**A Novel Approach to Facilitate the Adoption of Sustainable Innovations in Low-income Countries: Lessons from Small-Scale Farms in Nicaragua\***

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**Abstract**

*There are about 500 million small-scale farms in low-income countries on the planet. Farmers have been slow to adopt a threefold set of sustainable agronomic practices known as “Conservation Agriculture” (CA) that has been shown to double productivity. Our study of a novel CA project in Nicaragua, organized based on principles that counter convention, may point to improved ways of understanding and managing sustainable innovations in low-income countries. In particular, by connecting core ideas from the innovation literature to the literature that explores the role of intermediaries such as NGOs, our case study suggests that the efficacy of NGOs to facilitate the adoption of sustainable innovations by small-scale farmers in these settings may be enhanced if NGOs employ non-centrist approaches in order to address the critical uncertainties associated with such innovations. We discuss how our findings contradict some of long-standing arguments in the literature, and their implications for theory and practice.*

**Keywords**

Sustainable innovation adoption, local innovation systems, international development, organizational learning, sustainability, non-governmental organizations, small-scale farms, sustainable agriculture

**Introduction**

This paper looks at the adoption of sustainable innovations among small-scale farms in low-income countries. This research setting is unusual within the organization studies literature, but it is of considerable relevance. In particular, with 500 million small-scale farms (less than 5 acres/2 hectares) on the planet, they are by far the most prevalent type of organization in the world (Meyer, 2010). Moreover, this organizational form is in great need of the help of organizational scholars: up to 70 percent of the nearly 1 billion chronically-malnourished people on the planet are small-scale farmers.

More specifically, the paper examines the promotion and adoption of a particular sustainable innovation among small-scale farms, called “Conservation Agriculture” (CA), which refers to the holistic implementation of three simple agricultural practices: 1) minimal mechanical disturbance of the soil (e.g., zero tillage), 2) placement of mulch or crop residue on top of the soil in seasons when crops are not being grown, and 3) crop rotation (e.g., after a season of growing corn, which takes nitrogen from the soil, follow up by having two growing seasons with a nitrogen-fixing leguminous crops, such as beans). CA has become a darling of the international development community thanks to research that shows that it doubles productivity while reducing financial input costs (e.g., reduces need to purchase fertilizers), improves soil quality (it actually takes carbon from the atmosphere and sequesters it in the soil), and often enhances the health of the larger community (e.g., Pretty et al., 2011; Giller et al., 2009). Moreover, CA also has each of four qualities that have been shown to facilitate the adoption and diffusion of innovations (Kapoor et al., 2014; Rogers, 1995). First, CA has a relative advantage compared to present practices (CA doubles on-the-farm productivity, Pretty et al., 2011; Umar, 2014). Second, CA is easy to understand and use (“Everybody can do it,” Silici et al., 2011, p. 143). Third, CA is easy to implement on a trial basis (MacRae et al., 1990). Fourth, CA has benefits that are easy to observe because farmers can clearly see that their trial plots are more productive than their other fields (Dumanski et al., 2006).

Even so, CA has shown a low adoption rate among small-scale farmers in low-income countries, even among those who have personal first-hand experience with the benefits of CA on their own farms (Giller et al., 2009), with abandonment rates of 40 to 60 percent (Penot et al., 2011). “There is an [faulty] implicit assumption by CA experts and promoters that once the smallholders are shown the agronomic and economic benefits of CA, their profit maximizing calculus would automatically lead them to adopt it” (Umar, 2014, p. 2). In light of this perplexing lack of embracing a superior sustainable innovation, a growing number of experts in the field suggest that the low adoption rate of CA among small-scale farmers is not an *agronomic* problem, but rather a challenge for *management* scholars to weigh in on (e.g., Lele & Trigo, 2010; Pretty et al., 2011; Bell & Dyck, 2011). In particular, there is need for a better understanding of the uncertainties associated with adopting innovations in these settings, and in particular *how* intermediaries like NGOs can help addressing these uncertainties to facilitate a more permanent transition to sustainability (i.e., CA) as small-scale farmers’ main *modus operandi* (e.g., Heugens & Scherer, 2010; Shivarajan & Srinivasan, 2013). Therefore, this paper seeks to answer the research question of what international development NGOs can do to facilitate the adoption of sustainable innovations, like CA practices, amongst small-scale farmers in low-income countries.

To answer our research question, we structure the paper in four parts. First, we briefly review the literatures that inform the theoretical framework of our study, which will be the base for a typology of NGOs’ approach to facilitate innovation in low-income countries. Second, we present the research site examined via a case study methodology based on an NGO working to promote CA practices in Nicaragua. Third, we discuss our findings, which suggest that sustainable innovation can be facilitated by NGOs who deliberately adopt a non-centrist approach that emphasizes local experimentation and innovation rather than following prescribed (imported) standards. Finally, we conclude with a discussion of the contribution and implications of this research for organization studies and opportunities for future research.

**Theoretical framework**

***The dominance of centrist approaches to innovation and sustainability***

When it comes to questions of how NGOs might best manage the introduction of sustainable innovations among small-scale farmers in low-income countries, much of the literature takes a decidedly instructionist or centrist approach that emphasis training “best practices” (e.g., Dyck et al., 2000). Perhaps the most notable and influential example comes from Rogers (1995), who argues that a “compromised” initial implementation may hamper the diffusion of a “proven” innovation like CA. Consistent with this conventional view, NGOs generally go to great lengths to avoid the problems associated with a “compromised” initial implementation of CA. They do this by hosting community training workshops and directing field staff to provide detailed instructions and stringent guidelines and standards for how to apply CA, and often by rewarding the farmers who follow those instructions with incentives (e.g., free seed, hoes, etc.). It is important for farmers to get it “right” the first time because, as Rogers (1995) explains, otherwise adopters may be inclined to abandon or “re-invent” an innovation like CA in a way that diminishes its desirable “proven” qualities.

