Adoption of Conservation Agriculture (CA) Practices under Farmer Field Schools in Nampula, Mozambique

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Agricultural development efforts across the world have been and continue to be carried with the intention of improving the quality and quantity of crops and/or of animals, both of which are grown and kept intentionally by farmers as a source of food, fuel, and/or fiber in a sustainable manner. Since the dawn of settled agriculture, the spread of crops, domesticated animals, and methods for growing the former and keeping the latter proceeded in more or less an osmotic fashion. In the most simplified version of this osmotic transmission, a farmer would pass on seeds or information to their fellow farmers as a result of their interest based on observation of the crops or animals. Through observation, communication, and practice on their own fields, a crop or a method would spread slowly outwards based on contextual similarities between both people and ecologies.

The waves of independence that swept across most of Africa from the late 1950's into the 1970's carried with them the agriculture watershed known as the Green Revolution, and the attendant and large-scale efforts by newly independent governments to build pathways out of poverty through strong emphasis on commodity crops. These efforts included the development of agriculture research centers, formalized seed breeding through parastatal agencies with a strong emphasis on hybrid maize, a much greater emphasis on the use of mineral fertilizers, and the expansion of agriculture extension services to bring the tenets of the Green Revolution to the rural farmer. In some cases, particularly in Anglophone southern and eastern Africa, governments flush with commodity revenues from mining, tobacco, and the like utilized forms of positive coercion to both modernize agriculture and build political economy.

However, the Green Revolution and the so-called attendant "modernization" agriculture had numerous flaws:

1. The Green Revolution was heavily oriented on "modern" agricultural methods to produce crops as commodities for commercial production, and that required inputs such as hybrid seeds and fertilizers, and the infrastructure to supply these inputs.
2. The research and extension efforts were almost exclusively aimed at men. Women, the primary producer of foodstuffs for the household, received virtually no agriculture extension services, nor was there much in the way of research and / or extension oriented toward the diversity of crops that they produced.
3. The imposition of a system that was the product of Western science very often displaced temporally significant indigenous knowledge of practices that were well-tuned to the staggering diversity of agroecological contexts.

The association of agriculture modernity to external farming inputs and provision of knowledge, has created a gap in institutional farming knowledge, and worse, disenfranchised farmers from their own potential knowledge.

Promotion of Conservation Agriculture (CA) Through Farmer Field Schools

Conservation Agriculture (CA) is an agriculture approach that focuses on soil conservation and improvement through the achievement and continual application three principles:

1. Minimum tillage;
2. Permanent organic soil cover;
3. Crop rotation / diversification.

CARE has since 2010 implemented CA interventions in the coastal districts of Angoche, Larde, and Moma in southeast Nampula Province utilizing Farmer Field Schools (FFS) approaches in partnership with the Associaçao Nacional de Extensão Rural (National Association for Rural Extension or AENA). The fundamental idea behind the FFS approach is to gather groups of people with a common interest to study the "how and why" of a specific, typically agriculture-related topic. As per its name, FFS are largely centered around a field utilized as a learning space, where farmers and FFS facilitators design, set up, monitor and evaluate different agricultural practices. This creates a safe environment for farmers to collectively learn and adapt practices such as CA to their own nearby fields. It can also act as an entry point for further group formation, such as village savings clubs, farmer associations, or producers' cooperatives.

In a typical FFS, a group of 10 – 30 farmers meets on a fixed schedule in a local field setting with the guidance of a trained facilitator. They design a plot layout to make one or more comparisons between local conventional practices and alternative practices. They experiment with and observe key elements of the agro-ecosystem by measuring plant development, taking samples of insects, doing counts of diseased plants, yields, soil characteristics, etc. At the conclusion of their meetings, they present their findings in a plenary session, followed by discussion and planning for subsequent weeks' activities.

