RESEARCH PROGRAM ON Water, Land and Ecosystems

CGIAR

Evidences

Study #2205

Contributing Projects:

- P432 - Land Restoration Planning and Performance Management

Part I: Public communications

Type: OICR: Outcome Impact Case Report

Status: Completed

Year: 2017

Title: Evidence-based soils agronomy for raising crop production in Africa

Short outcome/impact statement:
A growing suite of innovative low-cost decision-support tools and soil datasets produced by ICRAF and its partners through the Africa Soil Information Service (AfSIS) and are being used by 14 African governments and other investors to map soil properties and measure crop nutritional responses to different soil management regimes. These technologies are guiding the sustainable restoration of degraded lands and have results in the development of several state-of-the-art national soil information systems (in Ethiopia, Ghana, Nigeria, and Tanzania).

Outcome story for communications use:
Shepherd, K. 2016. Scientists use technology to shine a light on Africa?s farms. http://blog.worldagroforestry.org/index.php/2016/10/06/21st-century-explorers-seek-new-riches-africa/

Multiple blogs at this site: http://www.worldagroforestry.org/sd/landhealth/land_health_blogs

Engines of Our Ingenuity. No. 3091 Soil Spectroscopy. http://uh.edu/engines/epi3091.htm

Links to any communications materials relating to this outcome: <Not Defined>

Part II: CGIAR system level reporting

Link to Common Results Reporting Indicator of Policies : Yes

Policies contribution: <Not Defined>

Stage of maturity of change reported: Stage 2

Links to the Strategic Results Framework:
Sub-IDOs:

- Land, water and forest degradation (Including deforestation) minimized and reversed

Is this OICR linked to some SRF 2022/2030 target?: Yes

SRF 2022/2030 targets:

- # of hectares degraded land area restored

Description of activity / study: Nutrient and organic matter depletion in African croplands is a significant land degradation process. This work is contributing to the restoration of degraded croplands by measuring and mapping soil properties, and plant nutritional responses, to different soil management interventions, thus enabling the refinement and better targeting of soil management measures.

Geographic scope:

- Global

Comments: The speed and low cost of light-based soil-plant diagnostic tools allow soil and plant analysis to be applied and assessed at national scale (Continent level mapping in 14 African countries).

Key Contributors:

Contributing CRPs/Platforms:

- WLE - Water, Land and Ecosystems

Contributing Flagships:

- F1: Restoring Degraded Landscapes (RDL)

Contributing Regional programs: <Not Defined>

Contributing external partners:

- ISRIC - International Soil Reference and Information Centre
- Rothamsted Research
- The Earth Institute, Columbia University

CGIAR innovation(s) or findings that have resulted in this outcome or impact:

<Not Defined>

Innovations: <Not Defined>

Elaboration of Outcome/Impact Statement:

ICRAF/WLE developed soil-plant spectral diagnostic protocols for rapid and low-cost analysis of soil properties and plant nutrients using only light (infrared, x-rays). The technology allows soil and plant analysis to be conducted faster, and at much wider scales, than previously possible, allowing quicker and cheaper sample analysis from many georeferenced sites. This in turn permits digital mapping of soil properties and measurement of nutrient constraints faced by different crops in multiple agronomic trials over large areas [1-5].

Through the Africa Soil Information Service (AfSIS) and other projects, the Soil-Plant Spectral Diagnostics Laboratory has helped 14 government institutions, 3 private sector labs and one development agency, to adopt the technology. New soil spectral data generated across sub-Saharan Africa have been combined with legacy soil profile data to create soil property maps of Africa at 250 m resolution (SoilGrids). The maps are being used by research and development agencies to plan soil sampling campaigns, site crop trials, and guide land management decisions, for example by various CGIAR projects in eastern Africa, and by the World Soil Information organization (ISRIC) based at Wageningen University, for fertilizer recommendations in West Africa [6].

At national level, AfSIS helped develop state-of-the-art soil information systems based on spectral technology in Ethiopia (EthioSIS), Ghana (GhaSIS), Nigeria (NiSIS), and Tanzania (TanSIS). The Ethiopian Government generated digital soil maps to inform fertilizer blending decisions and fertilizer and liming requirements. EthioSIS and TanSIS are each running five infrared spectrometers in different parts of the country. AfSIS and TanSIS generated maps of areas requiring liming in Tanzania. These are being used to plan investments by the Ministry of Agriculture and the Bill & Melinda Gates Foundation. The Ethiopian Agricultural Transformation Agency and the Tanzanian Ministry of Agriculture sent strong letters of support, and ICRAF received other impressive testimonials [7].

