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Overcoming the Poverty Trap for Smallholder Farmers in Tanzania

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Abstract. Smallholder farmers in many countries remain trapped in a vicious cycle of endemic poverty where a multitude of interconnected challenges limit their ability to improve their livelihoods. Based on a study of supplier relationships and input sourcing activities among smallholder farmers in Tanzania, we identify an unequal power dynamic as being at the heart of this poverty trap; a trap that both perpetuates, and is perpetuated by, a lack of access to resources and quality agricultural inputs, a lack of information and support, and pressure to make trade-offs and decisions. Our research offers a new perspective to approaching an understanding of the smallholder environment; whereby, instead of focusing exclusively on market-related dynamics as the solution space, we place greater emphasis on the supply-side dynamics and relationships associated with input-sourcing processes. Using a grounded theory approach and a causal loop mapping methodology, we depict and explain this complex and challenging environment. Our causal loop diagram aids in breaking-down the poverty trap into it's component parts, thus offering a holistic and comprehensive platform from which to launch into finding practical and sustainable solutions on how the poverty trap might be overcome, through targeted and collaborative efforts across similar African populations farming in similar regions.

Keywords: Smallholder farmer, input sourcing, Tanzania, poverty reduction, grounded theory.

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1. Introduction

Smallholder farmers in developing countries play an essential role in food supply chains. Yet they remain overwhelmed by endemic poverty, often living on less than $2 per day (World Bank, 2016). It is concerning that those who provide the essential function of transforming raw materials into food receive so little reward for their contribution. While other scholars have placed emphasis on the weaknesses of smallholders in relation to the market as one cause of this situation (Markelova and Mwangi, 2010; Omiti et al., 2009; Barrett, 2008), in this study we focus on the other side of the equation, the input supply chain, which we argue, plays an equally important role. Specifically, we ask two research questions. (1) How does the organization of agricultural input supply chains contribute to the poverty trap for smallholder farmers? (2) How might the challenges experienced by smallholders be overcome?

We conducted a qualitative grounded theory study of the agricultural crop input supply chain of Meru District, Tanzania, a setting that is likely typical of conditions in a broader range of regions and countries where smallholder populations encounter similar challenges. Our system-based approach offers two main contributions. First, we examine the input supply chain itself, providing insight into the experience of smallholders and allowing us to present an original conceptual framework in the form of a causal loop diagram reflecting the complexity of their challenges. Second, we suggest areas where targeted and collective action could be taken (e.g., by governments, Non-Profit Organizations (NPOs) or Non-Government Organizations (NGOs), and industry) to improve the lives of smallholders over the long term.

1.1 Agricultural Crop Inputs in Sub-Saharan Africa

Several Sub-Saharan countries experience low agricultural productivity, linked according to the literature, to the “inadequate use of modern inputs” (Benson and Mogues, 2018; Mwinuka

et al., 2017; Mapila et al., 2012). Increased use of modern inputs such as fertilizers, improved seeds and various chemicals is being recommended to counter the challenge of lower productivity, and to encourage higher profits for farmers (Bhandari, 2013). This is expected to enable agricultural growth, which would promote regional economic development and lead to poverty reduction (Sheahan and Barret, 2017).

For example, inorganic fertilizer has been shown to offer a solution to the productivity challenge (Larson and Frisvold, 1996). The use of improved seeds is normally found in conjunction with improved (inorganic) fertilizers which also provides a way to increase crop yields, eliminate poverty, improve food security (Tura et al., 2010), and generate resilient incomes (Kansiime et al., 2016). Additionally, the use of agro-chemicals can contribute to increased crop yields and these are becoming increasingly important in response to a deficit in human labour in the agricultural sector, while also offering benefits to the wider scope of food security (Gianessi, 2013). Improved inputs can also reduce production and operating costs and improve planting and harvesting timelines; however to achieve this, inputs must be sourced in an effective manner, and used correctly (Gramzow et al., 2018) with adequate follow-up and monitoring (Tura et al., 2010).

With so many potential benefits from improved inputs, one might ask why they are not being used at every opportunity by smallholders. Our research provides some insight into this question. Both the cost of supply chain activities, which increase prices for smallholders (Benson and Mogues, 2018) and the inability of farmers to physically access available quantities at the correct time (Larson and Frisvold, 1996) are partially to blame. Tura et al. (2010) note a variety of other factors that can impede adoption of improved inputs, such as capital, credit, literacy, visits by extension agents and experience.

1.2 Two Sides of the Equation & The Missing Link

In contrast to the existing literature on inputs, the current research on market activities affecting farmers in developing countries is more extensive and suggests ways in which market relationships can be addressed. For example, market-enabling activities such as Fair-Trade (Raynolds, 2012) and certified organic production are gaining traction in some local markets across Africa (Parrott et al., 2006). However, these are primarily oriented towards exports and therefore are not necessarily accessible to smallholders producing non-export crops, particularly in sub-Saharan Africa (Freidberg and Goldstein, 2001). Contract farming and its implications has also been investigated as a market alternative, through the mechanism of supermarkets or other large firms (Wang et al., 2014; Oya, 2011; Bolwig et al., 2009). However, the consequence to impoverished smallholders in developing countries is often negative (Minten et al., 2009; Porter and Phillips-Howard, 1997), due to challenges in maintaining contract compliance and because the terms of smallholder acceptance and firm contract offers vary, posing an unstable environment for smallholders (Barrett et al., 2011).

Barrett (2008) suggests that market participation is the key to allow smallholders to escape poverty, by generating sustainable income and encouraging more general economic growth (Markelova and Mwangi, 2010; Omiti et al., 2009). Thus, a reduction in the costs of accessing markets, better organization of smallholders and improved access to production resources would benefit smallholders (Barrett, 2008). Much policy research has been conducted on how to encourage smallholder market participation (Yami and Van Asten, 2017; Teklewold et al., 2013; Hinderink and Sterkenburg, 1985). The literature has also focused on smallholder decision-making, such as whether to send crops immediately to market or store crops post-harvest to gain potential benefit from later sales (Kadjo et al., 2018).

Notwithstanding research that explores the diverse aspects of market dynamics and smallholder participation, or the existing body of literature regarding inputs, we see a need for more in-depth investigations into the challenges that are still restricting smallholders from accessing improved inputs and how they may be overcome. If the system is being fed with sub-par activities and inputs, a market-only-focused approach to improving outcomes can only reach so far (Mutoko et al., 2014). A study such as ours that analyzes the issues surrounding input sourcing can supplement market-based analyses, as part of a more comprehensive approach to better understanding how poverty persists in these communities, and considering approaches that may be taken to combat it.

1.3 Relationships & Captivity

Relationships are an important aspect of any supply chain and are particularly important within the context of smallholders, given their propensity to use informal, trust-based contracts (Mehta et al., 2011). While operating in an informal environment, gaps between individual expectations of accountability and transparency (Mutonyi et al., 2018) result in varying levels of control within each relationship, depending on the relative power of each actor. Ultimately this can result in a series of complex relationships with varying levels of risk for each participant in the process (Bensaou, 1991). Bensaou (1991) also describes the situation of buyer/supplier captivity, where one actor finds him/herself a captive buyer to one or a few established suppliers who wield greater bargaining power within a concentrated market defined by stable demand, minimal innovation, and limited growth. Bensaou (1991) also notes that captive suppliers can be found in unstable markets with high competition and few buyers, leading suppliers to be heavily dependent on their buyers, and with reduced bargaining power.

When we look at smallholder positioning within a rural supply chain, we see that their relationships with other actors could lead them into being both a captive buyer and a captive supplier; however the dynamics by which this happens in specific cases is not clear a priori. Our study investigates the issue of captivity within the input supply chain and what steps can be taken to address and potentially improve, or equalize these relationships.

2. Material & Methods

2.1 Research Context

This study focuses on Tanzania, a Sub-Saharan African country whose economy has high dependence on agriculture, constituting 65% of the workforce and slightly less than one quarter of GDP (CIA World Factbook, 2020). This essential sector is predominantly comprised of smallholder farmers who are responsible for approximately 75% of total agricultural output (FAO, 2018). Despite their high value to the economy, 39% of smallholders find themselves below the national poverty line (FAO, 2018). Making matters worse, limited access to modern inputs results in low productivity, variable yields and low profits (Arce and Caballero, 2015), contributing to ongoing poverty. Tanzania is therefore, a highly suitable context for our study.

Our fieldwork (Figure 1) was conducted in the Meru District of Tanzania over a one-month period, in partnership with Farm Radio International (FRI), a Canadian non-profit that uses radio to strengthen farming communities by partnering with local radio stations to broadcast information focusing on agriculture and rural development throughout Sub-Saharan Africa.

2.2 Research Design and Sampling

We follow an exploratory naturalistic inquiry research design, focusing on the experiences of people within their social and cultural contexts (Salkind, 2010). A grounded theory methodology (Charmaz, 2006) was employed based on a systematic process of constant analysis

and comparison of data derived from the participants' experiences, through which we aimed to develop theory rather than test an *a priori* hypothesis.

