2005-2010. This is largely due to inefficiencies in commodity value chains such as high processing, transport and handling costs, various local fees/levies and illicit taxes (e.g. road checkpoints), which depress producer prices (FAO, 2015). A major omission of the list of inefficiencies in the above study was the issue of low crop yields on the farmers' fields compared the potential yields of the crop varieties.

Another major policy weakness towards the implementation of the policies is the inability to spatially identify the soil, ecological and environmental condition suitable for the long term sustainability of the various crop production related initiatives. For example, the discussion on implementation 1D1F has seldom been around the scientific determination of the comparative advantages of soil and ecological settings of the various factory and associated farmland locations, for the long-term production of the industry-associated crop commodities.

A recent review of the PFJ initiative concluded that if implemented as planned, the PFJ fertilizer subsidy program is effective in achieving its goals to improve Ghana's economy through increased productivity, sectorial and overall economic growth, job creation and household welfare (Iddrisu et al., 2020). Unfortunately, the policy document and entire review process did not consider the role of soil, climate and ecological variability nationwide, for the sustainable and economic production of the target project crops and therefore make the conclusions doubtful in terms of long-term sustainability of the crops production effort.

3. SPECIFIC ISSUES TO BE ADDRESSED BY THE POLICY

Vision of the Policy

Ghana needs to ensure that the soil is efficiently and sustainably managed to meet our current and future needs. It is proposed that Ghana Soil Management Policy would envision a situation where all soils in every part of Ghana is conserved for its ecological values and the ecosystem services it provides, and soil health is enhanced for sustainable crops production.

There is therefore the need for enhanced science, technology and innovations based policy for protecting the integrity of soil resources of every part of Ghana for sustainable agricultural development to achieve long term food security and addressing emerging problems of land competition for food production, real estate, bio-energy demand, erosion in ecosystem services and threats to biodiversity in the following broad sectors:

A. Food and Nutritional Security

In terms of food and nutritional security considerations, based on current and future national projections and aspirations of agriculture and land use services, the policy is to focus on addressing the following issues on soil resource management:

- Facilitate enhanced strategic dialogue among decision makers and all stakeholders for awareness creation on the key role of soil resources for sustainable land management and sustainable socio-economic development;
- Provide national governance guidelines to address critical soil issues in relation to food security, nutritional security, human health as well as societal well-being;
- Provide guidance towards harnessing soil knowledge and research through a common agro-ecological zone and national communication platforms incorporating real local challenges;
- Establish and operationalize an effective network for addressing soil crosscutting issues with clear priority towards the reservation and protection of prime agricultural lands;
- Establish and operationalize guidelines to improve soil protection and sustainable soil productivity, ecosystem services and threats to biodiversity

B. Harnessing science and technology for sustainable soil resources management.

Recognizing the critical role of the country's soil resources for socio-economic development, the policy should focus on strategic integration of science, technology and innovation to guide and enforce the decisions on every aspect of soil management activity towards ensuring that the soil resources of Ghana is conserved and even improved to continue to provide agricultural and environmental services without degradation, in the following critical areas:

- Harness and develop through training and capacity building, a critical mass of soil management professionals (including scientists and extensions staff) to provide scientific insight and guidance into every developmental activity currently being undertaken on every part of Ghana and also activities earmarked for future implementation. In addition, effort should also be made to address the low level of community awareness and understanding of threats to soil resources and the long-term consequences, as well as intensify education at both primary and secondary school levels in soil management for sustainable development;
- Provide a national research agenda and focus on soil and land use based on the development aspirations of the country and the current potential of the soil resources (soil quality) to support such programs;
- Provide strategic reinvestment in soils for more research to generate critical information through a detailed soil characterization of soil fertility, soil biota, soil carbon, soil moisture relationships and the needed soil management practice change to ensure sustainable land use and improved cropland productivity;
- Establish a national soils information database for monitoring, collection, storage and provision of access to data for land use planning. All isolated soil databases in Ghana created by institutions such as the CSIR-SRI, GhaSIS and MOFA soil databases are to be integrated into a National Soil Database to effectively manage soil information with effective direction and investment support.

C. Standards for soil conservation for agricultural and environmental services.

The policy should ensure that the integrity of Ghana's soil resources is preserved and enhanced for continuous provision of agricultural and environmental services. In pursuance of this, the policy must formulate some basic standards with the appropriate legal framework for certain critical soil quality conditions such as soil pH, Soil Carbon, and soil erosion, to protect the soil from physico-chemical, biological, and ecological degradation as a result of land use. In this direction, the policy must indicate certain minimum levels of such soil quality indices that must be adhered to (and enforced) on all croplands, rangelands, reclamation and rehabilitation areas as well as on all other land uses.

