Sustainable Soil Management: Key to Driving Agricultural Productivity in Support of the Aspirations of MW2063

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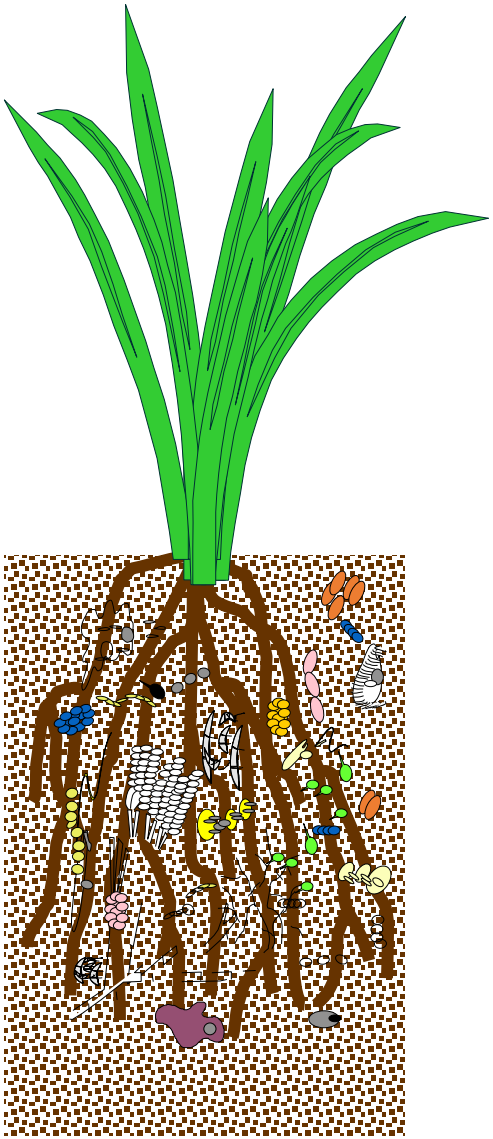
National Planning Commission (NPC)

LUANAR

MwAPATA INSTITUTE

Soil health and crop productivity



Bare and Exposed

Malawi needs to save its soils

Case study Chia Lagoon

Dry Season- Water Blue

Rainy Season- Water Brown

Scenario on the ground

- In 2010, the mean soil loss rate was estimated at 26 ton/ha/yr, which rose to 29 ton/ha/yr in 2014 and to 30 ton/ha/yr in 2017.
  - Topsoil loss rates slightly increased by over **10%** between 2010 and 2017.
- The average annual loss rate of the main plant nutrients due to topsoil loss was 108 g/ha of total N, 350 g/ha of available P, and 16.6 g/ha of exchangeable K in 2017
  - *This is equivalent to a loss of 3% of a 50 kg-bag of NPK fertilizer per hectare annually through soil erosion*
- This portrays a significant level of prevalence of soil degradation in the country. The most prevalent degradation types are:
  - *a decline in soil fertility,*
  - *threat of soil acidification,*
  - *and an increase in erosion (sheet, rill, and gully)*.

Drivers of Soil Degradation in MW

- Poor maintenance of existing erosion control structure
- Inadequate soil fertility management, dominant fragile soils, steep slopes
- Limited extension services
- Poor adoption of soil conservation technologies
- Low levels of awareness on soil degradation and conservation technologies
- Low level of farmer-investment in soil conservation
- Erratic and high rainfall intensities, and
- Reduction of protective soil cover.

MW 2063 Plausible Aspirations in line with SSM

- **Improved and Sustainable Land Management Practices**
- **Optimal Utilization of Land Resources**
- **Climate Smart and Resilient Agriculture**
- **Improving fertilizer use efficiency -** Conduct a soil fertility analysis (soil carbon mapping) for specific fertilizer recommendations in agro-ecological zones

Practical interventions for improving SSM in Malawi: Policy

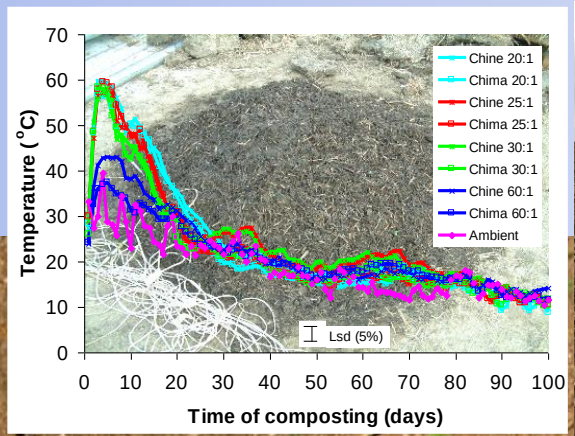
- Emerging issues
  - Weak policies, legislations, enforcement, and overlap of mandates among institutions involved in regulation

