

# Implications of 4+°C global warming on potential of carbon trading for mitigation and food security

## - analytical framework and an Ethiopian case

Helena Kahiluoto, Karoliina Rimhanen, Belay Tseganeh, Reimund Rötter

MTT Agrifood Research Finland

### Introduction

Carbon trading offers an opportunity to finance mitigation and adaptation and to enhance equity between the developed world emitting most and the low-income countries suffering hardest. The mitigation potential through agriculture in Africa has been estimated at 17% and the economic potential at 10% of the global total mitigation potential of the sector. Avoidance of deforestation accounts for 29% and forests for 14% of the global total mitigation potential. For example in Ethiopia, agriculture-related emissions represent 67% of the total greenhouse gas (GHG) emissions. This creates a high potential for mitigation options with benefits for agricultural productivity and for adaptive capacity. However, the share of SSA constitutes less than one percent of the carbon market at present.

The objectives of the study were to

- 1) create an analytical framework to examine the factors affecting the potential of mitigation to enhance food and energy security in a changing climate, and to
- 2) apply the framework to Sub-Saharan Africa (SSA), Ethiopia and the Central Rift Valley (CRV).

### Mitigation potential

The technical agriculture-related carbon sequestration and carbon trading potential (Figure 2) correspond to 40-100% and 120-260% of the total annual GHG emissions of that sector in SSA and Ethiopia, respectively.

### Material and methods

Options for carbon sequestration were quantified through a bottom-up approach based on literature and local data from on-going collaborative studies. Constraints for implementing the options and for access to carbon markets, and the distribution of their benefits for the food insecure, were explored through interviews with stakeholders in CRV.

### Analytical framework

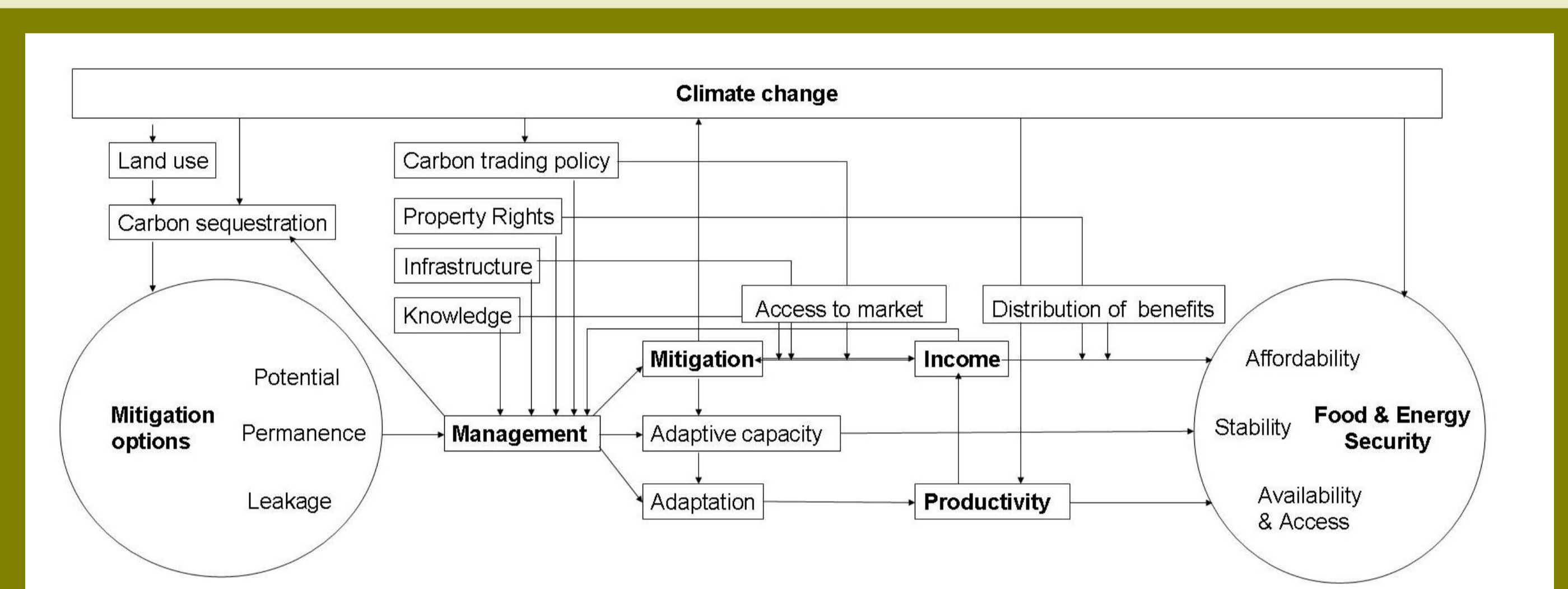


Figure 1. Factors affecting the potential of mitigation to enhance food and energy security

The analytical framework (Figure 1) highlights 1) management options, which are the means to realise the mitigation potential, and 2) their impact on mitigation, income and productivity of land.

