POLICY BRIEF

September **2019**

Conventional Agriculture:

Still a viable solution to food security in the ASALS

KEY HIGHLIGHTS

- Conservation tillage is not good for soils prone to surface crusting and sealing, a characteristic of most of the soils in the semi-arid areas of Kenya
- Degraded soils and poor farming methods lead to low maize production and vulnerability of smallholder farming systems in Kenya
- There is a need for a hybrid of conventional tillage (deep tillage - disc plough and harrowing) and conservation agriculture practices such as crop rotation and maintenance of soil cover for increased maize yields in the ASALs

Introduction

Maize is the most important and widely consumed food crop in Kenya. It is the staple food crop for 96 % of the population with 125 kg per capita consumption and provides 40 % of the calorie requirements. In the arid and semi-arid lands (ASALs), maize is produced under rainfed conditions characterized by inadequate amounts, short duration, poorly distributed and highly variable between and within seasons hence low average production of 2 t/ha with potential yields of over 6 t/ha (GoK, 2010). Despite its importance, maize yields have remained low in semi-arid and sub-humid areas due to various reasons (Fig 1). Potential yields can be achieved through the use of improved seed, optimal fertilizer rates and recommended crop husbandry practices. However, the cost of acquiring these inputs remains beyond the reach of the smallholder farmers who are major producers (70 % of total production) (Gachene and Kimaru, 2003). Therefore, tillage can be a solution for improving the maize yields in ASAL farming systems and contribute to higher and more stable yields that can fill up the yield gaps created by among other things, sporadic rainfalls among other production challenges.

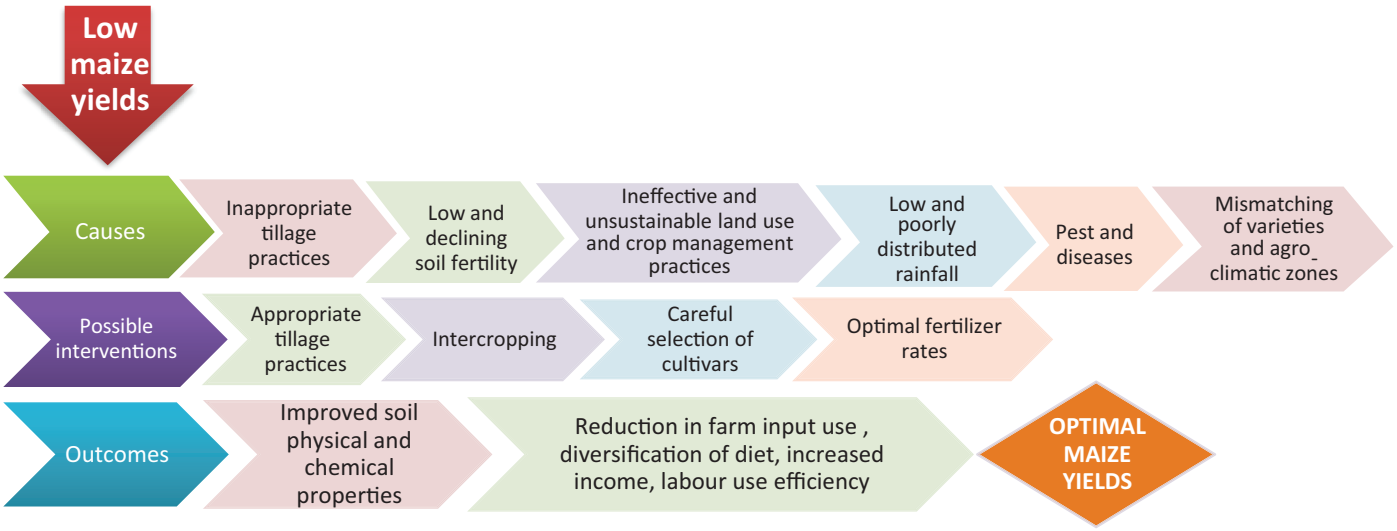

Figure 1: *Causes of low maize yields, possible intervention and expected outcomes in Kenyan ASALs*

Why tillage?

Tillage in the predominately maize-based cropping systems on smallholder farms in Eastern Kenya is mostly manual, using ox ploughs and handhoe. Tillage – based conventional agriculture is assumed to have led to soil organic matter decline, water runoff, soil erosion and other manifestations of physical, chemical and biological soil degradation (Biamah, 2005). Although conservation tillage is highly advocated, there is strong evidence that this kind of practice may not be good in soils prone to surface crusting and sealing, typical of soils in the semi-arid areas of Kenya (Gitau et al., 2006). The local biophysical conditions in the smallholder farming systems in these semi-arid areas need to be considered and deliberate adaptation efforts made for increasing food security in the ASALs.