- Proposed Actions
  - Mainstream SSM in all sectoral policies
  - Improve inter-sectoral planning and implementation
  - Revise over due strategies and policies
  - Increase funding towards SSM
  - Build human, and institutional capacity on SSM

- Continue with strategic organic fertilizer campaigns (manure)
- Integrated soil fertility management (organic+ inorganic fertilizer use) to enhance use efficiencies

Practical interventions for improving SSM in Malawi: Technology Generation

- DARS through Agricultural Technology Clearing Committee (ATCC) has cleared and released several soil fertility improvement technologies for adoption and practice by farmers in Malawi
  - Some of the released technologies, with a consideration of an integrated approach include **legume intensification**, **use of biofertilizers (inoculants)**, **bio-inorganic fertilizers**, soil and water conservation management practices that include **Conservation Agriculture (CA)** and **organic resources** (organic fertilizers) that *encompass compost manure, livestock manure and live mulches*.



Practical interventions for improving SSM in Malawi: Technology Generation

- Microbial-based materials that improve soil fertility through *biological nitrogen fixation* and *solubilization of various nutrients* such as phosphorus, potassium, zinc and Sulphur

- Rhizobial inoculants have been used for some time in Malawi and recently the private sector has been involved in multiplication and marketing

- More collaborative research (DARS & LUANAR) is underway in this area to come up with more effective inoculants that target balanced plant nutrition ***but progress is always hampered by funding challenges***

Practical interventions for improving SSM in Malawi: Effective Technologies/Practices

- **Agricultural Technologies** (crop rotations, conservation agriculture, conservation practices, cover cropping, manure management and application, fertilizer application)
- **Soil and water conservation** (including: check dams, gully protection, terracing, contour bunds, infiltration trenches, and/or ridges)
- **Community forest areas and woodlots** (including: private woodlots/village forest areas)
- **Forest management** (including: protection of existing natural forest; rehabilitation of degraded and deforested forest areas; improved management of existing plantations; promote regenerative capacities)
- **River and stream-bank restoration** (including: tree planting and/or natural regeneration along rivers/streams

Among anti-erosion practices **vertiver grass** and terraces are most successful strategies for farmers to tackle events of extreme soil loss

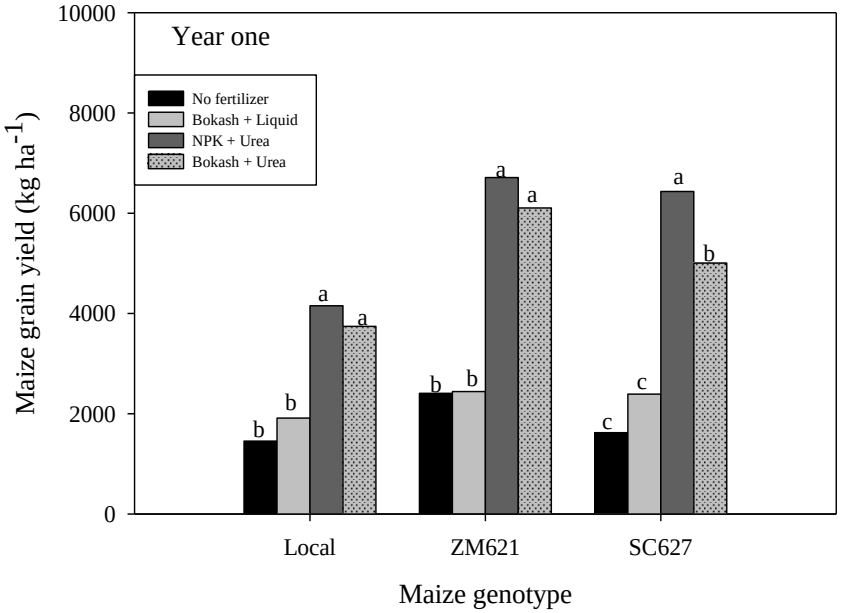
Soil fertility restoration practices **crop diversification and crop rotation** are most successful strategies for farmers