An emphasis on an instructionist/centrist approach is also evident in related literatures, including studies which point to the importance of setting standards to create stability and sameness (e.g., special issue in *Organization Studies* by Brunsson et al., 2012). Standards not only define boundaries but also enable and shape interactions (Ponte & Cheyns, 2013). The literature has looked quite closely at how sustainable agricultural practices may be diffused through sustainability standards, where the approach is dominated by top-down instructionist perspectives where a few organizations (i.e., standard setters) dictate what other organizations should do, especially in low-income countries (Perez-Aleman, 2011; Timmermans & Epstein, 2010). This top-down power relation can be executed by standard setters through incentives (e.g., availability of funding for investments) and penalties (e.g., increasing trade barriers, removing incentives with noncompliance) that are offered or imposed on organizations located in low-income countries. Whereas sustainability standards may perform an important role in enhancing the adoption and diffusion of sustainable innovations in sectors that are export-oriented to global markets and where established global chains and players exist, such as global coffee chains (SSI, 2014), we suggest that it is highly debatable whether this top-down instructionist approach to sustainability standards is effective in small-scale organizations (e.g., farms) operating in and targeting domestic markets at low-income countries (e.g., Nicaragua).

An emerging stream of research questions the merits of a conventional emphasis on standardization. For example, a study based on the standardization process in the coffee industry coined the term ‘meta-standardization’ (Reinecke et al., 2012), which refers to mechanisms that allow for standards multiplicity and competing standards co-existing simultaneously. Voluntary sustainability standards show similar flexibility, when multiple stakeholders work together to establish a set of premises to induce sustainability (Fransen & Kolk, 2007; Ponte & Cheyns, 2013), and the literature acknowledges that there are currently more than 400 voluntary sustainability standards operating internationally (Wijen, 2014). However, the ability of small-scale organizations in low-income countries to shape standard-setting to their advantage is extremely limited, and choosing to adopt one standard over others often leads to the exclusion of some groups of actors (Ponte & Cheyns, 2013).

In this context, the local innovation systems literature becomes of particular relevance for our study as it provides a much less instructionist/standardized perspective to innovation and sustainability than, for example, the national innovation system perspective (Asheim & Isaksen, 2002). Within local innovation systems, local agents create, adapt, modify, improve and disseminate relevant knowledge and technologies to their peers (Freeman, 1987). According to Bathelt et al. (2004), this facilitates the emergence of localized capabilities: “socio-institutional settings, inter-firm communication and interactive processes of localised learning play decisive roles in processes of innovation and growth.” While national innovation systems are designed and managed at the national level (i.e., top-down in nature), the key to the local innovation system perspective is the importance of two-way leaning and two-directional knowledge flows often highlighted in the literature (Wolfe & Gertler, 2004; Silvestre & Silva Neto, 2014a; Dyck, 2002).

Innovations systems theory has previously been applied to small-scale farms. Taweekul et al. (2009) describe a farmer-to-farmer learning process (FFLP) designed to enable small-scale farmers in low-income countries to learn by comparing their operations with their neighbors. FFLP suggests that this will encourage farmers to try out new production methods and technologies more quickly, reduce costs by exchanging experiences, and teach (and learn from) others. According to Makitie (2013, p. 23), “this kind of social learning would also effectively develop the farmer’s tacit knowledge which is highly important in agricultural activities” and “would also make sure that the innovations adopted meet the needs of the farmers.” The local innovation system theory also emphasizes the need to consider local needs by carefully addressing their socio-cultural issues (Muscio, 2006; Silvestre, 2015a).

***Why do “proven” sustainable innovations fail to diffuse?***

The adoption of sustainable innovations is influenced by numerous social and institutional factors. A conventional view suggests that sustainable innovations occur and diffuse rapidly when there are market and regulatory incentive mechanisms in place, and “can be cost-effectively harnessed through the use of economic-incentive based policy” (Jaffe et al., 2005, p. 164). There is a long-standing view that incentives are critical for the adoption of standardized innovations (Alonge & Martin, 1995; Kassie et al., 2013). This thinking is evident in the practices of NGOs who—alongside providing careful instructions to avoid a “compromised” initial implementation of sustainable innovations (Rogers, 1995)—often incentivize farmers (e.g., with free seed, hoes, etc.) to follow those instructions for the entire period of project (e.g., 3 years).

However, some researchers question the effectiveness of incentives for fostering innovation in low-income countries (e.g., Guan & Yam, 2015). First, it can create an “incentive-dependency” trap, which ends up making the initiative unsustainable in the long run (Hartzenberg, 2001; Jafari et al., 2017). Second, there is little evidence that incentives actually foster sustainable innovations in low-income settings (Crespi et al., 2016). In particular, one of the key barriers to innovation adoption are the uncertainties associated with the learning and its implementation in a given context (Maskell & Malmberg, 1999; Tidd, 2001). According to Lane & Maxfield (2005), there are three types of innovation uncertainties: truth uncertainty, semantic uncertainty, and ontological uncertainty. Innovation uncertainties can be associated with multiple drivers such as the nature of the technology itself (Dosi, 1982), the market feasibility and demand (Adner & Levinthal, 2001), the ability to appropriate the benefits of the innovation (Von Hipel, 1982), and its acceptance by society (Smith et al., 2010). This discussion is critical to our research regarding why, despite its “proven” superior qualities, CA has shown such a low adoption rates among small-scale farmers in low-income countries (Giller et al., 2009; Penot et al., 2011).

