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How can agricultural research translation projects targeting smallholder production systems be strengthened by using Theory of Change?

Elisabeth Rajala [a], Isabel Vogel [b], Anneli Sundin [c], Daovy Kongmanila [d], Maria G. Nassuna-Musoke [e], Robert Musundire [f], Marianne Nasha Mulangala [g], Linley Chiwona-Karltun [h], Ulf Magnusson [i], Sofia Boqvist [a,*]

[a] Department of Biomedical Sciences and Veterinary Public Health, Swedish University of Agricultural Sciences, Uppsala, Sweden
[b] Isabel Vogel Ltd, United Kingdom
[c] Stockholm Environmental Institute, Stockholm, Sweden
[d] Faculty of Agriculture, National University of Laos, Vientiane, Lao PDR, Laos
[e] College of Veterinary Medicine, Animal Resources and Biosecurity, Makerere University, Kampala, Uganda
[f] Department of Crop Science and Post-Harvest Technology, Chinhoyi University of Technology, Chinhoyi, Zimbabwe
[g] Association des Femmes D'Affaires du Congo, Democratic, Republic of the Congo
[h] Department of Urban and Rural Development, Swedish University of Agricultural Sciences, Uppsala, Sweden
[i] Department of Clinical Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden

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ABSTRACT

Sustainable development of smallholder agriculture production in low and lower middle-income countries are crucial for improving food security. To accommodate this science based evidence needs to bridge with agricultural practices and policy development, which requires coordinated actions and long term strategies involving multiple stakeholders. This paper argues that using a Theory of Change (ToC) approach, with strong emphasis on communication and stakeholder engagement, science based knowledge can be more effectively integrated in agricultural development, but also in policy development. Three projects addressing different challenges within livestock production are used to illustrate the use of and challenges with using a ToC framework. A key for reaching outcome was early involvement of relevant stakeholders in implementing teams and using the flexibility included in the ToC approach from design to implementation.

1. Introduction

Despite global economic growth and millions of people being lifted out of poverty, food insecurity and nutrient deficiency, also known as hidden hunger (Gödecke et al., 2018), remain major challenges in many parts of the world. In fact, the number of people suffering from hunger has actually increased slightly in recent years (FAO et al., 2019). The challenge of achieving food and nutrition security (SDG2) is particularly difficult for sub-Saharan Africa (SSA) due to low productivity on the smallholder farms that provide the majority of domestic food supply (UN, 2019). Increasing productivity in smallholder farm systems is critical in achieving food security and in contributing to sustainable food production systems (Caron et al., 2018; Herrero et al., 2010). A large proportion of smallholder farmers in low-income countries in Asia and Africa own livestock, which play a major role in sustaining livelihoods, food and nutrition security (Herrero et al., 2013; Smith et al., 2013). Livestock contribute directly to food security by providing milk, meat and eggs, although the poorest often tend to sell these high-value animal-source products to generate household income (Dumas et al., 2018; Rufino et al., 2013; Smith et al., 2013). However, to increase productivity in smallholder farming systems, evidence based knowledge have to be better linked to policy development processes, and practises to include the best technologies and innovations in agriculture (Steenwerth et al., 2014; Johnson, 2018, Thornton et al., 2017). This requires coordinated actions and investment by farmers, researchers, private sector, civil society and policymakers (Lipper et al., 2014; McDermott et al., 2010). Without these links, assumptions made about technological innovations, smallholder farming etc. may be inaccurate (Blesh et al., 2019). Experience in agricultural research for development (AR4D) suggests that the process of improving agricultural productivity and

* Corresponding author.
E-mail address: Sofia.Boqvist@slu.se (S. Boqvist).

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sustainability using science based knowledge can be facilitated by employing a systematic, outcome-oriented approach to designing and implementing translations projects, for example by using Theory of Change (ToC) (Thornton et al., 2017; Douthwaite et al., 2017; Omore et al., 2019; Mayne and Johnson, 2015).

