Climbing Jacob's Ladder: A Phenomenological Inquiry to Understand Ugandan Farmers' Experiences Using Fertilizers

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This article examines factors influencing Ugandan subsistence farmers' adoption or rejection of mineral fertilizers using the theory of planned behavior as a theoretical lens (Ajzen, 2011). We conducted semi-structured interviews with 30 Ugandan farmers in-situ. Participants were criterion selected based on their rate of adoption of fertilizers and membership in farmer groups. We analyzed the interviews following phenomenological research design. Four themes emerged, they were (a) we are better together, working in farmer groups improves outcomes, (b) behavioral change begins within the family and farmer groups, (c) farmers need greater access to agricultural production knowledge and inputs, and (d) changes in farmers' knowledge leads to intentional behavior changes. The themes were summarized to generate the phenomenological essence of climbing Jacob's ladder. The factors that influenced fertilizer adoption included being a member of a formally recognized and registered farmer group. Farmer group members were more likely to understand the benefits of fertilizer use, while also receiving training regarding fertilizers from NGO and Extension agencies. Farmers not belonging to farmer groups had less access to fertilizers and were less likely to adopt fertilizers due to a lack of confidence in their ability to apply them and a lack of financial resources. Challenges and barriers participants experienced when learning about fertilizers included limited training opportunities from credible, research-based agencies, a lack of access to fertilizers at the markets, and a lack of funding to purchase inputs. The study elucidates how researchers can apply the theory of planned behavior to understand farmers' decision-making process regarding fertilizer use in Uganda and may inform future educational interventions aimed at increasing fertilizer adoption.

Keywords: Uganda farmers; Extension education; Fertilizer use; Subsistence farming; Phenomenological research design; Barriers to fertilizer adoption.

Introduction and Review of the Literature

The Need for Increased Food and Fiber Production Globally

We investigated Ugandan subsistence farmers' perceptions of fertilizer use and barriers to adoption. It is essential for global agricultural productivity to increase significantly as the population advances to nine billion by 2050 (FAO, 2015). There has been insufficient research conducted on identifying educational and Extension practices that holistically assist farmers in meeting the challenges facing increasing agricultural production, especially in Sub-Saharan Africa (SSA). SSA farmers face many challenges such as limited financial and input resources, imperfect markets, lack of agronomic knowledge, and market constraints. Overall, there is a need to increase the adoption of agricultural inputs, including fertilizers, in developing countries to improve soil fertility and subsequent yields to meet the demands of population growth (Connolly, Sodre, & Phillips-Connolly, 2016).

Uganda is a rapidly growing SSA country with a population comprised of mostly youth who lack formal education and practical training in agricultural sciences (FAO, 2015). A third of Ugandans (31.4%) are between the ages of 10-24 years, and 56% of the population is under the

age of 18 (FAO, 2015). Furthermore, 72% of Uganda's population works within the agricultural sector as subsistence farmers who are reliant on local food production for survival. Generally, subsistence farmers lack both formal and practical knowledge to improve the quality and quantity of their produce. To meet the demands of an increasing local and global population, Ugandan farmers need greater access to best agricultural practices including technical innovations to reduce their reliance on foreign hunger assistance and other aid programs (FAO, 2015).

Need for Fertilizer Adoption

Over the past 100 years, developed agricultural economies in the West and Far East have converted from subsistence farming to highly mechanized practices by adopting technologies such as fertilizers and pesticides. The use of yield-enhancing agricultural inputs have resulted in increased productivity in a short time (Barrett & Sheahan, 2017). The green revolution affected countries around the world, especially those within Asia and Latin America. However, SSA countries did not participate in the 20th century green revolution because of a lack of universally accepted policies with national and state governments (Quiñones, Borlaug, & Dowswell, 1997), leading to an overall lack of advancement across their economies (Barrett & Sheahan, 2017).

Without an increase in agricultural input use, SSA farmers' ability to produce enough food for the projected population will be compromised (Barrett & Sheahan, 2017). Experts predict that much of the growth will come from emerging markets in Brazil, Russia, India, China, and South Africa (BRICS). Beyond BRICS, Connolly et al. (2016) reported that the next breadbasket for global agriculture production must be SSA but only if African farmers increase their rate of adoption of fertilizers.

One aspect of stimulating fertilizer use in SSA is determining why farmers have not adopted fertilizers to improve soil fertility and enhance agricultural production (Chahed, 2018; Quiñones et al., 1997). Barriers to adopting fertilizers both economic and social are poorly understood, which prompted this study.