The TCOS framework (Hall & Martin, 2005; Hall et al., 2011) may help to understand how NGOs can better address innovation uncertainties associated with sustainable innovations in low-income countries. The TCOS framework (an acronym that stands for technological, commercial, organizational and societal uncertainties) proposes that four drivers for innovation uncertainty must be carefully addressed collectively by NGOs and other local agents, otherwise adoption rates may be reduced and the diffusion may fail. These four components of the TCOS framework are:

i) *Technological feasibility*, which refers to the uncertainty associated with the existence (or not) and possibility to develop the required technology. To address this uncertainty, innovations must be demonstrably technologically feasible, based on existing capabilities.

ii) *Commercial viability*, which refers to the uncertainty associated with the existence (or not) and possibility to create a market for an innovation. To address this uncertainty, innovations must be demonstrably commercially viable.

iii) *Organisational appropriability*, which refers to the uncertainty associated with the potential to appropriate the benefits of the innovation and how easy it is to be imitated. To address this uncertainty, the development and exploitation of the innovations must be demonstrably congruent with organization strategy.

iv) *Societal acceptability*, which refers to the uncertainty associated with the potentially detrimental societal side-effects (including environmental, social, cultural or political). To address this uncertainty, these potential side effects must be recognized and addressed.

The TCOS framework has been used to analyse innovations in multiple settings and stages, including biotechnology innovations in Germany (Hueske et al., 2015), manufacturing in Malaysia (Abdullah et al., 2016), energy innovations and their implications for the poor in Brazil (Silvestre, 2015b), and the replacement of candles and kerosene lanterns with semiconductor white light-emitting-diodes (WLEDs) in various low-income locations (Hall et al., 2014a). Applications in the field of agriculture include the development of naturally-colored cotton (Hall et al., 2014a) and castor plantation for biodiesel production (Hall et al., 2011), both in less-developed regions in Brazil, and research on golden rice in Asia (Hall et al., 2014b). Taken together, this literature argues that carefully addressing these four drivers for innovation uncertainty is crucial for enhancing innovation adoption and facilitating diffusion.

***NGOS as intermediaries: Two types of NGO approaches to facilitate innovation***

The literature considers intermediary organizations such as NGOs to be of fundamental importance for addressing uncertainties associated with the innovation process (Bessant & Rush, 1995; Green, 2015). Several attempts to categorize NGOs have been made (Vakil, 1997). For example, social NGOs can be classified into three categories based on their primary activities: *advocacy* NGOs work on behalf of other groups who lack voice, *operational* NGOs provide critical goods and services to clients with unmet needs, and *hybrid* NGOs use both advocacy and operational means to achieve a social objective (Parker, 2003; Teegen et al., 2004). However, for the present study, rather than categorizing NGOs according to the activities they undertake, it is more helpful to classify them based on the approach they adopt. Panda (2007) identifies three generic NGO approaches to management—“top-down”, “bottom-up,” and “hybrid”—which he finds useful for describing 40 NGOs in India. Dyck et al. (2017) provide a detailed discussion on what these three approaches look like in terms of the general management functions of planning, organizing and controlling. In this paper, however, we provide a two-part typology of NGO approaches to sustainable innovations for small-scale farmers in low-income countries based on the TCOS uncertainty framework: a “centrist” approach and a “non-centrist” approach (see Table 1).

**--- Insert Table 1 about here ---**

The centrist NGO approach to sustainable innovation, which is well represented in the literature, is aligned with the conventional top-down view of knowledge flows, where the NGO plays a ‘teaching role’ while local agents play a ‘student role’. According to Howells (2006), functions of intermediaries in the innovation process include, for example, technology transfer, knowledge dissemination, decision-making support, and filling existing gaps. Geels & Deuten (2006) suggest that intermediaries play three key roles: aggregating lessons from across multiple local projects, establishing an institutional infrastructure for the innovation, and framing and coordinating action. Both studies imply that the NGO itself is the one leading the initiative, assume that the NGO “knows better,” and that the NGO’s role is to teach local agents how to do it. In sum, the emphasis is on NGOs identifying the best practices (standardization) that they get others to adopt (centrist).

A body of literature has reacted to this centrist approach, underscoring that the role of NGOs is still regarded as controversial, especially in low-income countries.For example, Ager (1999) offers evidence that NGOs do not perform as well in facilitating innovation as they are conventionally described. Reimann (2005) summarizes the criticisms of conventional centrist NGOs into five categories: effectiveness, accountability/transparency, autonomy, commercialization and political motives. Other studies exam the legitimacy of NGOs in low-income countries (Appe, 2016). Arenas et al. (2009) suggest that local stakeholders have different concerns about the legitimacy of NGOs that could be grouped in three categories: issues associated with NGOs’ identity (e.g., does the NGO know best? Does it foster two-way learning?), issues with NGOs’ right to intervene (e.g., does the NGO have an obligation to teach what it believes to be best practices? Does it participate on terms set by local communities?); and issues with how NGOs intervene (i.e., does the NGO employ acceptable tactics to make its voice heard?).

