DEVELOPMENT OF DIGITAL SOIL FERTILITY MAPS FOR POLICY DECISION AND FARM-SPECIFIC RECOMMENDATIONS TO ENHANCE AGRICULTURAL PRODUCTIVITY IN KENYA

Current Status and Challenges of Kenya's DSM

Declining soil fertility is a major challenge to food production in Kenya. This is exacerbated by **excessive nutrient mining** and uniform fertilizer recommendations in a spatially variable agricultural landscape.

To tackle this, several soil fertility programs have been implemented;

- Fertilizer Use Recommendation Project: **FURP (1985-1992)** - Implemented in 32 districts and published 24-districtwise fertilizer recommendation guidelines
- National Accelerated Agricultural Input Access Programme: **NAIAAP (2012-2014)** – Implemented in 44 out of 47 Counties and collected 9,600 soil samples

Current Status and Challenges of Kenya's DSM

Challenges

1. Limited new soil data sets – national scale;
2. Limited geo-referenced soil data – need for new baseline data;
3. High turnaround time in soil data analysis
4. Limited accessibility and availability to affordable soil health services – need to stakeholder needs assessment and use case development;
5. Low data and information standardization i.e inconsistent metadata – challenges in federating soil data - need for standardization;
6. Concerns of data custodians about sharing sensitive data and the uncertainty around assigning data sharing permissions

WB funding – through NAVCDP and FSRP to address this challenges

Project Goal & Objectives

Goal: To contribute to improved food and nutrition security, and enhanced household incomes and livelihoods in Kenya.

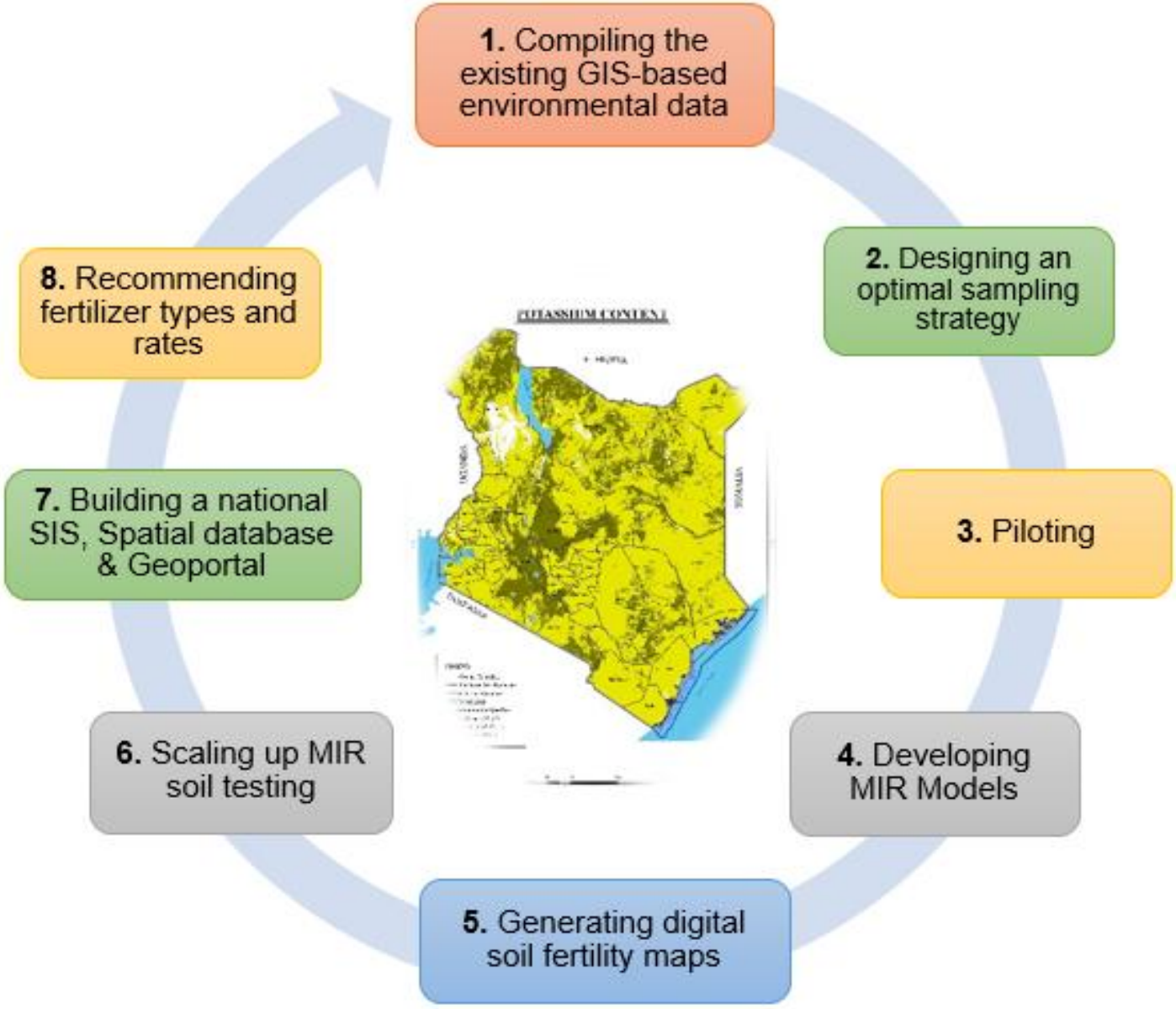
Overall objective:

To develop digital soil fertility maps and farm-specific fertilizer recommendations for improved agricultural productivity in Kenya

Specific objectives:

1. Determine the soil fertility status of agricultural landscapes in Kenya;
2. Develop and use digital soil fertility maps for evidence-based fertilization guidelines for Kenya;
3. Determine appropriate, farm-specific fertilizer recommendations for priority agricultural value chains;
4. Build a digital soil database and information system for sustainable soil health management;

Main Activities of Digital Soil Mapping Project



Selected elements for dry & wet chemistry analysis

Parameters
pH
Organic carbon
Available phosphorus
Calcium
Potassium
Sodium
Magnesium
Iron
Copper

Parameters
Zinc
Total nitrogen
Boron
Sulfur
Selenium
Molybdenum
Manganese
Cadmium
Arsenic
Aluminium
Soil texture
Bulk Density

Number of sampling points per county

Code	County	Area (Km^2)	No. of Wards	Digitally Registered Farmers	Sampling Points
1	Mombasa	218.86	30		0
2	Kwale	8,270.14	20	100,099	1233
3	Kilifi	12,609.74	35	162,707	1571
4	Tana River	38,437.01	15	72,617	797
5	Lamu	6,273.13	10	12,982	312
6	Taita Taveta	17,084.03	20	51,158	1796
7	Garissa	44,175.21	30	89,683	484
8	Wajir	56,686.22	30	24,074	352
9	Mandera	25,991.76	30	89,660	1094
10	Marsabit	70,961.91	20	57,622	766
11	Isiolo	25,336.24	10	35,164	338
12	Meru	6,933.05	45	274,877	3439
13	Tharaka-Nithi	2,638.84	15	91,325	1360
14	Embu	2,818.05	20	122,510	1896
15	Kitui	30,496.59	40	226,969	1874
16	Machakos	6,208.25	40	198,286	1627