Barriers to Fertilizer Use SSA

Previous research regarding barriers to fertilizer adoption in SSA included limited availability of product at markets, a lack of research on fertilizer application rates, and inadequate agronomic fertilizer application knowledge (Liverpool-Tasie et al., 2017). In addition, Extension agents were reported to have low competencies regarding proper fertilizer use, limiting the diffusion of innovation (Ragasa, Ulimwengu, Randriamamonjy, & Badibanga, 2016). SSA countries have implemented programs to stimulate fertilizer demand including investing in Extension agents to teach farmers about managing soil fertility, providing subsidy programs, and enhancing farmers' access to credit-based programs to purchase fertilizers. However, the majority of subsidy and credit-based programs were unsuccessful in raising SSA fertilizer application rates because of poor national infrastructure, substandard transportation systems, poor soil quality, and a lack fertilizer availability at the markets (Liverpool-Tasie et al., 2017).

The growth of agricultural productivity in SSA is far behind most other nations. Olwande, Sikei, & Mathenge (2009) reported that Kenya was the only country that achieved a 30% increase in fertilizer use starting in the early 1990's. With few African countries using fertilizers at rates needed to boost production, as well as ineffective Extension systems to diffuse best practices in agricultural production, researchers have concluded that SSA is doomed to remain in poverty despite numerous educational and incentive programs (Christianensen, 2017; Ragasa et al., 2016), warranting the need for additional study on the barriers to adoption among farmers.

Fertilizer Use in Uganda

African farmers use less than 1% of the total global fertilizer application, resulting in 29.1% of the world's land mass receiving little to no fertilizers (Yanggen, Kelly, Reardon, & Naseem, 1998; World Bank, 2013). Uganda has the lowest rate of fertilizer adoption in SSA with only 3.2% of farmers applying then. When fertilizers are applied, application rates are minuscule at less than one kilogram of fertilizer applied per year (Henao & Baanante, 2006).

In addition, one-third of the landmass in Uganda is suitable for agricultural production. However, the agricultural capacity is further diminished because of a lack of irrigation capacity on 42% of the farmland (FAO, 2015; Uganda Bureau of Statistics, 2010). Uganda has great potential to increase agricultural outputs if farmers adopt the use of fertilizers and irrigation (Barrett & Sheahan, 2017).

Purpose of the Study

The study's purpose was to describe the lived experiences that presaged Ugandan farmers' decision to adopt the use of fertilizer as an agricultural production practice.

Theoretical Framework

Ajzen's (2011) theory of planned behavior (TPB) was based on the assumption that individuals will make decisions rationally while simultaneously considering the implications of their decisions, leading to a behavioral intention. An individual's intentions (INT) are affected by their attitudes (ATT) toward the behavior, the subjective norms (SN) that exist within society, and the individual's perceived behavioral control (PBC). People are more likely to have positive attitudes toward an action and exhibit behaviors toward adoption when they believe that they can execute them successfully, and the behaviors are in line with subjective norms.

We used the TPB as a lens to frame farmers' decisions toward fertilizer adoption. ATT toward a particular behavior, SN, and PBC are precursors to INT, which precipitate behavioral change. ATT foretells one's favorable or unfavorable evaluation of intended behaviors, leading to INT of a future behavior. SN are an individual's perceived social pressure to perform behaviors. The TPB explains how beliefs and social expectations motivate behavior. Therefore,

unraveling Ugandan farmers' ATT, SN, and PBC are critical to understanding their decision to adopt fertilizer use.

Several meta-analytic studies have confirmed TPB for usefulness and validity (Armitage & Conner, 2001; Godin & Kok, 1996). The TPB provided a lens to frame how participants established social norms. According to the TPB, Ugandan farmers' acceptance of fertilizers served as a function of perceived usefulness to their current farming practices.

Research Methods

Reflexive Statement

Our shared epistemological stance is pragmatic, both having been raised in agricultural production families. We seek practical solutions to complex problems, favoring applied research methods. Our research practice is grounded in the constructivist paradigm as a way to understand participants' experiences from an emic perspective (Creswell & Poth, 2018). We have worked internationally in the Caribbean as a Peace Corps Volunteer (1987-88) and Fulbright scholar in Kenya (2009) and Thailand (2012, Dr. Kelsey) and as an AgriCoprs Volunteer (2017, Mr. Mulvaney). Our White, rural, and middle-class cultural backgrounds inform our understanding of agricultural development from a privileged, first world perspective. We were drawn to agricultural education as a centerpiece of our vocational aspirations because we desire to seek solutions through the action research cycle. The research reported here exemplifies our attempt to contribute to agricultural development through a better understanding of the problem from participants' voices.