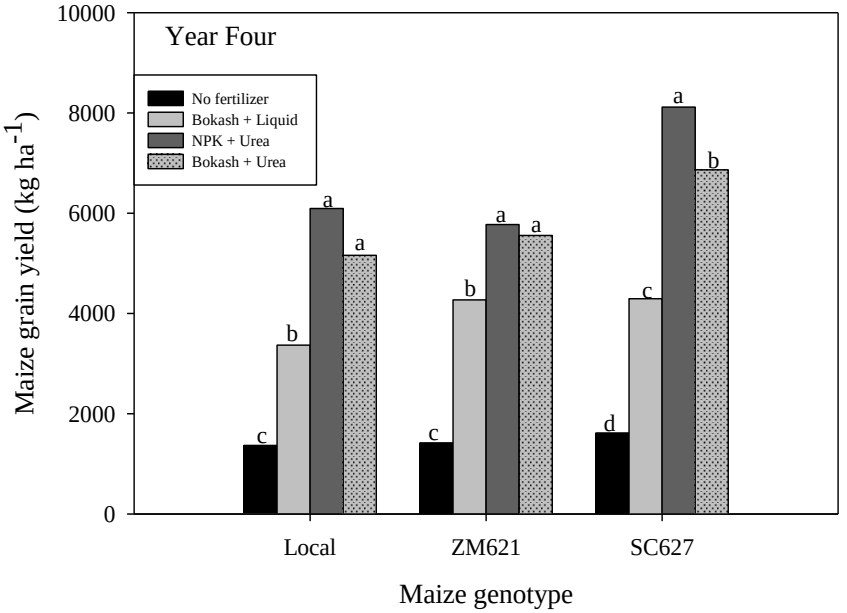
Practical interventions for improving SSM in Malawi: Approaches to reduce inorganic fertilizer

- **Maize Legume Rotation systems** has a potential of reducing 50% fertilizer applied in the subsequent season.
  - *Maize yield increases of above 50% have been reported from integration of legume residual effects and half the rate of recommended fertilizer with implication on reducing the costs incurred on inorganic fertilizer (Njira et al., 2020)*
- **Manure**: Manure application has a potential of reducing fertilizer application by 20-50% depending on quality and quantity
- **Legume maize intercropping** has potential of reducing up to 25% of fertilizer vs monocrop
- **Soil testing and area specific fertilizer recommendation**

Practical interventions for improving soil health in Malawi: *Manures and organic fertilizers*

- Some encouraging results have been reported on improved soil health and crop yields





Maize grain yield (kg ha^{-1}) as affected by Fertility Inputs x Variety at various study locations in Malawi during 2007-2008 and 2010-2011 seasons. Bars designated by same letter belonging to same variety are not significantly different from each other (Ngwira et al., 2013)

Practical interventions for improving soil health in Malawi: *Manures and organic fertilizers*

- Challenges with compost though promising:
  - Adoption of compost technology by farmers still remains low.
    - Some studies conducted in Malawi indicated adoption of compost manure technology by farmers to be at 32% (Mustafa-Msukwa et al., 2011).
  - Some of the major reasons cited by a few farmers include **lack of labour**, **inadequate water**, **lack of interest, inadequate skills and inadequate and poor availability of composting feedstock** (Mustafa-Msukwa et al., 2011).
  - Most of the composts produced by farmers are of low nutritional quality as this is influenced by materials used

Practical interventions for improving soil health in Malawi: Legume intensification and agroforestry systems

Challenges with these technologies:

- ***Lack of stable markets*** for the legumes and ***seed availability***
- On the other hand, non-edible agroforestry species are faced with **adoption challenges**

Increased soil organic matter and nutrient cycling, enhanced moisture retention and resilience to climate change effects