ToC belongs to a family of evaluation approaches known as programme theory, which also include logic models, outcome chains and impact pathways (Funnell and Rogers, 2011; Weiss, 1995; Chen, 1994). From its origins in programme evaluation in the 1960s, the ToC approach has become widely established in mainstream development practice as a systematic way of clarifying the underlying theories and cause-effect pathways that underpin initiatives working to promote social and economic change, particularly in complex interventions such as AR4D (Mayne and Johnson, 2015; Omore et al., 2019; Brouwers, 2013; Vogel 2012a, 2012b; Douthwaite et al., 2007). The resulting causal models and impact pathways are applied across the whole cycle of programme design, planning, implementation and evaluation (van Es et al., 2015). However, unlike its cousin the Logical Framework, ToC remains a non-standardised approach, offering flexibility to potential users to adapt the approach for their purposes and contexts (Valters 2015; van Es et al., 2015; Vogel 2012a; James, 2011). This made the ToC approach useful for the AgriFoSe2030 projects included in this paper. AgriFoSe 2030 (Agriculture for Food Security 2030) is a multi-disciplinary, multi-sector programme contributing to transformation of smallholder farming to more productive systems using science based knowledge (AgriFoSe2030, 2019). The programme is funded by the Swedish International Development Cooperation Agency (Sida) and contributes to the social, economic, and environmental sustainability of the agricultural sector in sub-Saharan Africa (SSA) and South and Southeast Asia for improved food and nutrition security (SDG2). Drawing on this insight, AgriFoSe2030 offered a selection of research translation projects the opportunity to work with a ToC specialist and experts in stakeholder engagement and communications to help design and implement their projects, with a view to enhancing their potential to include science based knowledge in practise improvement and policy development.

The aim of this paper is to explore to what extent the benefits with ToC held true for three AgrifoSe2030 projects aiming to translate science into policy and practice. The paper offers reflections on how the adaptation and use of the ToC supported the design, implementation and outcomes of the AgriFoSe2030 projects. The projects address different challenges within livestock production in SSA and South and Southeast Asia.

2. Methodology

2.1. Selection of projects and stakeholders

Three projects focusing on insect production and consumption in Zimbabwe and the Democratic Republic of Congo (DRC); goat management in Lao People's Democratic Republic (Lao PDR); and dairy production and artificial insemination (AI) in Uganda, were selected through a call process targeting researchers that had previously engaged in the AgriFoSe2030 programme. The projects were formulated and developed by the researchers, with support from AgriFoSe 2030. The first set of key stakeholders were identified by the investigators themselves at the proposal stage, through exploring opportunities in their settings of interest. These stakeholders were then closely involved formulating the project objectives, the first step in designing projects with good potential for impact (this is described more in detail below). The projects ran for about one and a half year, ending in December 2018 and had limited but flexible budgets.

2.2. Project design

Given the lack of standardisation in how ToC is applied, we opted to draw on an adapted version of a ToC stepwise approach and existing guidelines for ToCs for research (Fig. 1) (IDRC, 2017; van Es et al., 2015). The three projects began by synthesising available evidence on practices relating to insect production and consumption, goat management and dairy production. All three projects drew on science-based practices and also generated their own primary action research as part of their work. Key components in generating evidence were the scoping studies and situational analyses performed in all three projects as part of the inception phase. At the start of the projects, the project leaders and teams joined a workshop with key stakeholders from their project context to develop their respective ToCs. Stakeholders who attended included representatives from the Chinoiyi municipality, Zimbabwe (insect project); members of the Lao PDR extension service (goat farming project); a senior official from the Ministry of Agriculture, Uganda (dairy project).

