Status of soil resources in Ethiopia and priorities for sustainable management

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Ethiopian ATA
Agricultural Transformation Agency
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Agenda

Status of soil resources in Ethiopia

Overview of Ethiopia's soils program

Introduction

- With a rapidly growing population, Ethiopia needs to increase food production in grain equivalent, by **at least one million metric tons**.
- Currently about **85-90 percent** of the population (68-70 million, or around 12 million households), **lives on agriculture**
- **Total cultivated land** is around **12 million hectares**, majority as semi-commercial or subsistence farming systems
- Population growth and agricultural production are not growing *at par*
- Due to land shortage, **expansion to marginal lands and protected areas** has also become a common practice.

Cont……

- **Land degradation** has also been at its worst until recently.
- As a result, **nutrient depletion** has also been very severe.
- The **arable soils** are amongst the oldest in Africa and are **highly degraded and eroded** by a combination of water and wind erosion
- Farmers **remove all crop biomass** from the fields and use less farm yard manure.
- crop productivity has been low, and **cereal yield** national average is still **less than 2t/ha**
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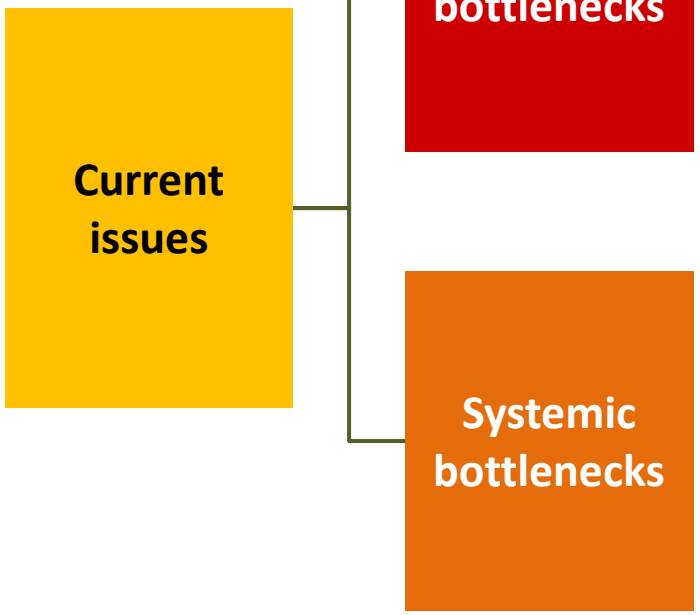
- **Cont……**
- The figure for **pulse crops** is generally around **o.8 t/ha**
- These have resulted in the deficiency of key nutrients such as **N, P, K, S, and Zn**.
- Recent investigations also show deficiency of **boron, and copper** in some areas.
- Other soil productivity related problems include:
  - **Water logging**
  - **Acidity**
  - **Alkalinity**
- Farmers' use of fertilizers is also low.

The Ethiopian soil sector is currently affected by multiple issues relating to soil health and soil system

