CIMMYT

SIMLESA
Sustainable Intensification of Maize and Legume Systems for Food Security in Eastern and Southern Africa

ETHIOPIAN INSTITUTE OF AGRICULTURAL RESEARCH

Australian Government
Australian Centre for International Agricultural Research

COUNTRY POLICY BRIEF ENHANCING AGRICULTURAL RESILIENCE AND SUSTAINABILITY IN ETHIOPIA

Maintaining crop residues in the field saves soils and improves crop yields

Summary and key facts

Soil erosion is a major problem limiting crop production and increasing the risk of famine in Ethiopia

Compared to conventional tillage practices, crop residue retention through mulching can significantly reduce surface water run-off by up to 25 percent. This improves the resilience of crops during dry spells and droughts

Maintaining crop residue reduces soil erosion and loss. Conservation tillage practices - where minimum tillage, residue retention and intercropping are combined - reduces soil loss by 98%

Conservation tillage increases farm water and soil moisture conservation. On farm trials show soil moisture conservation increased significantly - by 4.46%- for under conservation agriculture maize common bean intercropping

Improvements to soil fertility through crop residue retention improves crop agronomic traits. Increases in plant height, rate of germination, plant population, yield and plant biomass mainly due to maize-bean intercropping and mulching/residue retention under conservation agriculture

What is the problem?

Removal of crop residues is a major contributor to soil erosion

Soil erosion is a major problem limiting crop production and increasing the risk of famine in Ethiopia. The wearing away of a topsoil of an estimated 2 billion m3 a year due to exhaustive tillage and mono-cropping that is destroying soil fertility limiting plant growth.

Out of the nation's total surface area just over half is agriculturally productive. However, this productive land is rapidly shrinking due to soil erosion. Out of the 60 million hectares of productive land an estimated 27 hectares are considered significantly eroded, 14 million hectares seriously eroded and 2 million have reached the point of no return. One of the greatest challenges to sustainable farming is the removal of crop residues due to open cattle grazing systems. Open grazing results in the removal of crop residues from fields causing soil compaction. This results in hard pans and makes planting difficult even when using simple planters or simple rippers that are suitable for smallholders who practice conservation agriculture.

Annual crop residues are estimated to be 22.4 million tons, from which about 10.3 million tons are used as fuel. Much of the residues are also used to feed animals as much of the agricultural land consist of free grazing fields. The reduced amount of crop residues means it cannot be used in conservation farming to protect soils.

What solutions were identified from research?

Maintaining crop residue in the field controls soil erosion and improves soils

In 2010, the Sustainable Intensification of Maize-Legume Cropping systems for Food Security in Eastern and Southern Africa (SIMLESA) project were introduced in Ethiopia. SIMLESA research has involved trialing a paradigm shift towards Conservation Agriculture-based Sustainable Intensification (CASI). CASI technologies and practices combine the principles of conservation agriculture and principles of improving agricultural productivity with less use of resources and pressure on the environment, resulting in the increase of productivity and sustainability. This involved promoting practices that emphasized minimizing tillage, crop rotations and intercrops, and maintaining soil cover using crop residues. Along with using inputs such as improved seed varieties, fertilizer and agricultural machinery.

Research results from Bako Agricultural Research Center found there was reduced agricultural runoff through conservation tillage - minimum tillage combined with residue/mulch retention - compared to the conventional farmer practice - repeatedly tilling the bare soil which was cleaned off previous crop residues.

Agricultural runoff was 25.39 and 10.37% for maize-common bean intercropping and maize monocropping under minimum tillage and residue retention, respectively. The crop residue cover and infiltration rates associated with conservation tillage maximize the amount of water, soil, fertilizers and other agricultural that would stay in field to the benefit of the crop.

Residue retention/mulching reduced soil loss.

Results from CASI experiments in high rainfall environments in Ethiopia showed that continuous sole maize production under conventional tillage practice, where no residue is conserved and repeatedly tilled, has the highest soil loss

9.84 t/ha
average loss

Soil loss control was
97.9%

higher due to residue retention compared to the conventional tillage. This might be attributed to high sediment trapping capacity of the straw mulch.

Residue retention/mulching increased on-farm water conservation.

Results from CASI experiments in the western sub-humid environments demonstrated that soil moisture storage increased by

4.46%
for maize and common bean intercropping mulched under minimum tillage

1.76%
sole maize mulched under minimum tillage

compared to continuous sole maize production under repeated tillage and residue removal.

What are the opportunities for policy action?

Introduce new forages, promote forage conservation technologies

The success of CASI in Ethiopia is highly dependent on crop residue management. Crop residues provide protective cover for the soil and increase soil infiltration. In many parts of the country, however, crop residues have traditionally been used for multiple purposes including fuel, building materials and animal feed, which conflict with their use in conservation agriculture. Among these, livestock feed is the most widespread in the country. The Ministry of Agriculture and Natural Resources and higher policy makers at different levels as well as other concerned bodies should include approaches for increased residue retention as mulch on farm land in the country's agricultural technology scaling programs.