Research Evidence

A two year on farm experiment was carried out in Mbiuni location, Mwala Sub- County (2012 - 2013) on soils with low organic matter hence prone to soil crusting. The experiment included four (4) conventional tillage practices and two (2) conservation agriculture (CA) practices (Fig 2). The financial analysis of the various treatments, inputs and labor were carried out based on the prevailing market prices

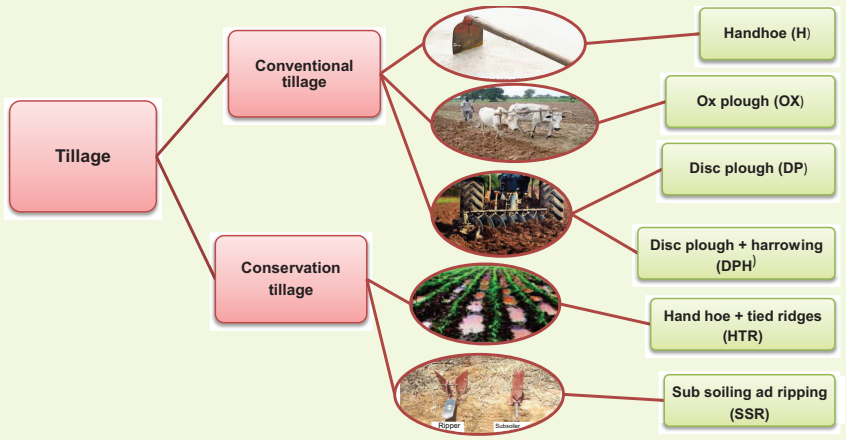

Figure 2: *Types of tillage used in Mbiuni location, Mwala Sub - County*

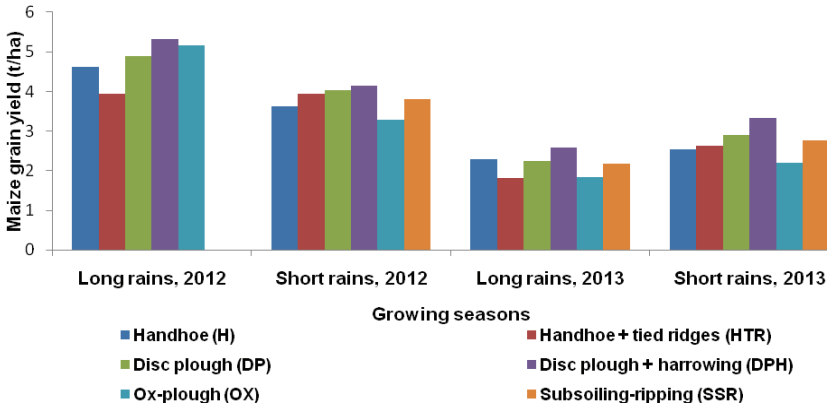

Figure 3: *Maize grain yields as influenced by tillage practices in Mbiuni Location, Mwala District (*SSR was not determined in long rains of 2012 due to lack of ripper and sub-soiler in the area and had to be fabricated)*

Financial analysis of the tillage methods

The average total variable costs associated with each tillage practice under sole maize show a decreasing trend of DPH > DP > SSR > HTR > OX > H with values ranging from KES 61 500 to KES 68 000 (Fig 4). The higher costs in DPH and DP are attributable to the cost of hiring a tractor and the additional cost of a harrow for an acre of land for the DPH plots. Evaluation of different tillage and cropping systems on an economic basis is an important factor in the feasibility of tillage and cropping systems. Net benefits variability is more vital than variability in grain yields. An average trend by tillage on the net benefits, shows a decreasing order of DPH > H > DP > OX > HTR > SSR, with values of KES 46 820 to KES 78 520 in the sole maize plots.

The savings in production costs in the conservation tillage practices (SSR and HTR) in this study could not offset the benefits and yields accrued by the conventional tillage methods (DP, DPH, OX and H) (Fig 4). This being one of the key factors discouraging the adoption of conservation tillage practices in the maize-legume based smallholder farming systems.

Maize yields under the different tillage methods

On evaluating a four - season average grain yield, disc ploughed plots had higher grain yields of 3.5 t/ha to 3.8 t/ha (Fig 3). This demonstrated that conventional tillage favored maize grain yields in Mwala Sub-County. The annual disturbance and crushing of soils caused by tillage practices produce better soil tilth which improves the seedling emergence, plant population density and consequently crop yields. In the deep tillage in the tractor – ploughed plots (DP/DPH), better root growth and nutrient uptake by the crop. This increases physiological and metabolic activities and reproductive development of crop which result in increased yields over those of other tillage practices.