The non-centrist approach to innovation (Table 1) describes NGOs that adopt a more bottom-up, two-directional approach to innovation, working alongside local agents (e.g., the farmers and other organizations). This is consistent with an unconventional approach where all the agents (including the NGOs themselves) will jointly learn (and teach) as they collectively progress toward the solutions of their social problems. In this regard, Klerkx et al. (2009; pp. 7-8) suggests:

“The type of intermediary that is becoming increasingly important is not the ‘traditional’ third party in a one-to-one relationship, such as conventional agricultural extension, but a ‘systemic’ intermediary as an in-between in a many-to-many relationship […playing] a role that is neither involved in the creation of knowledge nor in its use in innovation, but one that binds together the various elements of an innovation system and ensures that demands are articulated to suppliers, that partners connect, and that information flows and learning occurs.”

The non-centrist approach is consistent with the local innovation system perspective that highlights the importance of contextual factors and local interaction. This literature emphasizes “inter-organization networking, inter-personal connections, local learning processes and ‘sticky’ knowledge embedded in social interaction” (Muscio, 2006, p. 775). In particular, the proximity of the agents (including the NGO) in a social and cultural sense (i.e., shared values and culture) facilitates the communication of tacit knowledge, which often requires a high degree of mutual trust and understanding (Maskell & Malmberg, 1999). In sum, to adopt this approach, NGOs must really embed themselves into the local context (e.g., socio-ecological and political issues) and make a deliberate effort to understand the local struggles, background and perspectives.

**Research methods**

This research used a case study methodology that involved an interactive, participatory and emergent process, grounded in the literature, interviews, field observations and written reports. Case study research aims to examine a real-life phenomenon in its natural context, and often offers a complex, intricate and multifaceted analysis (Yin, 2003; Stake, 1995). In case study research, the process is highly interactive and tightly linked to data, where the accumulation of knowledge involves a continual cycling between theory and data (Eisenhardt, 1989). Case study research can be used as a type of test called ‘falsification’ by Karl Popper, in which a general proposition or hypothesis is held to be invalid if it is rejected by even one observation, and thus the general proposition itself must be either revised or rejected (Flyvbjerg, 2006).

The focal research site in this study was a CA project in Nicaragua managed by the NGO called the Mennonite Central Committee (MCC). Choosing this particular project was consistent with a theoretical sampling strategy, where cases are chosen because they are unusually revelatory, extreme exemplars, or opportunities for data access (Yin, 2003; Eisenhardt & Graebner, 2007). This project was interesting because it was the first CA project we know of in Central America, and because there seemed to be some noteworthy things happening in the communities where it was being implemented.

The data collection strategy had two main components. First, primary data collection was undertaken based on a week-long on-site visit and examination of the CA project in Nicaragua, when one of the researchers had been invited to visit this site by MCC’s Food Security & Livelihoods Coordinator, with whom the researcher had previously visited other CA projects around the world. The researcher was asked to observe what was happening, and provide informal feedback to the participants in the project. Second, we also analyzed secondary data, most importantly a series of reports associated with MCC and the Nicaraguan CA project that were subsequently made available to the research team.

Note that the researcher did not go into the field having in mind the specific research agenda and literature review described here, nor did the researcher develop structured interview protocols to ask specific questions associated with the framework used in this paper. Rather, the insights detailed in this paper emerged from fieldwork, from participation in activities *in loco*, from long informal conversations with international development workers and farmers, and from reflecting on what was being said (and not being said) by participants. The researchers moved back and forth from the field notes to the literature, returning to recorded interviews and NGO project reports, analysing observational notes and “minutes” taken during meetings, and following up with key informants by phone and email. The central ideas regarding the counter-conventional shortcomings about the centrist approach arose directly from interviews and field observations in Nicaragua.

Our long history of research in this field, which has formed the basis for several previous publications and working papers, helped us to understand and interpret what was going on in the case setting in Nicaragua. For example, a member of the research team went on research-based study trips over a three-year period to visit various NGO projects around the world where CA practices were being promoted. This included on-farm visits in Bolivia, Brazil, China, North Korea and Paraguay, and involved about 45 (informal) interviews with international and local development workers and farmers from these countries. These interviews ranged from 10 minutes to 90 minutes in duration. Some of these interviews were recorded, and written notes were kept of field visits generally. The two researchers have also participated for over a decade in various roles (researcher, consumer, observer) on small-scale farms in North America and South America that implement CA practices. One researcher has several family members involved in multiple small-scale agricultural ventures implementing CA practices in South America, places that this researcher visits yearly.

The Nicaraguan CA project began officially in May, 2012, run under the auspices of MCC with support from another NGO, the Canadian Foodgrainsbank (CFBG). Nicaragua itself is an interesting example of a low-income country, with a population of 6 million people and a per capita GDP of about $3,000US, where 80 percent of the population lives on less than $2US per day. The case described here is a small pilot project that included 15 small-scale farms, one local project coordinator, and three local (volunteer) “technicians” who visited the farms and provided support to the participating farmers regarding CA practices. Both MCC and CFGB have extensive experience working with CA projects in Africa, and in early 2011 had commissioned an analysis of CA on small-scale farms in Central America and South America which found that, although many of the agronomic practices associated with CA are prevalent in various forms, when defined rigidly there was virtually no CA being practiced on small-scale farms in Central and South American countries (Woodring, 2011). They followed this up with a second study in late 2011 that examined the approaches used by NGOs promoting CA-related practices in Honduras, which involved a North American delegation visiting each of five NGOs that had been short-listed as exemplary in this regard (Braul et al., 2011).