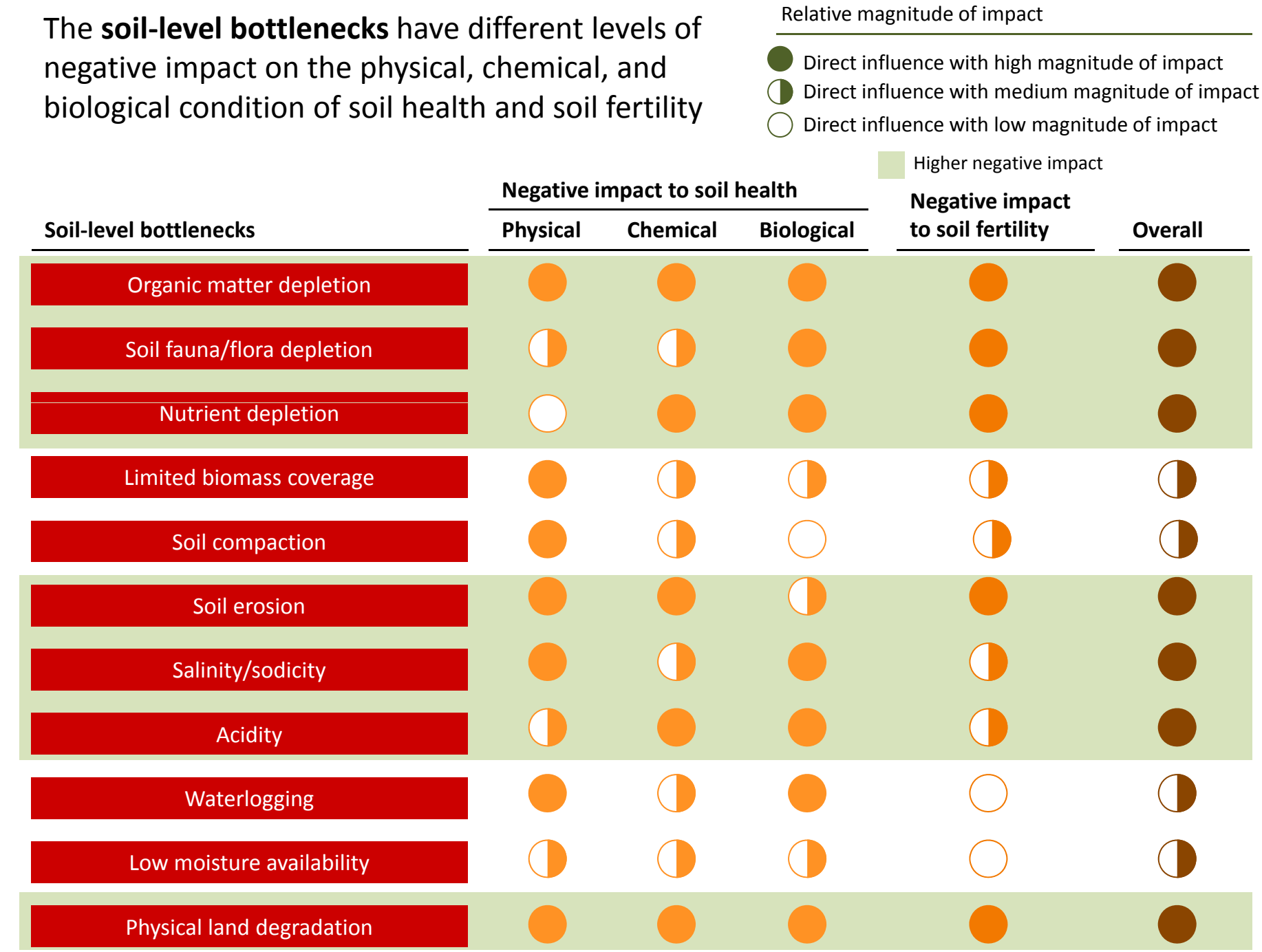


Description

- There are major physical, chemical and biological issues in the current Ethiopian soils against health and fertility
- Apart from the soil itself, there are also bottlenecks in the system (e.g., knowledge management, policy support)

SOURCE: Team analysis

The **soil-level bottlenecks** have different levels of negative impact on the physical, chemical, and biological condition of soil health and soil fertility

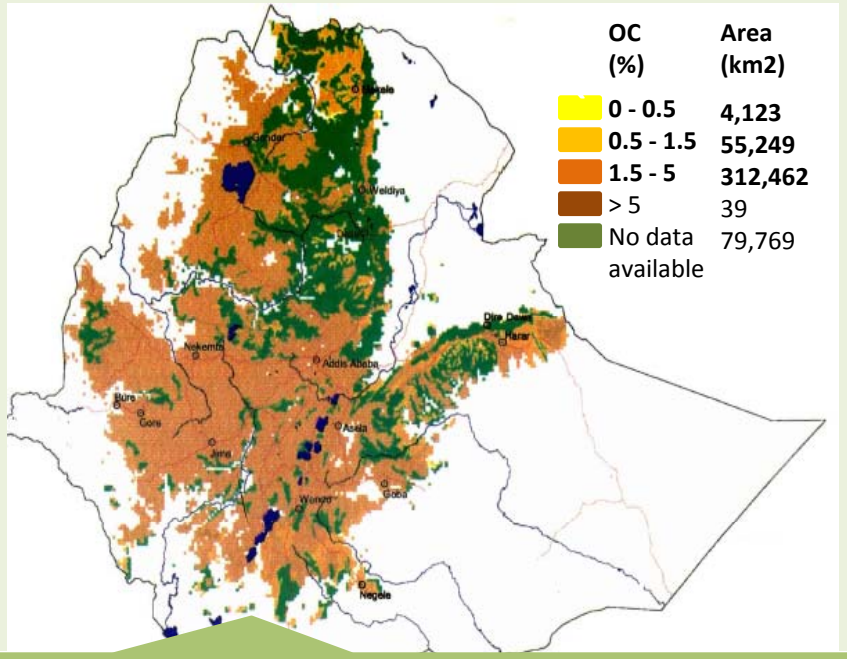


SOURCE: ATA, Expert Input

Organic matter depletion: Organic matter has been highly depleted in Ethiopian soils across a wide coverage of the nation

Ethiopia's highlands, covering ~40% of the nation, historically have extremely low soil carbon content

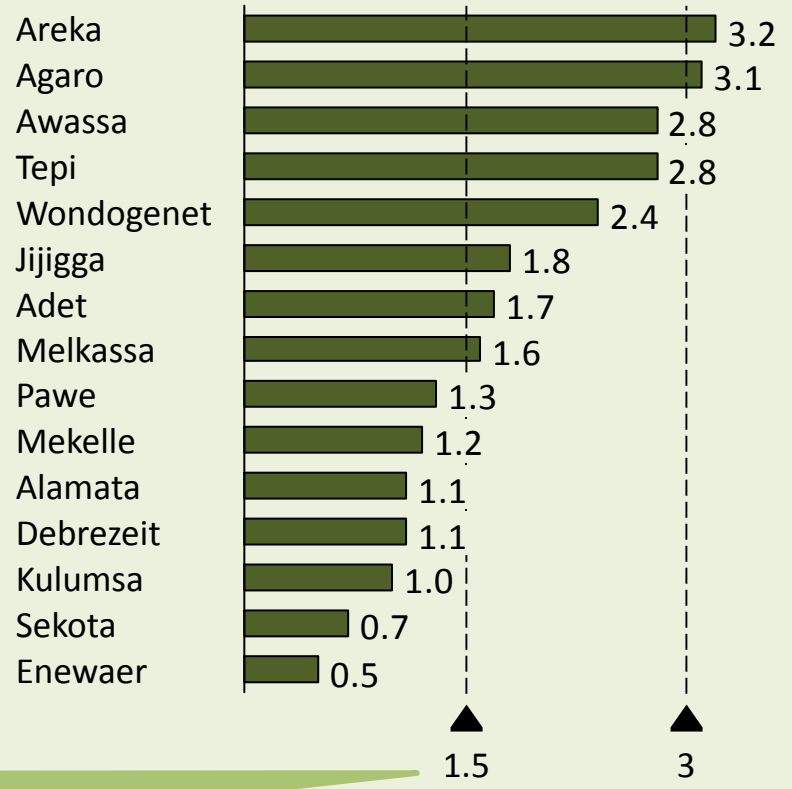
Organic carbon content in the highlands of Ethiopia, 1984, Percent