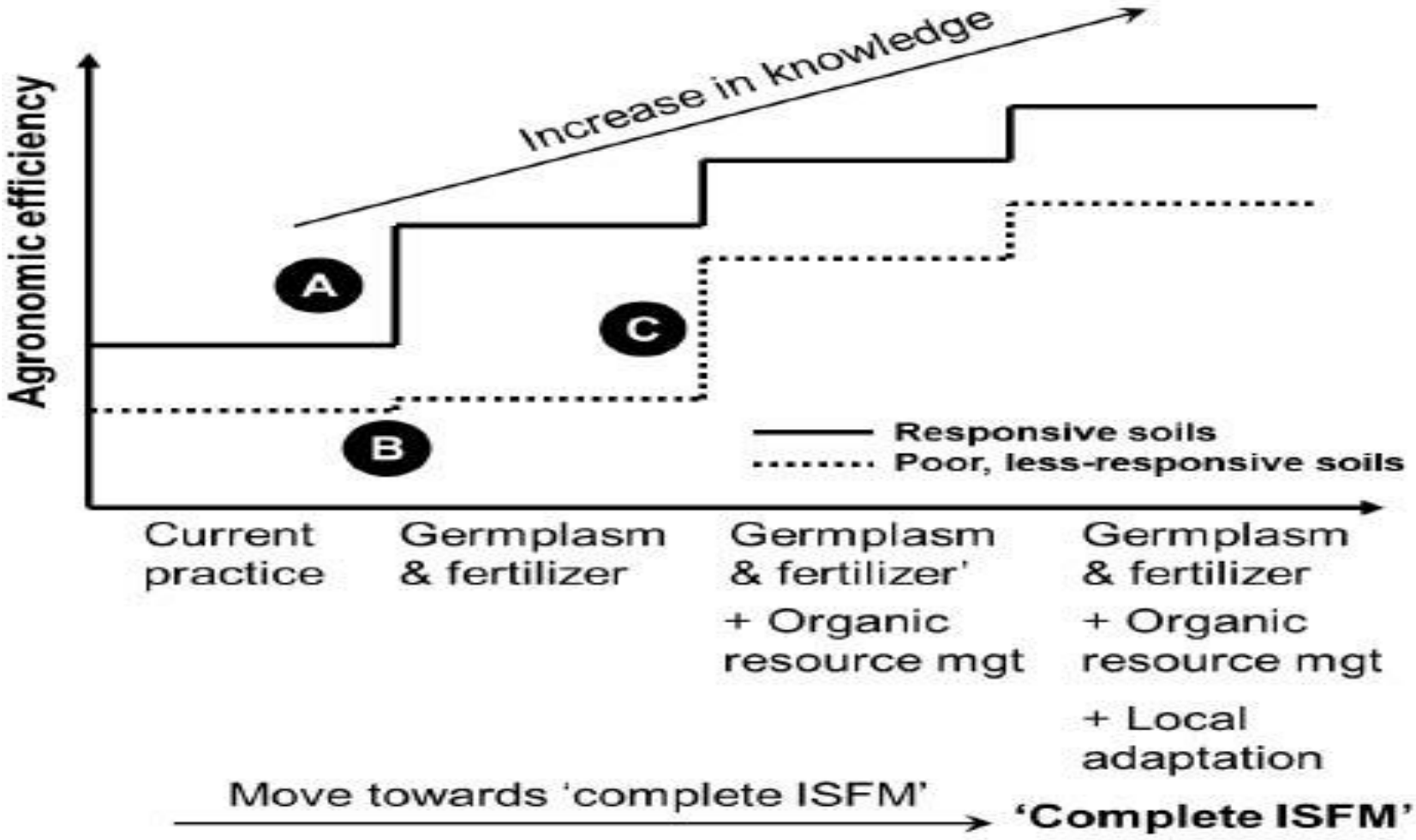
Practical interventions for improving SSM in Malawi: Agriculture input subsidy program

- Emerging issues
  - Crowding out extension services
  - Late delivery of inputs
  - Too much emphasis on inorganic fertilizer
  - Political economy

Low Agronomic Use Efficiency of N, from the present 12 – 14 kg maize grain/ kg N fertilizer applied

- Proposed Actions
  - Broadening the Scope of Input Subsidy Programs
  - Streamlining the role of extension workers in the administration of agricultural Input Subsidies
  - Develop an Inclusive Monitoring and Evaluation System for the Input Subsidy Program

