Scaling of integrated options of FMNR, Soil and Water Conservation and Micro Dosing of Fertilizers using the planed comparison approach

A Guideline for development of field protocols

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1. Justification

This guideline aims at supporting the process of scaling of integrated options of restoration of soil fertility in the project on ''Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: taking successes in land restoration to scale''. The adoption of the approach of Planed Comparison (PC) as tool to supporting the process of scaling is justified by the context and the main goal of the project.

1.1 Context

The inherent poverty of soils, water constraints and the limited resource of small farmers to afford fertilizers are the main factors that limit agricultural productivity in West Africa Sahel (WAS). Lands are continuously cultivated, subject to uncontrolled grazing for long period with low external inputs. Human and animal pressure and failure by the farmers to apply resilience enhancing land management options are the main causes of soil fertility decline and land degradation. The cropping systems of farmers are complex and diversified. They combining different crops, trees, traditional practices and some improved technologies that enhancing synergies and minimize risks. Farmers need to be directly support to adopt contextually appropriate and inclusive options, as well as actively promoting their uptake at the landscape scale. Instead of individual technologies, more integrated systems combining improved technologies, crops and trees such as the agroforestry systems could help developing relevant management options to improve soil fertility and agricultural productivity. Integrated management innovations that ensure food security to the fast growing population is a relevant strategic to prevent land degradation.

A quick survey and focus group discussion with 560 farmers in 14 villages of 4 regions of Niger revealed that farmers are aware and confirmed that the direct causes of land degradation are overexploitation, poverty (lack of financial resources to afford inputs and technologies), unavailability of fallow, organic manure, tree cutting, decrease of rainfall, soil erosion (silting caused by wind and water) and population and animal pressure (Bado et al, 2016). The main causes of land degradation were overexploitation and the decline of soil fertility (85% of farmers), tree cutting (71%). The suggested solutions of farmers to improve agricultural productivity and preventing land degradation were the micro dosing application of organic manure or mineral fertilizer when available (62% of farmers) and application of the rainwater-harvesting technologies such as the Zaï, half-moons. The role of trees was pursued by 92% of farmers who considered that trees play an important role as windbreaks that protect the young plants, improves of soil moisture conservation, soil fertility, reduces runoff erosion, increase crop yields, provides fodder for livestock (Acacia albida), supply wood, shade and gathering.

Through a literature review, FMNRA or Régénération Naturelle Assistée (RNA) in French or *Sassabin Zamani* in Hausa was identified as a successful experience in WAS, particularly in Niger. The basic principle of FMNR consists of identifying and protecting the wildlings of trees and shrubs on farmland, a systematic regeneration of living stumps and emergent seedling of indigenous trees, which previously had been slashed and burned in field preparation. The Farmer Managed Natural Regeneration (FMNR) was considered as good alternative to the difficult problem of tree planting. The FMNR made good success but in very limited zones. Most of the farmers (70%) requested training support to apply FMNR.

The challenge is to take such successful experience to scale. However, FMNR is never applied alone. FMNR is generally combined with other technologies and practices such as soil and water conserving (SWC) technologies (Zaï, half moons, stone bunds, semicircular bunds), options of fertilization (manures, crop residues, small doses of mineral fertilizer), improved or local varieties and cropping systems (association or intercropping of legume-cereal).

In line with the limited resources of smallholder farmers to invest in fertilizer, ICRISAT has developed the micro dosing technology that significantly improve crop yields with small quantity of fertilizer (mineral, organic or both). Integrated Management Options (IMO) that combine FMNR, SWC technologies and micro dosing of fertilizers could provide interesting innovations for better management of cropping systems to improve soil fertility and restoring degraded lands.

1.2 The approach of Planed comparison

The approach of the project on restoration of degraded lands comprises combination of interventions in technology, delivery mechanisms, and policy and institutions.

The project aims to transform lives and landscapes by bringing new 'options' to farmers. However, they're no single solution for everyone/everywhere. Through the literature review, workshop with stakeholders and surveys and focus group discussions with farmers, the project has collected a wide list of options for different situations (region, cropping systems, ect). We hypothesized that farmers in some specific contexts will successfully implement some of the wide list of options. The key gaps of knowledge are: i) the effects of interactions within technologies in the same options; ii) the capacity of farmers to manage; iii) the best options by context; iv) the constraints and conditions for implementation and; v) the variables of success.

The options that were identified from the literature review; workshop with stakeholders and surveys and focus group discussions with farmers will be tested in nested scale planned comparisons, using large N designs in a co-learning cycle with farmers, rather than only trying best bets over narrow ranges of context.

The PC approach will be used to taking the management options to scale through the rollout of the options by context (OxC). The OxC approach involves (a) identifying an initial set of potentially promising options for each targeted site; (b) facilitating 'deep' participatory processes with various groups of farmers to interrogate this initial set and, where relevant, those they are already implementing; and (c) continuously reviewing and refining supported options together with farmers, as well as devising innovative ways of addressing challenging and contextually rooted issues. The PC approach aims at scaling relevant management innovations to a large number of farmers by demonstrating the performance and impact of the new innovation in specific contexts.

