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Impact of smallholder farmer horizontal and vertical linkages on access to prime markets and household welfare in sub-Saharan Africa: The case of Tanzania

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Introduction

Agricultural development policies and investments in sub-Saharan African (SSA) countries have largely focused on crop and livestock production (Almond and Hainsworth 2005). Only about 6% of full-time equivalent researchers are socio-economists (ASTI raw data). Additionally, in a study of five SSA countries, Benin and Yu (2012) observed that total expenditure on marketing, feeder roads and regulation as percent of total public agricultural expenditure (PAE) was lower than 32%. This clearly shows the production orientation of PAE and apparent neglect of market development, which is key to increasing farmer incentives for land investments (Barrett et al 2010; Barrett 2008). Moreover, Schmidhuber and Bruinsma (2011) estimated that to achieve food security by 2025, 37% of the additional US$50.2 billion investments required will be for developing rural infrastructure and market access.

Past experience has shown that investment in smallholder farmer production that is not supported by strategies to enhance access to markets does not lead to long-term adoption of improved agricultural practices. For example, work in Ethiopia, Tanzania, Zambia and elsewhere to push hybrid maize and inorganic fertilizer through on-farm demonstrations by organizations like Sasakawa Global 2000 (SG2000) led to significant productivity growth and almost 100% adoption by participating farmers. One of the important attributes of SG2000 that led to the large impact on adoption rate was its in-kind input loan. Access to credit and marketing services was required for adoption of expensive external input by smallholder farmers. However, beneficiaries of SG2000 program reverted back to the old practices of using unimproved maize seeds and non-application of fertilizer after the project ended (Stepanek et al 1999). In Ethiopia, for example, the government adopted SG2000 in its national extension program (NEP) that targeted 3.6 million farmers (out of a total of 10 million rural households) to use the SG2000 model by 1998 (ibid). The resulting high adoption of improved maize seed and inorganic fertilizer, however, resulted in a production glut that pushed maize prices to a level that rendered unprofitable use of purchased maize seeds and fertilizer. This experience has resulted into renewed attention to the value chain

approach in support of the agricultural sector and a new surge of public support with accompanying measures for infrastructure development (World Bank, 2007).[1]

Developing horizontal and vertical linkages is often argued to be an effective organizational innovation in FVCs to overcome constraints for small-scale producers and traders to participate in high value markets (e.g. Biénabe, & Sautier, 2005; Kaganzi et al 2009). Horizontal linkages is a long-term cooperative social capital formed to accomplish common goals among farmers or agricultural traders/processors with beneficial interdependence, trust and resource pooling (USAID 2015; Berkes, 2002; Trienekens, 2011 and Faida, 2006). Vertical linkage is a social capital across non-competing actors – i.e. actors at different levels of the value chain (Ibid). For example, cooperation of producers (farmers) with processors is a vertical linkage since the two are not competing and are at different levels along the value chain.

Using Tanzania as case study, we analyze the impacts of horizontal and vertical linkages in food value chains (FVCs) (specifically among smallholder farmers and traders) on market access, household welfare assess the drivers of participation in horizontal and vertical linkages by producers and traders. The study contributes to the literature since very few past studies on horizontal and vertical linkages have analyzed their impacts on income and food security. Additionally, the present research contributes to analysis of the impact of social capital and other group characteristics on the marketing performance of lower-tier organizations such as producer groups, an aspect which has not yet received significant attention in past studies. We use econometric approaches to analyze the drivers of the horizontal and vertical linkages. In addition, qualitative interviews were conducted in the sunflower value chain, which is used as a case study on horizontal and vertical linkages in Tanzania.

The rest of the paper is organized as follows. The next section lays out the conceptual framework for addressing constraints that inhibit smallholder farmer access to prime markets. This is followed by a review of agricultural marketing policies related to horizontal and vertical linkages. The data and methods and quantitative results are discussed in the fourth section. Section 5 presents the sunflower case study. Finally, conclusions and policy implications are drawn based on the empirical evidence and institutional and policy analysis.