Agronomic use efficiency improvement



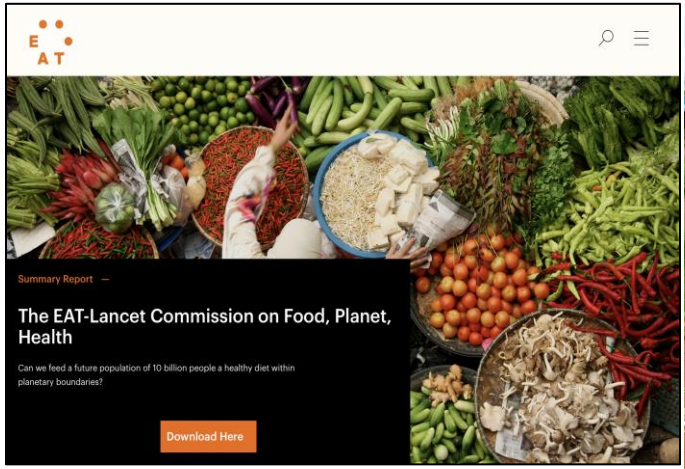
Relationship between agronomic efficiency (AE) of fertilizers and organic resource and the implementation of various components of ISFM

Why is the adoption of soil health technologies important?

- Until recently, the choice of soil health technologies available to farmers was largely determined by the need to increase production, profits and productivity

- Now agriculture has to fulfil diverse objectives: it needs to be internationally competitive by producing agricultural products of high quality while meeting environmental sustainability goals

- Adoption of soil health enhancing technologies can help boost agricultural exports through production of high quality products



Barriers to the uptake of soil health technologies

- Economic profitability of the technology
- Farmer's financial constraints and access to credit
- Farmer's familiarity with the technology, and their knowledge and education levels
- Uncertainty about agricultural support policies and world market prices
- Local/site-specific conditions
- Structural factors such as size of the farm
- Cost of new technology to farmer — some new technologies are often expensive when they are first introduced, thus penalizing early adopters
- Scale of production for the technology — technologies produced in small quantities have difficulties to produce promising results on large scale

How government can influence adoption of soil health technologies

- Research and demonstration farms (demand driven)
- Vibrant extension systems
- Specific policies favoring promising farming practices (e.g. CA, Agroforestry etc)
- Education and awareness; and information dissemination
- Public engagement through consultation mechanisms
- Good public-private sector engagements with harmonized delivery of information about technologies

Policy Recommendations

- Enhance adoption of Climate Smart Agriculture Practices in Malawi's Farming Systems
  - Building the necessary capacity of farmers on integrated soil fertility management (ISFM) practices through proper training,
  - Providing incentives and motivations to encourage the uptake of improved soil fertility management interventions by farmers *through provision of insurance against crop failure conditional to adoption of improved soil health interventions*.
  - Stimulating Community Initiatives in Sustainable Land Management
- Mainstreaming of Sustainable land management activities in national and district programs
- Promote/support operationalization of SLM on a programmatic level

Policy Recommendations

- Develop an information management system for tracking SLM activities at the national/district level
- Promote/support the development of guidelines for district level bye-laws that incentivize SLM practices
- Promotion of Complementary practices to inorganic fertilizers under affordable inputs programme

Policy Recommendations

- Create soil maps of nutrient deficiencies and soil acidity constraints
- Establish Soil Testing Laboratories (STLs) and Mobile Soil Testing Laboratories (MSTLs) at district level (Agri-clinics)
- Increasing farmer and extension staff knowledge on fertilizer use

