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A framework for priority-setting in climate smart agriculture research

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ABSTRACT

Climate-smart agriculture (CSA) is widely promoted as an approach for reorienting agricultural development under the realities of climate change. Prioritising research-for-development activities is crucial, given the need to utilise scarce resources as effectively as possible. However, no framework exists for assessing and comparing different CSA research investments. Several aspects make it challenging to prioritise CSA research, including its multi-dimensional nature (productivity, adaptation and mitigation), the uncertainty surrounding many climate impacts, and the scale and temporal dependencies that may affect the benefits and costs of CSA adoption. Here we propose a framework for prioritising agricultural research investments across scales and review different approaches to setting priorities among agricultural research projects. Many priority-setting case studies address the short- to medium-term and at relatively local scales. We suggest that a mix of actions that span spatial and temporal time scales is needed to be adaptive to a changing climate, address immediate problems and create enabling conditions for enduring change.

1. Introduction

By 2050, agricultural production will need to increase substantially to feed growing and urbanising populations, particularly in sub-Saharan Africa (SSA) and South Asia.Estimates of the increase needed vary between 25 and 70%, depending on the assumptions made about efficiency and consumption pattern changes (Alexandratos and Bruinsma, 2012; Hunter et al., 2017). Increased food production will have to be done in the face of a changing climate and increased climate variability (Porter et al., 2014), while improving nutritional outcomes and reducing the carbon cost of farming and its contribution to greenhouse gas emissions (Tubiello et al., 2015). This cannot be achieved simply by farming at lower intensity and taking more land; there is not enough land to convert at acceptable economic and environmental cost (Lambin et al., 2013; Tscharntke et al., 2012; Karlsson et al., 2017; Keating et al., 2014; Searchinger et al., 2015).

One response to these recognised needs has been the development of approaches such as sustainable intensification (SI) (Garnett et al., 2013; Montpellier Panel, 2013) and climate-smart agriculture (CSA) (Lipper et al., 2014). Such approaches have brought recognition that there will

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be multiple alternative pathways to sustainable agricultural systems, and their suitability and outcomes will vary, depending on agro-ecological zone, farming system, resource endowment, cultural preferences, institutions and policies. Another response has been to seek better understanding of the current and likely future structure of farming. Currently, 30% of most food commodities in Africa and Asia are produced on farms of < 2 ha, and 60–75% is produced on farms of < 20 ha (Herrero et al., 2017; Ricciardi et al., 2018). Industrialisation of agriculture will accelerate in some places, but in others, smallholders' contributions will remain critical, at least in the short to medium term.Although widespread intensification of production is urgently needed in SSA and elsewhere over the next 20 years, smallholders will still form the key target group for agricultural research for development (Masters et al., 2013).

How well are smallholders in lower-income countries adapting to the many challenges they face?Agricultural research for development has resulted in many different interventions over the last decades. A recent analysis of case studies across the tropics shows that only 16% of households have been actively intensifying their production in the last 10–15 years (Thornton et al., 2018a). There are many constraints facing smallholders regarding adoption of agricultural technology; so how are interventions to be taken to the scale needed if food and nutrition security is to be achieved? Given what is known about the importance of local context in smallholder systems, which interventions should be the focus? This highlights the need for prioritising different interventions, whether technical or policy-related, based on impact assessment (Raitzer, 2009). Such studies can provide information to assist in the allocation of scarce resources to research and scaling-up activities that best match funders' and governments' development objectives. This is increasingly important as many countries seek finance to implement their prioritised nationally determined contributions (NDCs) to achieve mitigation, adaptation and land degradation neutrality (LDN) targets as well as the Sustainable Development Goals (UN, 2015; Richards et al., 2015; Orr et al., 2017).

Here we consider prioritisation of research interventions in relation to CSA. While there is a growing literature on CSA prioritisation, with a wide array of different approaches and methods, we currently lack a flexible framework for assessing and comparing different interventions and investments that addresses the key elements of CSA.Here we propose such a framework. In the next section, CSA is outlined, describing some of its features that make prioritisation a challenge. Section 3 lays out a suggested framework for doing this in relation to CSA, and its use is illustrated in Section 5 based on a brief review of existing tools and methods for priority setting in agriculture and some case-study examples. We conclude with a consideration of remaining challenges.