Conceptual framework: Enhancing smallholder farmer access to prime markets

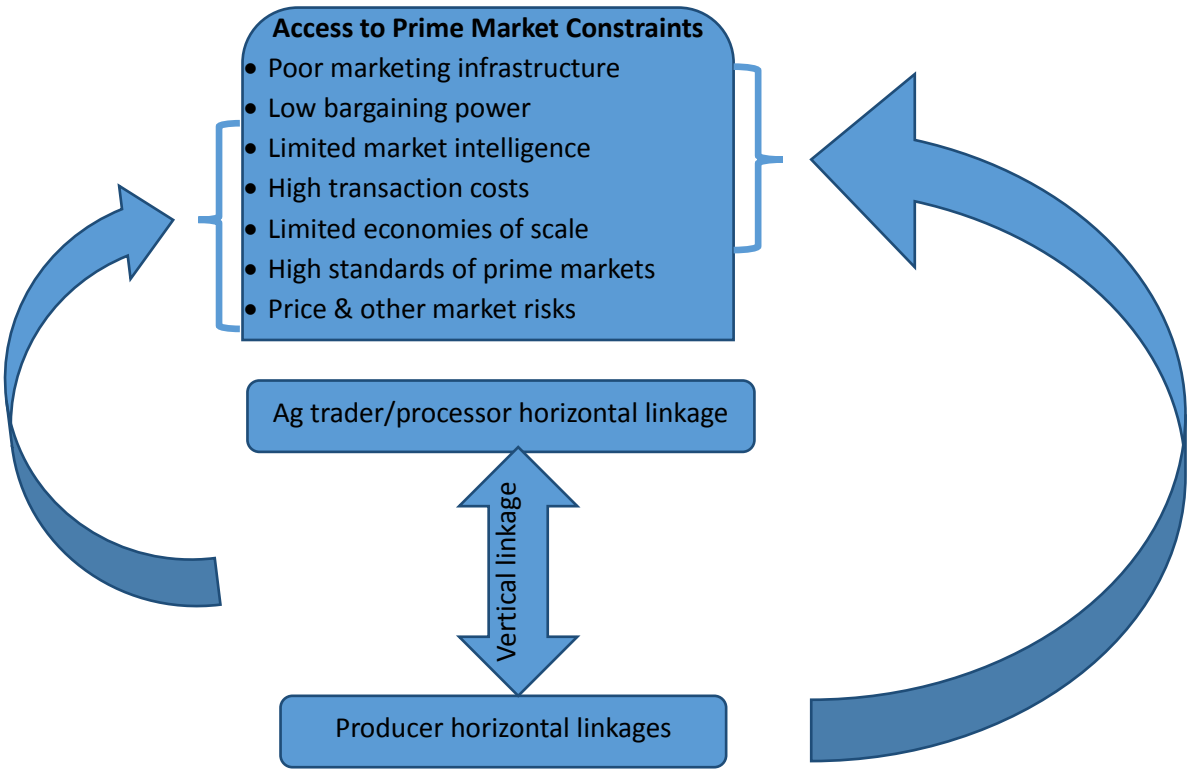
Following a seminal paper by Ostrom (1990) on the greater efficiency of collective natural resource management (NRM), a large number of studies have examined community or group level NRM and how it compares with centrally managed natural resources (Uphoff and Wijayaratna 2000; Agrawal 2001). There has been limited analysis of the impact of collective action on smallholder farmer access to markets (e.g. Barham and Chitemi 2009). Most past studies on collective marketing have largely focused on larger groups like cooperatives

[1] Recent examples of the renewed agricultural sector support include the Agricultural Transformation Agency (ATA) in Ethiopia and Nigeria and the Agriculture Delivery Division (ADD) in Tanzania.

(Francesconi et al 2011; Bernard et al 20009; Jones, 2004; Johnson et al., 2002). Only few studies have examined the role of smaller group collective marketing in enhancing smallholder access to markets (Ibid).