Number of sampling points per county

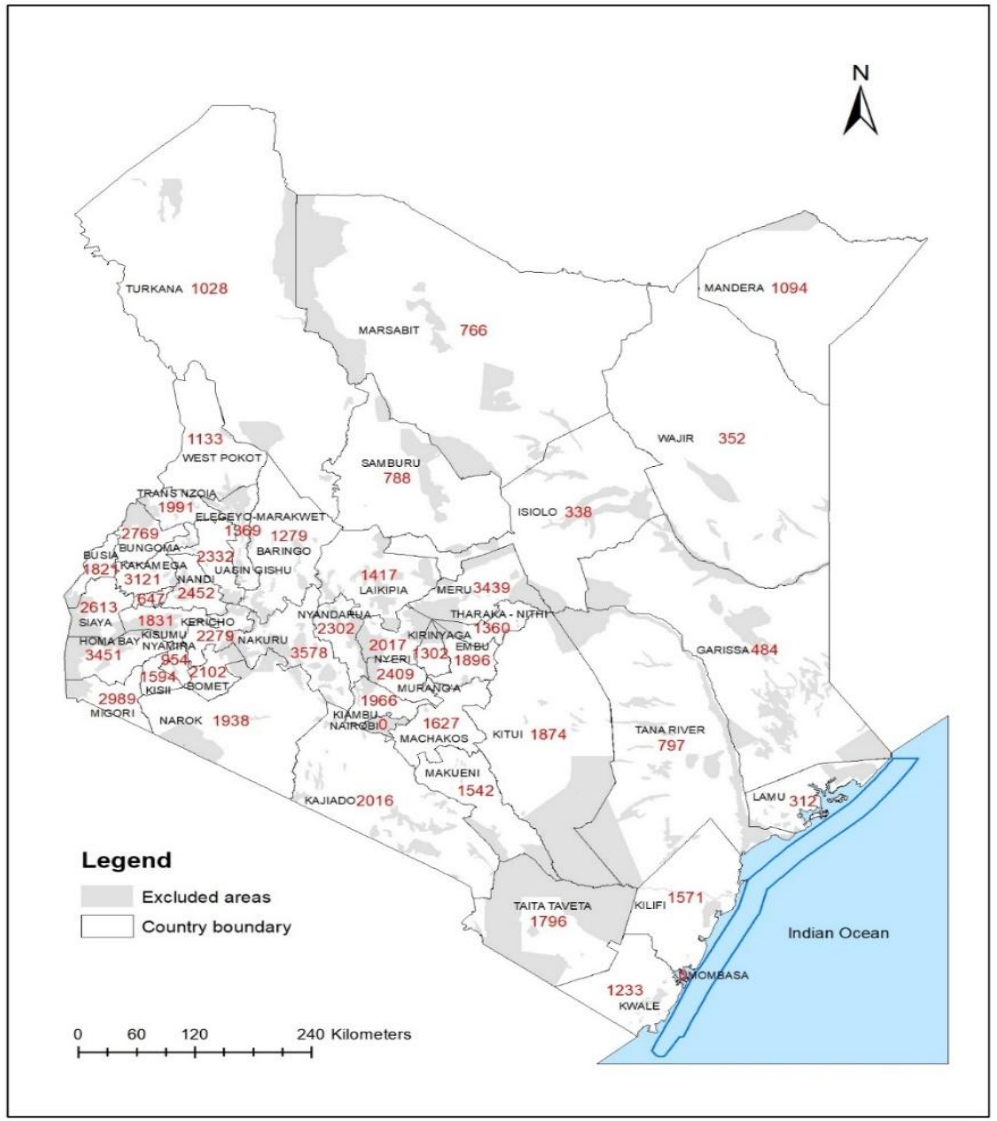
Code	County	Area (Km^2)	No. of Wards	Digitally Registered Farmers	Sampling Points
17	Makueni	8,008.76	30	180,027	1542
18	Nyandarua	3,245.26	25	117,834	2302
19	Nyeri	3,337.11	30	131,309	2017
20	Kirinyaga	1,479.09	20	126,033	1302
21	Muranga	2,558.83	35	188,401	2409
22	Kiambu	2,543.43	60	123,207	1966
23	Turkana	68,680.85	30	95,134	1028
24	West Pokot	9,169.52	20	87,293	1133
25	Samburu	21,022.42	15	48,700	788
26	Trans Nzoia	2,495.54	25	155,383	1991
27	Uasin Gishu	3,345.23	30	127,376	2332
28	Elgeyo-Marakwet	3,029.79	20	79,813	1369
29	Nandi	2,884.19	30	145,354	2452
30	Baringo	11,015.38	30	102,083	1279
31	Laikipia	9,461.97	15	92,466	1417
32	Nakuru	7,495.10	55	221,276	3578

