6th International Symposium for Farming Systems Design
Agricultural systems by design

Integrating legumes while increasing maize yields – five seasons of co-learning in western Kenya

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1 Introduction

Sustainable intensification of smallholder agriculture in sub-Saharan Africa (SSA) is a key pathway to provide food for the growing population (e.g. SDSN 2013; Vanlauwe et al. 2014). Grain legumes are seen as a central option for sustainable intensification as they fix nitrogen (N) from the air (reducing the need for mineral N fertiliser), are nutritious food and can be more profitable than staple crops such as maize (Giller et al. 2013). Yet adoption of options for sustainable intensification is often limited by knowledge and resource constraints, due to the poverty trap within which smallholder farmers operate (Tittonell and Giller 2013). The objective of this study was to assess the outcomes of a trajectory of five seasons of co-learning, when resource constraints are partly alleviated. This paper focuses on the adoption process of legumes as part of the intensified maize-legume cropping system, which together comprise the main crop component of the farming systems.

2 Materials and methods

An iterative co-learning trajectory of five seasons was used to find options for sustainable intensification that fit within the local context, involving participating farmers, local experts and researchers (Fig. 1). At the heart of this trajectory was a series of five co-learning workshops prior to each cropping season. A 'workshops' group included 13 farmers and took part in the co-learning trajectory. The control was a 'no-workshops' group (n=13) who did not take part in workshops and to whom no advice was given. Both groups received an input voucher each season (US$ 100 season^{-1}) to (partly) alleviate resource constraints. The voucher comprised a list of inputs: i.e. maize, common bean, soyabean, and groundnut seed; mineral fertilisers; soyabean inoculant, and dairy concentrate, which were distributed by the project. Topics for the first workshop were selected by researchers. In subsequent workshops topics were based both on questions and issues raised by farmers in seasonal evaluation interviews

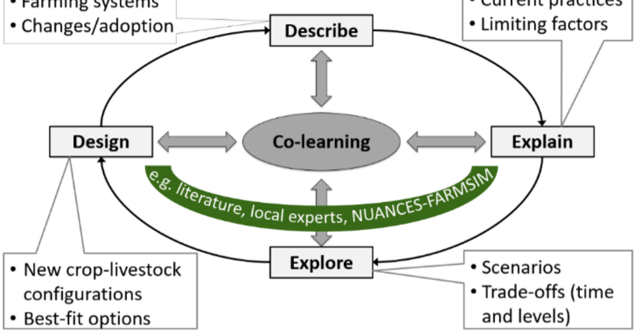

Fig. 1. Co-learning with farmers, local experts and researchers based on different types and sources of information as part of the DEED-cycle of Describe (D), Explain (E), Explore (E), and Design (D). Adapted from Descheemaeker et al. (2019).

(workshops group only) and evolving earlier topics. A baseline detailed farm characterisation was conducted before the project and farm management and yields were assessed in following seasons. A final evaluation interview, this time including farmers from the “no-workshops” group, was held at the end of the fifth season. The study took place in Vihiga county, western Kenya, with both groups in separate sub-locations which were sufficiently apart to prevent knowledge exchange between groups.

3 Results and Discussion

Intensification through the vouchers

Input use increased substantially due to the vouchers. Before the start of the project farmers spent US$ 0 to 30 season^{-1} household^{-1} on the inputs that were now available through the US$ 100 voucher. The voucher was mainly (70-80%) spent on improved maize seed and mineral fertiliser for maize (diammonium phosphate and calcium ammonium nitrate). Maize yields increased from on average 1-2 Mg ha^{-1} in the two seasons prior to the project to 4-5 Mg ha^{-1} in the last three seasons of the project.

Soyabean: from first hype to normality

In the first season only soyabean and common bean inputs were available as legume inputs. Particular attention was given to the possible benefits of soyabean (e.g. rotational effects, market value) in the workshop. Nearly all farmers in both groups planted soyabean in the first season. Average area cropped with soyabean across households went from 0% of their total farm area in the two seasons prior to the project to 7% and 14% for the no-workshops and workshops group respectively in the first season (Fig. 2). This difference between the groups may have been a result of the workshops. In the subsequent seasons the soyabean area fell to 5% or less in both groups. Evaluation interviews following season one showed widespread discontent with soyabean: pest damage by birds and squirrels and difficult market conditions were major constraints. A number of farmers however, continued with soyabean cultivation. In season five, 4 of 13 farmers in the no-workshops group and 8 of 13 farmers of the workshops group planted soyabean. It was particularly valued as a rotation or intercrop in Striga-affected fields and liked for its nutritional quality. The initial uptake in the first season may be seen as ‘try-outs’ (Misiko and Tittonell 2011) – important for learning, but may not necessarily be leading to adoption.