Various subsequent reports associated with the Nicaraguan CA project were developed and formed part of the data analysed for this study (mostly prepared by MCC’s regional project coordinator, who visited the project several times a year; e.g., Harder, 2013a, 2013b, 2014). The researcher spent a week as part of a small delegation visiting the project in Nicaragua in November, 2013. The delegation was hosted by MCC’s regional project coordinator, and included MCC’s Food Security & Livelihoods Coordinator who oversees this project, and a senior program officer at CFGB which was the funding agency for the project. The weeklong visit to Nicaragua involved a series of interactions (e.g., conversations, meetings, activities) with various MCC staff. This included visiting with and collecting observational and (informal) interview data from technicians and farmers participating in the pilot project (including video-taped material of on-farm meetings and several larger community meetings). It also included observing various meetings of farmers and NGO workers, where detailed notes were kept including, for example, a regional farmer-to-farmer exchange meeting (120 utterances), a meeting that included members of the visiting delegation, the local project leader, his local technicians, and other partnering local NGOs (134 utterances), and a meeting involving the visiting delegation and two lead staff persons working for MCC in Nicaragua (261 utterances). Finally, the researcher took advantage of numerous opportunities (e.g., evenings, travel time to farms) to ask questions and discuss emerging understandings and ideas with the expat NGO workers involved in this project. All three NGO workers, including the senior MCC and CFGB staff who have extensive experience with CA projects around the world, were invited to comment on an earlier version of this paper.

Note that in our findings we report data from both firsthand observations as well as from written reports prepared by NGO staff working on the project. In the spirit of triangulation, we do this only on matters where the written report is consistent with the researcher’s experience in the field. We believe that the quotes from the written reports are valuable because they reflect the “official” views of the NGO staff involved in this project, thereby reinforcing and strengthening the argument that these are not based merely on the researcher’s one-week observation of the case.

**Findings**

We present our findings using the four dimensions of the TCOS framework, as depicted in Table 1. It became evident during our fieldwork and analysis of written documents that the approach used by MCC to facilitate the adoption of CA practices among small-scale farmers in Nicaragua was qualitatively different from the conventional centrist approach used by NGOs. In particular, we found that MCC had addressed the four TCOS areas of uncertainty in a manner consistent with a non-centrist approach as described in Table 1. As will become apparent in our presentation of the findings, MCC emphasized two-way knowledge flow, a localized knowledge base, farmers as knowledge creators, collaborative learning, and had a socio-ecological emphasis where building local capacity is a fundamental indicator of success.

***The TCOS uncertainties of innovation***

 *Technological feasibility.* When it comes to the technological uncertainties, we found at least three key differences in the NGO’s approach in the Nicaragua project that differentiated it from a conventional centrist approach. First, rather than emphasize hallmarks of the Green Revolution and conventional industrialized agriculture—such as mechanization and high inputs (e.g., chemical pesticides and herbicides)— MCC emphasized Conservation Agriculture, a leading approach to multifunctional agriculture (Kassan et al., 2009). Thus MCC’s approach was based on a proven technology (i.e., the set of practices associated with CA) known to enhance the environment and the surrounding communities.

Second, compared to a conventional centrist approach, MCC had a more holistic focus on overall farm livelihood. Whereas conventional measures of success emphasize growing more calories as efficiently as possible (i.e., focus on maximizing productivity), and usually focus on one or two staple crops, MCC deliberately counter-balanced this with an emphasis also on the importance of nutrition and other livelihood issues (e.g., role of women). This more holistic approach was evident in the on-site visits, and is described in the NGOs’ preparatory studies leading up to the Nicaragua project that recommended incorporating ideas about diversified family gardens (e.g., nutritional vegetables) and planting some cash crops (income generation) into its food security programming in the region, including:

“perennial plants such as cassava, papaya, pineapple, plantain, bananas, citrus, mango, and avocado … Annual vegetables and root crops such as sweet potato, cabbage, lettuce, tomatoes, onions, and carrots can also be grown to diversify the diets, and also provide some income to families allowing them to purchase other foods” (Braul et al., 2011).

Third, MCC had a strong emphasis on accompaniment, interaction and experimentation (versus conventional centrist approaches). Whereas conventional programming may be very rigid in specifying rules associated with the best farm practices (to avoid “compromised” re-inventions, Rogers 1995), the farmers in the Nicaragua project were closely accompanied (i.e., visited once a week during growing season) and were explicitly encouraged to experiment and innovate (and also to document and share the results from their experiments), which is consistent with local innovation systems theory. As one farmer told the NGO representatives during the site visit: “You told us to improvise.” Indeed, “interest in innovation” and “willingness to participate in farmer exchanges and give feedback and recommendations based on their experience” were among the criteria for choosing participating farmers in the Nicaragua project (Project Agreement, 2012). This is consistent with recommendations in the preliminary report, which found that exemplary NGOs in the region consistently introduced new agronomic practices via farmer-led trials that:

“promoted on-farm experimentation and the development of local capacities. By putting farmers first in the development process, the probability of reaching intended outcomes is improved and there is increased project ownership by the farmers” (Braul et al., 2011).

*Commercial viability.* When it comes to the commercial uncertainties, we found at least three key differences in MCC’s approach in Nicaragua versus mainstream conventional centrist approaches. First, during the site visit it became clear that this project had a holistic livelihood orientation and was not simply about maximizing financial profits. For example, during one of the rides between farms, one of the technicians talked about poverty in the region, and about how CA brings “hope” (it’s about more than just food). Similar sentiments were expressed during the farmer-to-farmer exchange meeting, where farmers talked about being thankful for healthier food and families, about adapting to climate change, and about enhancing food security. One older gentlemen spoke with some passion about how CA was better for families, for production, for people, for the environment, and for overall health and well-being**.**

Second, the importance of the family-based operations that focus on quality (as opposed to volume) is apparent in a field note from the researcher after visiting a Nicaraguan farmer named Rita (pseudonym):

“We met with her in the middle of her field. I will never forget the sense of pride and deep satisfaction on her face and in her voice as she described the work she had done, how her neighbours would comment on her impressive crop when they walked by, and even how proud her parents were. ….The transformation of the field represented an instance of self-actualization and deepened relationships with her husband and daughter….This field was the fruit of her (and her family’s) labour, and I would not want to take any of that away from her or them.”