Supported by an expert in ToC (Vogel), the teams were taken through eight structured steps, as set out in Fig. 1. The process began with identifying the reason for working with ToC (Step 1), followed by articulation of the overall desired policy and practice change for each project (Step 2). The specific agricultural production challenge and its wider system context were then examined through situational analysis, bringing in previously mentioned scoping analysis and evidence, and combining this with the unique stakeholder knowledge and experience in the teams. This step helped to identify and map the system stakeholders involved – farmers, traders, investors, extension officers, local and national government entities, and other specific groups that needed to be engaged in the change process (Step 3). Using visualisation, mapping and strategic planning techniques such as Rich Pictures (Checkland 2000), stakeholder analysis and force field analysis (Thomas, 1985), the project teams then identified where practice and policy change was needed to transform smallholder farmers, among the specific institutional actors and stakeholders within their target production systems. From this, a set of pathways to reach their goal was constructed, and critical assumptions identified (Steps 4 and 5). The teams then applied their ToCs to refine their initial project strategies for the first six months, with specific focus on outreach, engagement and communication, with expert support from the AgriFoSe2030 Communications team (Step 6). Working collaboratively through these steps, in the workshop each team produced a ToC map, which was then captured digitally using LucidChart software (Lucid Software Inc., South Jordan, USA).

2.3. ToC in implementation, monitoring and adaptation

Once the project activities began, the ToC facilitator and the communications experts maintained regular contact with the project directors, using the ToC map as a guide to critically reflect on progress and changes in the context, test and update assumptions, and identify how stakeholder engagement strategies could be adapted. For monitoring and evaluation, as set out above, the projects used a ToC-led self-evaluation approach, with a critical reflection cycle based on tracking emerging outcomes in 'real time' along the projects' ToCs and their contexts, broadly aligned with the approach discussed in O'Flynn and Sonderskov (2015). With clearly defined outcomes, linked to different stakeholder groups, it was straightforward to identify outcome areas to track within the ToC at key stages, e.g. activities and outputs, and short-term outcomes. Short-term outcomes were conceptualised in the ToCs as changes in the awareness and attitudes of stakeholders, changes in stakeholder capacities and changes in practice and policy domains. Assumptions were also identified. Data for these outcome areas was collected through stakeholder surveys at baseline and endline, and complemented with participatory monitoring and evaluation with project participants and stakeholders, particularly on aspects of the ToC involving capacity change.

The projects did identify longer term outcomes, but as teams were limited in time and resource, large-scale collection of data on longer-

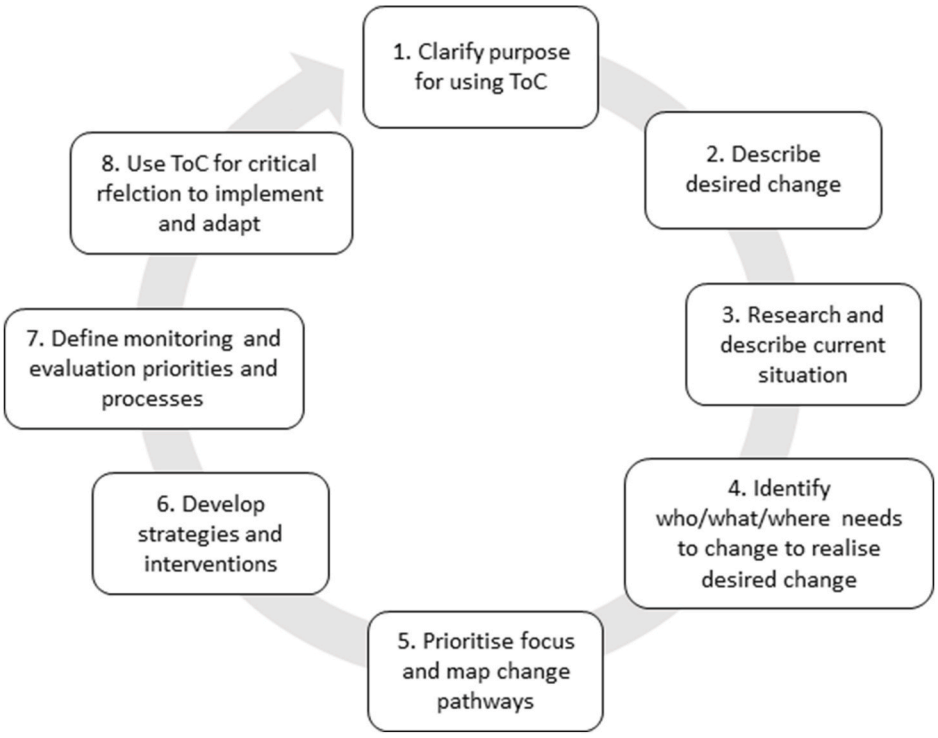

Fig. 1. The Theory of Change (ToC) stepwise approach. Diagram modified from van Es et al. (2015).