According to Tekalign et al.'s 1991 Soil, Plant, Water, Fertilizer, Animal Manure & Compost Analysis Manual, organic carbon below 1.5% is considered low; between 1.5% and 3% as moderate

Recent data shows there is a need to improve the soil organic matter content

Average soil organic carbon content in different areas[1]; 2006, Percent

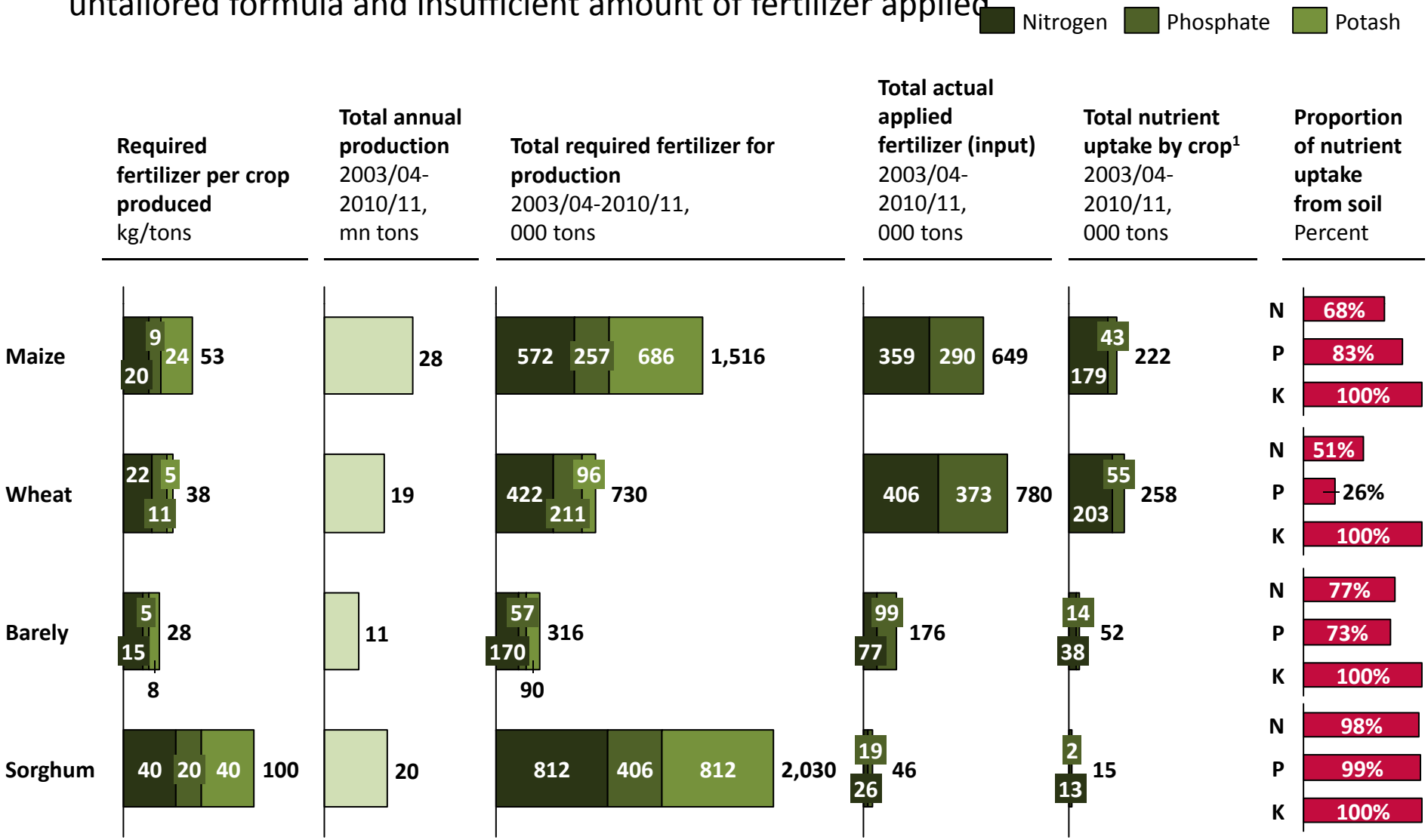


1 10-15 soil samples per area, from 0-30cm depth

SOURCE: ICRAF (1984), Tilahun Chibsa (2005), NSTC, Tekalign, Tadesse, Haque, I., and Aduayi, E.A. (1991), ATA