Third, the focus was on growing food for the family (livelihood) and the local markets (e.g., cash crops). There was virtually no mention of scaling the operations or seeking to target global markets. In an earlier visit to CA projects managed by the MCC in Brazil, the research had visited stalls in local community farmers’ markets that sold organic vegetables grown on farms associated with MCC’s local CA programming in that region (a similar initiative had not yet been taken in Nicaragua).

*Organisational appropriability.* MCC deliberately minimized providing external financial incentives to farmers. MCC’s approach was consistent with the view of ‘teaching them how to fish’ (instead of ‘giving them the fish’) and therefore MCC:

“worked at minimizing or removing external material inputs in order to enhance the sustainability and community ownership of the project. … [to increase the NGO’s] overall emphasis on helping smallholder farmers become aware of and rely on *their* [that is, the *farmers’* own] knowledge, attitudes, abilities and local resources as they engage in the development process (Braul et al., 2011; emphasis added here).

We also observed in the fieldwork and written reports that MCC designed the project in a way where neighbors were seen as partners (versus as competitors seeking to out-do one another). This is consistent with the view that imitating neighbors (through trial and error and sharing of experiences) is an opportunity to enhance everyone’s knowledge (as opposed to see it as a threat). Therefore, neighbor farmers were seen as partners in the journey. This is illustrated in convening regular “farmer to farmer exchanges,” an important part of the process designed by MCC into the Nicaragua project to facilitate local interaction, learning and innovation, and to complement accompaniment. During these meetings, farmers learn from each other’s failures and successes, thereby contributing to their learning and ability to innovate further to enhance their operations. Farmer to farmer knowledge exchange is widely accepted as an effective way of promoting the adoption of innovations and should be built into the process from the very beginning (Makitie, 2003; Taweekul et al., 2009; Woodring, 2011).

*Societal acceptability.* Our data suggest that MCC had a “whole systems” perspective that includes bio-systems as well as “whole people” (which differentiates it from a centrist techno-economic approach to innovation) (cf Girei, 2016). This whole systems perspective is evident in the orientation of MCC’s regional project coordinator: “I am completely convinced that in order to understand the 'success' or 'challenges' of a project, it is just as, if not more, important to understand the social/cultural dynamics as the agronomic” (Harder 2013a). Consistent with the TCOS approach, this shows a clear understanding of the importance of the socio-cultural issues in the local context, as opposed to treating these issues as secondary.

In addition to that, a high level of empowerment and entrepreneurial initiatives for innovation from farmers were also readily apparent during site visits. This was something MCC’s Food Security & Livelihoods Coordinator noted and marvelled:

“They [the farmers] have not just implemented CA as they learned it [from instructors], but improved it and made it their own. … Already [there is] a high level of innovation in the project in the first 2 years: sesame mulch, organic, using different crops. This is strongly correlated with the level of interaction between producers and promoters. … As we continue to grow the project, we need to continue to strongly encourage a culture of learning and experimentation” (taken from Harder, 2013b).

 Perhaps the most notable example of an important innovation that came from the farmers was to use sesame stalks as their mulch. This is not something that they would have been taught during their formal instruction on CA. The farmer who had told the NGO representatives “You told us to improvise” went on to add:

“You didn't teach us about sesame for mulch – we figured that out ourselves. Maybe sesame stalks aren’t as good in nitrogen fixing as what you suggested, but they have other benefits [e.g., sesame stalks are relatively available, and fortunately they don’t break down very quickly even in the harsh weather during the non-growing season].”

During a site visit one of the technicians described how the innovation to use sesame stalks had initially been suggested to him by a (female) neighbor. Although the local regional coordinator was a bit skeptical at first—he thought the sesame stalks would decompose too quickly in the harsh elements—he nevertheless supported the experiment. This innovation has become a great success—some farmers even speculated that the sesame stalks may help to reduce the weeds in the fields—and has diffused rapidly.

“The community where the four participating farmers are women (and [had] showed the weakest results in Year 1) showed the most significant improvement [in Year 2]. After seeing how effective the sesame mulch was in another community they intentionally planted sesame themselves or sought out other people growing sesame to use as mulch in their trials this year” (Harder 2013a).

Because of the success of using sesame stalks for mulch, demand for them has grown in the region. Where a few years ago local farmers did not know what to do with sesame stalks (they had previously burned them as “waste”), now there is talk of selling them for mulch.

Finally, in stark contrast to other CA projects where the rate of adoption seems inexplicably low (Giller et al., 2009; Penot et al., 2011; Umar, 2014), farmers in the Nicaragua project were excited to talk about their local innovations and keen to share their knowledge with others. The excitement from farmers to expand the CA project was palpable during the site visits. When they first joined the project, the NGO had requested participants not to expand it in the first two years, in order to provide opportunity to make some base-line observations about its efficacy and local best practices. By the time of the site visit (during year 2 of the project) it was clear that farmers were eager for the project to expand, as evident in observations from CFGB’s senior program officer who was “Impressed by the level of energy and excitement at the 2 year mark. They [members of the local community] are engaged and entrepreneurial” (taken from Harder, 2013b). This eagerness expansion was elaborated by the MCC’s regional project coordinator, who reported that the farmers and local NGOs involved:

“are very enthusiastic about expanding the project and are developing their longer term vision. Quite a number of organizations have come to visit to see the trials … and are interested in trying it out as well. … *At this point the most significant challenge I see in Nicaragua is figuring out how to work with organizations that are very optimistic and enthusiastic”* (Harder 2013a; emphasis added here).