term outcomes like yields was not possible. After the completion of the projects in 2019, a self-evaluation and learning workshop was held with all project teams and key stakeholders to reflect on their overall progress along the ToC, document the outcomes and impacts to which projects had contributed, and identify lessons for themselves and for future implementers.

3. Project results and outcomes

3.1. Edible insects for food security and health: from practice to evidence and policy implications

Edible insects are an important nutritional component and major complement to the African diet. More recently, insects have also been recognised as having significant potential as feed for livestock, poultry and fish, due to their high nutritional value and low environmental impact, especially as per capita income and associated demand for protein increase (Kelemu et al., 2015; Rumpold and Schluter, 2013). The project to promote integrated use of edible insects in urban and peri-urban areas of Zimbabwe and the DRC sought to build capacity and increase awareness among local urban authorities, to achieve sustainable and safe trading in edible insects. The project also sought to facilitate stakeholder engagement locally in advocating insect consumption in Zimbabwe and the DRC, to create an inclusive platform. The ultimate goal was to contribute to sustainable entrepreneurship and participation in the edible insect sector by women, young people and disadvantaged members of society.

3.1.1. Project outputs and outcomes

Trainings were held in Zimbabwe and the DRC to improve food safety measures, facilitate marketing and availability of edible insects. 90% of the participants were women, which reflects insect trading being an activity mainly carried out by women. Insect market facilities were established in both countries in collaboration with local municipalities and providing a tangible base from which to support a number of positive outcomes, such as improved food safety standards and hygiene, improved access to markets, enhanced exposure among new groups of consumers and stability in the supply of insects.

In Zimbabwe, the Chinhoyi Urban Insect Traders Association was established, which collaborates with the Chinhoyi Municipality on the market facility. As a spin-off effect, three additional Insect farmers and Traders Associations were established in provinces distant from Chinhoyi, Zimbabwe where the project was implemented. These associations have contributed to increased awareness of the nutritional and economic value of edible insects, better management of the value chain of edible insects, and awareness on the need to rely less on wild harvested insects as this affects the stability of the traders businesses. The associations are also into production of mealworms, crickets, mopane worms and Black Soldier Fly.

Another spin-off is that private and public partners, namely the Food and Agriculture Organization (FAO), Government of Zimbabwe Agricultural Extension Institutions and non-governmental organisations (NGOs) have teamed up with Chinhoyi University to initiate a Black Soldier Fly Farming initiative in Zimbabwe, for example by setting up a train of trainee programme reaching at least 1500 smallholder farmers.

In August 2019, the project organised an international conference (The First African Conference on Edible Insects) in Harare, on the use of insects as food and feed, hosted by Chinhoyi University of Technology and the AgrioFoSe2030 programme. The conference gathered scientists, academics, investors, policymakers, entrepreneurs and smallholders to consolidate research and the development of an edible insect industry in Africa and paved the way for private investment in this sector. At this conference, a resolution was reached to create national edible insect stakeholder platforms in nine countries in Africa. The conference attracted attention from the World Bank, FAO, International Centre of Insect Ecology and Physiology, Rockefeller Foundation East African Regional Office and the Government of Zimbabwe. Lastly, the Ministries of Agriculture and Natural Resources and Health in Zimbabwe issued a policy positions regarding consumption and utilization of insects as food resources.