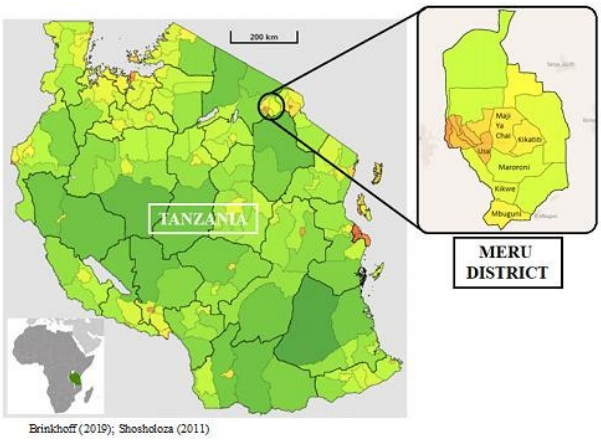

Figure 1 – Geographical Layout of Fieldwork

Initial, purposeful sampling (Charmaz, 2006) began by selecting villages where we could connect directly with smallholder farmers. Our informants had previously participated in the Upscaling Technologies in Agriculture through Knowledge Extension (UPTAKE) project, which provided the administrative umbrella for our data collection and in which Farm Radio International is a partner. Multiple suppliers were also contacted for individual interviews. The overall sampled group at this stage included male and female smallholders of all age groups, village-level (local) suppliers, large-scale suppliers, who engage in importing, production, and distribution functions, and Agricultural Extension Officers at the district and village level. Throughout the course of the initial sampling some gaps were identified, which necessitated further theoretical sampling (Charmaz, 2006). Consequently, we conducted two additional smallholder focus groups, and re-interviewed one large-scale supplier from the initial sample and a Tanzanian National Farmer Organization. Table 1 provides a summary of the sample of informants.

TABLE 1 - SAMPLING SUMMARY & COMPOSITION			
SAMPLING TYPE	**LOCATION**	**INTRVIEW TYPE & PARTICIPANTS**	**OBJECTIVE**
Initial Sampling	Kikatiti	Focus Group - Smallholder Farmers (Male & Female, 20 participants)	Understand how smallholders source and obtain their inputs and the associated challenges. Determine the critical inputs. Explore possible solutions to challenges.
	Kikatiti	Focus Group - Smallholder Farmers (Male & Female, 8 participants)	
	Kikatiti	Focus Group - Smallholder Farmers (Male & Female, 9 participants)	
	Kwaugoro	Focus Group - Smallholder Farmers (Male & Female, 33 participants)	
	Mbuguni	Focus Group - Smallholder Farmers (Male & Female, 18 participants)	
	Usa River	Village Agricultural Extension Officer (Female)	Determine existing regulations and external conditions.
		District Agricultural Extension Officer (Female)	
	Kikatiti	Village-Level Agro Dealer/Supplier (Male)	Understand activities further upstream. Determine challenges and potential solutions. Explore issues that smallholders identified and validate.
	Maji Ya Chai	Village-Level Agro Dealer/Supplier (Female)	
	Arusha	Importer/Producer/Distributor (Male)	
	Arusha	Importer/Producer/Distributor (Female)	
Theoretical Sampling	Kikwe	Focus Group - Smallholder Farmers (Male & Female, 16 participants)	Revisit the initial smallholder points using different techniques. Understand how smallholders make decisions.
	Karangai	Focus Group - Smallholder Farmers (Male & Female, 12 participants)	
	Arusha	Email Interview - Meru Agro	Re-visiting the Meru Agro Lead Farmer Initiative
	N/A	Email Interview - National Farmer Organization	Discussion of Roles and Contributions

2.3 Data Collection

Data were collected through semi-structured focus groups and interviews. Questions covered themes regarding the context, challenges of input sourcing, current solutions, sourcing processes and regulations. Data collection was facilitated by FRI's Tanzanian Office, who coordinated interviews with key informants and with focus groups, in coordination with village leadership. In total, data were collected from seven focus groups spanning five different villages in Meru District, for a total of 113 participants, representing both male and female smallholders of all age groups. Within one focus group, three participants representing local village leadership were also present. Two local suppliers and two large-scale suppliers were interviewed, as well as two Agricultural Extension Officers. Email correspondence allowed us to re-interview one of the

original respondents, and to engage with a representative of a National Farmer Organization, resulting in data being collected from total of 123 participants. Each focus group and interview was audio-recorded, translated (as required) and transcribed, leading to 124 pages of transcribed fieldnotes, and 81 pages of translated and transcribed audio files.

2.4 Data Analysis

The data were coded using procedures suggested by Charmaz (2006) and Gioia et al. (2013). We began with in vivo (first order) coding which remained very close to the data, followed by higher level axial and theoretical coding (developed from the initial codes) that is more conceptual and captures larger segments of data. To show how initial in-vivo codes were grouped together to arrive at more abstract themes, we provide a data structure diagram that illustrates our first order *concepts*, second order *themes*, and aggregate *dimensions* (Gioia et al., 2013) building cumulatively on each other. These labels are the terms we use throughout the description of our findings.

Our fieldnotes provided the platform for our coding process (Table 2), data analysis, and subsequent development of our data structure (Table 3). Over 600 separate concepts were initially identified through a line-by-line analysis of responses. These concepts were further analyzed and grouped into ten second-order themes. To develop our aggregate dimensions, second order themes were analyzed by their frequency of appearance across all the participant groups. The three most frequently-occurring themes provided a starting point to develop our dimensions. The remaining seven themes were deemed sufficiently important to be retained. Five of these themes were linked to one of the top three themes, based on similarity and relevance. The remaining two themes were relevant and significant to each other, and thus contributed to the development of a fourth distinct dimension.

TABLE 2 - CODING SAMPLES		
2nd ORDER THEMES	**ASSOCIATED QUOTE**	**GROUP**
UNEQUAL POWER DYNAMICS		
Being Held Captive	"For example, [you] worked hard all season, put a lot of expense [into] farming, and at the end of the day you don't get a good price for your crops. But also, you have a lot of needs. […] I need to send my kids to school and in the middle of the season I have to pay [back some loans], […]. Once you have your crops, you will need to sell even if it's [at] cheap price, you have no choice. You cannot wait until the price gets higher. […]."	Smallholder Farmer
	"The only reason why our crops go bad before it goes to the market [is] because we don't have modern machines to keep them fresh. […]."	Smallholder Farmer
Exposure to Risk	"So, what we do, we just look to the supplier, so when we see a supplier selling more than, most people go to that shop. We just go there. We [assume] maybe his seeds are the best seeds or he has good quality and stuff like that, so that's why we go to that shop when we see many people buying from that shop, so we can go to that seller to buy our seeds."	Smallholder Farmer
	"Sometimes you do have 20 sacks of maize and you want to keep them until the price gets high, but you can't do that because you don't have money to buy chemicals or pesticides to keep the maize in good condition. At the end of the day, you have to take your maize outside. You use the sun, and sometimes you don't have	Smallholder Farmer
ACCESSING RESOURCES & QUALITY INPUTS		
Availability of Resources & Quality Inputs	"I have the statistics that show that improved seed in Tanzania is 18%. 18% of smallholder famers use improved seed over the last year. Everybody else will use farmer-saved seeds."	Large-Scale Supplier
	"The women in our village, they struggle to get fresh drinking water. They travel a long way to get water and at the end of the day they don't get time to go to the farm. The whole village here, we don't have water so that's a big, big challenge for us."	Smallholder Farmer
	Because I go direct to a farmer [and] I make sure that farmer gets what is from me directly. Nothing has happened in between. So you can be able to trust [our] inputs.	Large-Scale Supplier
	"Nowadays […] there's a lot of fake seeds and fertilizers, which is driving us crazy as farmers."	Smallholder Farmer
Physically Accessing Inputs	"Before [an NGO] came over here, we used local transport like motorcycles, bicycles or walking. Myself, I use a donkey to go get the seeds from the center to my farm, but nowadays, since [the NGO] came over, they bring the seeds and all the stuff close to our village, so we don't have to go far away to get the agricultural [inputs] anymore."	Smallholder Farmer
	"Well, we do have this challenge sometimes. The problem is we have lack of transport and lack of infrastructure. Some of the road in the village here are not good. But we try to deal with the challenges. Sometimes we organize the whole village to repair the roads so we can get our crops off the farm. Sometimes, it's really difficult to get the crops from the farm, sometimes you don't have any transportation to get them out. So, at the end of the day, they just go bad and you lose your crops, some of them. So, it's really, really challenging us."	Smallholder Farmer
ACCESS TO INFORMATION & SUPPORT		
Access to Information and External Support	"To be honest, when it comes to check the quality of the product, it's really difficult for most of us, because most of us are not educated. So, it's really difficult, it's a big challenge for us because we don't know. Some of us, [we] don't know how to read and that's the problem".	Smallholder Farmer
	"We advise them to buy before, preparations. It's very important to buy them before the season." "One month before" "Most of them wait for the rain to come." "They are not sure of [when] the rain [will come], [this is why] we encourage them [to buy inputs ahead of time."	Agricultural Extension Officer
Relying on Others	"A big challenge [is] capital. Because [with] pesticides, fertilizers, you can see the price is increasing. So, a farmer cannot afford to buy all the inputs necessary, necessary inputs. But you can find, a few farmers who can afford it, but the others cannot. But we as extension officers, we advise them to, connect them to banks to get loans and the other institutions, you know, that get capital. Also, in the village, we advise farmers to start VCOBA."	Agricultural Extension Officer
	"To be honest, when it comes to check the quality of the product, it's really difficult for most of us, because most of us are not educated. So, it's really difficult, it's a big challenge for us because we don't know. Some of us, [we] don't know how to read and that's the problem."	Smallholder Farmer
TRADE-OFFS & DECISION MAKING		
Forecasting, Planning, and Preparation	"It depends with the season. Sometimes there is long season and short season. We don't really get the seeds or fertilizer before the rain starts. So, when the rain starts, we get to know that this is the short season or long season. Normally on our side the rains start in February up to April, but sometimes the rain can start in March. Once the rains start in March, you really know the season will be short. So, I have to go to the shop and buy seeds for the short season. So, that's why we wait for the rains and the season to start so you really get to know if the season will be long or short."	Smallholder Farmer
	"Overall, seeds, we don't get seeds at the right time. Sometimes the season gets started and there's no seeds because the supplier of the seeds, they don't really make sure that the seeds are there at the right time. We have this problem; we don't get seeds at the right time."	Smallholder Farmer
Wanting to do Better	"Definitely, if we knew that there [are] original [/not fake] seeds and overall agricultural equipment and stuff like that, we would definitely organize ourselves as a village, and go there, get the seeds and all the equipment we need. Because we know that at the end of the day, we're going to benefit because that stuff is original."	Smallholder Farmer
	"When you talk of different regions, [in the] Southern Highlands, there are a lot of farmers who grow maize...the Tanzanian government, they buy those crops, maybe for example maize, they buy them if there is in excess. So, [smallholders] plant it, they grow most crops, especially maize. If [there] is surplus, the Tanzanian government buys [the] maize and puts it in national food reserve to ensure food security in our country. If it happen[s] that the nearby country, maybe they have deficit of food, [the] Tanzania government [sells] the food to other countries. They have been divided into zones. [In the] northern zone we have national food reserve, Southern highland, [there are]two or three [National Food Reserves]. In our case, we don't know [how much is paid to smallholders]."	Agricultural Extension Officer
Ad-hoc Decision Making and Pressure to make Trade-Offs	"The thing is that, when the season starts and sometimes, the season has started but you don't find seeds, most of the time, especially seeds like beans. You can go to the shop but you don't find seeds at the right time, that's the problem."	Smallholder Farmer
	"The issue is that they need money during that time, so they have to sell. They have to sell."	Smallholder Farmer