At a meeting with several local Nicaraguan NGOs during the site visit it became clear that the local CA technicians, other NGOs, and the local project coordinator were keen to increase tenfold the number of farmers involved in the project. Here it was the role of the international NGOs to *temper* this enthusiasm, and suggest it may be more prudent to *slow down* the expansion of the project to keep it manageable and not exceed the on-the-ground accompaniment capacity. In short, rather than wonder why the diffusion of the sustainable innovation was underwhelming, in this pilot project the worry of the NGO was that it might spread too rapidly! In the end it was agreed to increase the number of participating farmers almost five-fold (Harder, 2014).

**Discussion and conclusion**

Our findings suggest that MCC’s CA project in Nicaragua is managed according to principles—in particular, its non-centrist approach—that seem to fly in the face of the NGOs’ conventional approach to innovation. Nevertheless, MCC’s non-centrist approach seems to be key to successfully addressing TCOS uncertainties associated with the adoption sustainable innovations. Of course, we are fully aware that our study has its limitations—based on a single case study, a one-week on-site visit and three years of reports, only 15 participating farmers—and that our exploratory study of this Nicaraguan CA pilot project does not “prove” that a non-centrist approach is better than a centrist approach. However, our study does provide an empirically-grounded basis upon which strengthen and further develop a non-centrist NGO approach to innovation in low-income countries, an alternative paradigm that holds some promise to address short-comings of conventional theory and practice, and to contribute to the larger literature. In short, we believe our study provides fertile ground for further theory testing and building, some of which we will now discuss.

Whereas centrist/instructionist approaches that train people via a one-way transfer of knowledge may seem efficient and be effective in some situations (Rogers, 1995; Brunsson et al., 2012), past experience demonstrates that it is ineffective when facilitating sustainable innovations like CA among small-scale farmers in low-income countries (Dyck et al., 2000; Silvestre & Silva Neto, 2014b). An emphasis on two-learning promises to enhance the experience of both parties and improve overall learning/adoption/diffusion (Chen et al., 2012) and is associated with increasing the self-esteem and dignity of farmers (Shivarajan & Srinivasan 2013). In particular, our findings point to the folly of a centrist “west knows best” view. For example, the expat experts in the Nicaragua project had no idea about the benefits of using sesame stalks as mulch. But, more importantly, even if these experts had known this, our study suggests that NGOs should still adopt a non-centrist approach when implementing CA because: 1) the farmers may discover other even better innovations, and 2) even if the farmers do not find better ideas, the fact that they are engaged in experimenting with new practices is inherently more valuable than top-down knowledge transfer that trains them to implement standardized “best” answers.

Building on this observation, our findings may offer a helpful contribution to the sustainability standards literature which suggests that standardized packages of sustainable practices facilitate adoption and enable diffusion (e.g., Brunsson et al., 2012). While this might be true in certain settings (e.g., SSI, 2014), it does not seem to apply in promoting CA among small-scale farms in low-income settings. In particular, past studies (e.g., Giller et al., 2009; Penot et al., 2011; Umar, 2014) in the field have shown that externally imposing standards (e.g., “best CA practices”) is not effective for small-scale farmers (even though, according to theory, it should be, given the assumed lack of pre-existing social infrastructure and capacity to foster local sustainable innovation among small-scale farmers in low-income settings). Our data provide some insight as to *why* standards do not work in these settings (even if they apparently have low innovative capacity).

We speculate that the social and cultural characteristics are so nuanced and specific in rural areas of low-income countries that externally-imposed sustainability standards are too distant from on-farm realities and consequently unable to effectively address local concerns (Muscio, 2006). In particular, although addressing technological, commercial and organizational uncertainties may appear to be somewhat more straightforward, addressing the societal uncertainties (that includes social, cultural, environmental and political uncertainties) is likely to be much more challenging. Therefore, we encourage future researchers to pay more attention to the pre-existing standards and norms that the new standards are intended to supplant. In our case, we found that the existing standards had become institutionalized, that is, infused with value “beyond the technical requirements of the task at hand” (Selznick, 1957, pp. 16-17). For example, farmers in the Nicaragua project talked about the difficulty of changing farming practices that had been around for generations, noting that change might be perceived as a sign of disrespect for elders, perhaps especially if the change is based on externally-developed standards. In such social context, a non-centrist and deliberate experimental approach that facilitates inter-generational teaching and learning can result in pooled wisdom, reduced resistance, capability building and positive change.

With this in mind, our study provides an occasion to extend the meaning of “meta-standardization” (Reinecke et al., 2012). Perhaps meta-standardization is not so much about setting overarching standards, but rather more about developing the (institutional) capacity to establish locally-relevant standards. Thus, we speculate that sustainable innovations are more likely to be adopted and diffused in such settings if meta-standardizational local experimentation mechanisms are in place, such as those embedded in local innovation systems. Alongside this observation, it is important to underscore that a non-centrist approach does not mean a non-organized approach. Even after building a strong foundation in the Nicaragua project, the NGO recognized the uncertainties of expanding too rapidly and going beyond the capacity to do so effectively.

