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TESTING OF SOIL PRODUCTIVITY ACROSS SLOPES AND INDEX MAPPING USING LANDPKS

MUAZU MAMMAN OMEIZA
Agricultural Technology Department, Kogi State Polytechnic Itakpe

ABSTRACT
A study was conducted to test soil samples using LandPKS at different depth across slopes and topography in the kogi agricultural development project ADP sites in lokoja the state capital of kogi state, Nigeria.A point across slope was selected from the study site situated behind the ADP building andcharacterized features of soils such as soil Texture, soil colour and land slopes were observed. Data generated were collected, tabulated and analysed by the Land Potential Knowledge System(LandPKS) whose various interface and results were used in determining soil productivity of that site and its reperesentation on the map using Soil mapping units or geographical information system GIS was shown on the platform. The study concludes that since soil testing is key during the pre-planting operations its result will go a long way in correcting land deficiencies by making recommendations for companies to provide fertilizers to be supplied in the right proportions for maximum productivity and sustainability.

Keywords: *LandPKS, Land Potential Knowledge System, Lokoja, Soiltesting, GPS and Soil Mapping*

INTRODUCTION
Soil testing are technique that can be employed widely to assess the potentials of soils to supplying the essential nutrients needed by crops and animals to attaining their maximum productivity and sustainability .Soil

test has immense benefits to farmers, gardeners, horticulturists and florists as its assist them in determining the potential use and value of farmlands

.Soil testing refers to the chemical analysis of soils and is well recognized as a scientific means for quick characterization of the fertility status of soils and predicting the nutrient requirement of crops. It also includes testing of soils for other properties like PH, texture, structure, Cation Exchange Capacity, water holding capacity, electrical conductivity and parameters for amelioration of chemically detoriated soils for recommending soil amendments, such as gypsum for alkali soils and lime for acidic soils.(Hanway.J.J.andHeidel.H.(1952)

In recent decades the world Bank assisted programs to supporting Agricultural projects in Nigeria and Africa at large has been on the top gear with the view to ameliorating poverty and improving livelihoods through value chain agricultural productions and this calls for the urgent need for increasing crop productivity which can be achieved through improving land potential and soil nutrient balance.

PH meter or measuring equipment can also assists in testing for cat ions and anions in the soil chemical composition which in turn allow the farmers to plan on the usage of fertilizer with the desirable ratio to correct nutrient deficit and excesses in the soil. The ions and the mineral elements present in a particular soil are responsible for the degree of acidity and alkalinity in a provided soil samples and their analysis can assist soil scientist to suggest by recommendation the natureor the appropriate composition of its element by ratio the desire fertilizer to be added to the soil.

Land Potential is defined to include both potential productivity and potential resilience(Herrick et al.2015).This definition integrates the potential to support virtually all terrestrial ecosystem services and biodiversity because they ultimately depend on some form of primary production. Both potential primary production and resilience ultimately depend on relatively static soil properties(texture, depth and minerology),topography and climate.(Herrick et al.2015)

Soil test is very paramount in the preparation of land for cultivation of crops for so many reasons among which are optimization of crop production, protections of the environment from contamination by runoff and leaching of excess fertilizers,to aid in the diagnosis of plant culture problems, to improve the nutritional balance of the growing media and to save money and conserve energy by applying only the fertilizer needed.(Cox,D.A.) Soil testing is an important diagnostic tool for determining the nutrient needs of plants and for environmental assessment as its widely accepted and used in most advanced crop production areas of the world to determine fertilization needs for crops.(A.P.Mallarino 2005).

STATEMENT OF RESEARCH PROBLEMS

Soil testing analysis, interpretations and improvement of calibration by soil scientist is time bound and capital intensive, but despite with the increasing interest in agriculture and land management the non-scientist are often limited by their inability to identifysoil features or to select the correct soil mapping information is based on the above problems that this paper Objective deals by developing an approach of using the Land Potential Knowledge System(LANDPKS) for soil features classifications, identification and their representation by unit and location in the soil map using GPS.

