PRIORITIES FOR SUSTAINABLE SOIL MANAGEMENT IN NIGERIA

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INTRODUCTION:

• Planning and execution of sound natural resource management at the watershed and landscape levels are increasingly important for retaining ecological integrity and ensuring that food and fibre systems are resilient enough to absorb shocks and stresses and avoid land and water resources degradation (FRP, 2005; IBRD/World Bank, 2006).

• Prioritizing and addressing desertification, land degradation and climate change challenges will be critical for achieving food security and nutrition, their adaptation to climate change, protection of biodiversity and development of resilience of soil to natural disasters to benefit from new scientific knowledge detailing the extent and importance of ecosystem services and their roles in sustaining human and agro-ecosystems.

• Therefore, investments on emerging scientific knowledge will be necessary in

1. The planning, prioritizing and deployment of appropriate soil management tools for intensive and sustainable soil productivity.
2. Improve access to existing knowledge and information on sustainable land management (SLM) and the consequences of inappropriate management.
3. Rehabilitate land that had been degraded for both productive and ecosystem functions (IBRD/World Bank, 2006).

INTRODUCTION CONT.

• In Nigeria and for agricultural purposes, sustainable soil management which combines technologies, policies and activities aimed at integrating socioeconomic principles with environmental concerns will simultaneously:

- maintain and enhance production
- reduce the level of production risk, and enhance soil capacity to buffer against degradation processes
- protect the potential of natural resources and prevent degradation of soil and water quality
- be economically viable
- be socially acceptable, and assure access to benefits from improved land management

INTRODUCTION CONT:

- About the Country Nigeria.

a. Geographical location and potentials for Agricultural productivity
b. Nature and potentials of the soils for sustainable agricultural production
c. Dominant Land use

- State of Soil Resources in Nigeria

  a. Major soil types/orders in Nigeria

  b. Land degradation

  c. Responses to land degradation

- Needs and Priorities for sustainable soil management
- Institutional settings for sustainable soil management
- Conclusion

The Country Nigeria:

Geographical location and potentials for agricultural productivity:

- The Federal Republic of Nigeria lies in West Africa between latitudes 4^0 and 14^0 North and between longitudes 2^0 2’ and 14^0 30’East. To the north of the country is bounded by Republic of Niger and Chad, to the West by Benin Republic, to the East by Cameroun Republic and to the South by the Atlantic Ocean (FAO, 2009; Aegheore, 2009).
- Nigeria is composed of thirty six (36) States and a Federal Capital Territory (Fig. 1) as administrative arms for running the country.

Fig. 1: Map of Nigeria showing the composite States and Federal Capital Territory

The Country Nigeria

- Nigeria (Fig 1) spreads over some 92 million hectares of land stretching from its Atlantic coast near the equator to 14^0 north (Ojanuga, 2006; Aegheore, 2009; FAO, 2009).
- The country is rated highly potential to produce agricultural commodities due to a combination of favourable climatic conditions, undulating topography, and cultivable soils.
- Annual rainfall decreases Northwards from 4000 mm close to the equator to 500 mm in the Northeast (Chude *et al*., 2011).
- Rainfall is uni-modal close to the equator and in low rainfall areas above 9^0, and bi-modal in areas receiving 1250 to 1500mm annual rainfall amounts between latitudes 4 and 9^0 North (FAO, 1984; Chude *et al*., 2011).
- Annual rainfall could be erratic with dry spells occurring during cropping seasons in some years (Odunze, 2011) in the north, pronounced dry season ranges from 3 to 8 months, occurring from the high rainfall areas in the South to the driest areas in the north.

The Country Nigeria Cont.

Chude *et al*. (2011) group agro-ecological zones in Nigeria into the following:

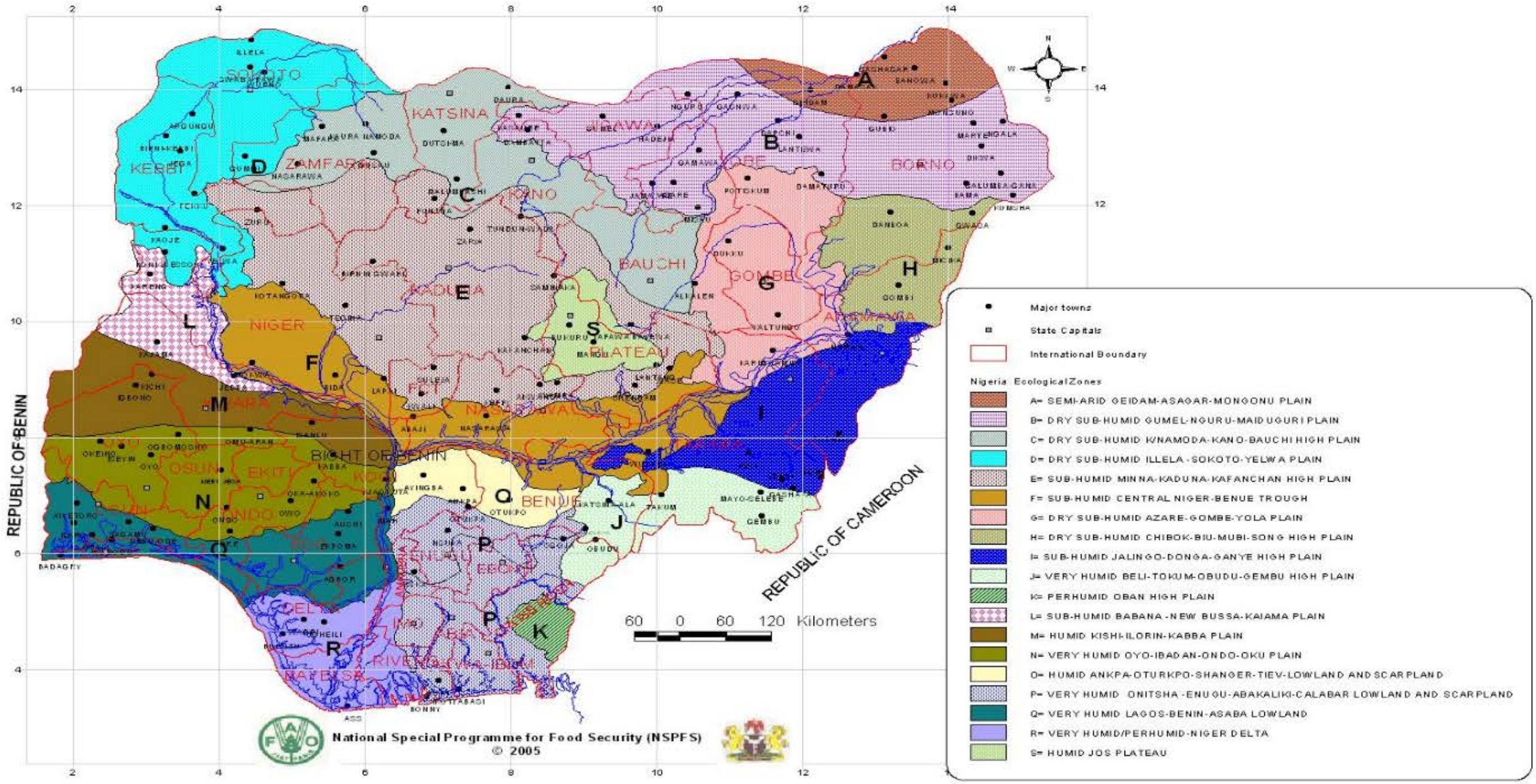
A	Semi-Arid Geidam-Asagar-Mongonu Plain,	B	Dry Sub-Humid Gumel-Nguru-Maiduguri Plain
C	Dry Sub-Humid K/Namoda-Kano-Bauchi High Plain,	D	Dry Sub-Humid Illela-Sokoto-Yelwa Plain
E	Sub-Humid Minna-Kaduna-Kafanchan High Plain,	F	Sub-Humid Central Niger-Benue Trough
G	Dry Sub-Humid Azare-Gombe-Yola Plain,	H	Dry Sub-Humid Chibok-Biu-Mubi-Song High Plain
I	Sub-Humid Jalingo-Donga-Ganye High Plain,	J	Very Humid Beli-Takum-Obudu-Gembu High Plain
K	Peri- Humid Oban High Plain,	L	Sub-Humid Babana-New Bussa-Kaiama Plain
M	Humid Kishi-Ilorin-Kabba Plain,	N	Very Humid Oyo-Ibadan-Ondo-Oka Plain
O	Humid Ankpa-Otukpo-Shanger Tiev Lowland and Scarpland,		
P	Very Humid Onitsha-Enugu-Abakaliki, Calabar Lowland and Scarpland		
Q	Very Humid Lagos-Benin-Asaba Lowland,	R	Very Humid/Perhumid Niger Delta
S	Humid Jos Plateau		