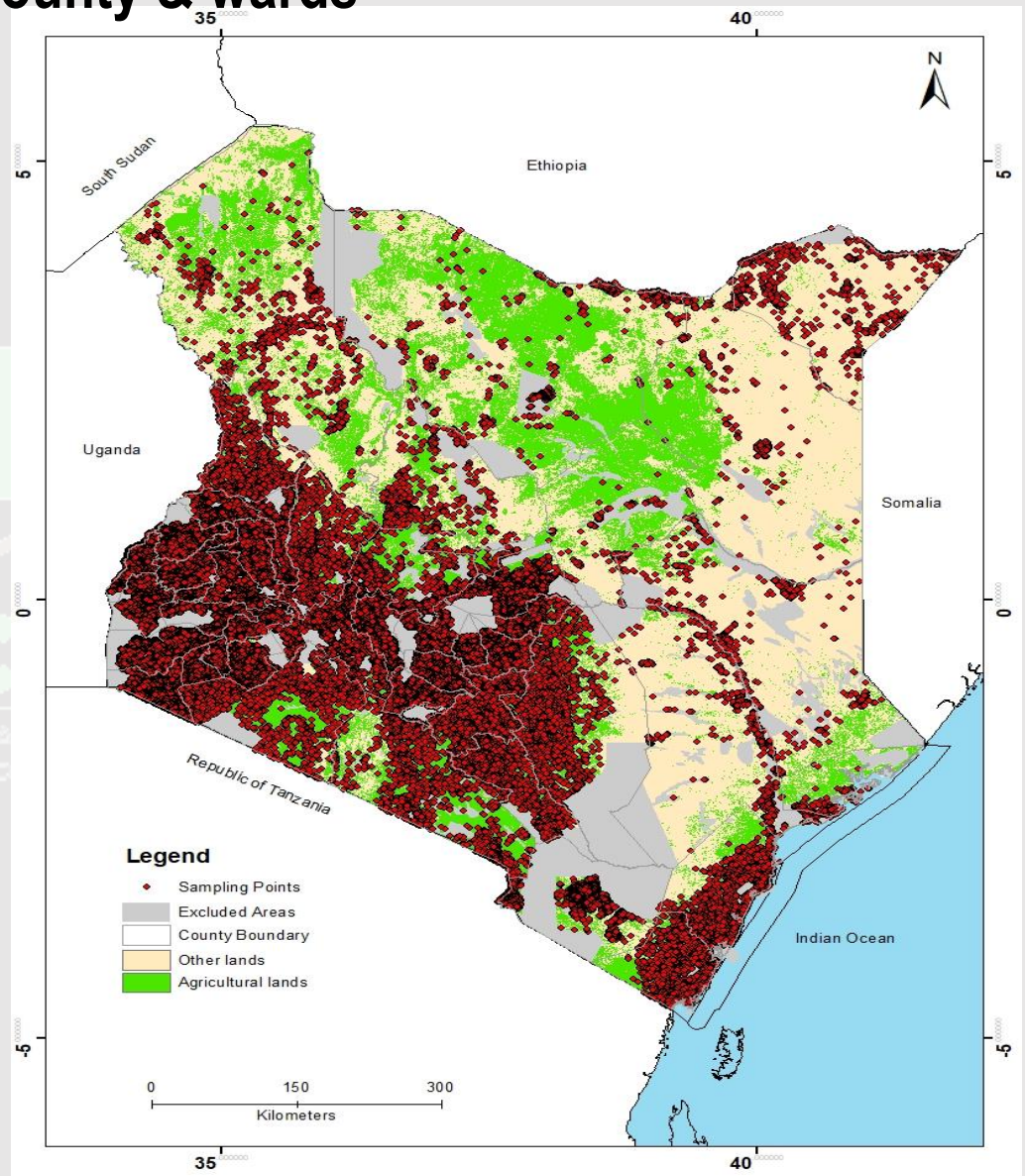
Number of sampling points per county

County Code	County	Area (Km^2)	No. of Wards	Digitally Registered Farmers	Sampling Points
33	Narok	17,933.10	30	149,838	1938
34	Kajiado	21,901.01	25	93,583	2016
35	Kericho	2,440.54	30	150,057	2279
36	Bomet	2,509.77	25	157,064	2102
37	Kakamega	3,017.68	60	261,151	3121
38	Vihiga	564.48	25	94,094	647
39	Bungoma	3,032.17	45	279,243	2769
40	Busia	1,695.04	35	203,283	1821
41	Siaya	2,530.40	30	193,260	2613
42	Kisumu	2,085.94	35	177,740	1831
43	Homa Bay	3,183.30	40	235,123	3451
44	Migori	2,595.94	40	163,666	2989
45	Kisii	1,317.53	45	217,444	1594
46	Nyamira	899.28	20	114,995	954
47	Nairobi	695.10	85		0

Soil Sampling Strategy, Standardized protocols,

Distribution of 77,969 sampling points/County & wards





Digital Soil Mapping for Policy Decision and Farm Specific Recommendations - ROADMAP

1 Preliminary

- Soil Sampling Strategy
- Public and Private stakeholder engagement
- Sensitization/awareness
- Standardized lab protocols
- Scanner Validation
- AP training materials

2 Pilot

- 581 sample points on crop and grazing land
- Private lab for Dry Chemistry
- Public/ private labs for wet chemistry
- DSM and fertilizer recommendations for 4 wards

3 Phase I

- 77,969 sample points across the country
- Acquisition of 6 MIR units for public labs
- MIR Capacity & Model development
- DSM & fertilizer recommendations for policy