Nutrient depletion: Majority of the macronutrient uptake in major cereal crops comes from soil, which is not replenished back into the soil due to the untailored formula and insufficient amount of fertilizer applied

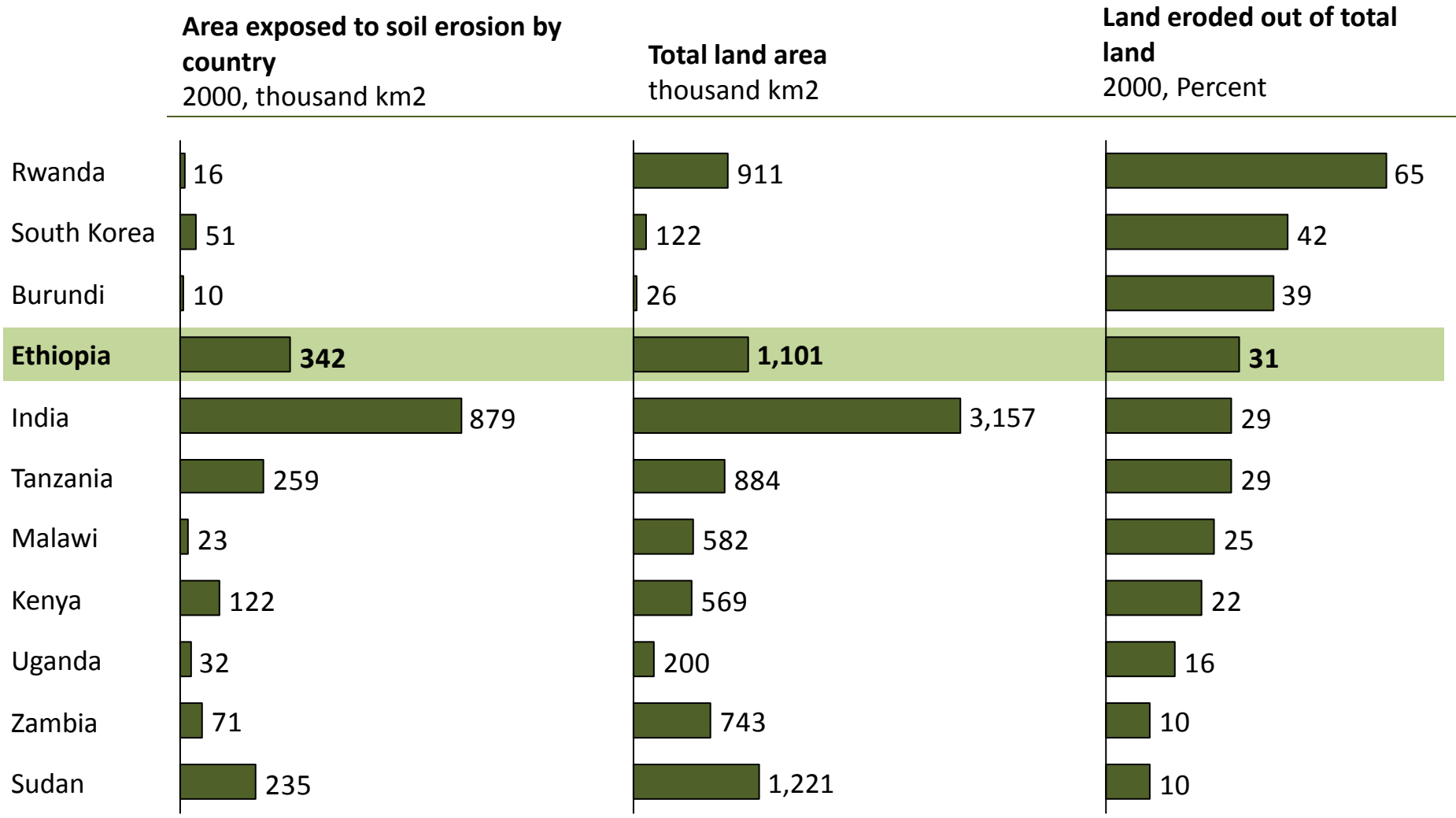
ROUGH ESTIMATE



1 Assumed 50% uptake rate from applied fertilizer for N and K, and 15% for P

SOURCE: IFA, CSA, ATA

Soil erosion: Compared to other East African and developing countries, Ethiopia is among countries with the highest soil erosion, with respect to the total available land



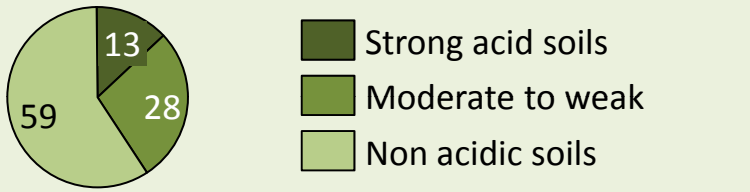
- **Since the rate of erosion could be different by each area, the rate of the erosion could indicate the above order of countries differently**
- **Ethiopia is estimated to go through topsoil erosion of 137t/ha/year**