and showed in Table 1 ratings of the zones to rainfed agricultural production potential.

Table 1: Ratings of Agro-ecological zone of Nigeria based on Rainfed Agricultural Productivity

Ranking	AEZs	Limiting Factors
High	E, F, G, I, L, M, O, S	**Nil**
Medium	C, H, J, N, Q	**High or low population density, land suitability**
Low	**A, B, D, K, P, R**	**Unfavourable agro-climate, land suitability, high population density**

AGROECOLOGICAL ZONES MAP OF NIGERIA



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Nature and potentials of the soils for sustainable agricultural production

- Geology of Nigeria is dominated by igneous structures that form most of the hills and highlands.
- Rocks of the basement complex, mainly of igneous origin are encountered in over 60% of the surface area (FAO, 2009).
- Cultivation of some soils could be limited by low water holding capacity; while others, could have poor permeability and weak root penetration caused by impervious layers like plinthitic, hard pans, rock-out-crops and excessive clay content in depths.
- Most soils are highly leached resulting in medium to high acidity, moderate to low cation exchange capacity and base saturation, and low to very low organic matter content.
- Soil nutrient replenishment and soil quality restoration from organic and mineral sources is a prerequisite for continuous cultivation of most soils in Nigeria; particularly under intensive production systems
- Many of the soils are susceptible to erosion due to their locations on the landscape; resulting into gullying in some areas, relatively low organic matter content and fragile structure.
- Soil degradation and attendant depressed yields due to nutrient mining, impoverished soil quality/health, inappropriate soil and moisture conservation practices is wide spread in the country

Dominant Land use: Rainfed Agriculture

- Combined effects of rainfall, temperature, humidity and particularly; the variations of these within agro-ecological zones, exerts a major influence on the types of indigenous and exotic plants that grow or can be introduced into the zone.
- About 90 percent of total agricultural output is produced by smallholder farmers who cultivate between 0.8 to 1.2 hectares in forest zones and 2 to 4 hectares in the savanna zones (Chude *et al*., 2011).
- Root and tuber cropping land use systems dominate in forest and forest-savanna transitional zones in the South; consisting mainly of cassava, yams, cocoyam, and sweet potatoes.
- Cereal grain cropping land use systems; such as guinea corn, millet, maize, rice and wheat are dominant in the Northern savanna zones.
- Other important crops in Nigeria; such as groundnut, melon, cowpea, soybean, Beniseed, cotton, okra, tomatoes, onion and peppers are widely grown as intercrops, relayed, strip crop or sole in the different vegetation zones.
- Cassava is also grown widely due to its tolerance of a wide range of soils. Tree crops such as palm tree, cocoa and rubber plantations are also common land use types in the south (FAO, 2009).

Pastoralism

• In Nigeria Ruminant livestock are numerous and provide substantial quantities of animal protein.

• Livestock rearing is a dominant land use type in the savannah zones of Nigeria; with cattle, sheep, goats, poultry, donkey and camels being prominent.

• Free range, Nomadic or pastoral systems of grazing practice (Plates 1) by herders are common in rural and less populated savanna zones, and account for the high rate of soil degradation by livestock, conflicts between crop farmers and cattle herders for land and herbage in urban and peri-urban communities (FAO, 2009).

Plates 1: Livestock movement in the Nigerian Savanna Zones

Irrigated Agriculture

- The Nigerian Government has promoted irrigated agriculture to argument rainfed farming across all the agro-ecological zones of the country and boost sustainable food crop production and ensure food security.
- River banks, stream watersheds, and flood plains are utilized for irrigated crop production.
- Currently upland and lowland rice production systems are encouraged in best-fit ecologies with a view to attain 2.5-3tha^{-1} and 5-6tha^{-1} paddy rice yield respectively for upland and lowland production systems.
- Vegetables like tomatoes, garden eggs, cabbage, onion, carrot and pepper are grown under rainfed, residual moisture and irrigated conditions.

State of Soil Resources in Nigeria: Major soil types/orders in Nigeria

- Major soils of Nigeria according to FAO Soil Taxonomy legends are: fluvisols, regosols, gleysols, acrisols, ferrasols, alisols, lixisols, cambisols, luvisols, nitosols, arenosols and vertisols that vary in their productivity rating as shown in Table 2
- Soils in Nigeria are formed from residues of deeply weathered, basement complex rocks, alluvial materials derived from humid, mixed alluvium and Aeolian deposits of dry tropical conditions.
- Most of the soils (Table 2) are cultivable during rainy seasons because of their adequate depths and permeability.
- However fluvisols, gleysols, regosols, luvisols lixisols, cambisols nitosols dominate soils of Nigeria with a total land area of 474Km^2 or 51.97% and therefore present most cultivable soils in Nigeria as belonging to the medium to good productivity class