Population

Thirty criterion-selected participants agreed to participate in the study. Staff from the International Fertilizer Development Center (IFDC) and the District Community Development Officer (DCDO) helped us to identify participants. The criteria for participation in the study included farmers who had received formal training from IFDC and/or the DCDO on how to use fertilizers and those who had not receive training. IFDC staff identified 22 chairpersons of registered farmer groups and eight farmers with no association with a registered farmer group. The IFDC and DCDO staff also helped us to establish rapport and trust among participants before the interviews took place. The university institutional review board approved the study before contact with participants.

Research Design

We used phenomenological research design to describe the lived experiences that presaged Ugandan farmers' decision to adopt fertilizer use. A phenomenon is "an event or a lived-through experience" that is shared by the community of interest (Van Manen, 2014, p. 65). Phenomenology design allowed us to explore the issue from a holistic stance to capture the lived experiences of participants, resulting in describing the *essence* or allegory to elucidate the

findings. The central phenomenon addressed in this study was farmers' ATT, SN, PBC, and INT regarding fertilizers use.

Data Collection

After reviewing the literature to identify salient variables affecting fertilizer use in SSA, we developed a semi-structured interview protocol to facilitate a naturalistic conversation with farmers. The interview questions were open-ended and focused on the participants' lived experiences as a substance farmer.

IFDC provided an interpreter to assist with conducting the interviews. Of the 30 participants, 22 were non-English speaking. The interpreter followed along with a copy of the interview protocol to ensure that all questions were asked and answered appropriately by participants. Eight farmers required no assistance from the interpreter. I conducted and recorded the interviews at the participants' farms or at the local sub-county building within their respective districts in October 2018.

We managed the data by transcribing the interviews verbatim. The cleaned transcripts were sent to the translator for member checking purposes. No statements were changed, indicating face validity (Tracy, 2010). The interview transcripts were loaded into Atlis.*ti*, a computer-based qualitative data analysis tool, for analysis (Saldaña, 2015).

Analysis consisted of reading the transcripts line-by-line and interpreting the meaning of the farmers' lived experiences while writing interpretative notes (memoing), and engaging in reflective thinking. We developed codes to tag significant statements from the original transcripts that held meaning for answering the research questions, a process of data reduction. We combined the significant statements to develop themes to explain what and how farmers experienced farming. A textual description of what participants experienced follows a structural description of how participants experienced farming and fertilizer use, presented as themes. The essence statement is an allegory used to enhance understanding of the central findings for narrative purposes (van Manen, 2014).

Engaging stakeholders in the research enhanced quality control. IFDC staff were actively involved in all phases of the study, including authorship. To ensure anonymity, we assigned pseudonyms to the participants and reported the findings as a composite profile to reflect individual responses. Participants' quotations were included in the findings to establish truth-value and to add authenticity to our normative belief statements (Tracy, 2010).

Results

Our findings focus on farmers' attitudes and social norms regarding fertilizers that lead to perceived behavior control in the decision-making process for adoption. The farmers were split into two groups; those who identified as a member of a farmer group within their local sub-county (n = 22), and those who identified as independent farmers' without the support of a farmer group (n = 8). A farmer group in Uganda is characterized by members who pay dues,

meet frequently to share production practices, and make joint decisions regarding resource allocation. NGO's and Extension agencies work through farmer group chairpersons to disseminate new innovations. Farmer group members have access to trainings to learn about best practices in agriculture, share plots of farmland, and have access to internal savings and loan programs. Table 1 lists participants' farmers group status, pseudonym, district, age, educational level, English language literacy level, and type of fertilizer used.