SOURCE: FAO, SCRP, ATA

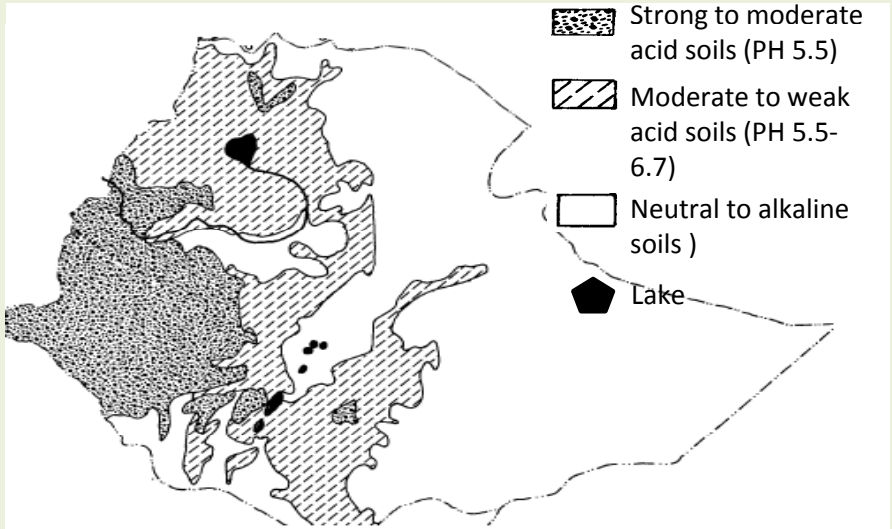
Acidity: In the past, soil acidification accounted for 40% of the total land, of which, the distribution is stronger in the high-potential perennial zone; and this situation now has the potential to worsen

Acidic farmland in Ethiopia accounts for 40% of the total land

Acidic soil coverage, among total land
1989, Percent



Acidic soil coverage distribution



- Given that the provided data is outdated, there is potential that this situation has worsened over the course of time
- However, there are on-going interventions to mitigate the negative impact, which is expected to minimize the problem going forward

SOURCE: Schlede (1989), ATA

Recent efforts being made by the Government

- Massive land rehabilitation and natural resource conservation efforts (SLMP)
- Scaling up best practices such as:
  - Improved Vertisol management
  - Acid soil management
  - Compost use by farmers
  - Introduction and testing of new fertilizers
  - ISFM
- Soil fertility mapping of agricultural lands
- Blended fertilizer program

The systemic bottlenecks can be grouped into five categories, from information management to organization and management systems

1

Soil information management

- Lack of up-to-date information on soil fertility
- No shared soil information database

2

Technology generation and dissemination, and linkage

- Lack of soil test-based fertilizer recommendations
- Lack of soil fertility and health management technology registry and release mechanism
- Low emphasis to soil fertility focused extension system
- Limited research emphasis on soil health and fertility
- Limited lab capabilities and capacity
- Inadequate use of, and inappropriate management for, irrigation
- Limited coordination between research, extension, and academia

3

Input value chain

- Limited accessibility/affordability to inputs (e.g., fertilizer, soil amendments)
- Inefficiency in distribution and marketing of fertilizers
- Other inefficiencies in the value chain
- Limited financial support to farmers' adoption of practices

4

Strategic and regulatory framework

- Limited quality control mechanisms and regulatory system for inputs
- Lack of proper agricultural land use management strategy and implementation

5

Organization and management systems

- Absence of an independent national soil research institute
- Lack of coordination among research institutions
- Limited coordination among soil laboratories