TABLE 3 - DATA STRUCTURE

FIRST ORDER CONCEPTS	SECOND ORDER	AGGREGATE
*Lacking capital / Financing options and payment mechanisms are limited *Limiting quantity and type (quality) of products of that be purchased *Not making enough to buy inputs for the next season / Production costs are higher than sales *Lacking adequate storage for inputs *Not enough time to do everything - investigating different avenues for input sourcing is not a top priority *Encouraging alternative sourcing options and cooperative solutions *Doing the most possible to ensure quality when purchasing *Not knowing true quality before planting / Room is being left in the supply chain to tamper with inputs *Trying to increase yields by using improved inputs *Relying on unreliable/reduced quality self-harvested seeds *Being held to a national standard for quality *Reducing time in inventory / the time inputs are on shelves	Availability of Resources & Quality Inputs	Accessing Resources & Quality Inputs
*Carrying capacity is limited *Travelling to suppliers is time-consuming and expensive *Lacking transportation options *Poor road conditions/infrastructure impedes access to inputs *Preferring local suppliers due to accessibility *Smallholders accessing large-scale suppliers and quality products is possible	Physically Accessing Inputs	
*Changing government involvement / Government understaffing directs responsibility to un-invested players *Limited understanding can result in barriers for farmers / Needing to know how to gather and use information effectively *Lacking efficient flow of information downstream *Accessing information via NGOs impacts relationship development with extension officers *Inconsistent knowledge amongst farmers / Not knowing how to approach finding solutions *Monitoring suppliers / Auditing is not having the desired results *No follow-up / Minimal follow-up *Providing limited scope solutions / Not tailoring solutions to end-user needs	Access to Information & External Support	Access to Information & Support
*[Smallholders] relying on suppliers to validate quality and provide quality products *[Smallholders] relying on supplier for information and education *[Smallholders] relying on non-government agencies for support *(Local Suppliers] receiving training but relying on certifications from ([Large-scale] supplier *[Extension Officers] relying on farmers to share learned information leaves gaps in communication *[Suppliers] relying on customers [Smallholders] to identify issues with the product / Relying on customers to ask questions	Relying on Others	
*Making trade-offs between cost and quantity purchased / Prioritizing price over quality *Taking away resources from the family that were not intended for sale *Coordinating efforts alone/without guidance *Feeling afraid of negative repercussions from suppliers / Mistrusting suppliers *Feeling desperate for money / Focusing on prioritizing basic activities such as water collection *Feeling uncertain (quality, how to use inputs, prices, etc.) / Feeling pressured and overwhelmed	Ad Hoc Decision Making & Pressure to Make Trade-Offs	Trade-Offs & Decision Making
*Desiring to increase income *Need to find ways to change what they are doing, not where they are doing it *Wanting to be more in control/, to change, to save time and money, and to have recourse options *Willing to change processes / Willing to try new approaches to input sourcing *Willing to work more/longer for increased payoff *Working together and merging resources is the key to success	Wanting to do Better	
*Reacting vice being proactive *Reacting to external and uncontrollable variables (i.e. weather) *Sourcing begins under a time-constraint / Buying whatever is available *Purchasing during peak demand times / Mass influx of demand limits supply *Consistent (timeframe) and sporadic (quantity & type) demand *Seeing and understanding the need to build relationships and generate a loyal customer base	Forecasting, Planning, Preparation (Reactive VS Proactive)	
*Relying on yields for survival *Being held captive by the market / Saturated market reduces selling price *Sourcing occurs through limited channels *Purchasing options are limited by availability of input and limited supply *Farming is their only experience / Not having another choice other than to farm *Encouraging a cycle of poverty	Being Held Captive	Unequal Power Dynamics
*High opportunity cost for the farmer, no impact to suppliers (local or large-scale) *Spending limited funds without certainty of return on investment *Returning inputs is a time consuming processes / Possibility for reimbursement is supplier-dependent / Risking delaying the planting season *[Suppliers] risking consequences if regulations are not adhered to *Risking high inventory holding costs [suppliers purchasing at wholesale quantity] *Being exposed to theft (of packaging)	Exposure to Risk	

To express the interconnectivity and complexity of these themes and dimensions, we present our findings and analysis using causal loop diagrams (Van Oorschot et al., 2013; Senge, 1990; Perlow et al., 2002). Senge (1990) proposed this feedback-loop approach as an aid in challenging the human propensity to think in a purely linear fashion, since seeing the entirety of the process is essential to understanding and solving a complex and dynamic problem such as ours. In the context of our research, these diagrams help demonstrate how one challenge within the input supply chain interacts with others, leading to a vicious circle and exacerbating the poverty trap experienced by smallholders.

2.5 Trustworthiness

Following Lincoln and Guba's (1985) recommendations, we took several measures to enhance the trustworthiness of our research. First, our interview and focus group guides were carefully reviewed by FRI staff from the Tanzanian office, to minimize personal distortions, and to facilitate honest and forthcoming dialogue with participants. Second, the extensive data obtained from smallholders was triangulated with information collected from other stakeholders. Finally, after the initial analysis, our data was double-coded by an individual external to the research team who reviewed both first-order and second-order codes to ensure that our interpretation of the participant experience was coherent and supported by the data.

3. Findings

3.1 Mapping the Input Supply Chain

The regional input supply chain of Meru District (Figure 2), although seemingly simple in terms of primary actors and activities, is made extremely complex given the often-overlapping participation of multiple influencing actors. This complexity stems from the relationships, and resulting power dynamics, that exist between these actors as a result of varying exchanges of inputs, information, and money as will be seen further in Section 3.2.

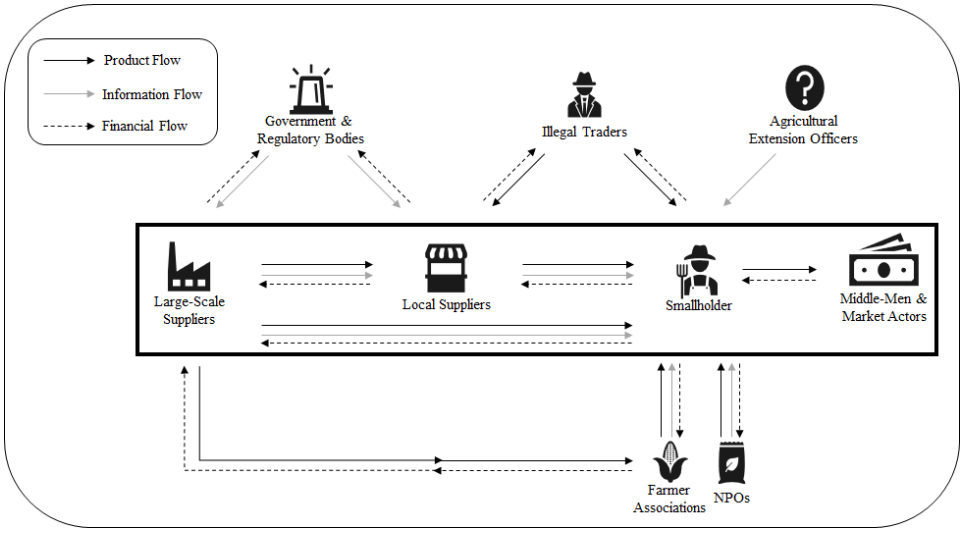

Figure 2 – The Input Supply Chain

The primary inputs used by smallholders (seeds, fertilizers, and pesticides) are all important elements in successful production, but cannot be considered in isolation as certain inputs require the use of other inputs in order to be effective (i.e., hybrid seeds require more pesticide and inorganic fertilizer). They are therefore considered holistically as we examine product flow through the chain. The above-noted inputs are injected into the supply chain through large-scale suppliers who perform a variety of import, production, and distribution functions, depending on the inputs they support. These large-scale suppliers are typically located within city centres, precluding direct access by smallholders due to the distance, time and cost associated with travelling from their villages. Inputs, accompanied by information on product use then flow from large-scale suppliers to local (village) suppliers, where inputs are sold at retail quantities and prices to farmers. Local suppliers operate out of small, one-room shops in conditions that are not favourable to storing perishable inputs such as seeds, nor large quantities of inventory. The smallholder customers are largely subsistence farmers, whose primary objective is to harvest enough crop to feed their families and, when possible, generate income by selling any surplus to support future input

expenditures and other needs (i.e., school fees, medicine, other food, home improvements and repairs):

> *"A small amount is sold to get some money for needs, for example, for school fees or for some other needs at home. […] There is not a specific amount of food to keep, [we just try] to keep enough food to get to the next season." – Smallholder farmer (Kikatiti village)*

In an effort to earn income, smallholders sell their surplus crops in local markets if accessibility permits, or they may sell to middle-men who then find market opportunities.