Table 1

Participants' Farmer Group Membership Status and Demographic Information

Farmers belonging to a farmer group	District	Age	Educational level[abc]	English Literacy[d]	Fertilizer Use[e]
Zaharah	Tororo	53	S4	Both	Organic
Asha	Tororo	52	P7	Both	Organic
Esther	Tororo	51	S4	Some	Mineral
Ami	Butaleja	55	None	None	Organic
Rabea	Tororo	31	S3	Both	Mineral
Sarama	Butaleja	47	Bachelor	Both	Both
Abby	Mbale	N/A	S3	Some	Both
Sabah	Butaleja	30	P7	None	Both
Sadah	Mbale	N/A	P5	None	None
Halah	Butaleja	46	P3	None	Mineral
Abdulla	Mbale	34	S2	Both	Organic
Aaden	Mbale	58	P6	None	Both
Noah	Tororo	59	Bachelor	Both	Mineral
Abraham	Butaleja	35	P3	Some	Organic
Omari	Butaleja	36	S4	Both	Both
Ode	Budaka	32	Bachelor	Both	Both
Ali	Tororo	50	S4	Both	Both
Amare	Budaka	40	P3	None	Mineral
Kwame	Butaleja	48	S2	Some	Both
Zane	Budaka	75	S2	Some	Both
Zakai	Butaleja	58	P7	Some	Mineral
Moses	Mbale	56	P2	None	Both
Farmers not belonging to farmer groups	District	Age	Educational level[abc]	English Literacy[d]	Fertilizer Use[e]
Kali	Budaka	27	S4	Some	Organic
Mada	Budaka	30	P7	Some	Organic
Mae	Budaka	35	P5	None	Organic
Laila	Budaka	45	P7	N/A	Both
Farya	Budaka	35	S2	Some	Organic
Caliana	Budaka	49	S3	Some	Organic
Saleem	Budaka	46	S3	Some	Both
Dawda	Budaka	64	S1	Some	Both

Note. [a]Primary school. [b]Secondary school. [c]University education. [d] *Both* denotes farmers' ability to write and speak fluent English with no assistance from the interpreter; *some* denotes farmers' ability to speak English conversationally with limited assistance from the interpreter; *none* denotes farmers' inability to speak English with full assistance from the interpreter. [e] *Both* denotes farmers' use of mineral and organic fertilizers; *none* denotes farmers' non-adoption fertilizers.

All of the farmers had positive attitudes toward fertilizer use. Further, they reported long-standing attitudes that fertilizers were innately beneficial for increasing their profits and improving the soil. As an illustration, when asked about their view on the use of fertilizers, the term "high yields" was mentioned by 19 of the 30 farmers. We present four themes to further elucidate the findings and conclude with the essence statement.

Theme 1: We are Better Together - Working in Farmer Groups Improves Outcomes

Normative belief. Farmers were better equipped to adopt fertilizers and other agricultural innovations when involved in registered farmer groups that enabled learning opportunities, sharing of resources among members, and potential for receiving training from outside organizations such as NGOs and Extension agencies. Farmer group members reported being "better together" as social norms (SN) supported the adoption of fertilizers.

Supporting Evidence. All of the 22 farmers that identified as a chairperson of a registered farmer group shared a desire to engage in additional learning opportunities to grow their knowledge of fertilizer use. The farmers wanted to learn more about improving their agricultural practices, and as leaders of their farmer groups, they had access to new information. Abdullah, chairperson, Mbale District, said that he learned about fertilizers through his group, stating, "the sharing of ideas and also, opportunities to meet other farmer group members provides my group the chance to be model farmers to go out and demonstrate to others in the community" (154-158). Farmer group chairpersons (n=22) reported the value of farmer groups by increasing opportunities for gaining knowledge about new innovations. When asked how being in the farmer group was helpful, Zakai responded through the interpreter stating, "I'm recognized. I can speak in public as I have been given an audience. I am respected publicly in the village as a chairperson. I have developed financially and now I'm the foreseer [leader] of the group" (71-72).

Theme 2: Behavioral Change Begins Within the Family and Extends to the Farmer Groups

Normative belief. Farmers' cultural identity necessitates that the family be a part of decision making prior to any changes made to farming methods, emphasizing the importance of considering SN within this population. The concept of family also extended to farmer group members.

Supporting Evidence. When asked how they made decisions, 14 of the 22 farmer group members responded by stating that they all "sit and discuss" prior to making decisions. When asked how he makes decisions, Abdullah, chairperson, said, "It is a joint decision. I am the head

of the family but when it comes to the farm, we make decisions as a family or group" (373-374). Farmers relied heavily on their farmer group members to provide information and updates regarding the use of innovations, including fertilizers. Ode said, "We realize as farmers during this dry season, when you do apply those fertilizers, there is a way it helps us even when it is dry, the crop can receive that small water. Mostly these days when our crops are in a flowering period those fertilizers do help us in the absence of rainfall" (197-200).