SOURCE: ATA

Agenda

Status of soil resources in Ethiopia

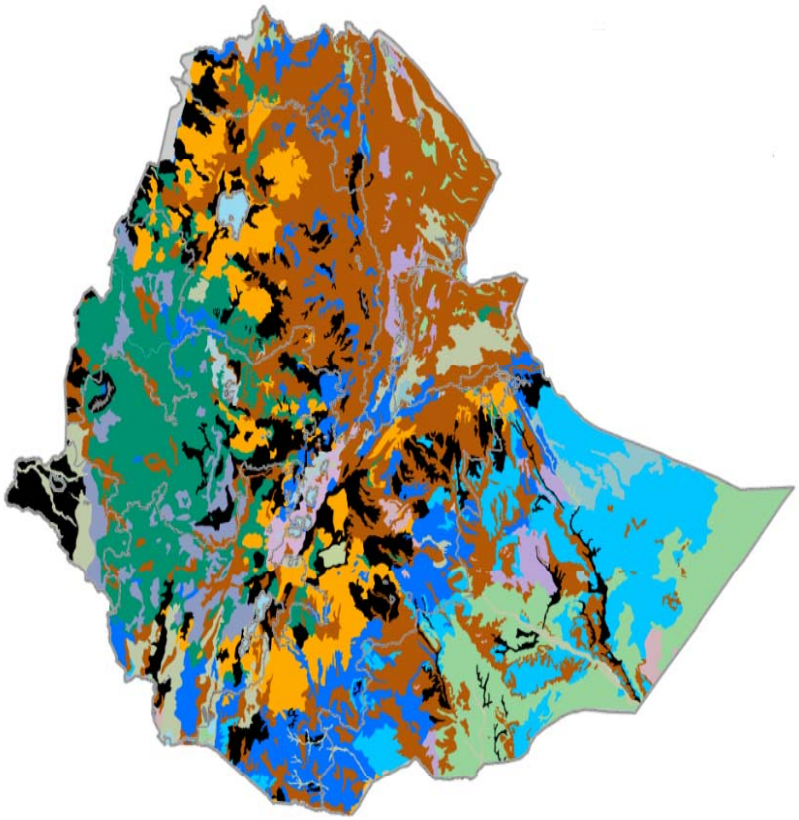
Overview of Ethiopia's soils program

Initiatives are currently focused on four key priority areas

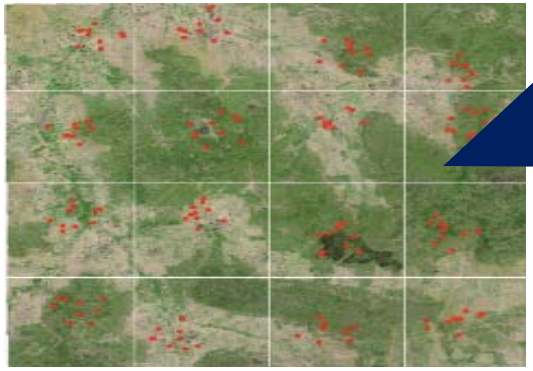
1. **EthioSIS**
2. **Fertilizer blending**
3. **Sustainable land management program (SLMP)**
4. **Integrated soil fertility management (ISFM)**

1 **EthioSiS:** Creating a detailed and functional soil fertility map for Ethiopia is instrumental for improved fertilizer recommendation and agricultural policy reforms

Existing soil maps in Ethiopia are obsolete with limited soil fertility information and need to be updated using contemporary technologies and analysis



Under EthioSIS initiative, will provide a framework for geostatistical projections on soil characteristics and nutrients using of existing remote sensing data and extensive physical soil sampling



Each 10 by 10 km sampling site is divided into randomly assigned clusters for soil sample collection;

Ethiopia will have 97 of these 10 x 10 km sites, at each 1 degree lat-long confluence point

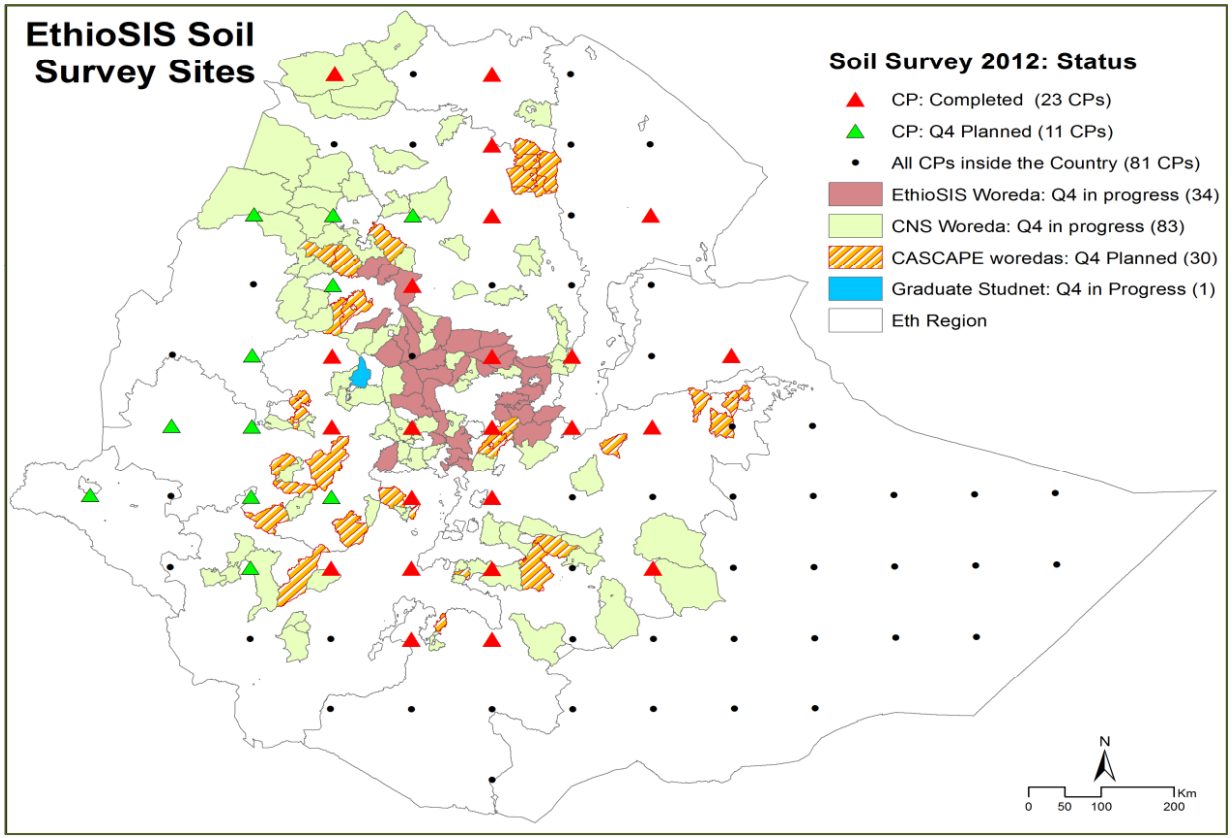
The initiative will set up – A National Soils Database (NSD) that will run a terabyte information at a specific site granularity

Detailed soil nutrient and characteristic maps for even one site run into terabytes. Ethiopia will have ~90 such sites