Mainstream livestock feed components in CASI projects

Development projects should be designed at a higher policy making level to incorporate livestock feed interventions alongside complete conservation agriculture promotion where residue retention is the principal component.

Establish and conserve forages

Increasing the range forage resources will reduce the need for removal of crop residues. Many forage species can also stabilize soil bunds on sloping lands. It is key to be sure farmers have access to high-quality forage planting materials.

Introduce green manure cover crops

The use of legumes through intercropping and/or crop rotation improve soil fertility and control weeds. It also reduces the demand for mulch and provides high quality feed for livestock. Legumes can also earn farmers extra cash, a benefit that should be used as an entry point when promoting them to farmers.

Establish and/or enforce grazing bylaws

These exist in most countries, but implementation is often lacking. CASI projects should assist in the implementation of good grazing practices supported with bylaws. Pastoralist communal land can be grazed in sections if communities are well organized. This maximizes forages through better pasture regeneration and allows crop production in un-grazed sections.

Why act now?

In Ethiopia, conventional agricultural practices such as frequent ploughing as well as the removal and burning of crop residues have contributed to the deterioration of the physical quality of the soil and hence decline in crop productivity. Conservation farming can improve soil health and crop yields. Benefits include, reducing runoff and soil loss and improving soil moisture. Without concerted action that uses a menu of options, there is little hope for reversing soil degradation.

References and sources

1. Bedru Beshir, Tadesse Berhanu, Legesse Hidoto, Feyera Merga, Goshime Muluneh, Yalfal Temesgen and Moti Jaleta (2019). Enhancing resilience and sustainability on african farms: Key findings and recommendations for Ethiopia. SIMLESA project country synthesis report. CIMMYT/EIAR. El Batan/Addis Ababa.
2. Canadian Food Grains, (2017). Conservation Agriculture Newsletter. Volume 3, Issue 1.
3. Dugassa N., Assefa A., Jou S., Hailu A., and Bogale G., (2017). Household energy and recycling of nutrients and carbon to the soil in integrated crop-livestock farming systems: a case study in Kumbursa village, Central Highlands of Ethiopia. GCB Bioenergy 9, 1588–1601.
4. European Union Energy Initiative, (2013). Biomass Energy Strategy for Ethiopia, in cooperation with the Ethiopian Ministry of Water and Energy.
5. FAO. 2016. Ethiopia Climate-Smart Agriculture Scoping Study. By Jirata, M., Grey, S. & Kilawe, E. FAO, Addis Ababa, Ethiopia.
6. Frederic K., Osmowskia J.S., Jeff C., Alemayehu A., Asmelash H.T., (2016). On the round or in the air? A methodological experiment on crop residue cover measurement in Ethiopia, Policy Research Working Paper 7813, World Bank Group
7. Frederic B., Moti J., Oriama O., Asheber T., (2013). Conservation Agriculture in African mixed crop-livestock systems: Expanding the niche. Agric. Ecosyst. Environ. Available at: http://dx.doi.org/10.1016/j.agee.2013.08.020
8. Funte, S., Negesse, T., and Legesse, G. (2012). Feed Resources and their management systems in Ethiopian highlands: The case of UmbuloWacho watershed in southern Ethiopia. Tropical and Subtropical Agro Ecosystems.
9. GIZ. (2015). GIZ Ethiopia: Lessons and experiences in sustainable land management. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Addis Ababa, Ethiopia.
10. Jaleta M, Kassie M, Erenstein O., (2015). Determinants of maize stover utilization as feed, fuel and soil amendment in mixed crop livestock systems, Ethiopia. Agric Syst 134:17–23.
11. Wakene N., Tolera A., Minale L., Tolessa D., Tenaw W., Assefa M., Zarihun A., (2011). Soil fertility management technologies for sustainable maize production in Ethiopia. Proceedings of the Third National Maize Workshop of Ethiopia. April 18–20, 2011, Addis Ababa, Ethiopia.

Please also visit us at:

www.simlesa.cimmyt.org for more publications and data on Ethiopia and other SIMLESA program countries

Acknowledgements

Financed by the Australian Centre for International Agricultural Research (ACIAR), SIMLESA program was led by the International Maize and Wheat Improvement Center (CIMMYT) in collaboration with Ethiopian Institute of Agricultural Research (EIAR), numerous partners, including national agricultural research institutes in Kenya, Malawi, Mozambique, Tanzania, Rwanda and Uganda in collaboration with other CGIAR centers. Other regional and international partners include Queensland Alliance for Agriculture and Food Innovation (QAAFI) of the University of Queensland, Australia and the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), among others.

For further enquiries please contact

Tadesse Birhanu, SIMLESA coordinator for agronomy,
Email: marsymoy@gmail.com, phone: +251 917 817610

Bedru Beshir, SIMLESA country coordinator,
Email: bedrubeshir2009@gmail.com, phone: +251 911382489

Endeshaw Habte, SIMLESA Socio-econonomics,
Email: endhabte@gmail.com; phone: +251 921644376