Policy Recommendations

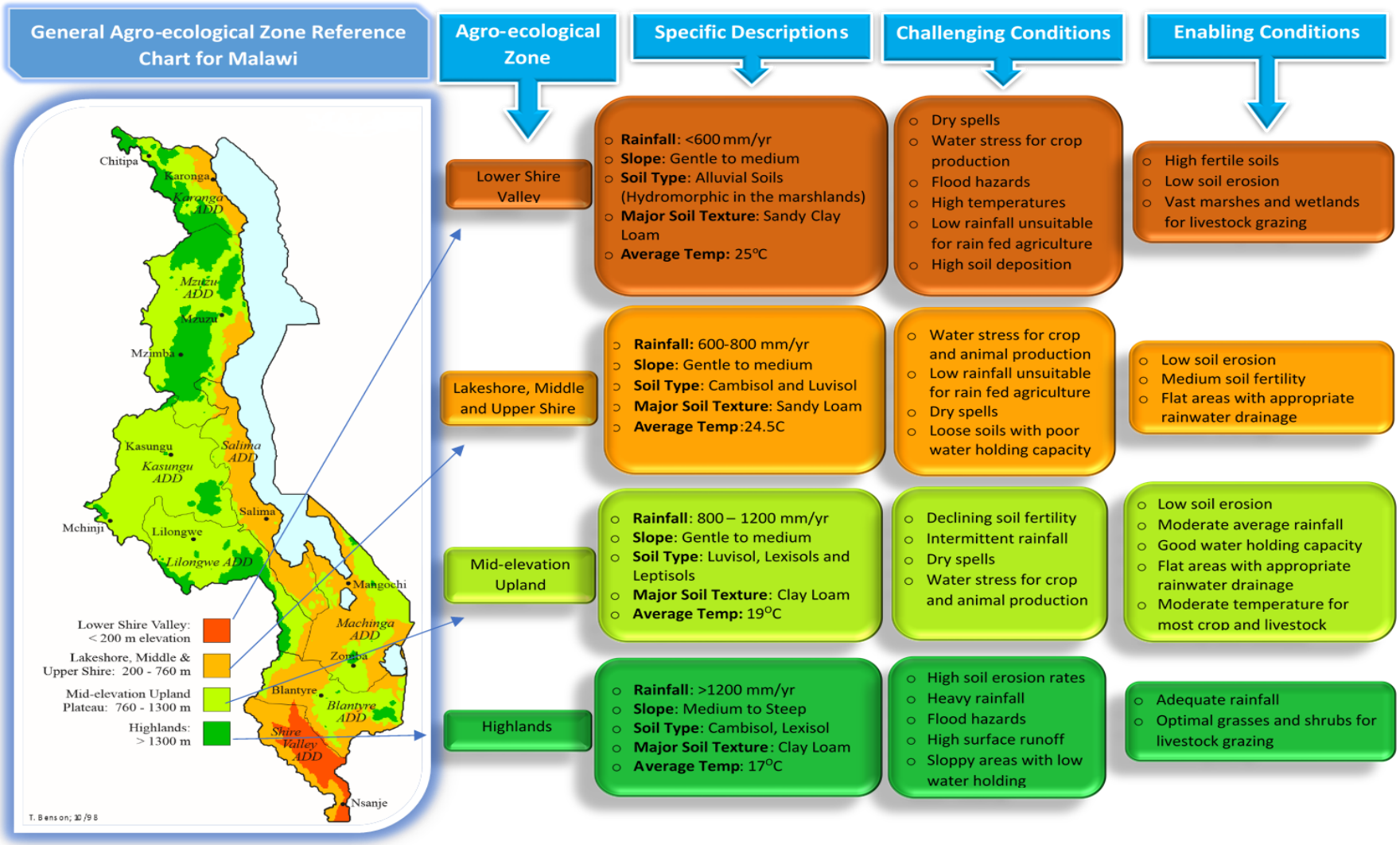
- Improving policies and strategies for sustainable land management
- Support the development of Nationwide SLM Coordination Unit
- Strengthen research and development in SLM