2. Climate smart agriculture

CSA is an approach for transforming and reorienting agricultural development under the realities of climate change (Lipper et al., 2014). Its goal is to achieve sustainable agricultural development for food security via three “pillars”:

- Sustainably increasing agricultural productivity from crops, livestock and fish, to contribute to achieving food and nutritional security as well as higher incomes, but not at the expense of the environment;
- Adapting to climate change, with a focus on reducing exposure to short-term risks, enhancing capacity to adapt and develop in the face of shocks and longer-term stresses, and maintaining healthy ecosystems that provide environmental services to farmers;
- Reducing and/or removing greenhouse gas emissions where possible, including through reduced emissions for each kg of food, fibre and fuel produced, avoiding deforestation from agriculture, and managing soils and trees in ways that enhance their potential as carbon sinks, thereby absorbing CO_2 from the atmosphere.

In some situations, CSA may produce triple-win outcomes: increased productivity in combination with reduced impacts to climate risks and shocks, and mitigation of climate change through reduced GHG emissions. Often, however, implementing CSA will involve addressing trade-offs between the three pillars and weighing the costs and benefits of different options based on stakeholders' objectives. Furthermore, CSA is context specific and although some interventions may be climate-smart in some places there are no interventions that are applicable to all situations, in all ecosystems, and in all sets of different institutional arrangements and political realities. But CSA is more than a set of practices or technologies; it is rather an approach for integrating multiple interventions across a range of food systems, landscapes, value chains and government regulation or policy (Lipper et al., 2014). The range of CSA interventions is wide, from soil, water management to carbon finance and incentive systems for low-carbon agriculture, for example (FAO, 2013). Its entry points range from the development of technologies and practices to the elaboration of climate change models and scenarios, information technologies, insurance schemes, and processes to strengthen the institutional and political enabling environment, particularly for marginalized groups. The breadth of possibilities and the context-specificity of much smallholder agriculture underline the importance of the role of priority setting in resource-constrained research settings.

The CSA approach has gained considerable traction in recent years, but it has been heavily contested, particularly with respect to social equity. There are concerns that CSA may transfer the burden of responsibility for climate change mitigation to marginalized producers and resource managers, and that CSA gives little attention to entrenched power relations that may block the emergence of more equitable agricultural systems (Karlsson et al., 2017). At the same time, support for CSA has come from many countries, particularly in Africa, that include agricultural adaptation and mention of CSA in their nationally determined contributions in the wake of the Paris Agreement (Richards et al., 2015). The inclusion of equity considerations in CSA remains a work in progress, but research is now emerging on the politics and governance of adaptation and the transformations that will be needed in farming systems in the future (Chandra et al., 2017; Purdon and Thornton, 2017).

3. A framework for CSA prioritisation

In this section, we propose a conceptual framework for the prioritisation of CSA research. The framework was developed in a workshop setting, informed in part by case studies developed by some of the participants (see Section 5.2 below). Before presenting the framework, we list some of the special challenges that CSA prioritisation can present.

3.1. Special challenges of CSA

CSA presents special challenges to priority setting, including the following.First, what is “climate smart” in relation to practices, technologies, and policies is heavily influenced by local context (Duong et al., 2016; Wreford et al., 2017). Smallholder farming systems are highly heterogeneous even over short distances, both biophysically and socio-economically. Second, climate smartness needs to be assessed in relation to three dimensions (productivity, adaptation and mitigation). Priority setting thus needs to address these different dimensions using what may be multiple metrics, so that resulting trade-offs and synergies can be evaluated (Bell et al., 2018). In addition, the importance placed on each dimension by different stakeholders is strongly dependent on context and objectives. Third, the size and nature of the benefits and dis-benefits that arise from CSA adoption may have both scale and temporal dependencies (McCarthy et al., 2018). Scale dependence may arise in relation to the aggregated regional impacts of the adoption of an intervention on production and prices, such as seasonal weather forecast. Temporal dependence may arise owing to the dynamic interrelationship between the three pillars of CSA through time; for instance, interventions that build up soil organic matter may translate into substantial production, carbon sequestration, adaptation and income