SOURCE: FAO;ATA; AfSIS

1

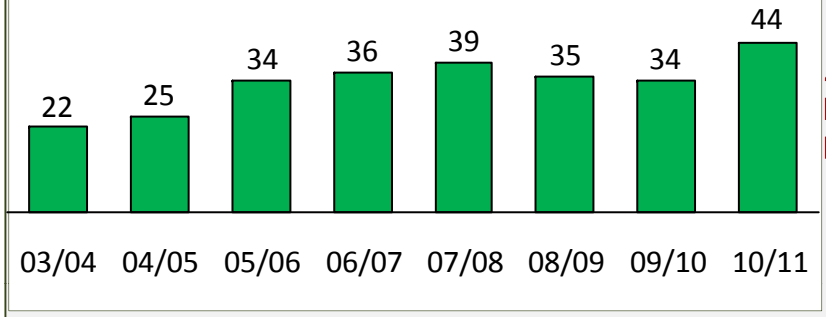
EthioSiS: Soil fertility maps will aid with the creation of new fertilizer blends for Ethiopia



- Analysis is being conducted on the nutritional status of soil in **150 woredas** (out of ~600)
- The project will create soil fertility maps that will be useful for three to four years
- Nutritional information will be used to create **optimal fertilizer blends** and inform **application rates**

2 Ethiopia's investment in fertilizer has not paid off; growth in fertilizer use has not resulted in commensurate increases in yield requiring alternatives such as enhancing local fertilizer production

Total fertilizer applied for cereal crop 0000' tones from 2003/04-2010/11

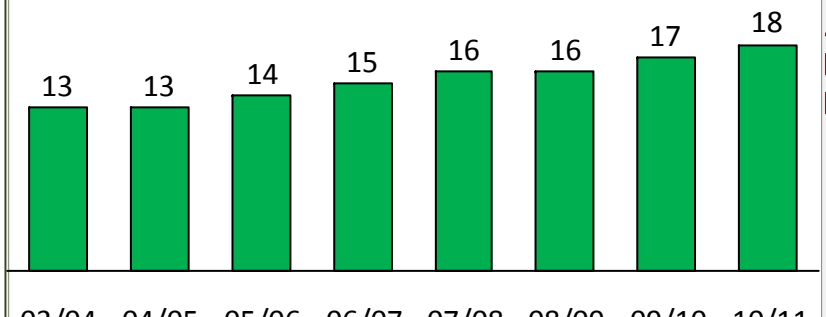


Annual Growth Rate (CAGR)

2003/04-10/11

≈ 10%

Total cereal yield Qt/ht from 2003/04-2010/11



Annual Growth Rate (CAGR)

2003/04-10/11

≈ 5%

Cost effective, low maintainace technology will be used to blende fertilizers

- Four new physical fertilizer blending plants will be established at cooperative unions, with capacity of over **250,000 tones per year**
- Dry blending facilities can create fertilizer blends with up to six nutrients and have flexibility to alter formulas based on soil data
- In-country plants will lower costs and make fertilizer more accessible

- ***Blanket application of DAP and UREA*** is not considerate of crop need, soil nutrient dynamics and agro-ecological factors
- Recent soil tests show ***deficiencies in 6-7 nutrients***, but DAP and Urea only supply 2 nutrients
- The government has resolved to address this issue by building ***fertilizer blending plants*** that can create blends specific to Ethiopia's soil needs

Source: CSA; Agricultural Sample Survey 2003/04-11,

2

Fertilizer blending: Four new fertilizer blending plants in Ethiopia will bring in-country capacity to produce new fertilizers with more nutrients

- Four new physical fertilizer blending plants will be established in Ethiopia, with capacity of over **250,000 tonnes per year**
- **Demonstrations at 48,000 sites** in 2013 will popularize new blended fertilizers with formulas
- The plants' flexible design will allow plants to accommodate a variety of **new formulas**

3

SLMP: Conservation efforts, which have been a focus area for a long time have recently witnessed success with the launch of SLMP in 2008