3.2. Improved goat keeping among smallholders for a nutritious diet and increased food security

Goats are suitable livestock for smallholder farmers who cannot afford to invest in cattle or buffalo, because goats require less space, inputs and capital (Boyazoglu et al., 2005; Escareño et al., 2012). However, goat production in Lao PDR has long faced challenges connected to low productivity and high mortality (LSB, 2010; Nampanya et al., 2010). There is generally a low level of knowledge of goat production among extension workers and little contact between them and experts within academia. There is increasing demand for goat meat in Lao PDR but this cannot be met by the current production system, mainly due to significant export of goat meat to neighbouring countries (Windsor et al., 2018). The aim of the project was to improve goat management practices in order to increase productivity and production of goat meat for the domestic and export market. The project targeted smallholder farmers, but also technicians and extension officers. To the authors' knowledge, there have been few, if any, livestock production projects in Lao PDR having contributed to increased cooperation between researchers and extension services.

3.2.1. Project outputs and outcomes

Capacity was built among 340 smallholder farmers (110 women) in two provinces. There were also specific trainings on goat management targeting women farmers. Model farms were set up to showcase best management and feeding practices, e.g. by building better housing systems and growing suitable feed crops. The project also resulted in closer contact between extension officers, smallholder farmers and academia. Farmers' groups, which had never previously existed in the region, were established on the initiative of the farmers. Through these groups, knowledge on goat production is being disseminated to other farmers. Evaluations showed that 74% of the farmer group members began to use feed supplement (minerals) regularly, 25% of the group members took better care of the young goats, and 76% of the farmers started to plant the pasture for their goats as a result of the project. Another major contribution was improved capacity among extension officers to support and give advice to smallholder goat keepers as there had been no previous training on this for this group. The extension officers have created a network contributing to knowledge sharing supported by the researchers at the National University of Laos, Vientiane, Lao PDR. Before the project start the extension officers had very little or no experience in goat production.

3.3. Promoting the Jersey cattle breed and an artificial insemination service for improved livelihoods on smallholder dairy farms

The dairy sector is important in Uganda, but animal productivity remains inefficient and the reported overall increasing trends in milk since 1991 were not due to increased productivity per cow, rather to growth in cattle population (Kanyima et al., 2015; Omondi et al., 2017; Tibezinda et al., 2016). Low adoption of technologies and inadequate management by livestock farmers contribute to poor productivity and many cattle farmers (large and small) in Uganda have reverted to natural breeding using unproven bulls instead of AI that uses high grade proven bulls. Smallholder farmers cannot afford the large exotic cattle breeds that have been promoted for intensive dairying since they require high inputs to rear and maintain and consequently many smallholder households are giving up cattle rearing due to lack of animal feed particularly in the dry season. Many farmers also keep low-producing indigenous breeds, partly for traditional and cultural reasons, although crossbreeds with exotic breeds less adapted to tropical conditions are also kept (Mugisha et al., 2014). The aims of the project were to contribute to more sustainable milk production by promoting crossing with the Jersey cattle breed, which is more efficient than existing exotic breeds commonly used in Uganda, and to promote use of AI to improve cattle breeding.

3.3.1. Project outputs and outcomes

The project resulted in increased knowledge in cattle management and reproduction among 430 smallholder dairy farmers (115 women) in the two included districts. It also resulted in greater awareness among smallholder farmers, animal technicians and veterinarians about the importance of using more robust dairy breeds, reproductive health management and AI. In addition, an animal fertility and breeding centre using AI was established at Makerere University in Kampala. The project also developed an information and communication technology tool to facilitate data collection on cow fertility on smallholder farms and to disseminate information and knowledge to extension workers to improve cow reproduction. Another important outcome was accelerated uptake of the Jersey cattle breed among farmers as reported by the AI technicians and support of uptake on a political level, at the Ministry of Agriculture, Animal Industries and Fisheries. This is illustrated by e.g. a commitment by the Acting Director of Animal Resources to budget for fast-tracking establishment of Jersey farmers' associations in Uganda. In addition, the project has created a business opportunity for private semen dealers, who has ordered for increased stock of Jersey semen. Also the animal fertility and breeding centre at the Makerere University has been revitalized and can provide better targeted services than before. A spin off effect is that AI skills training has been include in the curricula for the Bachelor of Veterinary Medicine as well as Bachelor of Animal Production Technology and Management degree programmes.

