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Jonathan Steinke "Citizen Science with Resource-Poor Farmers as a new Approach to Climate Adaptation and Food Security: Evidence from Honduras"

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Summary

Problem definition and proposal

Smallholder farmers in developing countries are among those most vulnerable to the adverse effects of climate change (Jones & Thornton 2003, Morton 2007). Adapting current farming practices to accommodate expected climate change will help ensure food security of farming households. Expanding the choice of crop varieties is a highly effective adaptation strategy (Rosenzweig & Tubiello 2007, Challinor et al. 2014), but farmers often lack access to existing varietal diversity. Stationary plant breeding and generic distribution of improved varieties has often failed to meet farmers' highly location-specific environmental conditions and socio-cultural needs (Ashby 2009, Vernooy 2009). Participatory methodologies such as participatory variety selection (PVS) address these problems, but are not scalable due to their reliance on organised farmer groups. In addition, adoption rates of new varieties may be low when selection is carried out at trial plots, but subsequent performance on farmers' own farms differs (Misiko 2013).

Modern communication technologies and recent experiences in citizen science (Hand 2010, Dickinson et al. 2012) open new opportunities for upscaling PVS and decentralising experimentation to smallholder farms. In Crowdsourcing Crop Improvement (CCI[1]), farmers cultivate experimental quantities of three crop varieties randomly assigned from a larger sample of 10-20 varieties, and report simple observations to researchers via triadic comparisons (Martin 2004, van Etten 2011). In this research approach, experimentation takes place on farmers' own plots. This accounts for realistic selection criteria and constraints, requirements for local group organisation are low, and data collection via mobile telephones allows massive upscaling. Farmers are exposed to varietal diversity and are empowered to identify locally specified adaption solutions. By fitting Bradley-Terry models (Bradley &

[1] By 2016, CCI is termed "triadic comparisons of technologies" (*tricot*), since the methodology may be applied for the dissemination and crowdsourced evaluation of sets of any farm technology, including seeds, but also farming inputs, tillage systems, fertilisers, etc. See Steinke & van Etten (2016) Farmer experimentation for climate adaptation with triadic comparisons of technologie (*tricot*). A methodogical guide, Bioversity International, Rome, Italy.

Terry 1952, Strobl et al. 2011) to farmers' observations, researchers may analyse the farmer-generated data, and possess a tool to evaluate promising germplasm in a rapid and cost-effective way, in multiple, diverse environments.

Objectives of the research

When the thesis research began, experiences with the CCI methodology, although practiced by Bioversity International in multiple countries on three continents, were still at an early stage. For further development, methodological improvement, and subsequent propagation of the approach, it was crucial to revisit assumptions required by the CCI approach, namely issues relating to viability, appropriateness to reach its goals, scaling, and gender equity. By providing evidence from a well-established CCI project with common bean in Honduras, the study aimed to contribute to Bioversity's ongoing work in developing a successful crowdsourcing research approach for the agricultural sciences. The thesis contributed to the development and improvement of the CCI approach through in-depth engagement with different stakeholders, and deriving recommendations for methodological adaptations. Five topic areas were studied, in agreement with researchers and CCI implementers at Bioversity and in Honduras:

(1) The appropriate selection of crop traits for the CCI project (and thus, the research agenda setting) by extensionists and researchers

(2) The accuracy of farmers' observations as a research tool

(3) Questions of gender equity in CCI

(4) Participants' motivation and effective incentives

(5) Obstacles to, and possible strategies for upscaling the local experiences.

Methodological approach

A mix of quantitative and qualitative, as well experimental and explorative methods was applied. For each topic area, between one and three research questions were defined, and target indicators used to answer these questions were defined in advance. For every research question, at least two distinct methods were engaged.

For topic area 1 (farmers' trait preferences), two econometric choice games were designed, and further information was obtained from individual interviews with farmers, as well as focus group discussions. For topic area 2 (accuracy of farmers' observations), observation experiments were set up, in which multiple farmers, as well as a local agricultural expert, were asked to make CCI-style observations (“triadic comparisons”) on the same trial. From the data, various coefficients related to accuracy were calculated and discussed. For topic area 3 (gender equity), work focused on (i) gender-inclusiveness of participation in CCI, and (ii) gender-inclusiveness of the variety evaluation in CCI. Individual interviews with key informants and farmers, focus group discussions and experimental data were used to evaluate five gender-sensitive indicators. I cooperated with a PhD student at Wageningen UR, the Netherlands to work on topic area 4 (farmers' motivation to participate). Qualitative information was gathered from individual interviews with farmers and key informants, as well as from focus group discussions, and quantitative data about farmers' agreement with seven potential motives on a Likert-type scale was analysed. Incentive theory was used to explain main motives, main incentives, and farmers' ultimate goal in participating in CCI.

Work for topic area 5 (upscaling of local experiences) focused on identifying and classifying currently observable methodological obstacles. Information was collected by individual interviews with key informants and farmers, focus group discussions and qualitative observation of trials and farmers' trial evaluations. As a contribution to methodological development of CCI, strategies for viably overcoming these obstacles were suggested.

Results and conclusions

Key results and conclusions are presented by topic area:

(1) Although trait preferences vary at individual and regional level, extensionists and researchers had made an adequate selection of crop evaluation criteria for farmers in all four research regions. The questions addressed in CCI are relevant for smallholder farmers. It is possible to select a small set of evaluative criteria that cover most relevant traits for a variety of households.

(2) Accuracy of farmers' observations relates to the ease of visual observability of the respective crop attribute, e.g., observations are more accurate for 'plant architecture' than they are for 'disease resistance'. For all four pre-harvest attributes that were analysed, 77-100 percent of farmers' observations were fully or nearly fully valid. Bradley-Terry models always ranked the trial varieties in the correct order, and were able to distinguish significantly the performance of at least the best and the worst out of the three trial varieties. Overall, CCI can produce accurate results.

(3) CCI promotes gender equity in rural communities due to the empowerment of women, mainly by building their agronomic capacity. No gender disparities with regard to trait preferences could be shown. Mainly due to women's research groups, women farmers make 42 % of all participants, but are underrepresented in representative positions.

(4) Motivation of participants in CCI is driven by rational motives. Farmers seek improved livelihood and food security, and perceive CCI as a promising strategy to this end. They are primarily incentivised to participate by the generation of social and human capital in training events, in particular gaining agronomic capacity. Side-events to CCI should always include agronomic capacity building to uphold motivation.

(5) Two types of methodological obstacles to massive upscaling of CCI were identified: Firstly, requirements of individual facilitation for participants are high, and secondly, CCI relies strongly on existing local groups. These obstacles may be tackled by simplifying the process of data collection and data feedback, e.g. by using mobile phone infrastructure for data collection and information feedback, by incentivising and training 'local facilitators' as CCI outreach staff in rural communities, and by exploring new distribution pathways for CCI trials.

In the thesis, strengths of CCI were identified, but also the scope for methodological adaptations and improvements was highlighted, and tangible recommendations were made. These include guidelines for successive training and capacity building events for participating farmers, recommendations for the design of data collection sheets (facilitating access for illiterate farmers), and a strategy to recruit and incentivise local CCI facilitators.