As much as possible, alternative practices are not automatically assumed to be, nor presented as, better than conventional practices. It is up to the farmers to determine what works best through his or her testing and observations of comparison between two trials. The principle purpose of the FFS is achieving participatory learning in order to provide a risk-free space in which farmers can discuss, design, disassemble, modify, and experiment with new agricultural practices. In so doing, the farmer groups can investigate a wide range of topics including but not limited to:

- Management of soil fertility and water resources;
- Varietal testing of different seeds / crops;
- Introduction of new crops;
- Agroforestry;
- Agronomic alterations, such as varying spacing, planting densities, planting dates, and number of weedings;
- Conservation Agriculture that incorporates green manure and cover crops;

The non-assumption or non-predication of an outcome from an alternative practice allows farmers to both formally and viscerally learn and refine alternative methods, increasing ownership of a practice by farmers. On a deeper level, it builds the confidence of both the group and the individual farmers to

conduct their own experiments, rebuilding their sense of confidence in developing experiential knowledge.

A critical element to building a durable FFS is understanding that not all topics can be addressed in one season, and FFS groups should continue with new topics and experiments in subsequent seasons that utilizing past trends, current agroecological conditions, and farmer interests, such as desires to experiment with new crops and/or agriculture products. In Nampula Province, FFS formed under CARE and AENA have in particular opted to refine their subsequent experiments centered around different combinations of plant spacing, as well as combinations of green manure / cover crops intercropped with either maize or cassava. This continual experimentation within the specific local agroecological contexts increases the likelihood that the FFS will be validated in the community as a viable means of both learning and developing improved agricultural practices, as well as allow for greater local ownership of developed methods and adoption of those same practices.

Starting in 2011, CARE and partners began supporting farmers to form FFS to experiment with options for locally appropriate sustainable agriculture packages that were largely based off of CA. Key elements include use of improved varieties, such as disease-resistant cassava, as well as maize, pigeon pea and cowpeas. This including the CA practices of minimum tillage, inter-cropping with legumes, and permanent ground cover with organic matter (whilst halting the burning of dry organic matter). Other agronomic techniques such as planting in lines and increasing plant populations were also introduced.

From 2013 onwards, the program has had a focus on identifying combinations of locally appropriate green manure cover crops that serve multiple purposes:

1. They should fix nitrogen;
2. Provide significant organic soil cover until the following planting season;
3. Reduce labor requirements (especially for women);
4. Provide nutritious edible foods during the so-called “shoulder” seasons by having earlier harvest during the hungry season (January – February), during the normal harvest period (April – May), and prolonging access to fresh food through later harvest (June – July).

Research methodology

Between August and September 2015, a team comprising CARE, AENA and Ministry of Agriculture’s district teams conducted a survey using wealth ranking and CARE’s Participatory Performance Tracker to understand adoption of recommended sustainable agriculture practices. This was done in focus group discussions with 520 farmers (FFS graduates, incoming FFS members, non-members) in 36 communities in Angoche, Larde and Moma districts in August – September 2015, and included on-field triangulation visits with 465 of these farmers.

Due to the sheer number of variables practiced, only practices strictly related to CA outcomes were considered. As such, the following variables were classified under the CA principles to which it was most closely related:

1. Minimum tillage:
2. Permanent soil cover (PSC) - No burning, Mulching, Use of any cover crops (Velvet bean, lab-lab, or jack bean), Intercropping

3. Crop diversification / crop rotation - Use of food legumes (pigeon peas, mung beans, and / or cowpeas), use of any cover crops (Velvet bean, lab-lab, or jack bean), Intercropping

Respondents were classified according to the practice or combination of practices according to the CA principles. For example, a farmer who practices minimum tillage, no burning, and intercropping could be ranked as ABC (a full adopter of CA), as they are fulfilling the basic principles, whereas a farmer practicing no burning only would be ranked as a B (partial adopter).

Findings

There is strong evidence to suggest that CA practices are being adopted both within and outside of the Farmer Field Schools. Further, adoption of practices leading to achieving of a single CA principle is as likely as adoption of practices that achieve two CA principles, though both are more likely to be achieved than adoption of all three principles.