As stated earlier, one significant contribution of this study is to simultaneously examine the impact of horizontal and vertical linkages on farmer access to prime markets. The conceptual framework presented in Figure 1 presents the major constraints that smallholder farmers face in accessing prime markets and how both horizontal and vertical linkages could be used to address them. The list of constraints is not exhaustive but rather points out only those which could be addressed using horizontal and vertical linkages. Studies have shown that group marketing increases smallholder farmers bargaining power and access to market information (Biénabe, & Sautier, 2005). Additionally, collective marketing reduces transaction costs and creates economies of scale as it allows smallholder farmers to aggregate produce from their small farms to supply to large consumers or agricultural traders who require large quantities (Ibid). Group marketing could also allow farmer groups to have vertical linkages that could involve binding contracts with large agricultural traders; such contracts could also enhance the group negotiation skills and improve their ability to produce products with the required higher regulatory standards (Musoke et al 2004; Best et al 2005; Kwapong and Kyorugendo 2010b). Vertical linkages could also help individual farmers or farmer groups reduce marketing risks as they secure reliable and higher prices than those prevailing in the open market (Kaganzi et al 2009; Develtere and Pollet 2008).

Figure 1: Conceptual framework of horizontal and vertical linkages



Agricultural marketing policies that promoted horizontal and vertical linkages

Farmer market participation in the export crops sector started before independence in most African countries. This led to formation of cooperatives by local farmers, which had very strong horizontal and vertical linkages (Mrema and Ndikumana 2013) and played a central role in market development of export crops in SSA before and after independence (Bernard and Spielman 2009; Mruma, 2014). Many of these cooperatives were involved not only in buying and selling crops, but also provided in-kind input loans to cooperative members, advisory services and operated processing plants – thus supporting the entire value chain (Gibbon, 2001; Mrema and Ndikumana, 2013). As a result farmers were able to fully participate in agricultural marketing. Most of the cooperatives (especially cotton, coffee, tea and tobacco) exported their crops directly, which enhanced their farmers to capture premium prices – the governments only played regulatory roles. Consequently, areas that grew export crops always merged to have higher income and better education than areas that grew only non-export crops. The Tanzanian cooperative sector, for instance, grew quickly and was considered to be the largest cooperative movement in Africa (Maghimbi, 2010). After independence in 1961, cooperatives were strongly promoted by the Government and by 1965, 1287 primary cooperatives were active in more than 20 crop sub-sectors and controlled more than 80% of agricultural production and marketing (Birchall and Simmons, 2010; Mruma, 2014). Maghimbi (2010) observed that many cooperatives "made profit and huge surpluses" and contributed to a strong positive trend in food production between 1954 and 1968.

Cooperative leaders were democratically elected (Gibbon, 2001) and this enhanced their downward accountability. Additionally, cooperative membership was voluntary (Wanyama 2013) and shareholders received dividends based on their shares. Cooperatives were relatively successful in supporting smallholder production in SSA until the 1970s (Putterman, 1992; Mrema and Ndikumana, 2013; Maghimbi 2010; Mruma, 2014). However, the new independent SSA governments gradually increased state influence in the cooperatives and downward accountability of the cooperatives was eroded. Many countries established Crop Development Authorities (CDA) whose leaders were elected by central governments and imposed on the farmers. CDAs or other parastatal organizations were established for export crops, which oversaw production, marketing and export (Putterman, 1995; Cooksey, 2003). For non-export crops, other forms of government-controlled organizations were formed. In some countries – such as Tanzania – participation in cooperatives became compulsory (Wanyama 2013).

Producer prices were determined by the government and were taxed directly and indirectly – resulting in lower prices for farmers. For example, for coffee and tobacco producer prices were only 23% and 15% of the international prices by mid-1980s, respectively (Barrett and Mutambatsere, 2008). Governments and donors also participated in the input market through distribution of subsidized or free fertilizer and/or seeds (Tripp and Rohbarch 2004;

Langyintuo et al 2010). Development of a private input sector was also hampered by these government interventions (Langyintuo et al 2010). The governments' heavy-handed intervention into cooperatives and their participation in marketing activities led to their consequent collapse in the early 1990s and made the governments to rethink strategies for reviving them (Kwapong and Kyorugendo 2010a).

Eventually, many SSA countries introduced liberalization policies in the late 1980s to 1990s (Kherallah et al 2000; World Bank, 2007). Market-oriented reforms limited the role of the governments in production and marketing and agricultural prices were decontrolled to allow development of a private agricultural trader sector (Beynon et al., 1992; World Bank, 2000; Putterman, 1995). However, the rapid withdrawal of governments in the marketing activities and control of cooperatives created a vacuum since the newly independent cooperatives and farmer groups did not have institutional and human capacity to efficiently operate economic activities (Develtere and Pollet 2008).