Farmer group members were able to network and participate in trainings provided by NGOs and Extension agencies. Through trainings, they grew their knowledge of fertilizers and implemented new practices. Before joining a farmer group, Zane, chairperson, did not believe in modern farming practices. When asked about his thoughts on fertilizers, Zane said, "I did not even know its purpose, so it was not necessary for me to use it" (113-114). Zane attributed his professional growth to his farming group encounters.

We found that learning about new technologies was best facilitated in a group setting. Abraham said, "In a group, if a farmer says that they have one acre of land and he wants to cultivate it, they come together to evaluate, working together to help one another" (45-49).

The notion of *togetherness* reinforced the importance of considering SN when planning for educational interventions. Adong, Mwaura and Okoboi (2012) also reported that Ugandan farmers benefited from farmer groups by having greater access to information that resulted in improved productivity by adopting new technologies.

Theme 3: Farmers Need Greater Access to Agricultural Production Knowledge and Inputs

Normative belief. Participants had limited opportunities to learn about fertilizers outside of the existing community.

Supporting Evidence. Farmer-to-farmer interactions were the main source of information regarding agricultural advancements. Educational programs offered through the National Agricultural Advisory Development Service (NAADS) and local Extension agents were less effective in disseminating information. All of the farmers (N = 30) reported a desire for improved access to information, training, funds to purchase inputs, local knowledge on how to apply fertilizers (application times and rates), and locations for purchase agricultural inputs. When asked what her biggest limitation to applying fertilizers was, Sarame said, "Affordability and accessibility. My group of farmers cannot access fertilizers" (192-193). Others expressed their concern over the lack of information and training available to farmers, despite being in a farming group. When asked about her limitation to using fertilizers, Caliana said, "I am still ignorant about it. If I were to get training and learn about its benefits, then maybe I can use it. Also, if I were to get training and the cost was low, then I would use it on my farm" (51-53).

Halah expressed the same barriers to fertilizer adoption. She said, "The problem is the cost, the expense. Also, I lack knowledge and have never been trained on how to use fertilizers and as you can see the other farmers just use it locally in the rice farm. Also I don't have any

idea on how it affects the soil and I want to learn how to use it and then testify (to other farmers)" (95-98).

All 30 participants lacked opportunities to varying degrees to learn about fertilizers through trainings provided by NGOs and Extension agencies. In addition, knowledge that circulated among farmers not associated for a farmer group came from the farmers' personal experiences rather than from research-based sources, resulting in limited advancements in production. In addition, farmer group members lacked strategies for making large fertilizer purchases, while non- farmer group members lacked information, training, and cooperative purchasing strategies to increase production through the adoption of fertilizer.

Theme 4: Changes in Farmers' Knowledge Leads to Intention to Change Behavior

Normative belief. Farmers with stated INT to adopt fertilizers were more likely to experience a change in behavior (PBC) after gaining new knowledge regarding fertilizers. Farmers' new knowledge came from NGO workshops or farmer group members. Those not belonging to a farming group were less likely to experience changes in behavior, lacking PBC.

Supporting Evidence. Farmers' who had access to farmer groups were more likely to use fertilizers. Intentional behavior was shaped by exposure to the benefits of fertilizer use on yields. All 30 farmers believed that fertilizers would increase yields and provide their households with added financial stability. However, only 19 of the 30 farmers were consistently using mineral fertilizers. The same 19 farmers also belonged to a farmer group. When asked why he did not use mineral fertilizers consistently, Abraham said, "I am using the type of organic fertilizer I am now because it is what I can afford. But, if I had a chance to use others, I would. The challenge is the price" (5-6).

All but one of the farmers were using either mineral or organic fertilizers. However, 10 farmers only used organic fertilizer because of a lack of training and knowledge of mineral fertilizers. Zaharrah said, "We have not been sensitized (trained). If there could have been somebody to tell us that the mineral fertilizer are here we would use them but we are ignorant about them" (128-129). The 10 farmers' who did not use mineral fertilizers lacked knowledge and training, leading to no behavioral changes regarding adoption, consistent with the TPB where individuals make intentional decisions based on expected outcomes (Ajzen, 2011).

Participants not belonging to farmer groups were willing to receive training regarding the use of mineral fertilizers; however, they lacked access to such. INT to adopt can be improved by providing training opportunities to farmers as well as access to funds for purchasing mineral fertilizers.