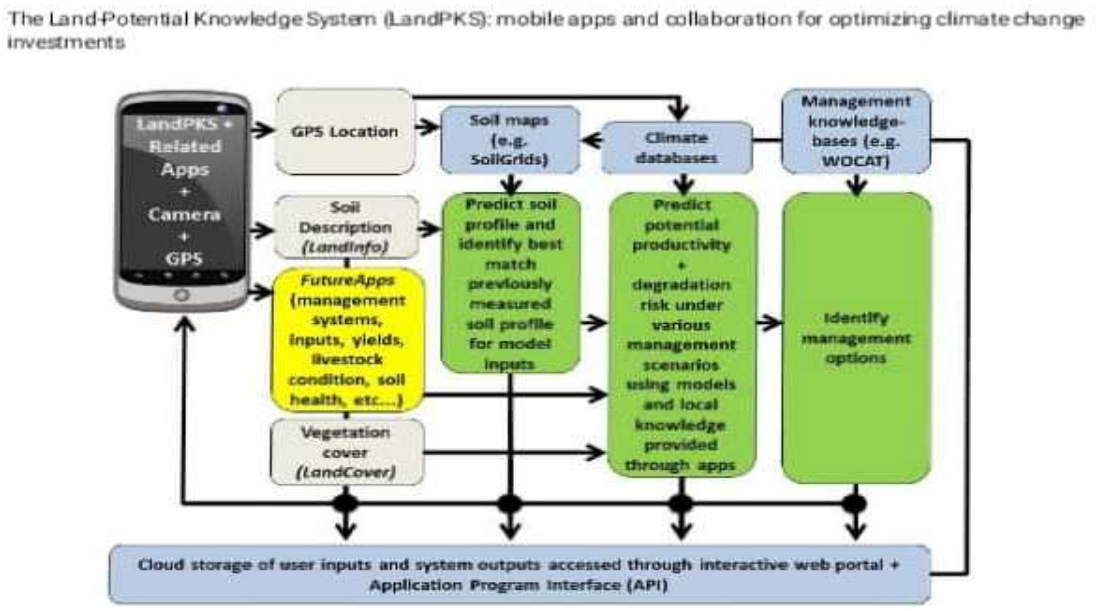
TheLandPKSis a mobile phone application largely funded by USAID and implemented by the united states Department of Agriculture. Itis being developed to provide individual users with point-based estimates of land potential based on integration of simple,geo-tagged user inputs with data, information(http://landpotential.org). LandPKS is designed to grant access to several global databases and help offset the major challenges land resource managers face in getting access to good – quality site-specific information on soils, vegetation, topography and climate.

To help address such land potential issuesLandPKS was deployed to farmers to be used as it comprises a free modular mobile app connected to cloud- based storage, globaldatabases, andmodels, downloadable from

Google play or the iTunes App store: and a system for sharing data, information and knowledge

.The initial components of LandPKS are two integrated mobile apps which are LandInfo and LandCover Apps.

Fig1:Diagramatic illustration of the automation of the LandPKS mobile app



Source:(http://landpotential.org). LandPKS

The LandInfo mobile App produces knowledge and information that explicitly define land potential(relative productivity and degradation risk) by identifying the land management system that is most appropriate for local conditions.(Herrick,J.E.et al.2013)

Tapping into recent advances in cloud computing ,digital soil mapping, Global positioning System(GPS) , enabled camera phones, the LandInfo app allows users to enter point-specific information about soil texture, topography and easily observable soil properties and in turn obtain site specific data including temperature, rainfall, estimated amount of water the soil can store for plants, and growing season length among others.(Nicholas Ozor .et.al 2015).

The LandCover application functions using a stick method in assessing vegetation cover and structure of plot of land. The outputs of the landcover provide important information such as percentages of bare ground and vegetation cover, which is important in rangeland health monitoring.(Nicholas Ozor.et.al.2015). We embarked on site sampling of soils from the respective location in the ADP Lokoja site for soil testing and demonstration of the usage of LandPKS for soil identification

AIM AND OBJECTIVE OF THE STUDY

The basic aim of this paper is to educate the farmers, soilscientist, extension agents and ecologists on the immense benefits of soil testing and its innovations as a unique techniques for rational fertilizer application and informed decisions to choices of land usages for agricultural activities. The aim will be achieved through the following specific objectives:

1.To determine the soil nutrients status and recommend nutrient supplement through chemical fertilizer and organic manures for the desire cropping and ecological systems.

2.To equip farmers and land planning managers with the technology of how land potential knowledge and information's are gathered, integrated and shared globally.

3.To identify mineral elements and ions deficiency or excesses through soil analysis and suggest solutions for productivity and sustainability.

4.To generate and input data for compilation of soil fertility index and mapping

5.To describes how landPKSinstallation, synchronization and generation of data's makes information to be accessible privately or shared globally through index mapping.