Soil Map of Nigeria

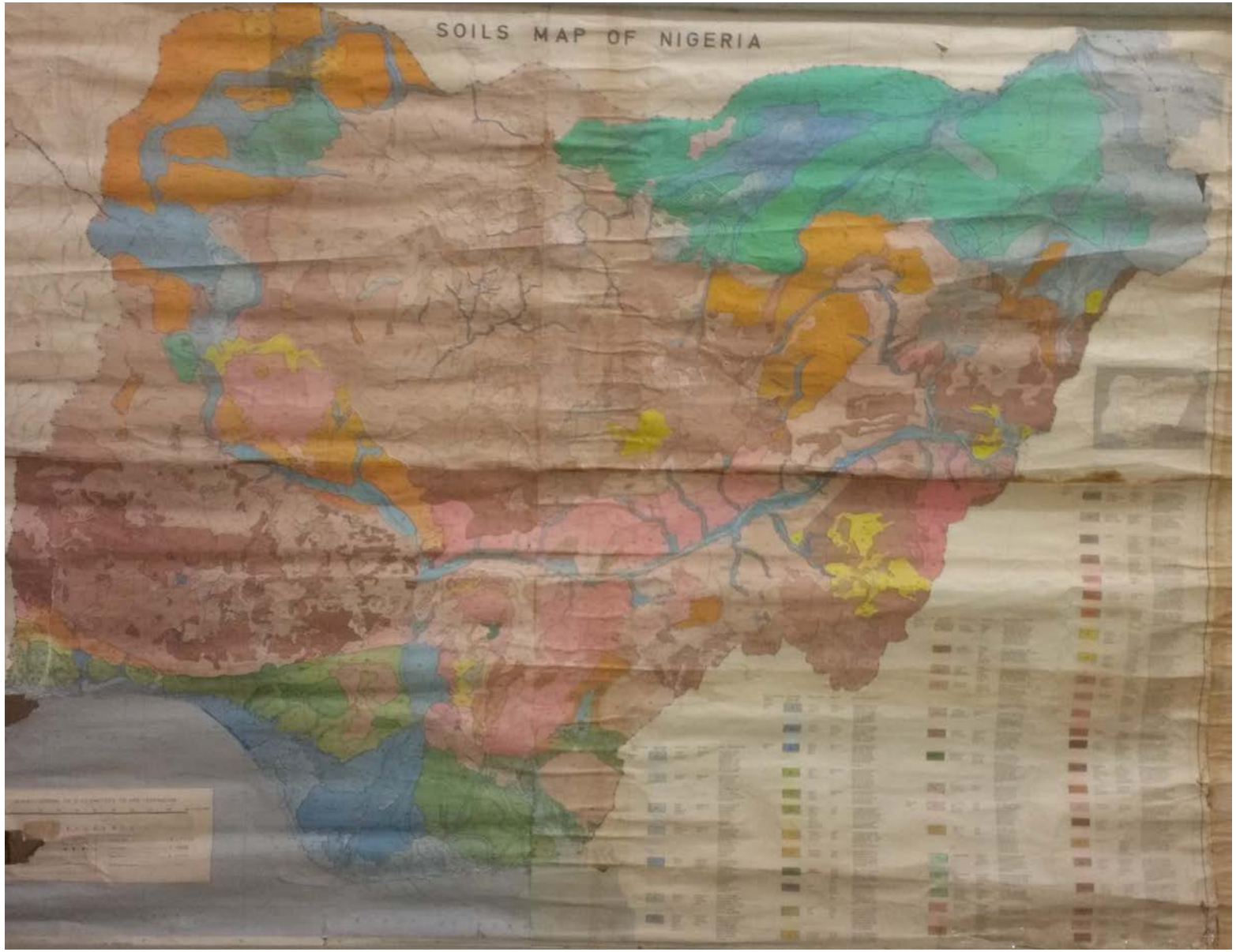


Table 2: Productivity Potentials of Nigerian Soils:

Soil Productivity rating	FAO Productivity Class	Area	
		Km^2	% total area
High (1)		-	-
Good (2)	Fluvisol, Gleysols, regosols	50.4	5.52
Medium (3)	Lixisols, Cambisols, Luvisols, Nitosols	423.6	46.45
Low (4)	Acrisols, Ferrasols, Alisos, Vertisols	289.2	31.72
Low (5)	Arenosols, Nitosols	148.8	16.32

Threats to Soil Quality

- The various threats to soil quality and ecosystem services in Nigeria include :

(1) Erosion (by water and wind),

(2) Soil organic carbon change,

(3) Soil contamination,

(4) Soil acidification,

(5) Salinization

Threats to Soil Quality Contd.

(6) Loss of soil biodiversity,

(7) Water-logging,

(8) Nutrient Mining,

(9) Soil Compaction and

(10) Soil Sealing

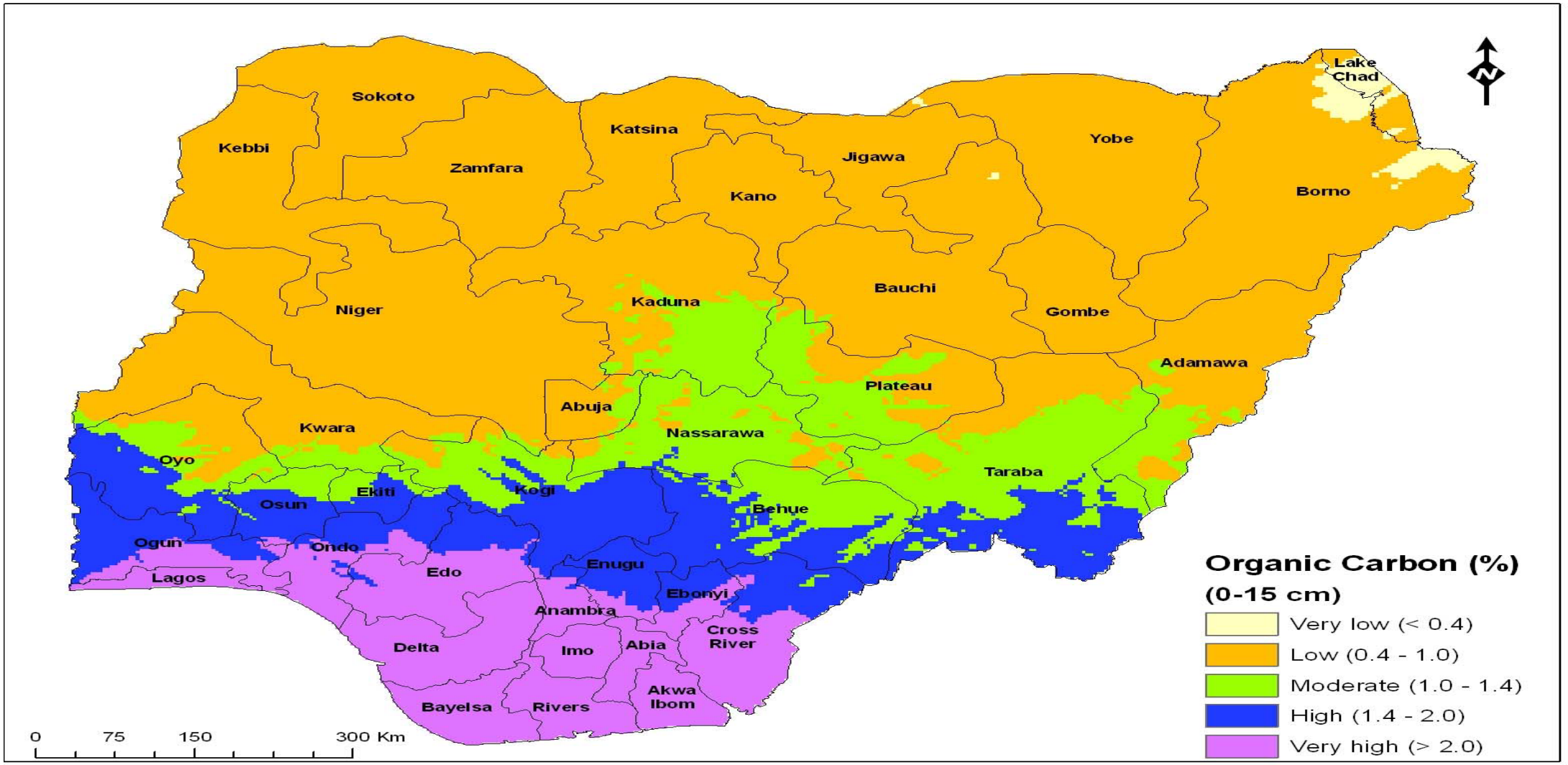
Land Degradation: Main Land Degradation types

- Loss of Vegetation Cover and Top soil
- Soil erosion and nutrient losses
- Salt Problem in soils