Discussion

The overarching purpose of phenomenological research design is to emerge an essence to illustrate and summarize findings. The essence forms the structure of essential meaning and illuminates the fundamental characteristics of the phenomena under study (Dahlberg, 2006).

Therefore, the allegory that best describes how and what farmers experienced regarding fertilizer use in Uganda was *climbing Jacob's ladder*.

Jacob's ladder refers to a biblical story from Genesis 28:10–17 where Jacob dreams about climbing a ladder to heaven but falls down repeatedly. He ascends and descends the ladder, never reaching his intended destination.

Farmers hoped to ascend the ladder toward increasing agricultural productivity and profitability; however, the climb proved to be a defeating and repeating process of adding one ladder rung (barrier) after the other. Barriers included a lack of knowledge regarding fertilizer application, a lack of access to fertilizers in the market, and a lack of access to credit or pooled funds through farmer groups to purchase fertilizers.

Farmers who were not group members experienced a closed community where knowledge was circulated among each other; however, little new information from NGOs and Extension agents penetrated the groups to advance farming practices. On the other hand, farmer group participants experienced supportive relationships among members and had access to outside agencies such as NGOs and Extension agencies that shared research-based information for improving agricultural production. They also had greater access to fertilizers, providing a boost up the ladder, thereby increasing INT behavior through increased PBC, resulting in increased mineral fertilizer adoption. Our findings support the theoretical application of the TPB to address the adoption of fertilizers in Uganda (Ajzen, 2011).

In summary, the 22 farmers who were a part of a farmer group provided evidence that offering all farmers support in a group setting to address SN can propel technological adoption and agricultural and science literacy within subsistence farming communities. This finding aligns with Adong, Mwaura, and Okoboi (2012) who reported that targeting farmer groups is an effective vehicle for promoting access to information and value addition in markets.

Participants were willing to increase fertilizer use on their private and group farms; however, they believed that the lack of training and exposure to fertilizer application methods justified the current levels of fertilizer adoption (PBC). This finding is consistent with Barrett and Sheahan (2017) and Liverpool-Tasie et al. (2017) who reported knowledge gaps among Ugandan farmers about fertilizer application rates and timing.

Additionally, our findings suggest a need to support farmers by conducting educational needs assessments at a local level to design trainings, as well as increasing fertilizer access. Needs assessments can serve to gain a better understand of the motivation farmers have to use fertilizers, while building trust and rapport within farmer groups. It is important to stress that educational interventions be conducted within the existing farmer groups, as social cultural norms require family and peer interactions for decision-making. Unlike the global north, where Extension education is delivered one-on-one as well as in groups (Dunne, Markey, & Kinsella, 2019), Ugandan farmers preferred receiving education in a community setting.

Participants desire behavior change but lacked external resources in order to support their intention. With additional training from NGOs and Extension agencies, farmers' groups can overcome barriers to improved yields by adopting fertilizers.

Based on these findings, we propose the following steps to remedy farmers' lack of knowledge regarding fertilizer application, lack of access to fertilizers, and social factors that inhibit behavioral change. These steps can be used to guide future research to promote fertilizer adoption through intentional behavioral change (Ajzen, 2011).

Change agents should first identify points of access that enable farmers to act upon their intentional behaviors such as attitudes toward fertilizers. While farmers desired to adopt fertilizers, they were unable to access fertilizers because they did not know where to purchase them and they did not have cash and/or subsidies to purchase fertilizers. Farmers attitude and subjective norms were positive toward fertilizer adoption. If farmers were provided access to fertilizers in the market and subsides, they would adopt fertilizers.

Second, encourage farmers to join farming groups. We found that farmers who belonged to farming groups learned about new technologies and gained access to cash and/or subsidies through NGOs and Extension agencies. Membership in farming groups also positively influenced attitudes, perceived behavioral control, and social norms that lead to intentional behavior change toward fertilizer adoption.

Third, implement participatory approaches within sub-districts to facilitate communication between farmers not associated with farmer groups and farmer group members. We found that farmers who did not belong to a group expressed overwhelming challenges due to lack of information regarding best practices in agriculture. Seeking ways to recruit farmers into farmer groups may enable ATT, SN, and PBC to move in the direction of INT to adopt fertilizers. Future research should investigate why farmers did not join farmer groups to understand additional barriers to adopting fertilizers.

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