4 Phase II

- Farmer- centred
- Kenyan Geospatial Database and SIS
- Recommendations at farm levels
- Additional 6 MIR Units positioned in strategic locations

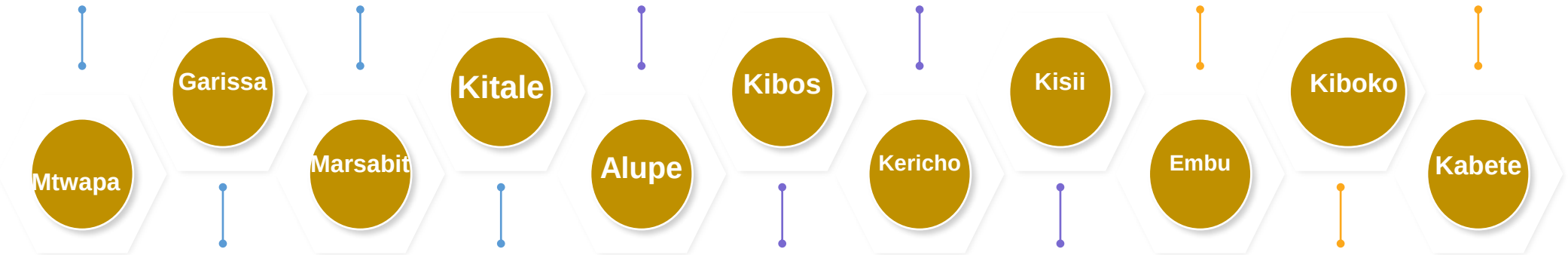
Partnership through Korea-Green Growth Trust Fund (KGGTF): Linking with Korea's Rural Development Administration

- Benchmarking Korea: Why Korea? (Success of Heuktoram, high-resolution data governance, and strong extension services).
- Knowledge Exchange in May 2026: Visit to RDA and other institutions
- Future collaborations: RDA will provide advice on DSM model validation, Co-generate a workshop in Nairobi etc.

Training of agreprenuers

	
Agri-preneurs training on soil sample collection protocol	Tier 3 training on soil sample collection using Maps.Me for navigation andKoboCollect

Planned Activity: Distribution of the MIR Units (Scanners)



Future plans of DSM & The Way Forward

1. Scaling Up

- Development of farm specific fertilizer recommendations

2. Plans for applications of DSM. Development of products and services for

- Crop suitability maps – ward level;
- Fertilization regimes – ward level – economics
- Fertilizer suitability – blending advice to the manufacturers
- Strengthen research-development-extension nexus

3. Linkages with policy

- Policy advice to the national subsidy program
- Policy advice on land management
- Soil health monitoring

LINKING DIGITAL SOIL MAPPING WORK TO OTHER POTENTIAL INITIATIVES

KenSIS: Kenya Soil Information System

SIS is an integrated/centralized platform designed to collect, store, analyze, manage, and disseminate soil data and information for informed decisions. one stop shop for quality, real-time soil data for land users, to address problems e.g. in agriculture.

KenSIS use cases: Fertilizer recommendations, land restoration, Carbon sequestration (climate change programmes)

a) CABI framework is relevant and promising for leveraging on.

b) Initial KenSIS activities required e.g. Mapping stakeholders, user need assessment, develop data sharing policy, Set-up a pilot KenSIS

LINKAGES WITH POLICY

Fertilizer & Soil Health Action Plan

1.Source and avail Organic, inorganic, organo-minerals and bio-fertilizers

2. Support research and development on organic & inorganic fertilizers and organo-minerals

3. Update fertilizer recommendations in an integrated manner (ISFM)

4. Review the current subsidies and identify the gaps to make them “SMART” by incorporating ISFM and supportive innovations

Agricultural Soil Management Policy

1. Support and build capacity on soil testing services, both human and infrastructure
2. Provide site specific information on fertilizer recommendations.

Expected Transformations From the Digital Soil Mapping Initiative

1) Accessibility: Taking soil testing services closer to farmers (11 regions)

2) Affordability: From Ksh.5,000 per sample to Ksh.900

3) Turn around Time of lab results & recommendations: From 14 to 3 days

4) Soil Health Database (KenSIS)

Expected Areas for Partnership with other Korean partners

Targeted Collaboration Areas

1. AI & Machine Learning - Development of Fertilizer Optimizer Use Case
2. Capacity Building – soil spectral technologies
3. Development and operationalization of Soil Information System database
4. Digital Agriculture

THANK YOU