Main Causes of Soil/Land Degradation

- Aridity, over-grazing, indiscriminate tree/vegetation cutting for fuel, fencing/construction and livestock feeding
- Increase/expansion of settlements (urban and rural), continuous cropping, inappropriate crop and soil management practices by soil users
- Encroachment of cropping into marginal lands and designated rangelands
- Poor urban settlements' planning and roads' construction.
- Field infestation with noxious weeds such as Striga spp.
- Land preparation equipment use, method

Soil Fertility Maps of Nigeria



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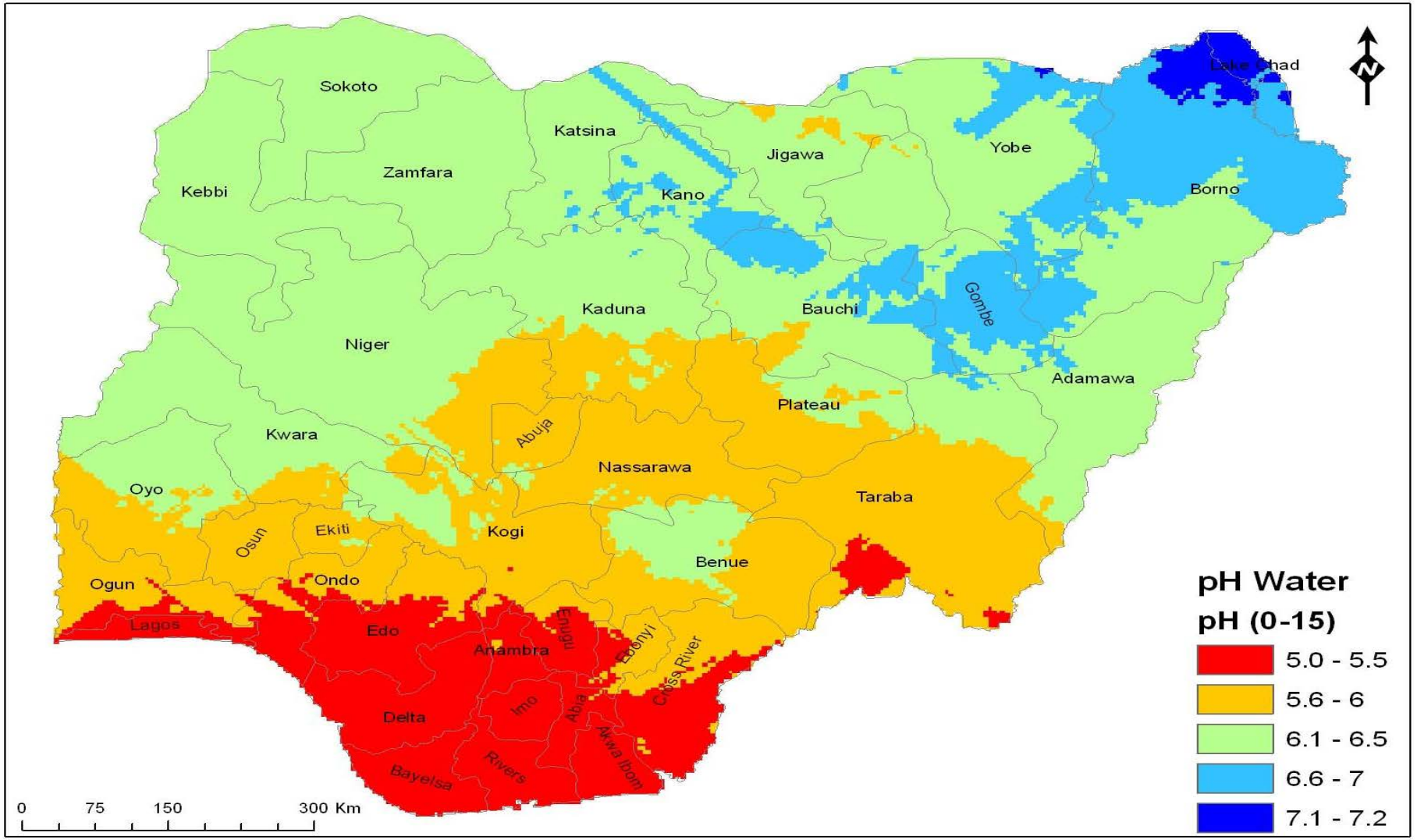

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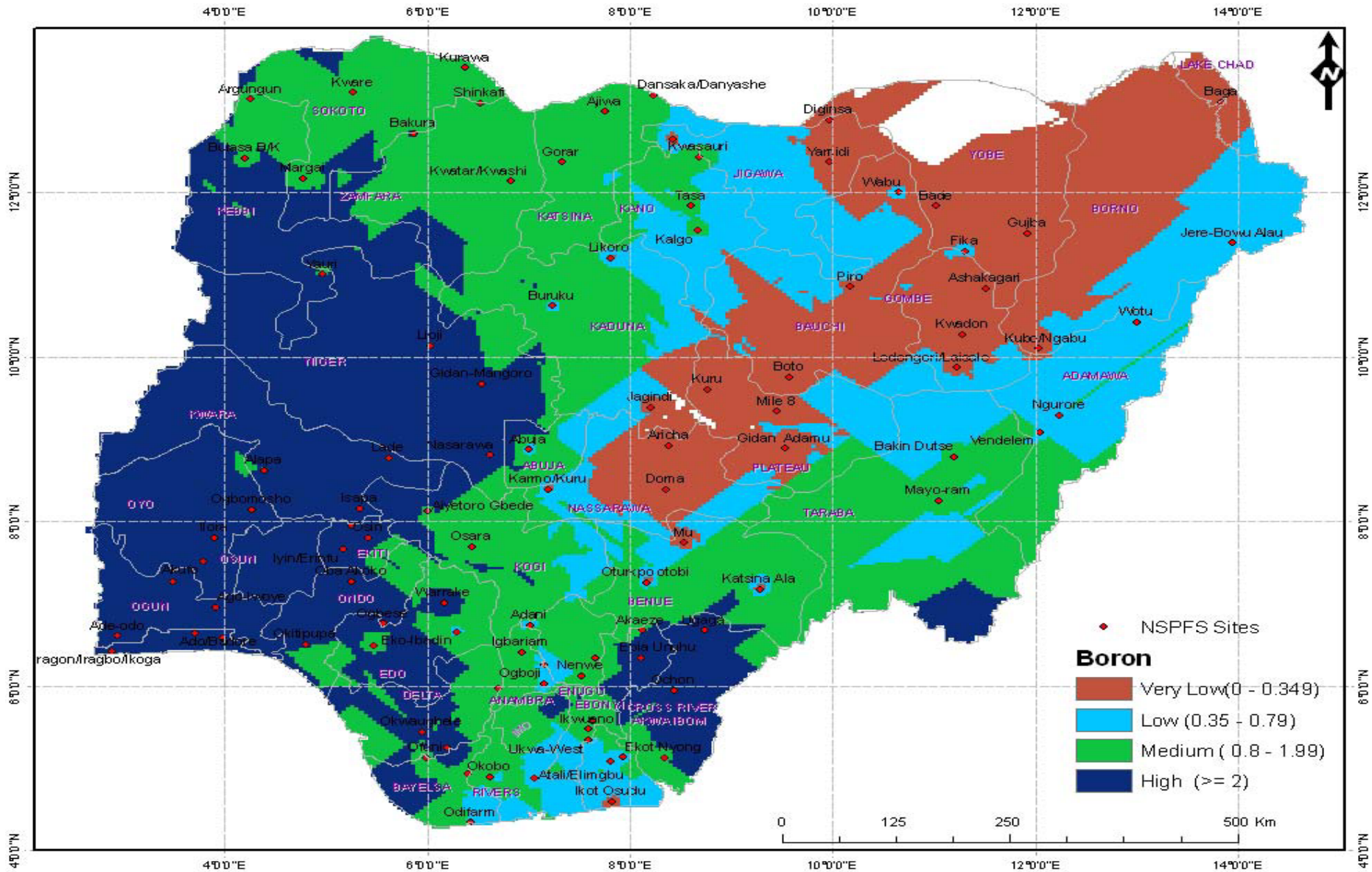