D. Soil health and human health integration

Recognizing the direct linkage between soil health and human health through the provision of food and nutritional security, the policy must analyze and establish guidelines to regulate the production of good quality and healthy food, fodder and industrial crops that address the issues of hunger, malnutrition and other lifestyle diseases. Minimum levels of food quality indices in agricultural produce must be developed and sanctioned for sale and use on all croplands. This would be achieved through the establishment of appropriate organic and inorganic fertilizer quality standards with relevant micro and secondary nutrients composition to address certain health and nutrition challenges of the population. This can be supported with the formulation of enabling incentive packages to drive adoption for the attainment of a healthy population.

E. Soil Organic Carbon for soil quality and climate regulation.

In the area of improving the soil organic carbon (SOC) content, which is the surest ways of preserving and improving the productivity of tropical soils as well as for climate regulation purposes, the policy must regulate and enforce the adoption soil organic matter improvement measures such as minimizing disturbance to soils from tillage, increasing inputs of carbon into the soil through manures and other sources of carbon, agroforestry, and other cropping system interventions that improves SOC. Relevant considerations on the quality standards of organic amendments acceptable on croplands, acceptable treatment (composting) processes that all organic resources (such as household, industrial and agricultural waste) must undergo before they can be used on croplands, as well as purposeful protocols on the integration of farming systems to exploit organic resources for soil fertility and climate regulation must be provided for enforcement.

F. Soil degradation and remediation.

The policy should also regulate and monitor all soil physical degradation processes associated with land use such as erosion, sand winning and mining. Soil erosion control measures and all land management practices that maintain soil cover to prevent the rapid degradation of lands associated to surface soil exposure to direct raindrop impact and the harsh tropical climatic conditions must be regulated and enforced. The policy must regulate the type of tillage operations acceptable on Ghana's croplands as well as levels of slope conditions where tillage operation for arable cropping or tree crop/forestry (conservation land use) can be allowed, for all landscapes. Dangers associated with soil surface exposure such as enhanced erosion and associated siltation of water bodies, reduced fertility and cropland productivity, reduced soil biodiversity, enhanced petro plinthite formation (hardening of soil), etc., must be prevented to ensure that the soil integrity is maintained. Land management practices with potential to offer effective soil cover either solely or in integration with tree and plantation crops must be evaluated for their ecosystem and financial benefits. Such practices must be effectively demonstrated with the appropriate incentives to facilitate adoption in all ecological zones of Ghana. In addition, the real cost of degradation associated to soil surface exposure to the nation, in terms of food security, soil and human health, deforestation and biodiversity loss, greenhouse effect, as well as clean-up costs and costs of reduced water quality must be quantified.

The policy should in addition, develop standards to monitor, regulate and enforce land management practices that lead to soil chemical degradation in terms of surface soil pH and EC as well as the application of lime/gypsum at appropriate rates to reduce acidity/alkalinity. The policy should demonstrate the net financial benefits of controlling acidity/alkalinity in surface and sub-soils acidity/salinity in relation to land management practices and set up standards of the acceptable levels to regulate land use in all agro-ecological zone of Ghana.

Regulating and monitoring acceptable levels of erosion, acidity, salinity and soil carbon on landscapes will ensure better yields and quality of agricultural products as well as provide a range of ecosystem services and benefits to both farmers and the broader public. Such ecosystem services include clean water for drinking and recreation, protection from erosion and floods, reduced rate of deforestation, reduced risks from pests and diseases and reduced need to use agricultural chemicals. Other range of cultural, spiritual and intellectual benefits such as enhancing sense of belonging to the ecosystem, mental wellbeing and acquisition of knowledge would also be attained.

G. Soil, environment, society and legal interaction.

The soil policy should also address the following issues of environmental, societal and legal considerations:

- Soil degradation through salinization, acidification, pollution with toxic elements (radionuclides, heavy metals and organic chemicals etc.).
- Surface and subsurface soil loss for construction work, mining (galamsey), urban landfills, etc.
- Soil biodiversity loss as a consequence of soil degradation and soil deterioration.
- Indiscriminate expansion of cities and towns leading to permanent loss of highly productive agricultural lands.
- Land grabs in the catchments of rivers, lakes, seasonal streams, etc. resulting in reduction in the storage capacity of reservoirs and loss of water bodies. In Ghana, most of such encroachment are done by churches and the petroleum retail outlets.
- Soil wastage through diversion of prime agricultural lands to permanent infrastructures like Special economic zones, industrial parks, urbanization, tourism, military installations etc.
- Establishment of integrated agroforestry/tree crops (shelter) belts at strategically located intervals, aligned at east-west orientation, within the Savannah landscapes to reduce wind speed, evapotranspiration, crop failure, improve biodiversity and also slow down southwards movement of desertification.