One Acre Fund has established a rural spectral lab in Kakamega, Kenya [8]. Applying portable X-ray Fluorescence devices (pXRF) for plant tissue analysis in on-farm trials in western Kenya has revealed deficiencies of P, K, S and micronutrients zinc, copper, and boron, for which appropriate fertilizer formulations should be tested.

ICRAF advised private companies now deploying spectral technology at scale: SoilCares runs testing services in 22 countries; in South Africa Omnia Fertilizer is using the technology, and OCP Africa is establishing a laboratory at the Université Mohammed VI Polytechnique and investing in mobile labs. Crop Nutrition Services Laboratory in Kenya has integrated the technology into soil testing services. The methods were used to characterise soils across 220 sentinel monitoring sites, including CGIAR sentinel landscapes.

Capacity development and advisory services have been provided to 14 African countries, China, Peru, and India.

References cited:
1 Hengl T.; J.G.B Leenaars; K.D. Shepherd; M.G. Walsh; G.B.M. Heuvelink; T. Mamo; H. Tilahun; E. Berkhout; M. Cooper; E. Fegraus; I. Wheeler; N.A. Kwabena. 2017. Soil nutrient maps of Sub-Saharan Africa: Assessment of soil nutrient content at 250 m spatial resolution using machine learning. Nutrient Cycling in Agroecosystems 109:77?102. https://link.springer.com/content/pdf/10.1007/s10705-017-9870-x.pdf. DOI 10.1007/s10705-017-9870-x.
2 Towett, E.K.; K.D. Shepherd; B.L Drake. 2016. Plant elemental composition and portable X-ray fluorescence (pXRF) spectroscopy: quantification under different analytical parameters. X-Ray Spectrometry 45: 17?124. DOI 10.1002/xrs.2678.
3 Nocita, M.; A. Stevens; B. Wesemael; M. Aitkenhead; M. Bachmann; B. Barth&#65533;s; E. Ben Dor; D.J. Brown; M. Clairotte; A. Csorba; P. Dardenne; J.A.M. Dematt&#65533;; V. Genot; C. Guerrero; M. Knadel; L. Montanarella; C. Noon; L Ramirez-Lopez; J. Robertson; H. Sakai; J.M. Soriano-Disla; K.D. Shepherd; B. Stenberg; E.K. Towett; R. Vargas; J. Wetterlind. 2015. Chapter Four - Soil Spectroscopy: An Alternative to Wet Chemistry for Soil Monitoring. Advances in Agronomy 132, 2015, Pages 139-159. https://doi.org/10.1016/bs.agron.2015.02.002
4 Shepherd, K.D., G. Shepherd, M.G. Walsh. 2015. Land health surveillance and response: A framework for evidence-informed land management. Agricultural Systems 132 (2015) 93?106. http://dx.doi.org/10.1016/j.agsy.2014.09.002
5 Tittonell, P., van Dis, R., Vanlauwe, B., and Shepherd, K. 2015. Managing Soil Heterogeneity in Smallholder African Landscapes Requires a New Form of Precision Agriculture. In: Lal, R and Stewart, B.A. (eds) Soil-Specific Farming: Precision Agriculture. Advances in Soil Science, CRC Press. Pages 199-224. http://www.crcnetbase.com/doi/abs/10.120/b18759-9
6 ISRIC. 2017. Taking fertilizer recommendations to scale for major crops in West Africa. https://www.isric.online/projects/taking-fertilizer-recommendations-scale-major-crops-west-africa.
7 Land Health Decisions: Testimonials. http://www.worldagroforestry.org/sd/landhealth/soil-plant-spectral-diagnostics-laboratory/testimonials.
8 One Acre Fund. 2017. Annual Report (pages 20-21). https://oneacrefund.org/blog/sharing-our-2017-annual-report/

Quantification: <Not Defined>

Gender, Youth, Capacity Development and Climate Change:
Gender relevance: 0 - Not Targeted
Youth relevance: 0 - Not Targeted
CapDev relevance: 1 - Significant
Climate Change relevance: <Not Defined>

Other cross-cutting dimensions: <Not Defined>

Other cross-cutting dimensions description: <Not Defined>

Outcome Impact Case Report link: Study #2205

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