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Understanding trade-offs in upscaling and integrating climate-smart agriculture and sustainable river basin management in Malawi

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ABSTRACT

This paper presents an assessment of the potential trade-offs between social, economic and environmental objectives when upscaling and integrating climate-smart agriculture (CSA) with integrated catchment management (ICM) at landscape level, with a case study in Malawi. In a workshop, government and NGO representatives and experts assessed trade-offs between the goals of ICM and CSA under four different scenarios of climatic and economic changes. The paper presents a novel combination of scenarios and a trade-off matrix exercise to critically evaluate trade-offs between CSA and ICM and link these to policy challenges and interventions. Our analysis shows that the compatibility of CSA and ICM policies depends on future climatic and economic developments, with a higher prevalence of perceived trade-offs in futures with low economic growth and high climate change. CSA was expected to have limited effect on reducing inequalities and investment in literacy and skills development are critical to ensure that marginalised groups benefit from CSA.

1. Introduction

Smallholder farmers in Africa operate in a complex and unpredictable system of climatic, economic, political, environmental and social conditions and constraints (Denning et al., 2009; Lasco et al., 2014). Yields and farmer incomes are constrained by low soil quality, limited infrastructure and poor access to markets for inputs and produce (Giller et al., 2011; Lee et al., 2012). Smallholder farmers are targeted by multiple poverty alleviation and development strategies, including international food security and environmental initiatives and financing sources, such as the UNFCCC's Green Climate Fund and the Global Environmental Facility, in which the concept of Climate-Smart Agriculture (CSA) is gaining traction.

CSA has three objectives: (1) to sustainably increase productivity, (2) improve resilience and adaptive capacity, and (3) reduce and/or remove greenhouse gas emissions, where possible (FAO, 2013). CSA options include both on-farm and beyond-farm agricultural and landscape management activities, but also require addressing the mediating institutions, finance and policies (ibid.). Elements of agroforestry, conservation agriculture, livestock, aquaculture, post-harvest and food-energy systems are captured by the term CSA (FAO, 2015a). Whilst this broad scope has the advantage that CSA provides a common header for many disciplines and organisations, it has been criticised for failing to provide a compelling basis for transformation towards poverty alleviation or sustainable development and prioritisation of farmers' rights and knowledge (Neufeldt et al., 2011, 2013; Sugden 2015).

CSA proponents claim that because of its broadly supported goals, CSA should be upscaled, play a central role in agricultural strategies and be integrated with the wider social-ecological system to ensure effective use of resources (Sayer et al., 2013), for example, as pursued under the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). This requires coordination at farm or community levels, as well as landscape levels (Scherr et al., 2012). CSA would have to be integrated with existing landscape approaches, which have already been adopted in policy for several sectors (Reed et al., 2015). The Government of Malawi (GoM, 2015), where our study is situated, has adopted new national guidelines for Integrated Catchment Management (ICM), the country's preferred landscape approach to natural resource management and planning to stimulate economic development, social equity, and environmental sustainability (Hooper 2005, pp. 12–13). The ICM guidelines only include conservation agriculture and permaculture as suitable CSA practices under Sustainable Land Management practices.

Management at landscape scale arguably enables a holistic view of

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competing objectives and interests in land use, and understanding and addressing trade-offs (Freeman et al., 2015). The objectives of CSA and ICM are not necessarily compatible in formulation and implementation (Seppelt et al., 2013). Some objectives seem to align: for example, CSA adaptation through on-farm tree planting may contribute to ICM objectives of reducing run-off and increasing infiltration (Lasco et al., 2014). But much of the CSA and ICM debates take place within – rather than across – the agricultural and water sectors respectively (FAO, 2015b). Past implementation of catchment management and agriculture policies has resulted in conflicts, for example, where irrigated farming on river banks is preferred to increase farm revenues but negatively affects siltation mitigation. These trade-offs relate to physical possibilities as well as preferences, norms and values of decision-makers and their societies (O'Neill and Spash, 2000).

In the dynamic, complex, multi-level and multi-stakeholder context of CSA and ICM, scenario analysis can help to deal with complexity and uncertainties and identify practices and adaptive strategies that are robust to various contexts (Vervoort et al., 2014). Scenarios are defined as coherent descriptions of plausible hypothetical future situations, including the developments that may generate that future (Van Notten, 2006; Kosow and Gaßner, 2008). Scenarios can be based on alternative development pathways that arise from combinations of uncertain but important socio-economic, environmental and technological conditions (Swart et al., 2003). This may help to identify policies necessary to steer societies onto preferred development pathways. Each scenario and 'policy mix', however, is likely to encounter different trade-offs between policy objectives.

The aim of the scenario exercise presented here was to understand whether CSA can be successfully upscaled and contribute to ICM objectives under different district-level climate change and economic growth scenarios in Malawi. We investigated for each scenario what the perceived impacts of CSA on wellbeing of stakeholder groups were, the perceived policy and implementation trade-offs between CSA and ICM, and the main interventions deemed necessary to successfully harness CSA to meet economic, social and environmental policy goals.