H. Soil fertility improvement for sustainable crops production.

In order to address the challenge of low yields on Ghana's croplands as a result of the low fertility status, the policy should develop and implement a fertilizer development and manufacturing framework that harnesses green and energy efficient technological initiatives to establish a fertilizer industry for the production of energy and cost efficient fertilizer products for their application on croplands. The exploitation of plasma technology (Hessel et al, 2013; Patil et al., 2015) for N_2 fixation for fertilizer production could be targeted for widespread adoption for Ghana's fertilizer industry. This effort will require further research and development investment but will eventually achieve a more environmentally friendly and cost effective fertilizer industrialization drive for national development. Another consideration should focus on the fortification of fertilizer products with specific micro and secondary minerals for the various specific crop production sectors to achieve higher and nutritionally quality crop produce for consumption and processing purposes.

The policy should also devote attention towards the development and implementation of an aggressive organic waste management framework that targets the recycling of all organic waste resource from agricultural, domestic and industrial sectors for their processing (through composting, charring, etc.) into rich organic fertilizer sources and other bio-based materials. This will enhance the fertility status of croplands with less expensive and green fertilizer sources, improve cropland C status and enhance climate resilient agricultural systems, help attain cleaner climate-smart cities, ensure cleaner river bodies and general environmental well-being through effective waste disposal.

Overall, the policy should encompass the socio-economic, ecological, legal and ethical issues that enhance soil stewardship practices to contribute to the formation of higher community consciousness in a more fundamental way, such that the premium of soil for national development can be better appreciated.

4. GUIDING PRINCIPLES FOR THE GHANA SOIL MANAGEMENT POLICY

The following guiding principles have been proposed to underpin this soil management policy towards the attainment of its vision. Most of suggested guiding principles have been adapted from the Australian experience (Schoknecht, 2010) and the Revised World Soil Charter (FAO, 2015) to suit Ghana's conditions:

1. Government of Ghana has a responsibility to provide an institutional and legal framework that encourages and supports sustainable management and discourages unsustainable management of soil resources;
2. Soil is a crucial natural asset, and sustainable management and protection of the soil resource is fundamental to our future prosperity;
3. Degradation of our soil resource is an ongoing issue resulting in partial or total loss of productivity and biodiversity, thereby reducing its capacity to provide agricultural and ecosystem services from the land, and creating significant offsite impacts;
4. Prevention of soil degradation is nearly always substantially cheaper than the cost of restoration, and in most cases is a much better investment;
5. It is the responsibility of individuals, communities, industries and governments to (not knowingly) degrade soil resources;
6. Soil management and policy decisions at all levels should be based on the best available science-based and evidence-based knowledge;
7. Sustainable soil management is most likely to be achieved through integrated approaches to sustainable agriculture and natural resource management (NRM) such as water and vegetation management, where long term condition of the resource is built in as a core consideration;
8. Industries that depend on the land have a responsibility to inform themselves about their impact on soil condition, and to promote and support sustainable soil management practices within their industry;
9. With the right to own, manage and use land and soil, landholders accept a duty of care to prevent soil degradation that affects others, and to implement management practices that maintain or improve soil condition and productive capacity;
10. Sustainable management of soil resources across the country requires coordination, cooperation and collaboration among all levels of government in partnership with industry, land managers and the community, regardless of land tenure;
11. There is the need for improved consideration and recognition of soil in wider debates on climate, biodiversity, environmental sanity, organic waste management, future food and nutritional security;
12. All individuals using or managing soil must act as stewards of the soil to ensure that this essential natural resource is managed sustainably to safeguard it for future generations;
13. Land users must undertake sustainable soil management in the production of goods and services;
14. It is the responsibility of individuals, communities and industries to develop their individual and landscape Soil Management Plans, involving a long-term vision which considers the whole of the parcel of land and its place in the catchment, that must conform to the vision and objectives of the National Soil Management Plan developed by the government;
15. The policy must be integrated into the National Development Plan, addressing the natural diversity of all soils and specific physical and socio-economic challenges of every part of Ghana's landscape in support of the National Developmental Agenda

5. PROPOSED PROCESS FOR THE GHANA SOIL POLICY DEVELOPMENT

There are two (2) main approaches normally adopted for the development of such policy documents. There is the traditional in-house policy development process that are carried out by government agencies or selected experts alone, and the participatory process that brings together relevant stakeholders to undertake the development process. It is however always very expensive and time consuming to adopt the participatory approach but the benefits over the long term are always significant. I therefore recommend the adoption of participatory soil policy development process for Ghana to allow for stakeholders who would be expected to implement the policy to be involved in its development.