History of land conservation efforts in Ethiopia

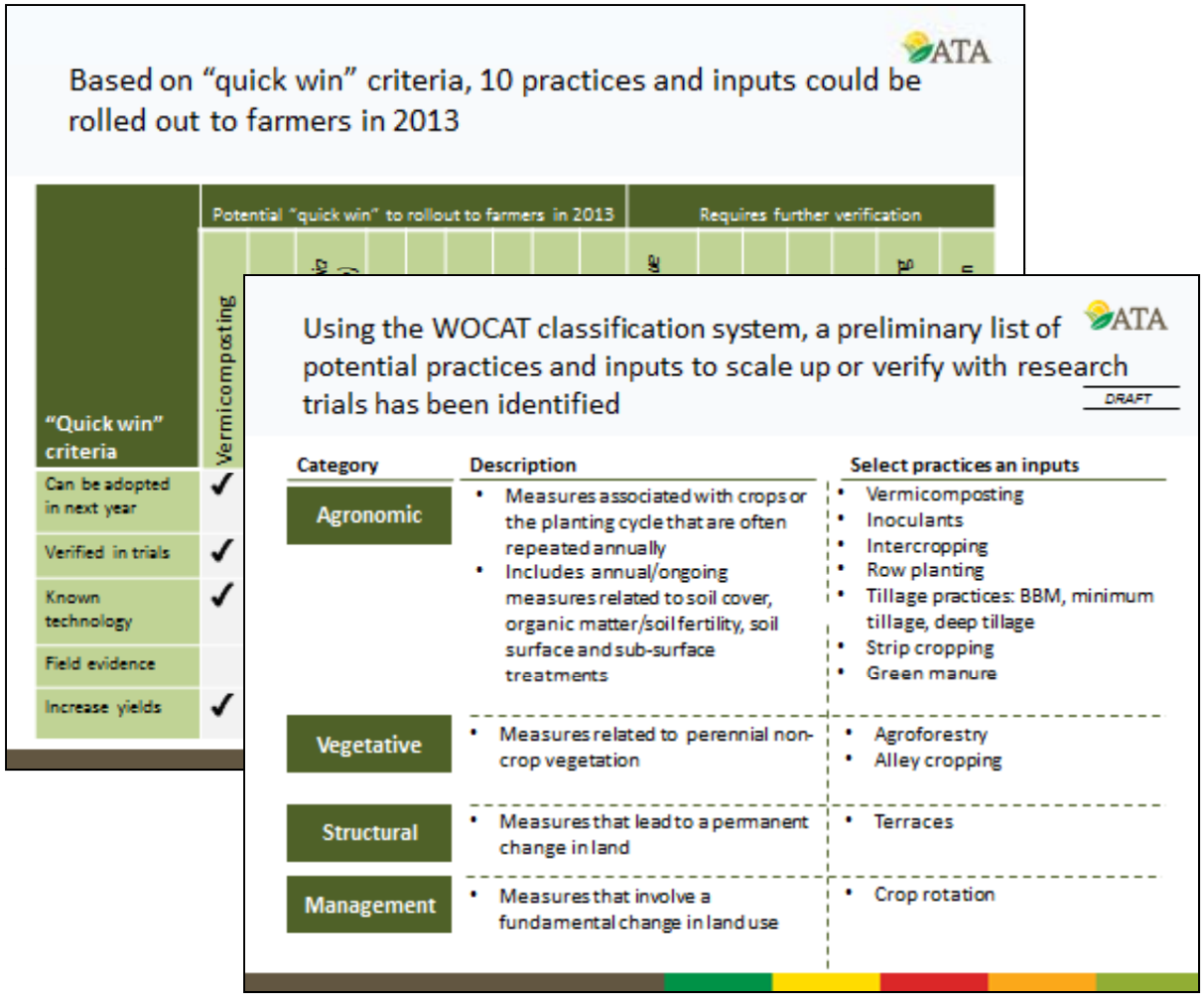
- Massive land **rehabilitation and conservation effort have been implemented since mid-1970s** by Ethiopian government and its partners
  - In Ethiopia, UN programs and funds (WFP, UNDP, UNEP) has partnered with MoARD for the past 45 years in soil and water conservation activity.
- **SLMP**, one of the conservation initiatives **launched in 2008** has managed to **reach scale successfully**:
  - The program primarily focusses on conservation measures which includes **physical conservation** measures as well as **biological conservation** measures
  - SLMP framework (now run by MoA) operates with a total budget of 103 M Euros from multiple donors (phase I started in 2008 and **phase II will start in 2013**)
  - Operates in **6 regional states** (Amhara, Tigray, SNNPR, Tigray and Gambella) in 235 woredas
  - The program has components of watershed management with a sub component focusing farmland and homestead development
  - The program was designed to address 500,000 watersheds so far reached 250,000 households

After the success of Phase I of SLMP (2008-2013), the second phase of SLMP will focus on:

- Shift from soil erosion/land rehabilitation to soil health and fertility
- Direction to ensure benefit from land management though increased productivity
- Fine tuning of technologies and measures, combining with local knowledge and working towards intensification through ISFM

4

ISFM: Will boost the adoption of better inputs and farming practices through research and farmer popularization



Based on "quick win" criteria, 10 practices and inputs could be rolled out to farmers in 2013

"Quick win" criteria	Vermicomposting
Can be adopted in next year	✓
Verified in trials	✓
Known technology	✓
Field evidence	
Increase yields	✓

Potential "quick win" to rollout to farmers in 2013 | Requires further verification

Using the WOCAT classification system, a preliminary list of potential practices and inputs to scale up or verify with research trials has been identified

DRAFT

Category	Description	Select practices an inputs
Agronomic	• Measures associated with crops or the planting cycle that are often repeated annually • Includes annual/ongoing measures related to soil cover, organic matter/soil fertility, soil surface and sub-surface treatments	• Vermicomposting • Inoculants • Intercropping • Row planting • Tillage practices: BBM, minimum tillage, deep tillage • Strip cropping • Green manure
Vegetative	• Measures related to perennial non-crop vegetation	• Agroforestry • Alley cropping
Structural	• Measures that lead to a permanent change in land	• Terraces
Management	• Measures that involve a fundamental change in land use	• Crop rotation

- Currently, soil input recommendations focus on inorganic fertilizers; some high-potential farming practices have **limited adoption**
- The ISFM program will role out verified inputs and practices to farmers in 2013 through **demonstrations**
- **Trials** will be conducted done to verify the effectiveness of high-potential, unverified inputs and practices

Innovations to help our country grow