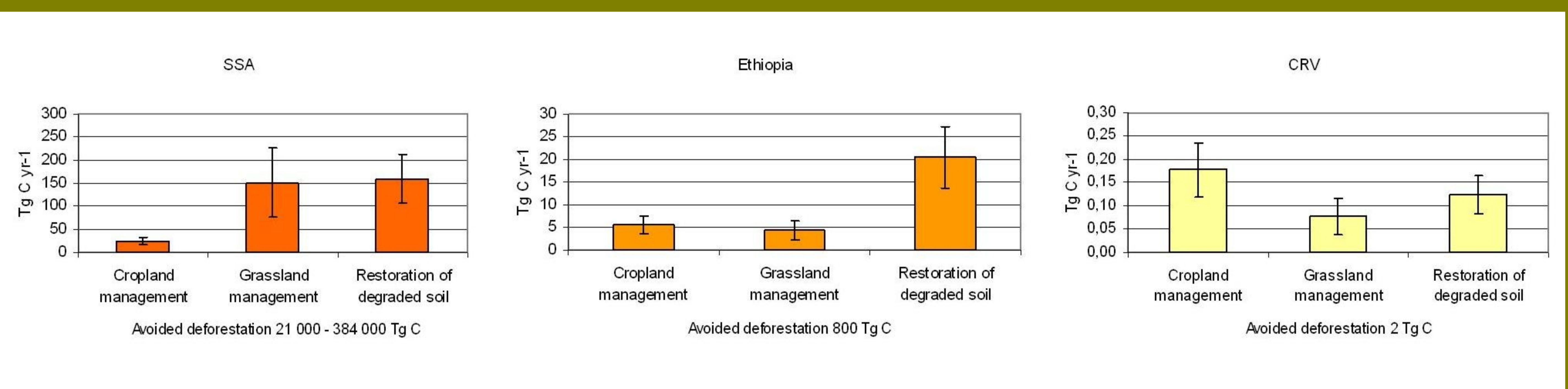


Figure 2. The technical potential for carbon sequestration through improved management (the range in literature as vertical lines).

### Impact of 4+°C global warming till 2100

The global warming of 4°C and more is assumed to result in SSA in considerable regional shifts in precipitation patterns. The growing season by 2050 is estimated to be 5-20% shorter, and crop yields 10 to 20% lower. About 5-10% of the currently marginal cropland will become transition zones from cropping to livestock keeping. For Ethiopia and CRV, the increase in land unsuitable for cropping will be even higher, 10 to 15% of the current cropland. This change will emphasise the importance of restoration of degraded land and grassland management as mitigation options relative to cropland management.

### Management options

Main causes of food insecurity in CRV are variable rainfall, overpressure on land, improper land management and low income. They result in low agricultural productivity and land degradation. Mitigation of climate change with potential for food security implies thus enhancing carbon sequestration, because it also improves soil fertility and thus food availability and access. Examples are agroforestry providing food, fodder and fuel, crop rotation, and replacement of burning manure and crop residues with biogas production and recycling the digestive.

### Obstacles for management and carbon trading

The agroecological and socio-economic conditions of CRV set constraints. For instance, no-tillage practices do not suit to most of the local soil and climatic conditions, according to the stakeholder interviews. The primary barrier, however, for access to carbon market seems to be lacking awareness in the region about that framework.

### Conclusions

Carbon trading has a notable potential to simultaneously enhance mitigation, and food availability and affordability in CRV. Agroforestry and replacing burning of manure with biogas are promising options. Lacking awareness of the carbon market is the primary obstacle to tackle with.

### References

- Batjes, N.H. 2004. Estimation of soil carbon gains upon improved management within croplands and grasslands of Africa. *Environment, Development and Sustainability* 6, 133-143.
- Jones, P.G., Thornton, P.K. 2009. Croppers to livestock keepers: Livelihood transitions to 2050 in Africa due to climate change. *Environmental Science and Policy* 12, 427-437.
- Jones, P.G., Thornton, P.K. 2003. The potential impacts of climate change in tropical agriculture: the case of maize in Africa and Latin America in 2055. *Global Environmental Change* 13, 51-59.
- Lal, R., Kimble, J.M., Follet, R.F. and Cole, C.V. (eds.). 1998. *The Potential of U.S. Cropland to Sequester Carbon and Mitigate the Greenhouse Effect*. Chelsea, MI, Ann Arbor Press, pp. 128.
- Sampson, R.N., Scholes, R.J. 2000. Additional human-induced activities – Article 3.4. In: R.T. Watson, I.R. Noble, B. Bolin, N.H. Ravindranath, D.J. Verardo and D.J. Dokken (eds.). *Land Use, Land-Use Change, and Forestry*. Cambridge. Published for the Intergovernmental Panel on Climate Change by Cambridge University Press, pp. 183-281.
- Thornton, P.K., Jones, P.G., Owiyo, T., Kruska, R.L., Herrero, M., Kristjansson, P., Notenbaert, A., Bekele, N., Omolo, A., with contributions from Orindi, V., Ochieng, A., Otiende, B., Bhadwal, S., Anantram, K., Nair, S., Kumar, V., Kelkar, U. 2006. *Mapping climate vulnerability and poverty in Africa*. Report to the Department for International Development, ILRI, Nairobi, Kenya, 200 pp.