2. Climate change and agriculture in Malawi

Malawi is at extreme risk of climate change because of its high levels of poverty, population density, exposure to climate-related events, and reliance on agriculture (Wheeler, 2011). Climate change predictions for Malawi from McSweeney et al. (2010) suggest that average temperatures may rise by 1.1 to 3.0 °C by the 2060s, and rainfall will decrease in the dry seasons and increase in the wet season. Wood and Moriniere (2013) suggest that maximum increases in temperature up to 2040 vary between 0.6 to 1.5 °C and 2.0 °C in the hottest months, rising further to 2.5 °C up to 2060. For the South of Malawi, precipitation is expected to reduce in November, increase in February and March, and decrease in April, with lower rainfall and number of days with rain. Yields of maize, the staple crop of Malawi, decrease with higher temperatures, and this reduction is intensified in drought conditions and absence of soil moisture. Late onset of rains, or late heavy rains, considerably increase the production costs of maize, as well as other crops such as groundnuts, peas and soybeans (Wood and Moriniere, 2013).

In Malawi, 71% of people live below the $1.90 poverty line, and 87% below the $3.10 a day line (OPHI, 2015). The population of Malawi largely depends on rainfed agriculture, with average land holdings of 0.42 ha per capita in rural areas (Mussa and Masanjala, 2015). Agriculture contributes around 30% to GDP, but the informal sector is much larger. Climatic variability therefore has major impacts on wellbeing (Conway et al., 2015). The drought in 2001/02 affected an estimated 2.8 million people, caused a 30% decline in maize production and resulted in a severe food crisis (Chabvunguma and Munthali, 2008). Nevertheless, the National Adaptation Program of Action has not been funded or implemented (EAD 2011, p.11).

The strategy of the Government of Malawi is to achieve sustainable economic growth through agricultural development and food security (GoM, 2009). The national Agriculture Sector Wide Plan (ASWAP, GoM, 2010) spent on average 71% of its budget from 2006 to 2013 on maize through the farm input subsidy program (FISP, FAO 2015b). Although the FISP improved maize production (Denning et al., 2009; Pauw et al., 2016, but see Lunduka et al., 2013), it may have alleviated but not reduced poverty (Arndt et al., 2016; Dorward et al., 2009). It has been associated with fraud and corruption (Hourticq et al., 2013), failed to stimulate crop diversification (Chibwana et al., 2012), and has not resulted in internationally competitive maize production (Dorward et al., 2009).

For more sustainable development in Malawi, ways to increase the performance of the agricultural sector, reduce poverty and environmental degradation have been sought in conservation agriculture and agroforestry. But government support and adoption rates among farmers are low (Kaczan et al., 2013). This has been attributed to rigid or inconsistent technical recommendations to farmers by different NGOs, clashes with other farmer livelihood activities, and low short-term revenues (Andersson and D'Souza, 2014). Alternative cereals such as millet and sorghum are seen as inferior, "crops for the desperate", whilst links between cultural preferences and political incentives for maize reduce crop diversification (Chinsinga et al., 2011).

Development practitioners in Malawi are now embracing a wider set of climate adaptation options, including water harvesting, irrigation, drought/heat resistant crops, weather forecasting and insurances (Denning et al., 2009). Besides improving farmer livelihoods and resilience, there is a case to be made for increasing agricultural productivity to reduce deforestation in catchments (MARGE, 2009). Annual rates of deforestation have been estimated between 2.8% and 3.5% (Zulu, 2010). Deforestation is linked to siltation, reduced hydropower production and water problems in urban areas (Wiyo et al., 2015). Almost all of Malawi's electricity production is hydropower, but most of the population relies on woodfuels (MARGE, 2009).

This study focused on Zomba District in Southern Malawi. Zomba has an area of 2580 km^2 and a population density of 230/km^2 and poverty rates are high. The Zomba Plateau divides the district into the Shire River Basin in the west and the Lake Chilwa Catchment Area in the east (ZDA, 2009). Most of the ten rivers in the district originate from the Plateau. Soil degradation and water depletion are the main environmental issues. Conservation agriculture is the flagship topic of the District's Agricultural Office, but most of the Office's funding is used for implementation of the ASWAP; conservation agriculture is mainly donor funded and implemented by NGOs.

3. Methods

3.1. Scenario development and trade-off analysis

Following Börjeson et al. (2006), the scenario approach taken here can be classified as a combination of explorative and normative. Explorative scenarios typically have a long time-horizon to allow for structural changes and are of qualitative nature (Börjeson et al., 2006), but defining how to achieve desirable futures is not their aim. We used an explorative approach to define the social-ecological factors that are beyond the control of the relevant actors. Normative approaches have a desired goal and chart pathways to achieve that goal. Here, we aimed to understand how the CSA and ICM objectives could be achieved under different future trajectories and to identify robust strategies.

Scenario analysis is one of many methods used in trade-off analysis for land use management, together with optimisation models, simulation techniques, empirical analyses and participatory approaches (Klapwijk et al., 2014). Where quantitative models are unavailable, qualitative scenarios can be used to analyse discrete outcomes. Qualitative trade-off analyses are particularly useful for urgent decisions with high levels of uncertainty and plural, conflicting values and may result in more legitimate and inclusive interventions (Van den Bergh, 2004).