2. Objective

The main objective is taking the relevant Integrated Management Options (IMO) of FMNR, SWC technologies (Zaï or half moons) and micro dosing of fertilizers (organic and/or mineral fertilizers) to large number of farmers in Niger. The specific objectives are to:

1. Assessing agronomic efficiencies and the best options by context
2. The constraints and conditions for implementation and;
3. The contextual variables of success for scaling

3. Methodology

The selected Integrated Management Options (IMOs), of FMNR, SWC technologies and micro dosing of fertilizers that improve biomass production, soil fertility and agricultural productivity of degraded lands will be tested in cluster of villages belonging to four (4) regions in Niger. The contexts to be compared are the soil types, the cropping systems and the rainfall. The IMOs to be tested are different combination of FMNR, SWC technologies and micro dosing of fertilizers. Depending of the context, the relevant IMOs will be selected through surveys and focus group discussion with farmers. At least 20 farmers per villages in the 160 villages-sites (3200 farmers) will be selected through focus group discussions (volunteers and visit to farmer's fields to confirm).

3.1 Selection village sites

Based on data of the base line surveys, climatic, biophysical and socio-economic criteria, a first list of potential village is selected by the team of the project. At the commune level, a meeting with brainstorming discussion is organized with local authorities to help selecting definitive list villages taking account the local policies and strategies.

3.2 Selection of options and farmers

The IMOs to be tested are selected on participative process with farmers. In a selected village, meetings, focus group discussion and brainstorming are organized with farmers. The list of options and the main components of each IMO are explained to farmers, allowing a participative selection of volunteer farmers who are interested to test one or more options. At the village level, the selected farmers will identify a lead farmer to serve as farmer focal point (FFP). At the commune level, the FFPs constitute the team of community of Practices (CP). The team of FFPs of the CP is coordinated at the commune level by a facilitator of the project. The CP provide a learning and sharing platform – for example to find out why they selected those technologies – what they care about- their beliefs about their technologies, what are the expectations of farmers.

The farmers who successfully implemented an option will be identified as Innovative Farmer (IF). The IFs will serve later as trainers to train others farmers (farmer-to-farmer training) in the village or other villages in the process of scaling.

3.3 Implementation

The field tests will be implemented in farmer's fields. Each participating farmer will test one or a maximum of 3 options, which are relevant to their particular context. To avoid any interfering, a study unit of 200m^2 (10m x 20m) for each option is randomly selected in the field of farmer. Each farmer constitutes a replication in a group of farmers who selected the same options. During the first year of implementation, farmers will be trained and assisted by the facilitator of the project on the technical aspects of the options they selected. The new selected farmers of 2th and 3th year will be trained by Ifs.

The establishment of the trials will be the responsibility of the IFAD-ICRISAT team with the support of national research system. ICRISAT team will organize farmers, gather the inputs required and set the timing for the establishment and ensure effective set up of these trials. The following steps will be followed, which is also illustrated in the attached annex diagram):

1. Community meetings will be held in the sites to present the potential options to be tested. Each village will then choose options it wants to try out in its pastureland;
2. Farmers volunteer to apply FMNR on their field
3. Provide training on FMNR and the treatment design to volunteer farmers, via the village-level facilitators;
4. Visit the fields to lay out the design by determining the size of the plots based on availability of land;
5. Acquire the inputs (acquire seed), - Identifying degraded pasturelands to be rehabilitated
6. Weeding of cropland to be restored prior to implementation of options to be compared- for example the SWM e.g., Construction of half-moons or zaï pits with the support of the NARS and ICRISAT teams. Construction can be done during the dry season but the seeding when the rain starts;
7. Each group of volunteer in each village to maintain and monitor the trial with technical support each time required. Monitoring will involve farmers, innovative focal farmers (those who can write), agricultural extension service technicians of the area or a student in internship if available, the NARS and ICRISAT teams at various levels. The last two actors will be playing a follow up role while the first listed will be collecting the data on the ground;
8. Data analysis and lessons sharing through the established communities of practice (village facilitators, innovative focal farmers, etc). The same actors listed in point 5 will be contributing in examining the data and pulling out the key messages to be shared as well as organizing the knowledge sharing events jointly with the project national team.

Table 1: Compare the combined effect of FMNR, SWC technologies (Zaï or others) and micro dosing of fertilizers on biomass production, crop yields and soil fertility