Efforts to revive the cooperatives have been implemented in several African countries. The number of independent cooperatives and cooperators has increased over the past 25 years (ibid.). A study covering 11 SSA countries showed that about 7% of the populations are members of about 150,000 cooperatives or cooperative-type organizations (Birchall and Ketilson 2009). However, the nature and conduct of cooperatives have changed significantly from their structure that prevailed before and couple of decades after independence (Ibid). Just as the pre and post-independence cooperatives, cooperatives in some countries that have emerged after the 1970s-1990 state-controlled cooperatives era are increasingly becoming autonomous, voluntary but more diversified and group-based as they are increasingly reducing the role of apex bodies that characterized the unified cooperative structure in the Anglophone countries (Develtere and Pollet 2008). In many countries, they are also becoming cooperative market driven and responsive to new opportunities – especially the growing supermarkets (Reardon et al 2003) and urbanization, both of which require bulk supply of agricultural produce that cannot be provided by individual small-scale farmers.

In Tanzania, the number of agricultural marketing cooperatives had declined significantly after the 1990s, with many of them not being active (Maghimbi, 2014; Mruma, 2014). Yet they remained relevant in some cash crop sectors, including tobacco, coffee, cotton, and cashew nuts in some regions (Mruma, 2014). At the same time, market liberalization led to an increase of private traders and greater competition in some sectors (Cooksey, 2003; Government of Tanzania - GoT, 2008). Overall, markets in many regions of Tanzania remain weakly developed due to a insufficient number of buyers and poor infrastructure (ibid.). Although different forms of farmer organizations have emerged, most farmers remain without access to collective action to market their produce (GoT, 2005). Cooperative development therefore continues to play a major strategy for the Government to support collective marketing and market access among small-scale farmers in Tanzania (GoT, 2008; GoT, 2013; GoT, 2015).

Analytical approaches and data

The main objective of the study, is to understand the current state of agricultural market participation (commercialization) as well horizontal and vertical linkages in FVCs of Tanzania, including in the Trans-SEC project regions, their impacts on household welfare and food security as well as their drivers. Subsequently, we estimate for the case of sunflower production in Tanzania the gross margin differences of different upgrading strategies (UPS) involving horizontal and vertical linkages.

Impacts of horizontal and vertical linkages on commercialization, household income and consumption

We use cross-sectional data to analyze the impact of horizontal and vertical linkages and commercialization on household welfare. We divide the households into two groups, those with either types of the three forms of social capital (horizontal, vertical and both horizontal and vertical linkages) – hereafter referred to simply as social capital – and those without. We define those with social capital as a treated group and those without social capital as a control group. We then use propensity score matching (PSM) (Rosenbaum and Rubin, 1983) to draw comparable groups of households with (treatment group) and without (control group) social capital. We compute average effects of treatment on the treated (ATT) (Caliendo and Kopeneig, 2008), which is the average impact of social capital on households with social capital.

$$ATT = E[\Delta | D = 1] = E[y_1 - y_0 | D = 1]$$

Where Y_1 is the outcome of interest (e.g. household income, consumption, etc) of the treatment group and Y_0 is the outcome of interest of the control group.

Drivers of horizontal and vertical linkages among farmers

Following Schultz (1982), human capital increases human capacity to better perceive and respond to the socio-economic environment. Accordingly, level of education, age, membership in organizations and sex are drivers of commercialization. Barrett (2008) and Boahene et al (1999) also show that access to rural services, including roads, technical advisory services, credit and endowment of productive assets and non-farm activities are major drivers of market participation in Africa. Land tenure also increases agricultural investment (Besley, 1995), which in turn increases marketable surplus. Accordingly, a model of the drivers of commercialization is given below

$$c = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_4 D_i + \varepsilon_i$$

Where $x_1$is a vector of household level capital endowment – namely human and physical capital; D_i is a vector of social capital – including horizontal linkage only, vertical linkage only and both horizontal and vertical linkage; x_2 is a vector of rural services – namely access to market, advisory services and credit; β_i are coefficients of the corresponding covariates; ε_i is a normally distributed error term.