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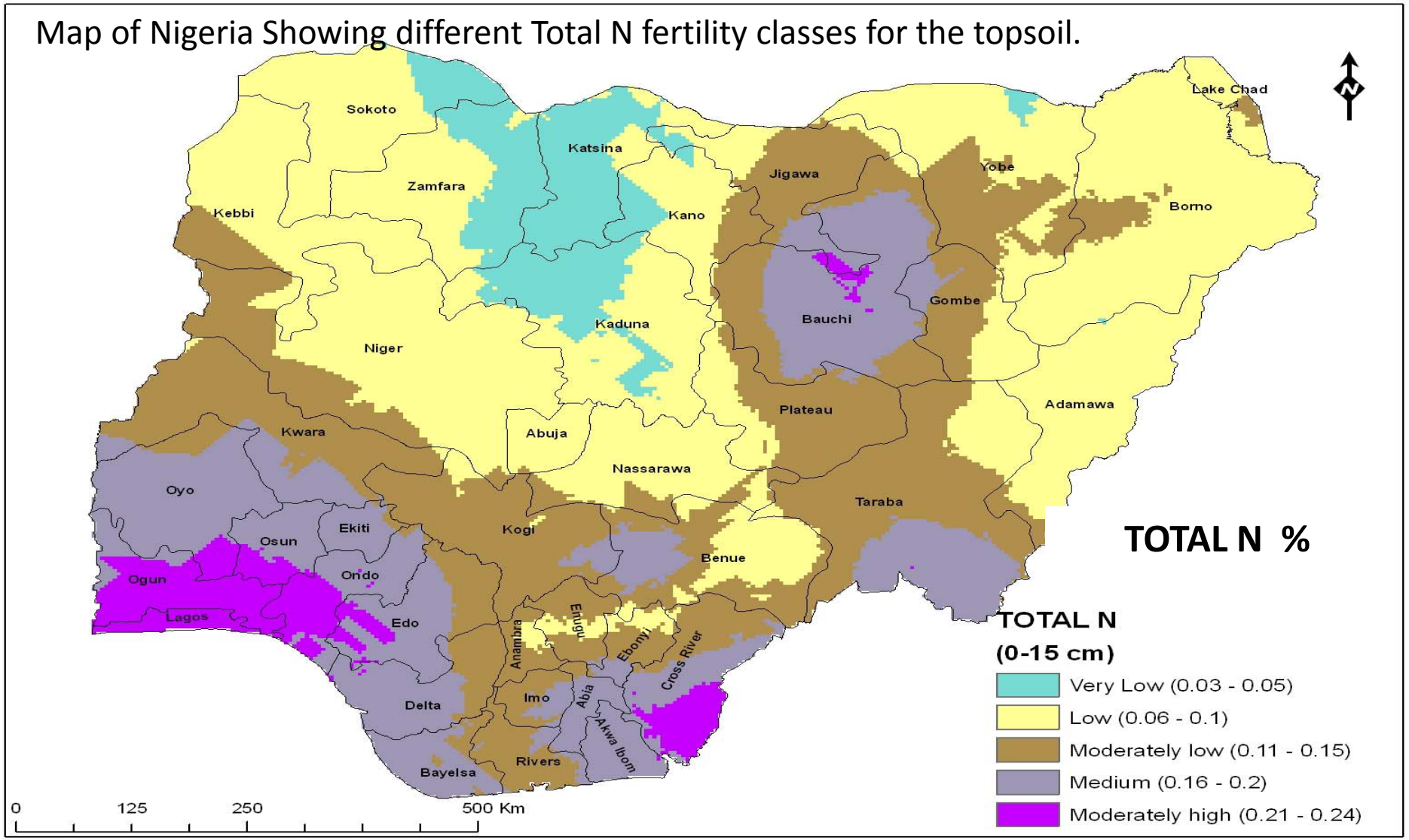

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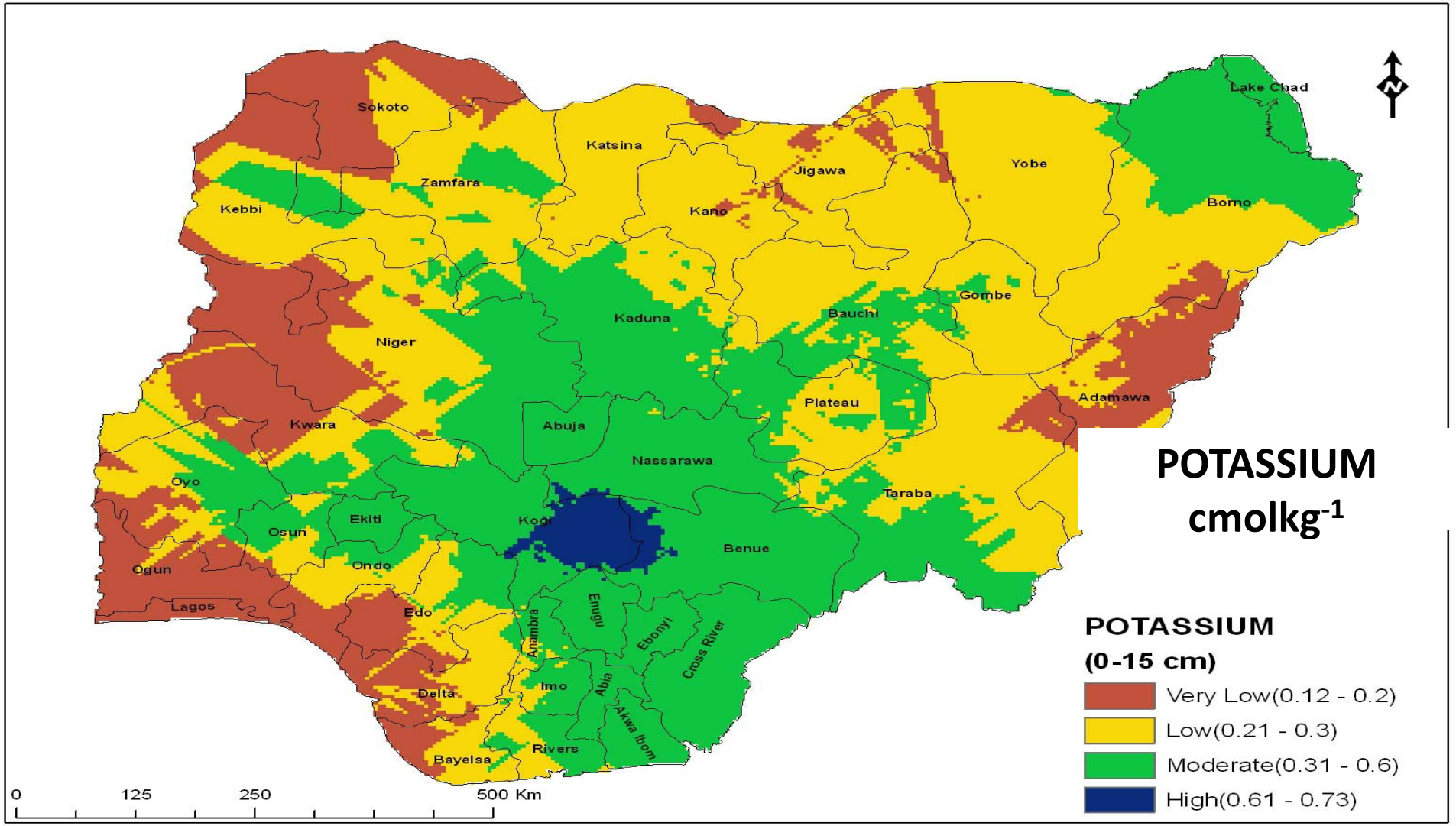