? Why mechanize?

Mechanization covers all levels of farming, from simple basic hand tools to more sophisticated and motorized equipment.

Benefits include;

- Eases and reduces grueling hard labor
- Relieves labor shortages
- Improves productivity and timeliness of agricultural operations
- Improves efficient use of resources

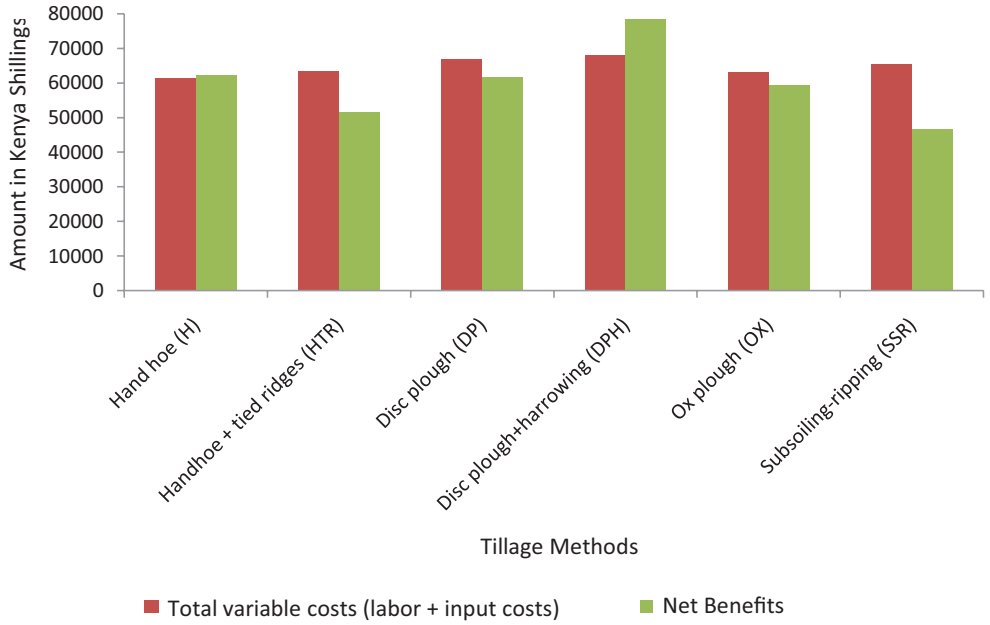

Figure 4: *: Total variable costs and net benefits associated with each tillage method in Mbiuni location, Mwala Sub-County*

What can ASALs Counties do?

- Promote annual deep tillage (disc plough, disc plough with harrowing) practices to produce better soil tilth which improves the seedling emergence, plant population density and consequently crop yields.
- Promote maize-legume intercropping that reduces the risk of crop failure, improve productivity per unit area and can provide a pathway to food security in vulnerable production systems.
- County governments need to invest in farmer field schools and demonstration centers' to support capacity building of farmers. The training and extension services should be designed to support smallholder farmers to mechanize, increasing income, ensuring food and nutrition security through crop diversification, appropriate tillage and adaptable mechanization.

Acknowledgments

This policy brief was supported by the AgriFose2030 program and the International Livestock Research Institute (ILRI) with financial support from the Swedish International Development Agency (SIDA). I wish to thank Stephen M. Mureithi for his valuable technical input and excellent editorial support.

References

- Biamah, E. K. (2005). Coping with drought: Options for soil and water management in semi-arid Kenya. Tropical Resource Management Papers, No. 58. Wageningen University and Research Centre (Wageningen UR).
- Gachene C. K. K. and Kimaru, G. (Eds.). (2003). *Soil fertility and Land productivity: A guide for extension workers in the Eastern Africa Region*. RELMA Technical handout Series 30. Nairobi, Kenya: Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency (SIDA). 164pp.
- Gitau, A. N., Gumbe, L. O. and Biamah, E. K. (2006). Influence of soil water on stress-strain behaviour of a compacting soil in semi-arid Kenya. *Soil and Tillage Research,* 89 (2): 144 – 154.
- Government of Kenya, [GoK] (2010). *Agricultural Sector Development Strategy*, 2010-2020. Government of Kenya. 120pp.

CONTACT ADDRESS

Anne Nyambura Karuma
Department of Land Resource Management and Agricultural Technology (LARMAT)
University of Nairobi
P. O. Box 29053-00625 Kangemi
Email: akaruma@uonbi.ac.ke

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

AgriFoSe2030
Agriculture for Food Security 2030
- Translating science into policy and practice

SLU · Lund University · SEI · University of Gothenburg

University of Nairobi