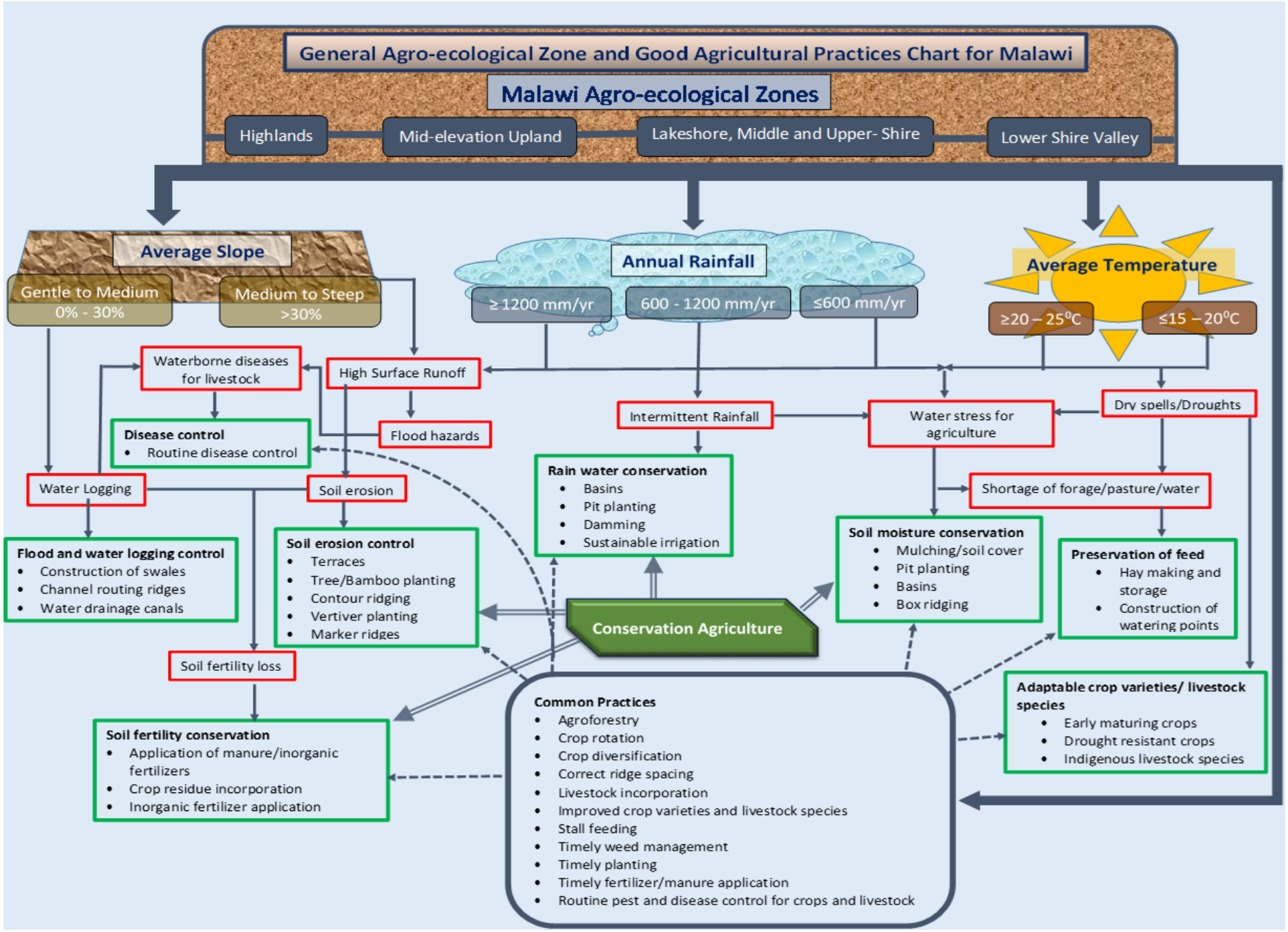
Policy Recommendations

- Narrow gender productivity gap by;
  - Increase women's access to credit, labour and time-saving equipment and services
  - Facilitate women's shift to high-value crops
  - Improve women's access to non-labour agricultural inputs

Technical & Extension Level Intervention

General Agro-Ecological Zone Reference for Malawi




General Agro-ecological Zone and Good Agricultural Practices Chart for Malawi
Malawi Agro-ecological Zones
Highlands
Mid-elevation Upland
Lakeshore, Middle and Upper- Shire
Lower Shire Valley
Average Slope
Gentle to Medium
0% - 30%
Medium to Steep
>30%
Annual Rainfall
≥1200 mm/yr
600 - 1200 mm/yr
≤600 mm/yr
Average Temperature
≥20 – 25⁰C
≤15 – 20⁰C
Waterborne diseases for livestock
High Surface Runoff
Intermittent Rainfall
Water stress for agriculture
Dry spells/Droughts
Disease control
Routine disease control
Flood hazards
Water Logging
Soil erosion
Rain water conservation
Basins
Pit planting
Damming
Sustainable irrigation
Shortage of forage/pasture/water
Flood and water logging control
Construction of swales
Channel routing ridges
Water drainage canals
Soil erosion control
Terraces
Tree/Bamboo planting
Contour ridging
Vertiver planting
Marker ridges
Soil moisture conservation
Mulching/soil cover
Pit planting
Basins
Box ridging
Preservation of feed
Hay making and storage
Construction of watering points
Conservation Agriculture
Soil fertility loss
Soil fertility conservation
Application of manure/inorganic fertilizers
Crop residue incorporation
Inorganic fertilizer application
Common Practices
Agroforestry
Crop rotation
Crop diversification
Correct ridge spacing
Livestock incorporation
Improved crop varieties and livestock species
Stall feeding
Timely weed management
Timely planting
Timely fertilizer/manure application
Routine pest and disease control for crops and livestock
Adaptable crop varieties/ livestock species
Early maturing crops
Drought resistant crops
Indigenous livestock species

Zikomo

Thank You

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