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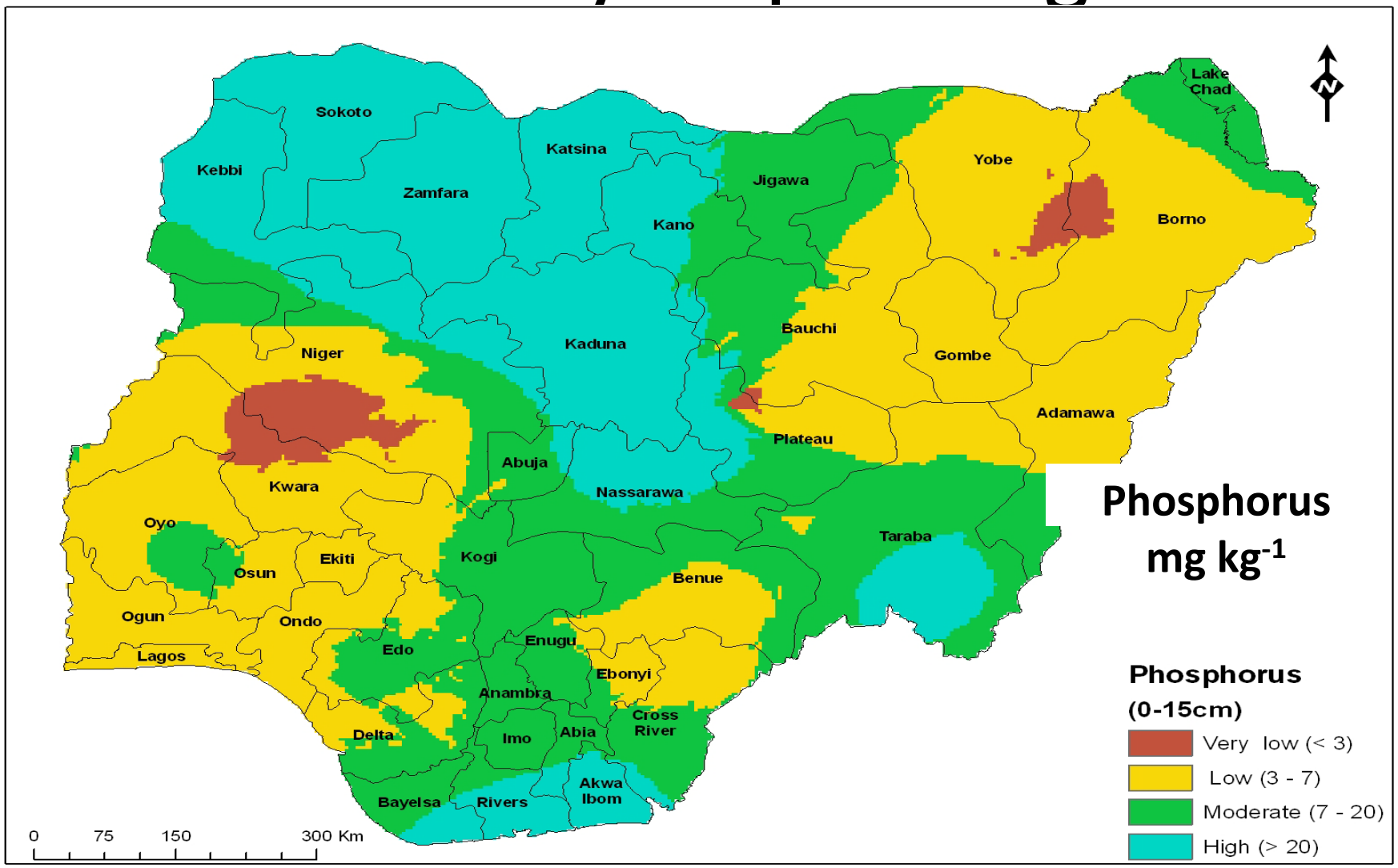

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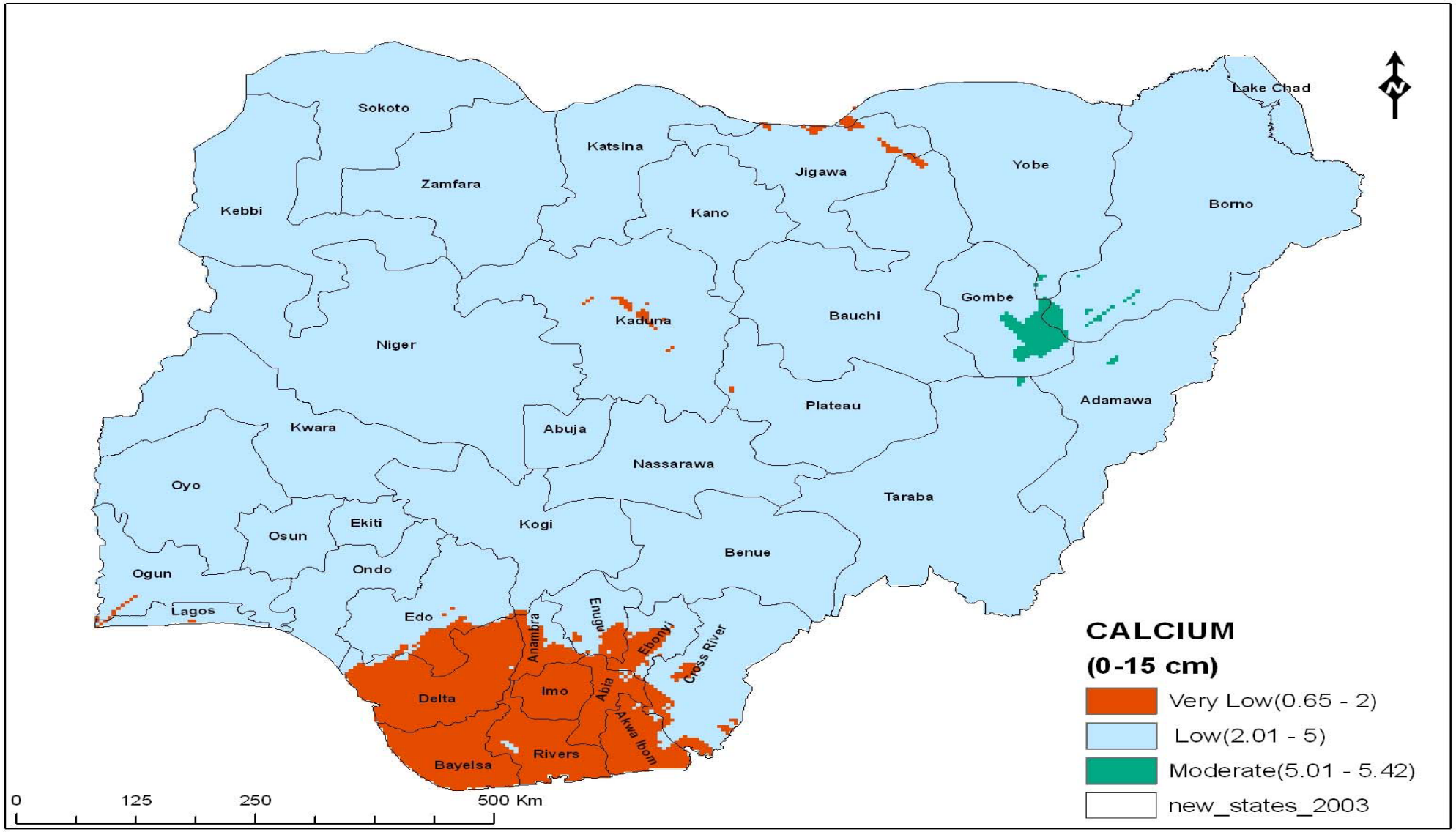