METHODOLOGY

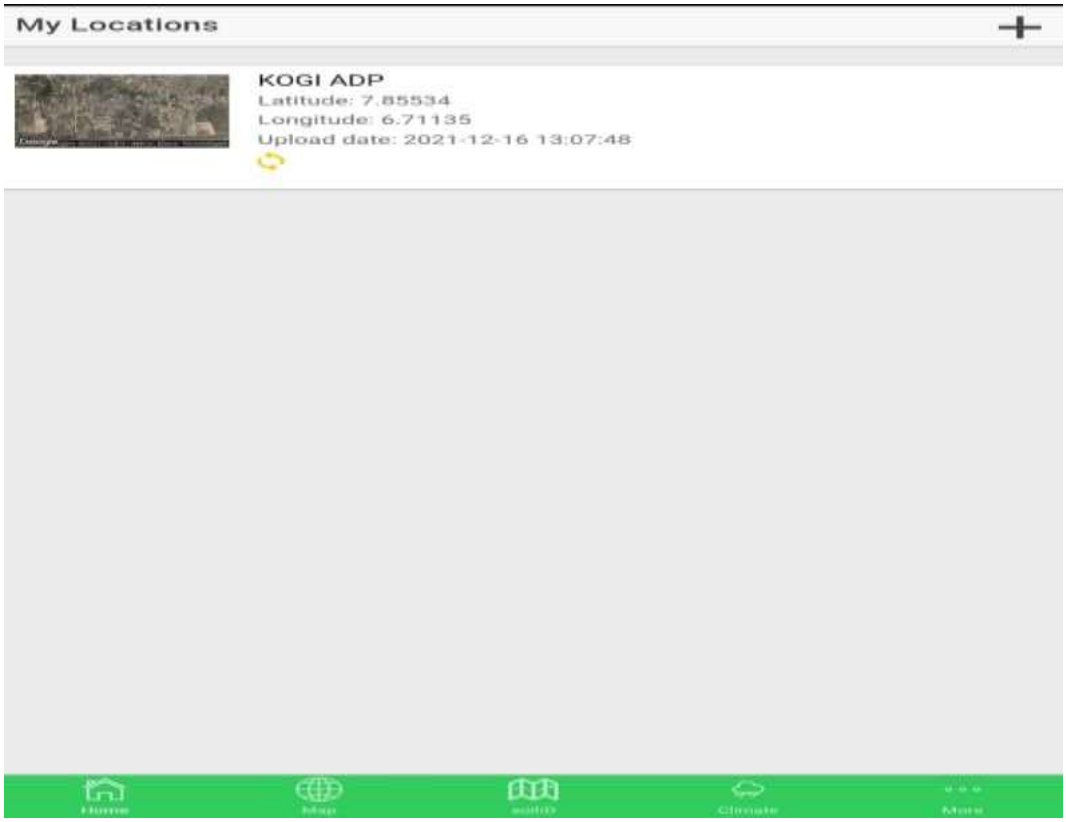
We made available all the necessary tools and equipment at the Agricultural development ADP site to conduct test by following the steps involve as directed by the applications usage instructions sessions by starting the sampling of the ADP garden of Latitude 7.85534,Longitude

6.71135 and altitude of 115m above sea level to test some soil samples and we made sure all the needed materials were on hand.

The material needed for the soil sampling exercise are boots, hand trowel ,shovel, spades, core sampler, probe, hammer, tapes, packaging nylons, tapes and markers, white paper(cardboard),Calibrated Stick, IPAD or an android phone connected to the internet or data packets subscriptions.

We downloaded the LandPKS mobile app using Android or IOS by providing our Gmail accountaddresses for authentication and when the app has successfully been downloaded into our phones we then click on the icon on the phone interface to load open. After opening we clicked on the + sign to create a new site wherea dialog box will pop up to input the site name, while coordinates likelatitude, longitude and altitude are obtained using the inbuilt GPS on the platform.

Fig2.The picture of my location user interface showing icons for homepage, soil ID and climate



Source:(http://landpotential.org). LandPKS

Furthermore we enter data into the input taband we were being guided by the app to comparing the features of the soil ranging fromsoil texture andstructure against the features embedded in the LandPKS through interactive session to identifying by predictions the choices for soil types and nutrient composition.

We dug a hole in the soil and made sure we took multiple soil samples of points at different depth of 0.1,1-10,10-20,20-50,50-70,70-100 and100-20 by using a calibrated metal stick which can be pushed into the soil at desirable depths by a hammer and a shovel.