4. Discussion

This paper explores to what extent the benefits with ToC held true for AgrifoSe2030 projects aiming to translate science into policy and practice. In all three projects, stakeholder representatives were part of the implementing team and were involved in the development of the projects' ToCs. This meant that, right from the outset of the project, highly relevant perspectives, experience and skill sets were combined from research, national and local government authorities, and extension agencies. Engaging stakeholders in processes to bridge science and policy on food security has been identified as challenging, but fundamental to reach outcome and impact (Chaudhury et al., 2013; Thornton et al., 2017; Douthwaite et al., 2017). In the AgriFoSe2030 projects it proved successful including relevant stakeholders during initial planning, which also contributed to building trust and relationships over time. Drawing on all stakeholders' perspectives, experience and skills to construct the ToC map strengthened the shared vision, identified the key target groups and developed a realistic 'pathway' to guide planning and implementation. The process also helped to identify and mobilise 'windows of opportunity' for the projects. Similar experiences of working with ToC in AR4D documented in Omore et al. (2019) and, Mayne and Johnson (2015), suggest that the *promise* of working with ToC lies in helping to clarify the pathways to impact, and establish a shared vision amongst all the stakeholders, not only about the end point but about the combined actions that are needed to promote change. In the AgriFoSe projects, the multi-stakeholder team helped to enhance project credibility, maximising their reach and mobilisation of target groups, and provided a platform for swift execution of project activities. For example, in Lao PDR, adopting a close, participatory, team-based approach involving extension staff, researchers and partners helped the project reach farmers and local communities in the provinces and promoted strong ownership of the initiative among the extension agencies.

In all three projects, the ToC process had identified the importance of supporting farmers and traders to form associations as a means of consolidating and spreading the benefits of the projects. However, at the start, this had felt unrealistic to the project teams, given the known challenges in establishing producer associations and the projects' short timelines. The challenges relating to establishing farmers or producers associations are context specific and include e.g. demographics, the institutional landscape in which the associations operate, the

environmental context, as well as underlying economic structure or local economic base (Schmidt et al., 2015). Nevertheless, by engaging key stakeholders at an early stage and involving them in the ToC process, opportunities for supporting groups in all three settings, for example, the Chinhoyi insect traders, the goat farmer groups in Lao PDR and the fast-tracking of funding for Jersey farmers to form an association in Uganda, opened up and were consolidated. Acting as demonstrators, these farmer and traders' groups created further opportunities for spin-off benefits in all the projects. In Uganda and Zimbabwe, the institutional stakeholder alliances leveraged additional inputs. For example, in the dairy project in Uganda, Makerere University made in-kind contributions to the project, while in the insect project in Zimbabwe, the local municipality leveraged additional funding to help construct the insect market building. Similar findings have been reported previously that the support of stakeholders to work together and move multiple activities in parallel are important for greater progress and impact (Omore et al., 2019; Mayne and Johanson, 2015).

All projects experienced challenges arising from the fact that the ToC process can be hard to learn at first, and outcomes-oriented planning is difficult. This was addressed by having a facilitated process and employing a number of techniques to de-mystify and translate concept, e.g. the business people in the group recognised ToC as being similar to business planning and market analysis in their setting (personal communication, Nasha Mulangala, Association des Femmes D'Affaires du Congo, Democratic Republic of Congo). Also, there were a number of assumptions which did not hold true which partly was due to unrealistic expectations of what could be achieved in a relative short project period. This led to some initially planned activities and outputs were replaced by alternatives that appeared more realistic, for example the intention to involve local leaders in the insect project in Zimbabwe.