Beyond the above primary actors who move inputs and products through the supply chain, there are multiple other actors who exert influence on it. These include regulatory bodies that conduct research, manage the training and licensing of large-scale and local suppliers, enforce regulations, ensure quality control, and certify inputs prior to sale by a large-scale supplier or provided by an NPO. Three regulatory bodies are: (1) The Tanzania Official Seed Certification Institute (TOSCI), (2) the Tanzania Fertilizer Regulatory Authority (TFRA), and (3) the Tropical Pesticide Research Institute (TPRI).

Moving down the chain, illegal traders may exert influence at the level of the local supplier and smallholder and pose a significant problem within the system:

> *"Traders can pick grain and then dress them like our seeds, sometimes using the same packages we are using […] we don't know where they are getting our packages. It's a problem for us, and a problem to the farmers." – Large-Scale Supplier (Arusha)*

Illegal traders sell uncertified or counterfeit inputs at enticingly low prices, ultimately diverting smallholders from purchasing quality inputs despite the certifications that are conducted by the various regulatory boards. Although there are mechanisms in place to handle these actors if they are identified and caught, there is currently no way to stop them completely.

Next, we find the Agricultural Extension Officers, whose role as government officials is to educate smallholders in identifying and using quality inputs, and to provide information on input sourcing and use. Finally, NPOs/NGOs and Farmer Associations work to facilitate access to

quality inputs or provide them directly, as well as offering other educational activities.

Throughout the chain, the primary (and preferred) mechanism of exchange is cash, due to issues with obtaining, or using, credit or financing options at both the level of the local supplier and smallholder. As we delved into the implications of the input supply chain for farmers, we identified multiple intricate and overlapping challenges that impede smallholders from accessing quality inputs in an efficient manner, ultimately impacting their ability to generate enough income to pull themselves out of poverty: a phenomenon that we label the "poverty trap."

3.2 The Poverty Trap

We use a causal loop diagram to depict and define the poverty trap experienced by smallholders, constructed on the basis of the aggregate dimensions we identified in our coding process. We now present the dynamics of the poverty trap step by step, adding a new loop (representing a dimension and key challenge for smallholders) and its associated variables (representing the themes) at each step, revealing the full complexity of connections between the challenges experienced by smallholders. Relationships between variables are displayed using directional arrows accompanied by "+" or "-" for positive or negative relationships, respectively.

3.2.1 Unequal Power Dynamics - The Heart of the Poverty Trap

> *"People with money [sellers], they have the power to speak to the government […] we try our best, but it doesn't really work […] because they have connections with people in power."– Smallholder farmer (Kikatiti village)*

The heart of the poverty trap is an unequal power dynamic between smallholders and other actors (see Figure 3); whereby more powerful actors are better positioned in negotiations, keeping smallholders in a captive state.

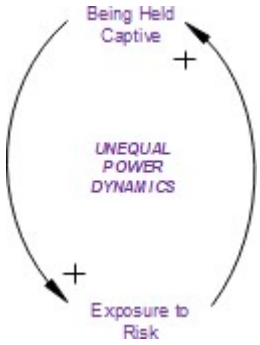

Figure 3 – The Heart of the Poverty Trap

In fact, smallholders are held captive on both sides of their supply chain by their sales market and by local input suppliers. We first address their captivityto market forces, where pressure from the market squeezes smallholders into a situation where they need all the support they can get to reduce cost and improve the quality of purchased inputs:

> *"We can produce good crops and take [them] to the market where we sell at whatever the market price is. […] The inputs are expensive compared to the amount we get from selling at the market, which means that we don't have enough money to spend on the next process, the next season." – Smallholder farmers (Karangai village)*

One smallholder from Karangai village noted that uncontrollable factors such as climate change, are causing operating costs to increase through the enhanced need for pesticides; costs which are not recovered through sales. With market saturation occurring with each harvest, selling prices decrease and limit the smallholders' ability to accrue a decent income. This results in a severe lack of on-hand capital, which forces smallholders to sell what they can as soon as possible regardless of the price. As several smallholders noted, it is better to have some money than none.

Many smallholders also lack the necessary resources to transport crops to market, forcing them to sell to middle-men at well below market value:

> *"If there was a specific market to sell [to], then we could try to find the transport to go there. But now, we have to sell with the middle-man." – Smallholder farmer (Mbuguni village)*

Further undermining the potential of profitable sales is the lack of appropriate facilities and equipment for storage or transformation of crops (e.g., turning tomatoes into tomato paste), thus

forcing them into making quick low-profit sales.

Smallholders are also held captive by local input suppliers downstream. Where innovation exists for specific inputs (e.g., drought-resistant seeds) the benefit to smallholders may be long in coming. Even when such products become available, their higher price renders them inaccessible to smallholders with limited means. Smallholder purchasing habits are also predictable, with inputs acquired routinely at the beginning of each planting season, which enables local suppliers to adjust prices for increased profit margins (sometimes regardless of government price controls), driving inputs further out of reach to smallholders. Furthermore, smallholders often lack the means to travel further than absolutely necessary and must therefore procure inputs from the closest supplier, who may not be in the same village. This effectively results in each local supplier holding a monopoly over their customer base.

As illustrated in Figure 3, the captivity of smallholders by more powerful actors at both ends of their operations generates risk, where smallholders are forced into routinely purchasing the cheapest (and often lowest-quality) and most accessible inputs each season. This purchasing behavior provides the potential for counterfeit inputs to be purchased by smallholders chasing low-cost inputs. Ultimately, the quality of the input cannot truly be known until crops mature (or not). By the time quality is known, the growing season is already over where crops are not sufficient, and time, money, and potential income have been lost, and smallholders' risk being unable to feed their families:

> *"Even if I get the seeds, sometimes those seeds, [their] quality is not good, it's fake. […] When I come to plant, I find out that the seeds are not original, it's fake, and they don't grow." – Smallholder farmer (Kikatiti village)*

Agricultural Extension officers and local suppliers advise smallholders to mitigate risks by reading the input packaging and looking for certification and manufacturing labels. This is only minimally effective, however, even for those who are able to read, given the potential for package

tampering by illegal traders. Smallholders are also encouraged to keep receipts and some seeds in the original packaging as proof of purchase in case compensation or reimbursement might be possible. However, the processes of returning inputs is time-consuming and expensive for local suppliers given that they are responsible to transport any returned seeds to the company for replacement. This process does not guarantee reimbursement, and can leave the local supplier out-of-pocket if they have provided an initial reimbursement to the affected smallholder. There is thus little incentive for local suppliers to assist in compensating smallholders for defective seeds. Although one smallholder focus group noted that some NGOs will offer them compensation if inputs are of poor quality, the general consensus amongst smallholders is that possibilities for reimbursement are extremely limited:

> *"Those people who sell us agricultural [inputs], like seeds, they don't care. They do their business. […] They don't want to take back seeds." – Smallholder farmer (Kikatiti village)*

Further, if replacement seeds are offered to smallholders in place of financial reimbursement, these too may be of poor quality and additional risk is incurred. Ultimately, any potential remedy comes too late, when the season is already lost.

With each repetition of the cycle, smallholders are increasingly held captive, leaving them with less room to maneuver, negotiate, or take control over their input sourcing activities, thereby exposing them to a continual cycle of risk associated with uncertainty of crop sales and input acquisition. The heart of the poverty trap stems from smallholders being beholden to more powerful actors on either side; having no choice but to bear the risk associated with these unequal relationships. This risk is then exacerbated by a series of other variables described throughout the rest of this sub-section.

3.2.2 Access to Resources & Quality Inputs

> *"To be honest, quality has been a big problem for us, it left us poor and we have no solution on what to do. At the end of the day, it's wasting our time. We spend a lot of time to farm,*

to plant, [etcetera], but we don't meet our targets." – Smallholder farmer (Kikatiti village)

Variables related to resource availability and quality inputs are added to our causal loop diagram in Figure 4, connecting to the risk variable of the previous loop. This results in reinforcement of captivity and the negative continuation of the unequal power dynamic.