To ascertain the differences in colour and texture along depths as in the fig3 below, the texture platform is used to compare samples features with predictions from the mobile App and camera captions of the various samples determine their distinct color and the samples are very much likely to have huge variations in soil nutrientsdistribution as well as soil development.

Fig3:Photography showing Testing for soil texture, soil color by photo captions with the embedded camera in the LandPKS app

The LANDPKSis a user friendly and all interactive APP whose captions on the various soil samples collected can be used to determine the texture and

colour while Prescence of soil rock fragments can be predicted to ascertain the soil texture and in turn make informed decisions on nutrients needed for cultivations through synchronization of data entered.

Caption entered into the input tab are saved for Soil ID and we clicked on the "Synchronized Now" icon at the top of the data input screen over internet connection to back up your data to the cloud for easy retrieval and further accessibility.

RESULT

Transmitted data and reports for soilID,Soil Health and Land Management popped out of the result tab and can be assessed in the portal in tabular forms, linear graph and mapsto be generated in PDF format as shown below .

The findings from the generated data reports was that all soils within the topographical locations where samples was taken are slightly acidic in nature after having tested them with a PH meter with electrodes provided and mostly sandy loam soils as reveals from depth 0-20cm sandy,50-70cm is sandy loam and clay from 100-120 which are typical of the middle belt of Nigeria and the south west Nigeria.

By standard the degree of acidity of the soil as well as its alkalinity and salinity are not suitable for growing most of the crops except little amendments are done depending on the nature of the crops.

Fig4:A generated report displayed by the LandPKS app

LandPKS

LandPKS Data Report

Site Name: KOGI ADP
Upload Date: 2021-12-16 13:07:48
User: mammanm75@gmail.com
Latitude: 7.85534
Longitude: 6.71135

LandInfo report

AWC Estimated to 20 cm (cm):
AWC Estimated to 1 Meter (cm):
Surface Infiltration Rate (mm/hr):
Soil Properties by depth:

Depth (cm)	Texture	Rock Fragment %	Soil Color
0-1	SAND		
1-10			
10-20	SAND		
20-50	SAND		
50-70	SANDY LOAM		
70-100	SANDY CLAY		
100-120			

Land Capability Classification: 3s-l

Land Capability Classification Criteria	LCC Class
Erosion risk (e) (e)	1
Soil depth (s-d) (s-d)	1
Surface soil texture (s-t) (s-t)	
Salinity (s-k) (s-k)	1
Surface stoniness (s-r) (s-r)	1
Soil water storage capacity (s-a) (s-a)	
Lime requirement (s-l) (s-l)	3
Flooding during growing season (w-f) (w-f)	1
Water table depth (w-d) (w-d)	1
Permeability (w-p) (w-p)	

Source:(http://landpotential.org). LandPKS

The findings from the generated data reportswas that all soils within the topographical locations where samples was taken are slightly acidic in nature and mostly sandy loam soils as reveals from depth 0-20cm sandy,50-70cm is sandy loam and clay from 100-120 which are typical of the middle belt of Nigeria and the south west Nigeria. But in global soil maps which are showed on the platform there are uncertainties about individual soil components not located and boundaries of soil mapping units not accurately drawn as a result of an obvious larger mapping scales i.e,1:1,000,000.

CONCLUSION

Agricultural lands in those areas need to involve further test of fertilizer provided to give specification to manufacturers on the nutrients mostly needed among the ratios of NPK for better productivity of crops. It is worth to note that soil basicity decrease across slopes from North to middle belt while acidity increases across slopes from middle belts to the southern Nigeria.

RECOMMENDATION

The soil properties or fertility variations as its being represented on the map or geo statistics data accessible to the world in the LandPKS, the maps can be used by fertilizer companies and research institutes to develop specialize fertilizer for desirable crops in different agro-ecological zones

world wide. More studies will be necessary in the long run to analyze the benefit of LandPKS technology towards addressing land potentials issues through soil testing for better choices that will empower farmers globally. The developers and partners of this mobile app and its like should invest in human capacity and end-usersparticipations in its feasibility planning and design stages.

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Jeffrey E.Herrick,AdamBeh,EdmundoBarrios,loanaBouvier,MarinaCoetzee,DavidDent,EmileElias,TomislavHengl,JasonW.Karl,HanspeterLiniger,JohnMatuszak,JasonC.Neff,LilianWanguiNdungu,MichaelObersteiner,KeithD.Shepherd,KevinC.Urama,Rik Bosch & Nicholas P.Webb