Our findings also suggest that poor small-scale farmers are more likely to embrace financially efficacious CA practices in the long term if they are introduced *without* NGO financial incentives rather than *with* incentives. In other words, providing financial incentives stifles the adoption of financially-beneficial CA practices for poor farmers. Our data suggest that there are three possible reasons for this. First, if farmers become dependent on incentives, then innovations may not financially sustainable without continued incentives in the long run (Jafari et al., 2017). Second, when farmers do not receive incentives, then they gain greater ownership of the innovation. Psychologically it encourages them to recognize that they are adopting an innovation because they want to (not because they were bribed to do so), and when they achieve success it is because of their hard work (not because of hand-outs and financial supports from others). Third, and related to this, the data suggest that the lack of financial incentives facilitates “awakening” the mind. The CA Nicaragua project provided something much more valuable and arguably more important than temporary financial incentives: it provided education about CA and supported the development of a social infrastructure and capabilities that facilitate on-going experimentation and localized knowledge creation and exchange. This social infrastructure allows farmers to continue to collaboratively experiment and learn long after the NGO is gone (e.g., consistent with Taweekul et al., 2009).

 Note how each of these three reasons are inter-linked with non-centrism. Incentives are linked to centrist approaches, where resources come from outsiders rather than residing in the community. In this way centrism limits the farmers’ ability to “own” the sustainable innovations that they are being incented to put into practice, and it reduces the likelihood of “awakening” in their own local communities. Thus, our findings concur with previous suggestions that NGOs should reconsider their use of financial incentives (Alonge & Martin, 1995; Crespi et al., 2016). Moreover, we also note that NGOs should instead invest more money in developing *non-centrist* social infrastructure that is perennial and facilitates farmers interacting with and learning from one another (e.g., through associations and cooperatives), and to “own” this new way of farming that they are co-developing.

In addition, our findings point to the merit of NGOs and scholars embracing a more holistic livelihoods-based approaches (e.g., Hussein & Nelson, 2016; Krantz, 2001; Scoones, 1998). Yes, it is clearly true that small-scale farmers in low-income countries need to improve production of calories—recall that 70% of the world’s chronically malnourished people live on small-scale farms. However, past research suggests that making production the sole goal of efforts to introduce sustainable innovations onto poor small-scale farms in low-income countries is ineffective. We believe this may be at least partly due to the fact that a focus on overall productivity inherently disrespects small-scale farmers as “whole” people, who have existence, relatedness and growth needs (e.g., Alderfer, 1972; Riisgaard, 2009).

In particular, we predict that NGOs will be more effective in facilitating sustainable innovation among small-scale farmers in low-income countries if they adopt a livelihood focus rather than trying to maximize productivity. Such a livelihood focus addresses concerns raised by Girei (2016), who argues that the dominant NGO paradigm has a pervasive emphasis on measuring tangible outcomes like calories grown, net financial costs, and standardization. In this light, our findings have important implications for the larger literature, which may be most notably evident in their contribution to the local innovation systems literature. Empirical research on the (non-centrist) local innovation systems has had disappointing results (see Cooke, 2005; Foster & Heeks, 2013). Looking through the lens of our findings, it is striking that most local innovation systems studies which do not live up expectations have had an emphasis on productivity measures, including studies of innovation systems studies applied to agriculture and low-income countries. For example, Ortiz et al. (2013) studied local potato innovation systems across four different countries—Bolivia, Ethiopia, Peru and Uganda—with the idea that innovation systems improvements should increase efficiency of their processes and products. Similarly, Velasco (2015) analysis of the coffee, flower and sugarcane local innovation systems in one single country, Colombia, also had an emphasis on productivity measures. Thus, we call for future research to examine the efficacy of local innovation systems cases that are based on the holistic needs of people and communities *in situ* (and go beyond a sole focus on productivity). We predict that if such a non-centrist approach is applied, then NGOs will be more successful in facilitating the adoption of sustainable innovations in settings similar to ours.

In conclusion, we encourage future research on NGOs who take a decidedly non-centrist approach to promoting sustainable innovations among small-scale farmers in low-income countries. In particular, the findings from our exploratory study suggest that, even though NGOs who adopt a centrist/standardized approach may seem to be able to address the first three factors of the TCOS framework (technological, commercial and organizational uncertainties), such a centrist approach is inherently unable to address the fourth, final and perhaps most challenging factor (societal uncertainties). In contrast, a non-centrist approach is particularly well-suited to address societal uncertainties, and at the same time provides a paradigmatic shift in how all four TCOS factors are addressed. Technologically this means emphasizing livelihood (vs productivity) issues, and low-input agriculture and farmers’ experimentation (vs one-directional instructionist training). Commercially this means emphasizing holistic well-being (versus a singular focus on financial well-being) and family-based farming on a human scale (versus large-scale agribusiness). Organizationally this means de-emphasizing financial incentives, embracing strategies based on collaboration rather than on competition and viewing imitation as an opportunity rather than a threat. In short, just as CA represents a paradigmatic agronomic change away from the best practices of the conventional Green Revolution, so also a non-centrist NGO approach to innovation and sustainability represents a paradigmatic management change away from the NGO best practices associated with conventional innovation management approaches. Perhaps such a shift in NGO approach is key to enabling the adoption of experimentation-based sustainable innovations and holistic well-being among the 500 million small-scale farms in low-income countries.

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**Table 1: Two different approaches NGOs can follow to innovation and sustainability of small-scale farms in low-income countries**

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