Drivers of social capital among agricultural traders

All variables discussed also apply in the case of agricultural traders. However, there are other drivers that are specific to agricultural traders. Number of languages spoken could allow

them to operate more efficiently than those who speak one language (Fafchamps and Minten 2002). However, multiplicity of languages may not have a significant impact in Tanzania, where Swahili is spoken by almost all Tanzanians. Having storage is likely to affect trading ability (Fafchamps et al 2005). Transaction costs could also trigger agricultural traders to have horizontal linkages in order to share transport costs (ibid). A model of the drivers of social capital can then be written as:

$$SC = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_2 x_3 + \beta_4 D_i + \varepsilon_i$$

Where SC is social capital – including horizontal only, vertical only and both horizontal and vertical linkages; x3 is a vector of agricultural trader specific covariates, including type of trader (wholesaler or retailer); transaction costs, having storage facility, number of languages spoken and distance to major supply source; as well as other covariates as defined above.

Data sources

The main data source for the household level analysis is the 2012-13 National Panel Survey (NPS2012-13), which is the third round of the nationally representative household panel survey implemented by the Tanzania Bureau of Statistics (NBS, 2014). We use the extended agricultural and rural development section of the NPS. The NPS is used for this study as it is representative at national scale as well as for each Agro Ecological Zone (AEZ) and therefore allows obtaining results specific to the project case study regions. The overall sample size of the NPS 2012/13 was 5,015 households, including Mainland Tanzania as well as Zanzibar. For this study all households reported to have cultivated any annual crops during 2012-13 were defined as farming households for this study and used in the analysis. The NPS includes very detailed plot- and crop-level information of production and use of crops. The crop section also includes one question about the main type of buyer to which the farmer sold the crops to (Grocery, Cooperatives, private traders, etc). The NPS lacks further questions on collective action in agricultural production and marketing. We therefore define having vertical linkages as selling through cooperatives and vertical linkages as selling to groceries.

In order to study different types of horizontal producer linkages (collective selling, processing and production) we rely on a farm household survey conducted in 2014 in semi-humid Morogoro and semi-arid Dodoma, with a total of around 900 respondents. The survey includes extensive agricultural sections and marketing activities, including information on sale contracts and collective action.

In addition, we use an agricultural trader survey conducted in Dodoma and Morogoro in 2014 to analyse their horizontal and vertical linkages. Respondents included agricultural output and input traders, at both wholesaler and retailer levels, middlemen, collectors, warehouse owners. The survey also involved agricultural processors and transporters. A total of 263 traders were interviewed – about a third of them were women (Table 1). The agricultural trader survey was conducted after randomly selecting the respondents from a sampling frame of all traders operating in the Trans-SEC project villages. Almost two-thirds of those interviewed were retailers while 17% were wholesalers. The trader survey focused on trader characteristics, operational costs, trading activities and marketing costs, as well as relationship and coordination status.

Table 1: Type and sex of traders sampled from Dodoma and Morogoro

	Wholesalers	Retailers	Transporters	Collectors	Agent/Brokers	Bulk traders
Number of traders						
Dodoma	23	94	0	10	2	1
• % of total	17.7	72.3	0.0	7.7	1.5	0.8
• % female	8.7	23.4	0.0	0.0	0.0	0.0
Morogoro	21	85	4	12	3	6
• % of total	16.0	64.9	3.1	9.2	2.3	4.6
• % female	0.0	37.6	0.0	0.0	0.0	33.3
Total	44	179	4	22	5	7
• % of total	16.9	68.6	1.5	8.4	1.9	2.7
• % female	4.5	30.2	0.0	0.0	0.0	28.6