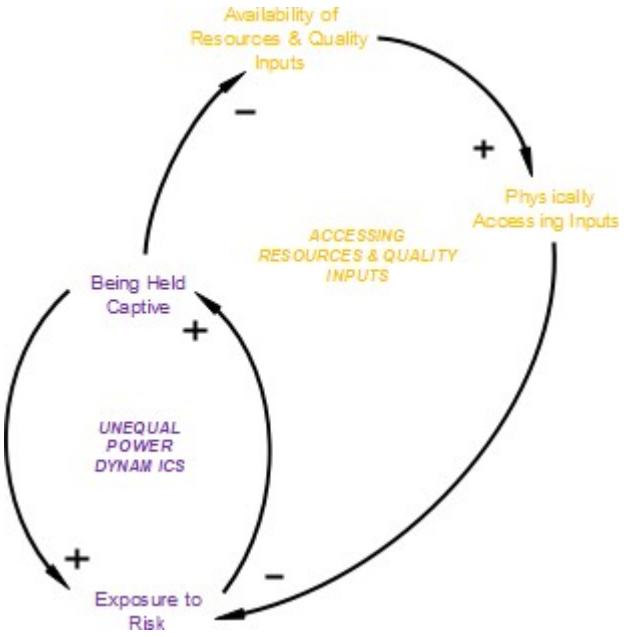

Figure 4 – Exacerbation of The Poverty Trap: Stage 1

The first variable in this loop concerns the availability of resources to smallholders, including credit/loans, capital, alternative payment mechanisms to cash, appropriate input storage facilities, and quality time, as well as the availability of quality inputs themselves. These are all limited by the power dynamics wedescribed above. For example, credit options offered by local suppliers are reserved for customers with whom they have a close relationship. This is not an option for the bulk of smallholders; 21% of smallholders who were asked about bank loans indicated that they had applied for a loan, with 18% having received one. One Agricultural Extension Officer noted that this low rate of application could be attributed to smallholders having little to no collateral and not fitting the 'mold' of eligibility for banks. Purchases are primarily conducted with cash. The absence of other financing options limits both the quantity and quality

of inputs that smallholders can purchase. Given these many challenges it is not surprising that limited capital was noted as one of the primary challenges across all smallholder focus groups, sometimes to the point where inputs were not affordable at all:

> *"Overall, […] the problem is lack of [capital] and the price is a little bit high, so we cannot afford at all." – Smallholder farmer (Kwaugoro village)*

To illustrate the earnings/cost ratio, on average, smallholders interviewed made 910,000 Tanzanian Shillings (TZS) (~$396 USD) from their previous season. To seed one acre of maize using the recommended quantity of 10kg per acre, prices from one local supplier range from 35,000 TZS (~$15 USD) for the lowest quality product to 55,000 TZS (~$25 USD) for the better quality product. As a more extreme example of seed prices, a 100g bag of high quality tomato seeds can cost as much as 360,000 TZS (~$154.50 USD), representing 40% of the average smallholder income.

In an effort to assist with credit, Agricultural Extension Officers encourage smallholders to create and participate in Village Community Banking Associations (VCOBAs) to collect savings and offer local loans to farmers, by farmers. However, the lack of start-up capital, the inability for individuals to contribute regularly, and lack of knowledge about how to coordinate such activities makes them difficult to implement.

When we speak about the availability of quality inputs, although these inputs are indeed available on the market, they are not necessarily within reach of the smallholders given their high cost. In the worst case, smallholders' risk (knowingly or unknowingly) purchasing fake inputs from illegal traders, given the lower cost. Further, one smallholder noted that local suppliers themselves may be the source of counterfeit inputs, making it particularly difficult to know which seeds are fake and which are not and who can be trusted.

In addition to inadequate crop storage mentioned in the previous section, smallholders also

lack the resources that would enable them to store inputs appropriately. Any storage facilities they may have access to are not capable of storing large volumes of inputs, nor do they provide the ability to control temperature, humidity and pest predation. As such, smallholders are precluded from purchasing inputs ahead of the planting season and storing them, even if only for a short period. Finally, time is another resource that constitutes a challenge for smallholders. For example, in villages lacking irrigation systems, farmers spend much of their time collecting water, which reduces the time available to conduct higher-value activities, such as finding alternative suppliers and product sourcing. Additionally, few smallholders have the time to follow-up on known issues so that problems, although raised to village leadership or extension officers, often remain pending and without resolution.

The second variable in the causal loop in Figure 4 deals with challenges of physically accessing inputs from suppliers. Smallholders participating in our study travel 2-30 km to reach local suppliers, over village roads that are often riddled with large rocks or potholes and can become further damaged by heavy rainfall. Even more challenging is travelling to the city (Arusha, the closest city to those villages within Meru District) which requires a 96km round-trip to access alternative suppliers, further impeded by the need to access the main road via the same damaged village roads.

> *"Sometimes it's very difficult to get the seeds because our infrastructure is not that great. We have no transport most of the time. Sometimes the rain is heavy and there is flooding so you cannot move around to get the seeds." – Smallholder farmer (Kikatiti village)*

For farmers without personally-owned transportation, there is the added cost of travel via bus, car or motorcycle hire, if funds permit. In the worst-case scenario they must walk, using a donkey or wheelbarrow to return home with their inputs. In turn, carrying capacity can be limited and the time required (which is already at a premium) increases; imagine an elderly smallholder walking for up to 30km over rough roads with 50kg (or more) of fertilizer and other necessary

inputs using a wheelbarrow. Although some local suppliers offer assistance with delivery in exceptional circumstances, this is not usually the case. Limited and costly transportation options, minimal carrying capacity, poor road conditions, and the distance itself reduces the ability of smallholders to source inputs from other vendors:

> *"For example, if I live far away from the shop and there is another shop [closer by] with a little bit higher price, I have to buy, because I don't have the transport to go far away to get seeds or fertilizers […].." – Smallholder farmer (Kikatiti village)*

Smallholders also indirectly bear the brunt of the distance and transportation costs incurred by local suppliers in transporting products from large-scale suppliers to their shops, including the cost of the transport itself, as well as the labour to load and unload trucks:

> *"For fertilizer, the government sets the price. For example, one bag of 50kg, we have to sell it for 58,000TZS, [and] buy it for 54,000TZS. But the big problem is […] [t]he cost to transport one bag from [town] to here is 1,500TZS. You also have labour costs to load/unload the truck. There is no profit in fertilizer." – Local Supplier (Meru District)*

On price-controlled fertilizer, where the government establishes the prices for all agrodealers across the input supply chain, these added transportation costs can prove detrimental to the local suppliers' bottom line and lead them to impose mark-ups beyond the allowable margins set by the government. The expense may thus be carried over to the smallholder.

As noted at the beginning of this section, the variables in this loop perpetuate and reinforce this same unequal power dynamic and generate further risk for the smallholders, thus propelling the system. Since it is already difficult to access the resources and inputs necessary to feed their families and gain income, smallholders cannot take on any additional risk, financial or otherwise, to seek out alternative suppliers who may not in any case be able to guarantee the sought-after quality. Many smallholders have no alternative but to return to the same local supplier the next season, so the same scenario, and therefore risk, is likely to recur season after season.

3.2.3 Access to Information & Support

> *"We never really had any education or instruction from agricultural officers. They don't really come and try to educate us on how to use seeds or to develop a proper routine of farming. We never really had an agricultural officer coming to help us." – Smallholder farmer (Kikatiti village)*

As with the previous loop, the addition of this next loop (Figure 5) drives the loop of unequal power dynamics through the risk variable, while also connecting to the resource accessibility loop.

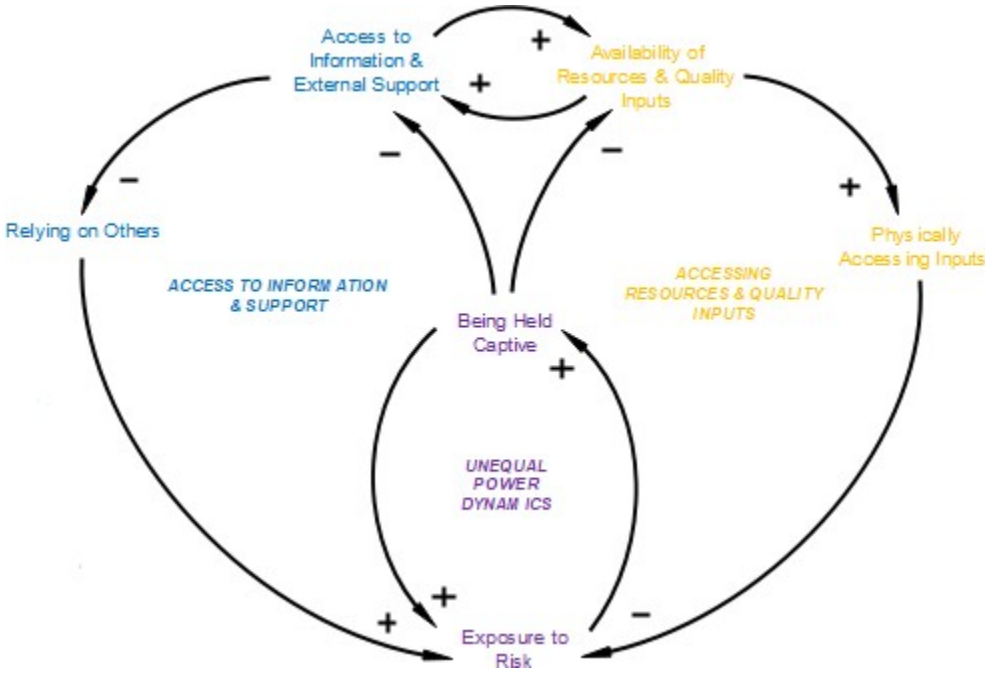

Figure 5 – Exacerbation of The Poverty Trap: Stage 2

Agricultural Extension Officers are the government officials connected directly to smallholders, having the mandate to train, educate, and offer support to smallholders; however, due to large geographical areas of responsibility and staffing shortages, their ability to effectively support smallholders is limited. Meru District reported 102,134 smallholders across 94 villages at the time of our interview, with only 34 village extension officers; well below the normal ratio of village extension officer to village at 1:1. With each officer currently responsible for multiple villages spread over a vast geographical area, it is impossible for them, regardless of capability

and motivation, to be easily accessible and fulfill their functions to a level beneficial to smallholders. This challenge was noted by one large-scale supplier given that they rely on Agricultural Extension Officers to provide essential product information to smallholders:

> *"Education is supposed to be delivered by extension [officers] and our country is so big. So the staff is not available. So farmers lack that education." – Large-Scale Supplier (Arusha)*

Inadvertent, uninformed (or mis-informed) use of inputs could result in substandard crops, which may be misconstrued as resulting from the purchase of poor-quality inputs rather than insufficient or flawed information. This could lead smallholders into spending more money and time than necessary in the pursuit of quality inputs or indeed making a conscious decision to avoid using a particular input completely, which could hinder production overall. For example, one smallholder noted that many people are getting sick due to a lack of knowledge on how to use agro-chemicals (pesticides). The possibility of negative health impacts due to improper (uninformed) use is often enough to deter someone from using a product and in turn miss the opportunity for higher crop yields, whereas with better information on how to use these hazardous inputs (e.g., using protective equipment), smallholders might be able to increase production. However, information alone may not provide the complete answer. As noted by one Agricultural Extension Officer, it is not always feasible for smallholders to obtain the recommended equipment due to its high cost:

> *"Up to 40% have knowledge [on pesticide use], but for most, the use of protective [equipment] is still a challenge. It's quite expensive. So most of them use… overcoats they made themselves, gumboots. Instead of using gloves, they wear plastic bags, so that pesticides cannot come in contact with the skin." – Agricultural Extension Officer*

Due to their staffing and coverage challenges, Agricultural Extension Officers rely upon local suppliers to provide critical product information to smallholders at the point of sale, since local suppliers are required to attend mandatory training conducted through various regulatory

boards. However, as two local suppliers mentioned, attending these seminars can be costly in terms of money, time and effort. Since farmers have little ability to access alternative suppliers, local suppliers do not necessarily have an incentive to provide information to customers, especially if it detracts from sales volume. Furthermore, the individual behind the desk conducting sales may not have been the one to attend training events and cannot offer the correct information. Agricultural Extension Officers acknowledge that this may not always be the most reliable mechanism by which to share information and educate smallholders:

> *"We as extension officers cannot reach all the farmers, so those [local suppliers] help us to give [smallholders] training. [However], some farmers, when you talk to them and ask about laws and regulations on how to use, maybe fertilizer and the precautions, they say they don't know. Because even if they go to the local market, the person who sells to them, knows nothing." – Agricultural Extension Officer*

It should be noted that despite the best efforts on the part of some local suppliers to advise smallholders on the benefits of quality despite the higher price, one local supplier suggested that farmers continue to choose the least costly inputs. Even when suppliers are endeavoring to provide quality products, their advice or guidance may not be heeded due to constraints and limitations in other areas, such as limited capital, or lack of trust.

Agricultural Extension Officers also attempt to increase their coverage by disseminating information through village meetings. However, given the long distance to travel to attend these meetings, they are not accessible to all farmers, and some smallholders become aware of the meeting only after the fact. As a partial solution, Agricultural Extension Officers encourage farmers to join groups where a representative may be sent to attend a meeting and pass on the information afterwards:

> *"We have also some farmer groups in the villages, so we advise farmers to make groups or be in their groups, to make easier work to train farmers." – Agricultural Extension Officer*

With the challenges of time and distance, it can still be difficult for farmer group representatives to connect with smallholders to pass on information afterwards. In some cases, a lack of capital and knowledge to organize and run such a group, negates this as an option.

NGOs and other aid organizations are also actively involved in trying to close the information gap by providing education and training, particularly on input use (and sometimes providing the inputs themselves). Many smallholders noted that these organizations have become the primary information source for them and are seen as more reliable and trustworthy than Agricultural Extension Officers. This creates a secondary issue where trust is diminished, which widens the already existing gap between smallholders and Agricultural Extension Officers and generates increased reliance on NGOs/NPOs and other aid organizations for information.

The reliance of smallholders on others is exacerbated by the difficulties they face in actually accessing information for themselves. While the majority of smallholder participants have cellphones, these are often of an older generation suitable for communication, not for research or accessing the internet. Furthermore, data networks that are fast enough to support this type of functionality are not accessible in the rural villages where smallholders live and work, nor are there computers that might be used to access relevant information, such as sourcing suppliers, comparing products, input use, etc. Even if the technology was readily available, those smallholders who are unable to read and/or write would still be unable to access information themselves. This results in a stronger reliance on local suppliers and Agricultural Extension Officers, who not only possess the information but control how it is shared.

With this additional loop, we see that given a lack of access to information and support, smallholders become heavily reliant on actors who are not necessarily motivated to provide them with the information and support they need. Given the power issues we have seen thus far, the

smallholders' reliance on other actors, particularly their local suppliers, is akin to the sheep relying on the wolf, given the extensive risk.

3.2.4 Trade-offs and Decision Making

> *"Quality seeds are there, but it's expensive. If you have good money, you can get quality seeds. Quality seeds are always there, [whenever] you get good money, you can get quality seeds. But [whenever] you have low money, you get low quality seeds."– Smallholder farmer (Kikwe Village)*

In this section, we add one final dimension to our causal loop diagram focused on trade-offs and decision making processes. This enables us to assess the full impact of the relationships between the variables composing the poverty trap (Figure 6).

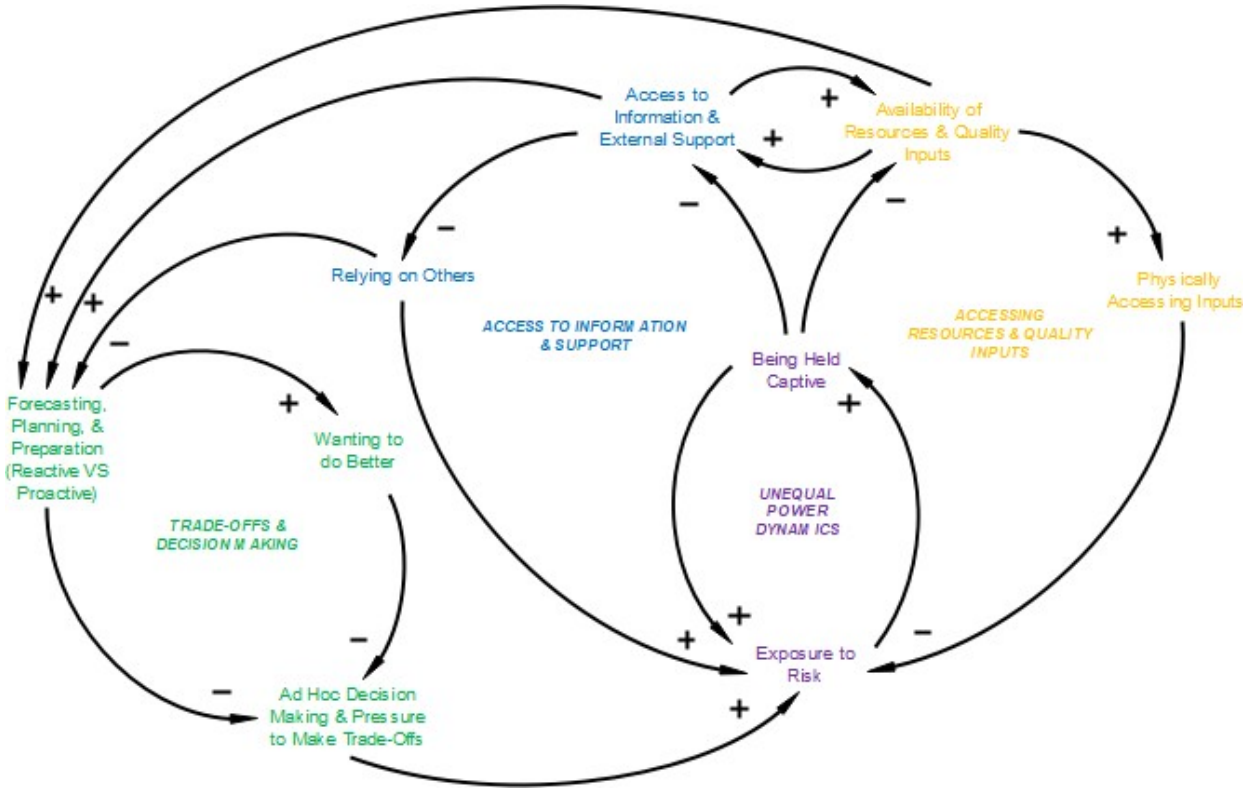

Figure 6 – The Poverty Trap

In fact, a lack of capital and credit means that smallholders are not necessarily able to set money aside to purchase inputs in the following season, limiting their ability to forecast, plan and prepare. This ultimately generates a significant amount of risk, with the imbalance tilted against

the smallholders whose crops may not be sufficient even for family needs, let alone for sale. To mitigate some of these challenges, smallholders will sometimes sell items that were not originally intended for sale to gain extra income. These items include any farmer-saved seeds from the previous season, livestock, milk, or eggs, which can offer a short-term solution to the uncertainty of income generation. This desperation-driven solution can have dramatic consequences for the family, since such assets are generally very important to a family unit and seldom intended for sale unless in exceptional circumstances:

> *"Sometimes we might even sell our livestock to get the money to go buy seeds or fertilizers, chemical fertilizers, then pesticides." – Smallholder farmer (Mbuguni village)*

A lack of information creates uncertainty about which inputs to purchase and when, and thus an environment in which options may not be fully weighed and where decisions are made in haste (to move to the next stages of planting). As just one example, smallholders, although advised against it by Agricultural Extension Officers, wait for the rains to arrive before beginning their input sourcing, increasing the potential for reactive rather than proactive decision-making due to a desperate effort to procure and use inputs in the shortest time frame possible to minimize deterioration of input quality.