Two of the three projects set out to influence policy as well as practice, mainly through engaging ministries of agriculture. The project ToCs reflected this important policy pathway, and had in fact involved or planned to involve national policy stakeholders in the project. However, the projects' experience suggests that policy change for new sectors is slow and can sometimes be better pursued using a bottom-up approach that demonstrates results. The experiences from the AgriFoSe2030 projects are in line with other reports showing that without clear and evidence based policy engagement strategies policies may be counteractive (Johnson et al., 2015). Due to the relative short project period the AgriFoSe2030 dairy project did not succeed with the initial plan to develop a show case district that would attract sufficient attention from the government to support national policy development. The difficulty for smaller projects to attract attention from governments for policy development was also reflected in the insect project in Zimbabwe and the DRC. Instead, the projects pivoted to another key pathway in their ToCs - engaging local government and municipal authorities, and local extension services. Here, all three projects saw much more successful engagement, and, in fact, these local linkages created further platforms for wider policy engagement, e.g. in Zimbabwe, the international conference on insects, and in Uganda, the commitment by the Acting Director of Animal Resources to budget for fast-tracking establishment of Jersey farmers' associations in Uganda. Institutional engagement, establishing strong links with local partners and adaptation to local conditions have been identified important for policy development (Johnson, 2018). This resonated with all teams' reflection that, when development projects begin by implementing useful changes initiated from grassroots level, this provides lived experience and grounded evidence. Policy makers can often feel more confident to use this as basis for changing policies to support measures proven to work under the prevailing circumstances. These locally-led linkages supported a more incremental but arguably more sustainable pathway to policy level change, and the ToC supported this change of pathway. This experience is supported by a study targeting environmental challenges (Cvitanovic and Hobday, 2018) which concludes that the study of bright spots - instances where science has successfully influenced policy and practice— creates a sense of optimism and help to identify key principles for success and allow for the development of more effective strategies for successfully translating science to policy and practice.

For monitoring and evaluation, a ToC-led self-evaluation approach was used to capture quantitative and qualitative outcomes. Developing narratives were found effective to describe qualitative outcomes, which also have been used by others (e.g. Thorntone et al., 2017). The AgriFoSe2030 projects are not yet at a stage where long-term outcome and impact can be evaluated, however, the ToC approach seems to be an effective methodology to make more efficient use of science based knowledge for agricultural development. However, already at the end of the relative short project period the projects were able to document short term impact, for example more request of Jersey semen for AI from private companies in Uganda, and improved connection between extension services and researchers in Lao PDR. A more thorough evaluation of the projects is expected to take place at the end of the AgriFoSe2030 programme (in 2023).

All projects reported that pivoting of strategies in response to changes in the context was supported by flexible management and budgeting from the AgriFoSe2030 leadership. These 'internal' stakeholders had also been involved in every step of the ToC planning, so they had a good overview of the projects and a good understanding of why and where they might need to be flexible in redirecting resources to other areas to achieve the desired outcomes. Regular contact and information flows between the projects, the management team and the supporting specialists helped to promote appropriate and responsive adjusting of plans. Previous publications support our findings that the flexibility to adapt projects rapidly in response to changes and opportunities, and the need for "complexity-aware" approaches are important for projects to be successfully carried through (Omore et al., 2019; Mayne and Johnson, 2015; Thornton et al., 2017; Douthwaite et al., 2017).

5. Conclusions

Improving food and nutrition security in low and low-middle income countries requires linking science to policy and practice. Overall, the projects presented here, targeting transformation of smallholder farms to more productive, sustainable systems, found evidence to support that ToC can help teams to explore and explain how their research translation efforts are expected to contribute to development impacts, and to understand how stakeholders need to be engaged, linked and coordinated to promote the desired outcomes. However, there was a coherent view among the researchers that the ToC process can be hard to learn at first, and outcomes-oriented planning is difficult. Another common experience was that changing policies for new sectors is slow and can sometimes be better pursued using a bottom-up approach that demonstrates results. Also, flexibility in terms of management, budgeting and project plans were identified as important factors to promote change towards the desired outcomes and societal impact. The AgriFoSe2030 projects are not yet at a stage where impact can be evaluated, however, the ToC approach seems to be an effective methodology to make more efficient use of science based knowledge in policy and practise.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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