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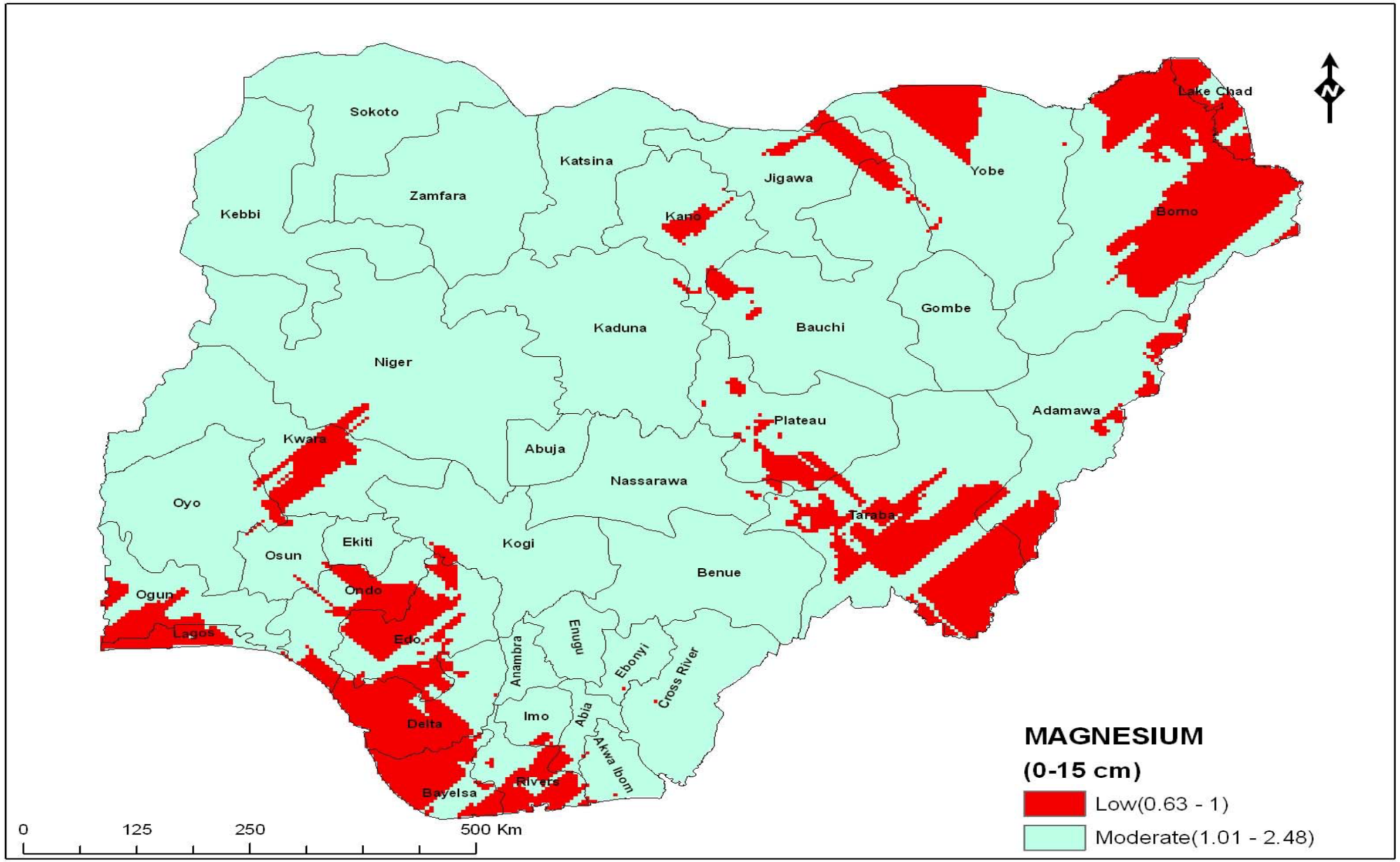
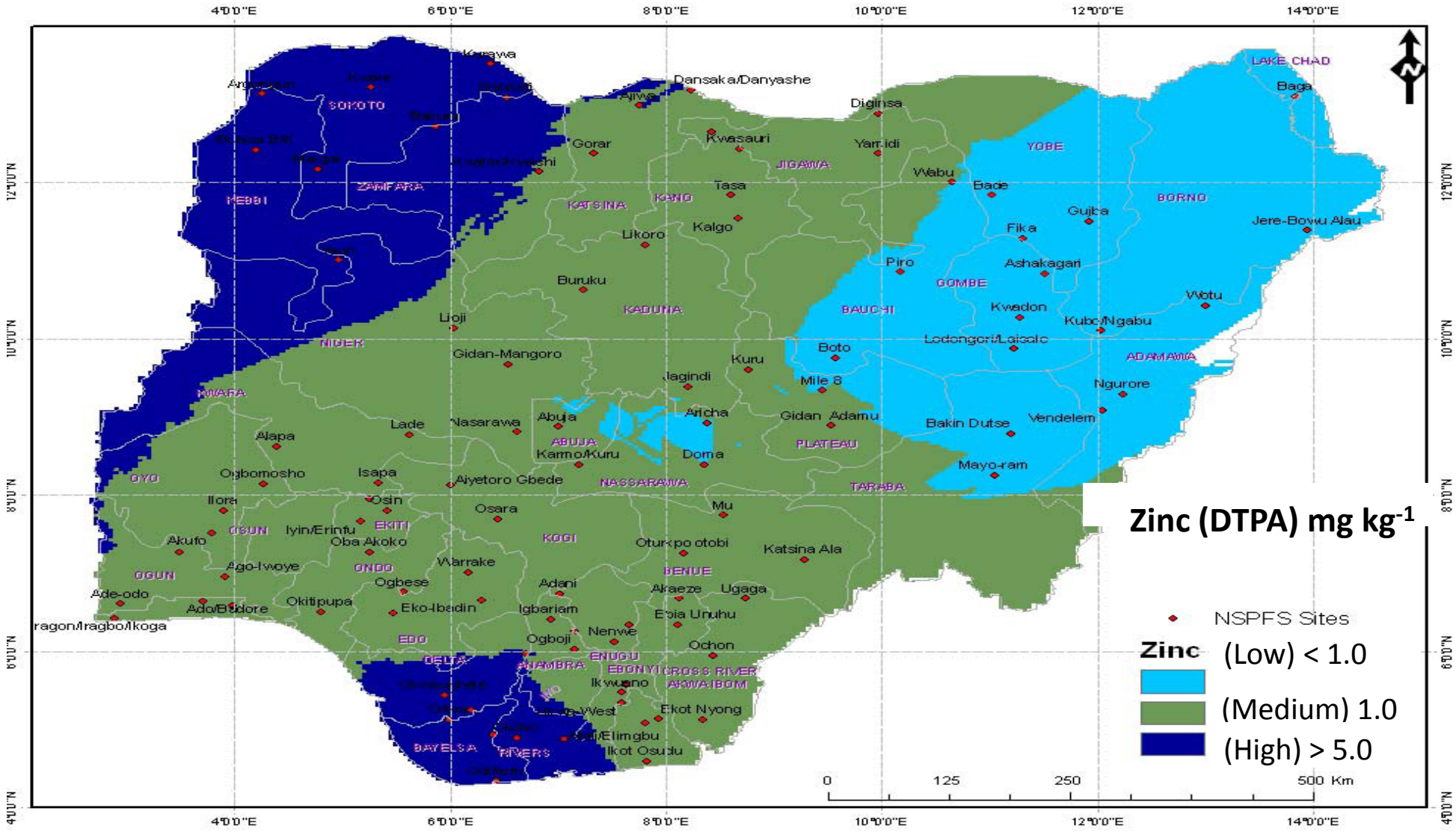