Number of villages: 160

Question or objectives	What is the question for the learning priority?	Restoring/improve soil fertility by combining FMNR, Zaï technique and micro dosing of fertilizer in Niger
Hypothesis	What is the premise?	Combining management options of FMNR, SWC and micro dosing technologies will lead to sustained improvements in farm livelihoods leading to the restoration of degraded lands and higher agricultural productivity and food security compared to fragmented interventions. In some specific contexts, farmers will successfully implement some options or with self-adjustments. The effects of interactions within technologies in the same options, the capacity of farmers to manage/adapt, the relevant options, constraints and conditions for implementation and the variables of success will be identified.
Options to compare	What are the alternative ways of implementing the options in order to answer the question?	Absolute control (Farmer practice), FMNR, SWC technologies (zaï, half-moon, micro dosing of fertilizer (mineral, organic or both).
Contexts to compare	Under what conditions will the options are undertaken?	Village/cluster of villages/communes/region/duration of FMNR/soil organic C , rainfall regime/erosion/herd size per household
Study units	Where will the measurements be taken?	Measurement plot on farmer field 400 m2 (20m x 20)
Responses to measure	What will be measured?	Number of trees/study unit to be converted per Species, Biomass Crop yields (per crops) Net Return Farmer assessment through communities of practice to understand their preferences, feedback, if the option is meeting their expectation or what are the constraints and weakness
Roles of farmers	What will the farmers do to implement the PC?	Provide the field for the experiment Management of the cropping calendar and activities (sowing, weeding, harvesting etc). Data collection (biomass, yields, cost) with assistance of technicians (ICRISAT/NGOs)
Roles of others	What will the other actor do to implement the PC?	ICRISAT and NGO (ASV, CDR): Supervise the field work with the village level facilitators (Dosso and Zinder) and farmers, laying out of the measurement plots ICRISAT: Designing protocols, providing training (village level facilitators) and assistance to monitoringand data collection and analysis (soil, biomass, yields) and reporting ProDAF: Assistance to field work, monitoring and field data collection with village levelfacilitators (Maradi, Tahoua and Zinder) INRAN/Universities: Providing and supervising students for field work
Study/experimental design	How will the PC get laid / rolled out? How are the farmers going be selected How many treatments, how many farmers, how many sites?	Participative selection of 160 villages (sites) (local authorities, ProDAF, NGOs): Participative selection of 20 farmers per village through meetings, focus group discussions (3200 farmers) Each farmer constitutes a replication in a group of farmers who selected the same options. Comparing at least combined management options (4 treatments): FMNR, FMNR+SWM,FMNR+ Micro dosing, FMNR+Macrodosing+SWC. Randomized measurement plots for biomass, yield, cost
Suggested timing (start and end)	When will the PC start and end	Start February 2017– End December 2018
Data collection sheets	Annex the data collection sheets for farmers and any additional for more rigorous data	Will include enough data including agronomic data (inputs, sowing date, varieties, cropping systems and rainfall at village level. Annex the data collection sheets for farmers and any additional for more rigorous data

3.4. Monitoring and data collection

Given the fact that very few number of farmers are able to read and write, monitoring will be led by the village-level facilitators in close collaboration with the innovative focal farmers involving students will contribute to national capacity building at the same time ensure quality data collection. A data collection form will be developed and distributed to the village-level facilitators before the start of the planting season (May 2017).

On –going baseline surveys are being conducted in all of the action sites. This survey is capturing the key contextual variables of the volunteer farmers. As of Feb 2017, two regions have been completed (Dosso and Zinder). Maradi, Tahou, and should be finished by the end of March. The target is 3000 farmers. The data is being collected on tablets using open data kit.

3.5. Data management and analysis

The baseline / contextual variables is being collected on tablets using open data kit and will be uploaded to a local database.

The field monitoring data will also be collected using tablets and open data kit.

Yearly data will be encoded and keyed in using an excel sheet and later cleaned before analysis. Collected data will be subjected to appropriate univariate or multivariate statistical analysis. Various communication means will be deployed to easy farmers understanding of the analyzed data.

Further details of the methodology are summarized in Table 1. Specific protocols will be developed for each individual management option that will be selected with farmers.

4 Long list of options

The below list is a long list of IMOs that was identified trough the baselines surveys and focus group discussions with farmers in the 5 regions. Each volunteer farmer will select specific IMOs he wants to test. A more detailed protocol of each selected IMO will be developed.

Table 2: Long-list of IMOs

IMO	Content
IMO1	Farmer's Practices (FP) : The traditional croping system, trees (species and density) and technics of fertilization, soil and water conservation.
IMO2	Farmer Managed Natural Regeneration (FMNR)
IMO3	FMNR + Manure broadcasting
IMO4	FMNR + Manure broadcasting + Localized application of Mineral Fertilizer
IMO5	FMNR + Localized application of Mineral Fertilizer
IMO6	FMNR + Macrodosing of Manure in Zaï pits
IMO7	FMNR + Macrodosing of Manure + Mineral Fertilizer in Zaï pits
IMO8	FMNR + Manure broadcasting in stone bands
IMO9	FMNR + Manure broadcasting + Localized application of Mineral Fertilizer in stone bands
IMO10	FMNR + Localized application of Mineral Fertilizer in stone bands
IMO11	FMNR + Macrodosing of Manure in Zaï pits and stone bands
IMO12	FMNR + Macrodosing of Manure + Mineral Fertilizer in Zaï pits and stone bands
IMO13	FMNR + Half Moons
IMO16	FMNR + Manure in Half Moons
IMO17	FMNR + Mineral Fertilizer in Half Moons
IMO18	FMNR + Manure + Mineral Fertilizer in Half Moons

Cropping systems

As a standard system commonly used by farmers, the intercropping Cereal/Legume will be used to testing the performances of the different IMOs. Farmers have the choice to used Millet or Sorghum as cereal crop and Groundnut or Cowpea as legume crop.