As previously discussed, smallholders rely on their local suppliers to provide the necessary inputs, and if the desired inputs are not available then the smallholder must make do with what is left on the shelves. As such, any proactive steps smallholders may be able to take in sourcing their inputs (e.g., planning for the quantity, price, or quality of required inputs, timing, etc.) are limited by the ability of the local supplier to support specific demand.

Perhaps the most interesting theme we discovered is the desire to be better, where smallholders know that there are better ways to conduct their activities. However, due to the accessibility issues they experience, and not having the information necessary to coordinate

activities amongst themselves, this desire to improve cannot be fulfilled. Several smallholder focus groups agreed that they would be willing to work more, spend more, and/or travel farther if they could be assured of a reputable supplier providing the quality inputs that would improve their crop yields; however, the multiple challenges discussed in the previous sections impede their ability to do so:

> *"We don't really have capital to farm as much as we wanted. If we had capital and we organize ourselves as farmers, we can get our own agricultural equipment shops, we can get easier [access], so we don't have to go far away to get seeds and [other inputs]. Basically, we need capital to organize our farms and our [activities] so we can [improve] our farming industry." – Smallholder farmer (Kikatiti village)*

Although the smallholders we interviewed have made attempts to solve the issues they face, several groups noted that they have stopped asking questions and searching for solutions; given that they receive nothing, they no longer see this pursuit as beneficial to them.

Again, this loop connects through the risk variable where the pressure to make trade-offs and ad-hoc decisions pose ever more risk to smallholders forcing them to remain in a reactive state where they must act quickly, since they cannot act early and acting late can mean losing the planting season completely. This reactive posture holds smallholders captive to the more powerful actors and they have no choice but to do the same thing they did before, even if the outcome is predictably to their disadvantage.

3.3 The Poverty Trap Explained

As seen in the previous sections, each loop feeds the risk variable, and thus spurs the inequality of the power dynamic. Each loop generates an extraordinary amount of risk for smallholders, such that we characterize the overall scenario as a situation of the 'risk you know is better than the risk you don't'. Even though faced with the high probability of earning consistently less income with each season, smallholders have no choice but to continue to buy their inputs and

sell their crops in the same way as before as they cannot take on more risk, further entrenching them in a captive state.

This persistent cycle which restricts access to resources, quality inputs, information and valuable support limits the smallholder's ability to take control of their input sourcing and improve their situation, made worse by an environment riven with risk and where they are nearly powerless in their business relationships. This cycle threatens to become a vicious cycle, where the smallholder's continued inability to access the necessary resources that could shift the power dynamic makes their situation progressively untenable. With unequal power at the heart of the issues experienced by smallholders, sustained by variables they cannot control, smallholders lack the capacity to change the dynamic affecting their income (and thus their ability to "make ends meet") season after season. They thus find themselves unable to escape a desperate situation.

4. Perspectives on Overcoming the Poverty Trap

Despite this difficult situation, our findings also identified some efforts being made to assist smallholders in overcoming the challenges revealed in our analysis. Below, we acknowledge three stakeholders that are currently working to change the cycle for smallholders: Government (Agricultural Extension Officers), private industry (large scale suppliers) and Non-Profit Organizations. These efforts link to four main themes in our conceptual framework (see Figure 7). We then build on this discussion to consider other pathways towards breaking the cycle, including the potential for collaborative efforts between stakeholders.

4.1 Existing Efforts to Break the Cycle

4.1.1 Government (Agricultural Extension Officers)

We identify Agricultural Extensions Officers as having the potential to affect positive change to the cycle through increasing smallholder access to information and external support, which can then decrease their reliance on others and offer better access to resources.

However, despite their best efforts and attempts to overcome the various information challenges as noted in Section 3.2.3, it remains difficult for Agricultural Extension Officers to provide smallholders with useful and accessible information, if it reaches them at all. The evidence in our case suggests that the effect of the Agricultural Extension Officers' engagement at the community level has been disappointing. Our interactions with participants in our focus groups suggest that this is most likely attributable to a lack of smallholder trust and confidence in these officials due to smallholders receiving limited feedback when questions or concerns are identified to Agricultural Extension Officers, which suggests potential approaches to improvement, particularly in following-up on smallholder queries. If improvements to the current relationships are made, then given better resources Agricultural Extension Officers may be better able to improve access to information and offer meaningful benefit.

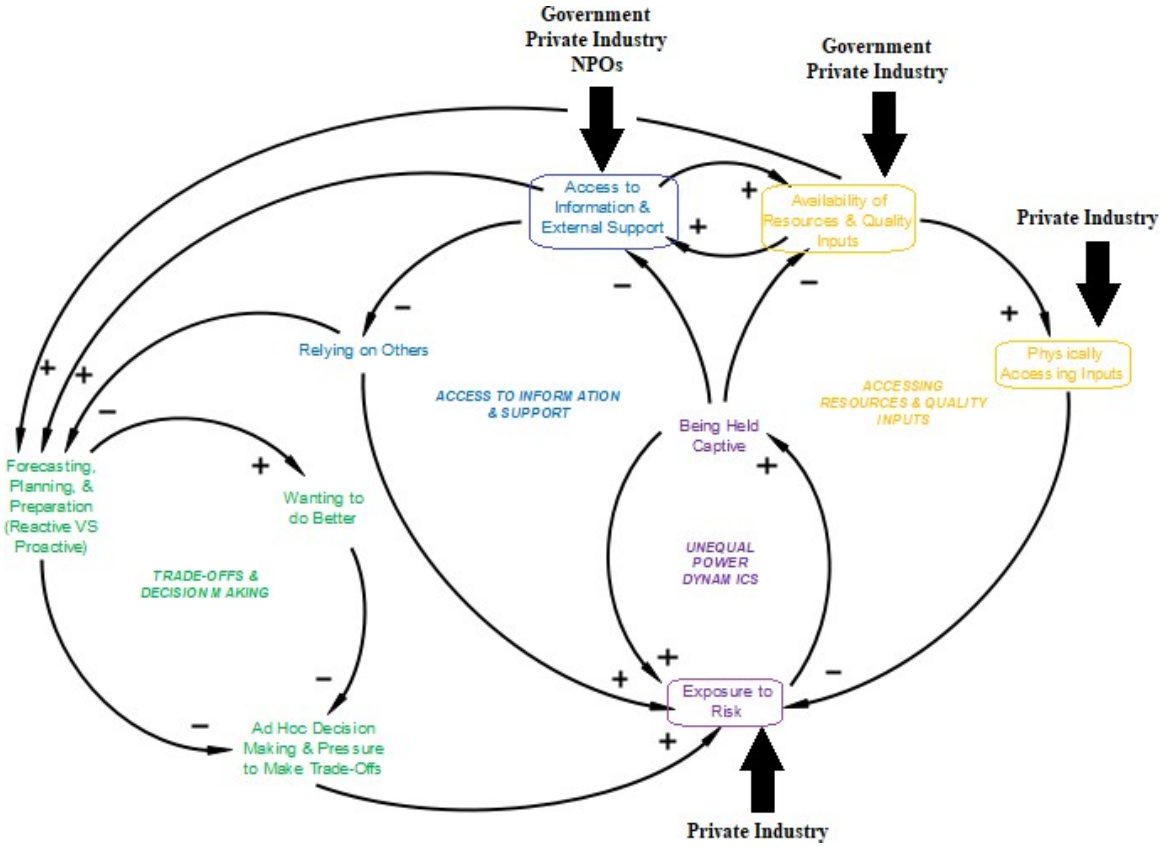

Figure 7 – Stakeholders and Pressure Points in the Conceptual Framework

We also identify an opportunity for Agricultural Extension Officers to target the variable of 'Availability of Resources' by contributing to policy development. To facilitate their recommended solutions for smallholders as noted in Section 3.2.3, these officials are optimally situated to encourage government-backed initiatives that facilitate smallholder access to better resources (such as credit) and encourage banks or other institutions to provide loans for smallholders.

4.1.2 Private Industry

Meru Agro is a large-scale supplier located in the city centre of Arusha who has made efforts to diversify their distribution network through their Lead Farmer initiative, based on a direct-to-smallholder model which has the added benefit of reducing some of the challenges faced by smallholders, or at least for those smallholders taking part in the initiative:

> *"Meru Agro saw this as an opportunity to use lead farmers to [make available] inputs to smallholder farmers because, due to poor infrastructure in most rural areas it is not easy for them to access agro inputs. Most agro dealers are in town centers." – Meru Agro Representative*

Key to this initiative are *lead farmers*, who are selected based on their farming abilities or their informal leadership role in the community. Lead farmers receive training through Mero Agro on good agronomic practices focused on identifying and using quality inputs, details of Meru Agro products, and how similar assistance can be provided to other farmers. Lead farmers are also provided with certified/quality inputs from the company on a credit basis and free of delivery charges, with the loan repaid from the resulting sales. Our respondent told us that Meru Agro has achieved some success with this initiative over the last two years since its conception:

> *"It has increased farm yields due to use of quality inputs in integration with good agronomic practices [and] it has reduced the issue of fake inputs especially, seeds because now farmers are able to distinguish fake inputs from quality inputs." – Meru Agro Representative*

Through this initiative, Meru Agro provides an opportunity to shift the power balance in the system by bypassing the local suppliers and possibly illegal traders. Four variables of our causal loop are addressed through this direct-to-smallholder model, demonstrating that it is indeed possible to target multiple areas simultaneously. This initiative might contribute to redressing the risk and exploitive power dynamics felt by smallholders, although clearly, the large suppliers benefit from this initiative as well.