Soil Fertility Maps of Nigeria

Map of Nigeria Showing different Zinc fertility classes.



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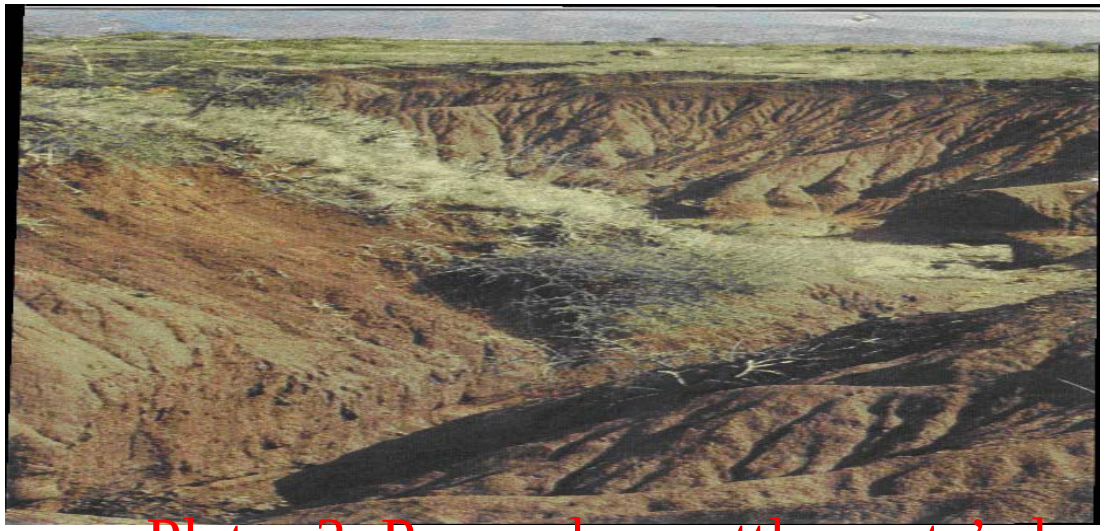
Responses to Land Degradation in Nigeria

Aridity, over-grazing, indiscriminate tree/vegetation cutting for fuel, fencing/construction and livestock feeding

Plate 2: Over-grazed land in arid Nigeria with sparsely distributed tree and shrubs

Increase/expansion of settlements (urban and rural), continuous cropping, inappropriate crop and soil management practices by soil users



Plates 3: Poor urban settlements' planning, roads' construction and farming practice failures causing gullying

Positive Response to Land Degradation

Good ground cover for enhanced soil health, sustainable productivity and use of animal traction for reduced tillage on tropical fragile soils

Controlling Striga menace and restore soil health using appropriate legume-cereal intercrops

NEED AND PRIORITIES FOR SUSTAINABLE SOIL/LAND MANAGEMENT

- Land resource inventories; including soils in Nigeria, are limited only to some parts of agricultural potential areas, though a reconnaissance level soil map of Nigeria has been produced. There is the urgent need to prioritize and produce detailed soil map of Nigeria with a focus on agriculturally potential ecologies.
- Strengthening the capacities of soil managers/stakeholder institutions (Institutional, technical, manpower, financial) to monitor and report on status of Nigerian soil resources.
- Increase the adoption of sustainable soil management practices and technologies; including integrated approaches of soil health/quality management, extension services and partnership/linkages for technology update and transfer.
- Linking modern technology with indigenous farming traditions.
- Establishment of a ‘National Soil Research Institute that should have the mandated to oversee the nations’ nonrenewable natural resource use/management. The absence of such an institution in the nations’ history accounts for the level of soil/land degradation and continued misuse, witnessed nationwide.
- Continued assessment, mapping and monitoring of land degradation (Land degradation monitoring system) across the nation.
- Soil testing services to assess the quality of soils and recommend site and crop specific fertilizers .
- Addressing the inadequacy of infrastructure and marketing organization.

Institutional Setup for Soil/Land Management in Nigeria

Federal Government of Nigeria (FGN)

- Federal Ministry of Agriculture and Rural Development
- Federal Ministries of Environment
- Federal Ministries of Water Resources
- National Meteorological Agency (NIMET)

The thirty six (36) States and Federal Capital Territory.

- States' Ministries of Agriculture and Rural Development
-States' Ministries of Environment
-States' Ministries of Water Resources

Institutional Setup for Soil/Land Management in Nigeria cont.

Local Government Areas (LGAs) of States and Federal Capital Territory

- LGAs Ministries of Agriculture
- LGAs Ministries of Environment
- LGAs Ministries of Water Resources

Academic Institutions:

- Federal, States and Private Universities, Polytechnics, Colleges of Agriculture and Colleges of Education.
- Universities of Agriculture, Faculties/Schools or Departments of Agriculture
- Faculties of Water resources, Environment etc.

FAO and Other Related International Organizations involved in Soil Research, Trainings and Projects

- Federal Ministry Levels
- State Levels
- University/Polytechnic/Colleges levels

CONCLUSION:

- Land/Soil degradation is a common sight in Nigeria and continues unabated due to the absence of a ‘National Soil Research Institute’ charged with the responsibility to oversee use, sustainable management of the nations’ nonrenewable natural resource (soil) and monitoring the incidence; if any, of land degradation across the country.
- Most productive agricultural lands are being rapidly impoverished due to low fertility restoration measures, nutrient mining by crops, soil erosion and improper soil management practices.
- Integrated soil health/quality management approach should be prioritized and adopted in agricultural soil use of the nation to ensure sustainable agricultural productivity, food security and environmental conservation.
- Detailed soil map of Nigeria with a focus on potential agricultural productive areas should be conducted to allow for sustainable intensification of agricultural production and the attainment of national food security

THANKS YOU FOR LISTENING

DON’T FORGET THE SOIL: SUSTAIN LAND STEWARDSHIP FOR ENVIRONMENTAL FRIENDLINESS AND SOIL PRODUCTIVITY