Preparatory phase

At the onset of the process must be a document that will guide the process in terms of outlining the responsibilities of decision-making bodies; establishing the rules of engagement; drafting work plans, timetables and budgets; preparing communication strategies; and building capacity to manage the process and engage stakeholder groups in a meaningful way. In addition, basic reference data and information should also be compiled and relevant analysis initiated. Enough time, staff and budget must be set aside for joint efforts such as task forces, briefings and workshops to facilitate the process.

The entire process must be organized to take about 12 -18 months to complete, to allow for sufficient stakeholder engagement in the development process, allow for the documentation and legislative processes to crystalize but also be short enough not to run the danger of losing momentum.

Providing key background information

It would be beneficial to compile and review existing information, conduct studies and collect data on soil resources, their management and use, benchmark soils (prime agricultural lands) for every ecological zone for crops production, fertility levels of existing croplands and degraded agricultural lands, climate and ecological consideration, as well as land tenure and the context within which they are governed for analysis, in terms of their suitability for the provision of current agricultural and environmental services and for the future.

Leadership and administrative support from Government

There is the need to fashion out at the onset a high-level political leadership and support to signal its importance and expected results. This commitment also assures stakeholders of the need for their involvement and avoids the risk of their seeing it as merely a symbolic or administrative exercise, especially if the minister responsible for Agriculture (MOFA), or MESTI, leads the process and promises to use (as well as enforce) the results to guide future decisions making. Similarly, securing the explicit endorsement from the President of Ghana, the Parliament or a similar high level government institutions at the start can help encourage other sectors, government ministries and agencies to become involved, particularly if the relevance of the process to their areas of responsibility or the risk of not participating can be demonstrated

Stakeholders and their Engagement

It would be critical for the process to undertake a soil management stakeholder analysis to determining who should be involved and how, the type of support needed for their engagement, and expectation from their engagement. Soil management stakeholders can be individuals, communities, groups, government bodies, NGOs, researchers, the academia, traditional authorities, private sector players, farmers, processors, exporters and all others who are affected by the policy to be developed or who could influence (facilitate or impede) its design and implementation.

Process Management

At the center of the soil policy development process is the determination and appointment of a competent Steering Committee and Technical Teams empowered with the required resources and authority to guide and manage the process.

The Ghana Soil Management Policy Steering Committee could be constituted to lead the policy development process and to provide the necessary political, administrative and technical support. Membership of the committee may include Governmental or Ministerial bodies to demonstrate the importance they attach to soil policy and also influence the design and outcome of the process for the wider national interest. Their participation would also allow for easy access to resources and information that are needed for the process, as well as ensure a better dissemination of conclusions and recommendations.

The steering committee, led by its coordinator who would be appointed by the responsible minister, would drive the process and guide the technical teams to ensure that operations run smoothly and important decisions are made. Membership of the committee would include key stakeholders who have the will, required competencies and positions to provide credible contribution towards the success of the process. Such required competencies would include advanced knowledge in relevant technical areas such as agriculture, soil management, land administration, policy development, soil resources research, environmental protection, farmers' representation, and the private sector.

In addition, the Steering Committee may appoint Technical Teams to develop specific guidelines for sustainable soil management in the following technical areas for consideration and possible adoption in line with the FAO Voluntary Guidelines for Sustainable Soil Management (FAO, 2017):

- Minimize soil erosion;
- Enhance soil organic matter content;
- Foster soil nutrient balance and cycles;
- Prevent, minimize and mitigate soil salinization and alkalinization;
- Prevent and minimize soil contamination;
- Prevent and minimize soil acidification;
- Preserve and enhance soil biodiversity;
- Minimize soil sealing;
- Prevent and mitigate soil compaction;
- Improve soil water management.

Other areas such as land tenure and administration for agricultural purposes may also need a special consideration.

The main output of the steering committee would be the development and submission of the draft policy for approval, possible related follow-up amendments, preparation for implementation and communication of all aspects of the policy development throughout all phases.

6. CONCLUSION

The current unsustainable soil management practices adopted on Ghana's croplands accelerate degradation and reduces the potential of the soil to continue to provide the agricultural and environmental services for the current and future needs. Fortunately, there is the growing recognition of the need to act more forcefully now in order to reverse the alarming trends and to restore as well as maintain a healthy soils required for feeding growing populations and also protect its integrity for future soil management requirements.

The process of reversing soil degradation and subsequent attainment of sustainable soil management regime on all croplands in support of Ghana's developmental agenda could be better achieved if the process is driven by a well thought-out policy initiative that harnesses the potential of soil resources in all landscapes as well as mobilize the energies of all stakeholders towards sustainable soil resources management based on science and technology.

It is hoped that the development, adoption and holistic implementation of the proposed policy framework would have the potential to improve the governance of Ghana's soil resources and ensure healthy and productive soils for the attainment of food and nutritional security as well as provide for the overall health and wellbeing of the people.

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