Notable as well is the evidence suggesting that across the three districts, adoption of practices satisfying all three CA principles or a single CA principle is more likely by former members of an FFS (FM), whereas non- (NoM) and new members (NeM) are more likely to be adopting two practices. There are likely two explanations for this phenomenon:

1) More experienced farmers are more likely to graduate towards adopting practices supporting all three CA principles due to longer exposure to the FFS intervention than new- and non-members, particularly as these farmers have seen success on their own farms;
2) Conversely, former member farmers may abandon ("unadopt") one or more practices without continual participation from the FFS intervention.

The data from Larde District, where the FFS have only recently been started, suggests that the former is likely the case, as fewer farmers have adopted practices support either two or three principles. Looking at the overall adoption of practices supporting two and three CA principles between districts (particularly Moma and Angoche) suggests that male farmers in Moma are more likely than female farmers to be adopting practices satisfying all three CA principles, whereas in Angoche, female farmers are more likely than male farmers to be adopting practices satisfying all three CA principles. This is a rather puzzling outcome given that the FFS population appears to be split fairly evenly between males and females.

What is very notable for their nearly complete absence are farmers who practicing methods satisfying either minimum tillage only (condition A), permanent soil cover (condition B), or both combined (condition AB). The vast majority of single-technology adopters practiced crop diversification/rotation techniques (condition C) or a combination of minimum tillage, permanent soil cover, and/or crop diversification (conditions AC, BC, or ABC). The high number (33%) of the total sample practicing crop diversification and rotation only suggests that farmers are more likely to test with practices such as intercropping, inclusion of new crops, etc., that are easiest to practice without changing the fundamental aspects under conventional agriculture of either tillage or soil cover.

Recommendations

Studies of both CA and failures of adoption of practices supporting CA are quite likely one of the more well-documented forms of angst among research institutes and non-governmental organizations in sub-Saharan Africa (Arslan, et al. 2013). Why is this? It helps to understand firstly that human decision-making is often based on complexity. **Adoption of any practice is likely not absolute, but rather takes place within an intricate web of relationships between that person and other persons (family and friends), their natural environment and their climate, their socio cultural norms and barriers, external political and economic forces, their history, as well as their own intentions.** In the case of some technologies, such as the adoption of improved varieties of cassava (e.g., such as CARE's work promoting disease resistant varieties of cassava), adoption is comparatively straightforward, as the technology should by itself improve yields with all other things being equal.

Adapt interventions to diverse agroecologies - For more complex interventions requiring more investment in terms of participation and time, consideration of these complexities needs to be inherent in technological design. The often common practice of once-off demonstration or isolated "mother-baby" trials, in which a farmer practices one or two technologies ("babies") replicated from formal research stations ("mothers") disengages small-scale farmers from participating in developing technologies that are better suited to their own particular configuration of social, ecological, economic and historic contexts. It also creates a problem of attribution; farmers lack the ability to claim external technologies as their own, and therefore, have less incentive to shape the technology. This is why many CA projects across the region have been slow to expand; focus has been stubbornly fixated on getting farmers of various stripes in diverse agroecological configurations to adopt an often narrow scope of "proven" practices.

By all metrics listed, review of various literature, and personal conversations with various staff and consultants that have worked on the project, **CARE's work with the promotion of Conservation Agriculture through Farmer Field Schools has done well to adapt itself to the local agroecology of contexts in coastal Nampula Province.** The fact that adoption of practices that support all three CA principles is around 28% for males and 32% for females that were former group members suggests that uptake of practices may be strongly influenced due to long term exposure to FFS activities, and that adoption seems to be relatively gender-balanced. What is even more notable is that there seems to be nothing in the way of once-off, so-called "handouts" or non-replicable inputs (e.g., fertilizer, hybrid seed, etc.) that are often parts of other interventions and tend to grievously distort CA adoption measurements[1]. I would therefore suppose that exclusion (e.g., farmers not adopting practices because of not receiving non-replicable inputs) of non-members from adoption of practices support is low, which is borne out by the fact that 58% of non-member male respondents and 65% of non-member female respondents adopted practices supporting at least two CA principles, and 18% and 15% of the same demographics have adopted practices supporting all three CA principles.

[1] It serves to note that self-replicable inputs (such as improved cassava cuttings, cowpeas seeds, etc.) are available through FFS vis-à-vis CARE, with the intention of encouraging farmers to multiply seed.