4.1.3 Non-Profit Organizations

Farm Radio International (FRI) is one of the non-profit organizations working to improve opportunities for smallholders in Tanzania. FRI works with radio broadcasting partners to share information with smallholders, and to engage them through participatory communication practices. This approach to communication gets smallholders actively involved in the discussion, particularly through 'listening groups' where they have the opportunity to participate directly and to help identify ways by which information sharing can be improved or tailored to their needs.

Radio provides an accessible platform even in remote areas (through household radios, or listening groups facilitated by FRI-provided radios), making information widely accessible with little to no financial penalty to the listener. In 2018/2019, FRI estimates that they, with their partners, reached 20 million people across rural Africa.

In reference to Figure 7, FRI directly targets the information variable. The volume of farmer-relevant information distributed though their network of radio partners, combined with the important feedback loop of participatory communication, enables FRI to help smallholders better understand how *they* can improve their knowledge base, to give themselves more agency. This can reduce the smallholder's reliance on others (and thus reduce their exposure to risk) and help rebalance the power dynamic in their interactions. Radio provides a convenient and inexpensive

way to gain this information, as farmers can listen to the radio concurrently with other activities. Learning 'over the air' means that literacy rates are not a concern, permitting the dissemination of the most relevant information to the most people. By enabling smallholders to further close the information gap, FRI helps shift the power dynamic in the farmers' favor, with potential to help overcome the poverty trap.

4.2 Other Approaches to Overcoming the Poverty Trap

During our focus groups, an alternative solution was revealed which was particularly attractive to participating smallholders; to create smallholder-run 'purchasing groups':

> *"That's a good idea, a very, very good idea to be organized all together and go buy all the agricultural equipment like seeds, fertilizer, and pesticides, that would be better. […] – Smallholder farmer (Kwaugoro village)*

> *"Buying as a group, is better because […] the price is low and the quality is fantastic because the seller, they are too shy to cheat on the groups. […]." – Smallholder farmer (Kwaugoro village)*

Although smallholders were enthusiastic about the prospect of conducting group-purchasing for their inputs and could appreciate it's potential value, they noted several impediments to success, including lack of capital, the time required to travel to the large-scale suppliers who offer wholesale, an inability to coordinate the input type and quantity to accommodate multiple needs and individual priorities, and the lack of suitable storage facilities to store wholesale volumes:

> *"I think that is the best way to organize as a group. […] But the challenge is everyone here has a different view of what they're going to plant for the season. […] That's why we don't get organized and go buy the seeds together. Sometimes, you find out, one of us in the group doesn't have money and they cannot join the group. So, at the end of the day you just go and buy individually". – Smallholder farmer (Mbuguni village)*

Despite these impediments, most of which we have previously identified as significant challenges through our causal loop analysis, we see the broad potential for this kind of initiative. We suggest that this could reduce reactive/ad-hoc decision-making through improved forecasting, planning,

and preparation, minimize negative trade-offs, reduce overall costs, increase the chances of receiving good quality inputs, and provide the opportunity for smallholders to benefit from supplier-based incentives, such as delivery.

To achieve positive outcomes from this type of activity, we suggest that collective, coordinated stakeholder action would be desirable. For example, Agricultural Extension Officers and NGOs could coordinate training for smallholders in how to organize and plan for input purchase and distribution within a large group with diverse needs (e.g., identifying overlapping and specific input needs), offer education to improve negotiating skills and understanding of contract management, and provide general oversight. Additionally, coordination between Agricultural Extension Officers, NGOs, and various private industry stakeholders could promote accessibility to credit or financing options (either with banks or large-scale suppliers), offer wholesale quantities that are reasonable for a group of smallholders, provide enhanced delivery options, and enable innovative storage solutions (e.g., consignment-storage of inputs at the large-scale suppliers' temperature and humidity controlled warehouses until required by the smallholder). As part of the collaborative effort, we suggest that smallholders be actively engaged in the process, substantiated by their desire to 'do better' and willingness to make the necessary effort to find solutions, where the opportunity exists to do so at manageable risk:

> *"We tried to solve the problem and to manage the challenge[s] we have, but the problem is that we don't go far away. That's why when we heard that [you were coming] here, we heard the news last night and when we [got] up in the morning, straight away we came here. We think maybe you can solve our problems and to deal with the challenges. That's why we're here and we're glad to be here." – Smallholder farmer (Kikatiti village)*

Through collaborative efforts, smallholders could have improved access to inputs directly from the source, diminishing the risk of obtaining low quality inputs and potentially eliminating the risk of obtaining fake inputs. With education and training to facilitate group coordination,

smallholders could begin to better predict their needs and learn how to better forecast, plan, and prepare for their seasons, and reduce their reliance on others. With continued guidance and support, farmers could feel more comfortable in managing additional risk. Finally, with the possibility of accessing alternative suppliers (other than their local supplier) and the opportunity for a higher return on investment given lower production costs, smallholders could become less captive to their current environment. With this holistic and coordinated approach, we see the potential to move past specialized, technical solutions, and to embark on a path towards long-lasting improvement for smallholders underwritten by a comprehensive, system-based approach which respects the intricacies and interconnections of their complex input-sourcing processes.

In reference to our causal loop diagram, we have identified three primary variables where targeted improvement efforts can be made through concerted and coordinated stakeholder action. The first variable is access to information and support. We anticipate that coordinated efforts could increase the amount, quality, and frequency of information and support, and would help equalize the power dynamic. The second variable concerns access to the particular resource of capital, potentially through provision of credit, financing, and (micro-) loan options, since smallholders are not currently guaranteed an open-handed response from traditional banks, suppliers, or even Village Community Banking Associations (if applicable). Enabling private sector organizations through government involvement and underwriting the risk of non-repayment, may be the only way to accomplish this. The final variable is that of quality inputs; however, we suggest that this cannot represent a viable long-lasting solution by itself, unless integrated with the two previously-mentioned areas. Providing quality inputs directly to the smallholder could offer improved crops and higher income; however, yields remain dependent on uncontrollable factors such as weather

and pests, and so quality inputs in-and-of-themselves may not be sufficient to create enough long-term income growth to provide lasting benefit.

We suggest that efforts towards these specific variables could better balance the power dynamic between actors over time and create more opportunities for smallholders to take control over their activities, to improve their livelihoods, and ultimately overcome the poverty trap. We further suggest that these efforts could aid in enhancing the quality of their production and contribute even more significantly to the agricultural and economic development of their region.

6. Discussion & Conclusions

To understand the challenges facing small-holder farmers in developing countries, our research offers a new perspective; instead of focusing on market dynamics exclusively, we place greater emphasis on the supply-side dynamics and relationships inherent in the input-sourcing processes. As seen through our framework, multiple overlapping issues create severe challenges around input-sourcing for small-holder farmers, and this complexity and interconnectedness must be taken into account if any improvement is to occur to their benefit. Solution development cannot occur in isolation and without contextualizing implementation as part of a holistic perspective; if challenges are approached as singular entities rather than as part of a larger whole with multiple cause and effects, we risk creating additional challenges not previously anticipated. We believe that our framework and our perspective have value beyond the specific setting studied, offering insight into how improved input sourcing might enable better standards of living across Sub-Saharan Africa and other regions where similar challenges exist.

Accountability and transparency between supply chain actors (Mutonyi et al., 2018) is challenging for large, power actors within subsistence markets given gaps in regulations and capital (Parmigiani and Rivera-Santos, 2015). We draw the conclusion that if it is challenging for

those who can easily access information and money, and who possess the necessary connections to operate within these markets, then it becomes nearly impossible for those smallholders who possess much less power and access. As such, the first step is to shift the power dynamics so as to provide smallholders with a better platform from which they can address issues and business. This is not the final solution; rather, it is the basis upon which efforts towards poverty reduction may begin. It is only after this unequal dynamic changes that improvements to other areas may occur, such as access to resources and quality input and access to information.

In order to shift this dynamic in favour of the smallholder such that they may more successfully navigate their markets and improve their processes on their own, targeted and collective stakeholder action focused on particular aspects of input sourcing which we have identified would be beneficial. We note specifically that collective stakeholder action should actively include smallholders and argue that this may only be achieved through training, improved accessibility to resources (Orsi et al., 2017), and access to credit resources (Wossen et al., 2017) where exposure to risk over the long and short-term can be reduced. Actively minimizing this risk would aid in building and maintaining relationships with other stakeholders, which can be the most difficult part of the collaborative process, but is also the key to success (Argenti, 2004) thus reducing the captivity of smallholders within the current environment. Engaged smallholder involvement may dispel some of the damaging effects that could arise if collaboration is not managed and coordinated effectively, particularly once principal stakeholders leave and smallholders are left again to depend only on their own resources (Luwanda and Stevens, 2015). However, as we have identified, there is not always an incentive for stakeholders to engage in collaborative efforts. We see the NGO role as vitally important and being the primary entity to coordinate activities amongst stakeholders.

Although the poverty trap as it currently exists is a complex web that is challenging to unravel, and thus to correct, it will be even more difficult to reverse the downward spiral that we see today. We hope that this paper stimulates conversation and offers an avenue for further research within this area, to understand the whole of the situation, not only the market aspect, and how collaborative efforts may be achieved within those targeted areas we describe. The goal is to unwind the poverty trap through balancing and refining the power dynamic, giving smallholders a greater voice within their daily business transactions to improve their livelihoods and increase agricultural output, thus offering a greater impact to local and national economies.

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