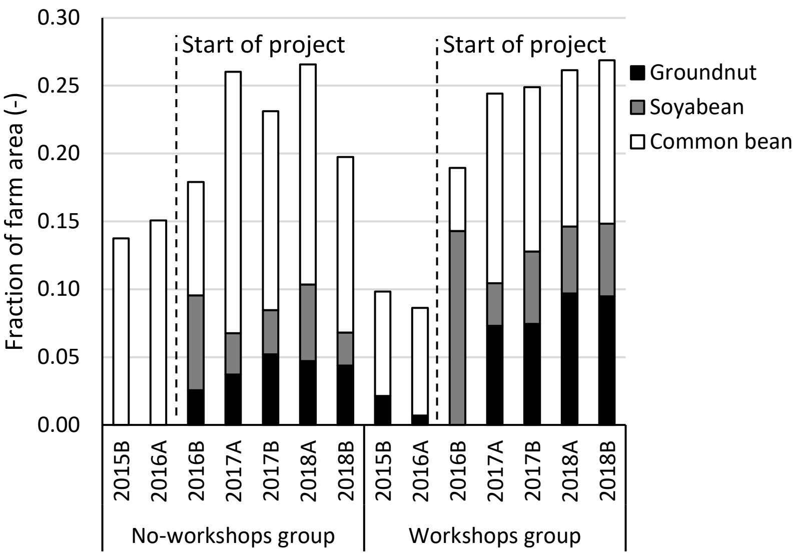

Fig. 2. Average fraction of farm area of no-workshops (n=13) and workshops (n=13) group farmers with grain legumes. Seasons 2015B and 2016A were before the start of project.

Slow but steady, growing importance of groundnut

As a response to the negative feedback about soyabean, groundnut was introduced in the second season as an alternative legume option. Only two farmers cultivated groundnut in the two seasons prior to the project (groundnut rosette virus had virtually eliminated the crop in western Kenya). All farmers of both groups had cultivated groundnut at least once after season five. In the fifth season on average 4% of the farm area was cultivated with groundnut by the no-workshops group and 9% by the workshops group (Fig. 2). In the workshops group also more farmers cultivated groundnut (13/13 farmers) than in the no-workshops group (9/13). Initial responses in the workshops group after season two were mixed. Poor seed quality resulted in poor germination and farmers could only judge this variety (c*v.* CG7, which was new to them) on the high yields per plant. Here, try-outs proved useful. With availing good quality seed in the following seasons, CG7 was highly appreciated for its resistance to groundnut rosette virus, large seed, high price, and relatively high yields. The good revenue (per unit area) from groundnut was also a key topic in the last two workshops, as an option to generate revenue to buy inputs when the project ended.

Challenges in the legume-maize crop configurations with intensification
Maize smothering legumes in intercropping came up as an important issue in the evaluation interview following season two. This was an unforeseen result of prolific maize growth due to increased fertiliser use. Land is particularly scarce in Vihiga, one of the most densely populated rural areas in SSA. Workshops farmers emphasised that they prioritized cultivating maize, striving for maize self-sufficiency, with legumes only as an intercrop. As a response, sole cropping of legumes and mbili-mbili (double row) intercropping (to improve light availability for the legume) were introduced in the third workshop. However few farmers tried the alternative spacing. Extra effort was made during the fourth and fifth seasons through planting demonstration plots together with farmers. After this, in total 10/13 workshops group farmers tried one of the alternative legume spacing options.

Increasing cultivated area of legumes for the workshops group
The area under grain legumes continued to increase for the workshops group throughout the co-learning trajectory, to 26% of the farm area in season five. Before the project this was 8-10%. For the no-workshops group the legume area was 14-15% before and 19% in season five, meaning that both the total percentage and the relative increase were larger for the workshops group. Moreover, the no-workshops group had a decreasing area or no increase for all three grain legumes in the last three seasons. They reported smothering of grain legumes by maize as a main reason (they were not aware of alternative spacing options). That legume area increased for both groups was likely a result of increased availability and accessibility of legume inputs. We attribute differences between the two groups to the co-learning trajectory.

4 Conclusions

Continuous co-learning while intensifying maize-legume systems appeared to be key in the continuing adoption of legumes. Co-learning through evaluation interviews and seasonal monitoring was essential for the researchers to respond swiftly to the smothering of legumes by maize and with an alternative crop to soyabean. The increased area under grain legumes in the no-workshops group during the project period indicates that availing legume inputs to farmers could increase the cultivated area of legumes.

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