Source: Trans-SEC agricultural trader survey, 2014

Descriptive results

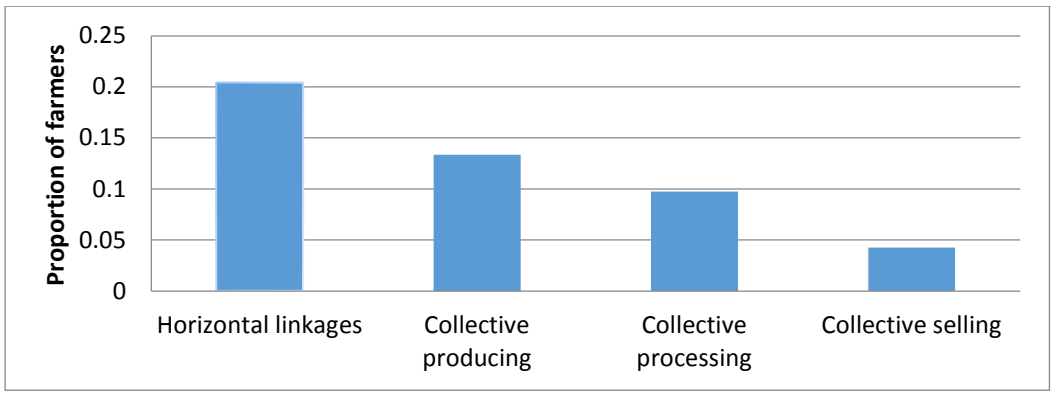
Crop commercialization, horizontal and vertical linkages

The NPS data shows that 64% of farmers sell some of their output to markets. We compute a commercialization index, which is the quantity marketed as share of total production. However, when dealing with multiple crops – as is the case with many smallholder farmers, the commercialization index (CI) is best presented as value of marketed surplus as share of total value of agricultural production. To ensure that farmers are significantly commercialized to the market, we set a CI of 50% as a threshold, beyond which a farmer is regarded as commercialized. Farmers selling less than 50% are regarded as subsistence-oriented. According to the NPS data, average crop CI in Tanzania is only at 27%, and only 24% of farm households sell more than 50% of their harvest to the market.

Yet, while crop commercialization is hypothesized to be an important pathway to increase farmers' welfare, there is a high heterogeneity of the type of market linkages and their effectiveness. The NPS shows that most farmers sell either to neighbors (54%), on local markets (29%) or to private traders (56%), usually at the farm gate, while only few sell to more formal outlets such as groceries (23%) or cooperatives (11%). The low share of households selling through cooperatives, shows the weak state of cooperative development in Tanzania, which before and after independence accounted for a major share of crop marketing in Tanzania (Mruma, 2014).

Figure 2 shows that only about 20% of households had horizontal linkages in Morogoro and Dodoma. Collective production was the most common linkage while marketing was the least common, which underscores the limited collective marketing that used to be a common aspect for farmers during the cooperative movement before independence. Yet, while market reforms have allowed private enterprises to participate in the trade and post-harvest sector and have aimed at creating market-based incentives for cooperatives to operate freely, the private sector and new cooperatives have not managed to provide sufficient market opportunities for Tanzanian farmers.

Figure 2: Types and prevalence of horizontal linkages among farmers in Dodoma and Morogoro



Source: Trans-SEC farm household survey (2013)

The trader survey in Dodoma and Morogoro confirms the low level of vertical linkages between traders and farmers. Only 16% of traders have vertical linkages with farmers (Table 2). However, about 30% of agricultural traders have horizontal linkages, which is significantly higher than farmer collective action (Figure 2). Only 6% have both horizontal and vertical linkages. Wholesalers, transporters and collectors are more organized in horizontal and vertical linkages than retailers. Consistent with expectations, 70% of collectors have horizontal linkages to take advantage of pooling transportation resources and other synergistic benefits. Traders are more often found in urban areas where they are more aware of opportunities for collective action than farmers in rural areas. Of traders who have vertical linkages, only 16% have agreements with suppliers (farmers) (Table 2) and 4% have binding contracts. In the Trans-SEC farm survey, only 4% of farmers mentioned to have a specific buyer and less than 1% reported to have oral or written sale contracts.

Table 2: Agricultural traders in Dodoma and Morogoro and their collective action

	Type of social capital		
Type of trader	Vertical	Horizontal	Horizontal & vertical
	Percent		

Wholesaler	25	55	18
Retailer	13	18	2
Transporters	25	50	25
Collectors	22	70	17
Agent/Brokers	17	17	0
Bulk traders	0	43	0
Total	16	30	6

Source: Trans-SEC trader survey (2013)

Transaction costs with and without horizontal and vertical linkages and internet connectivity

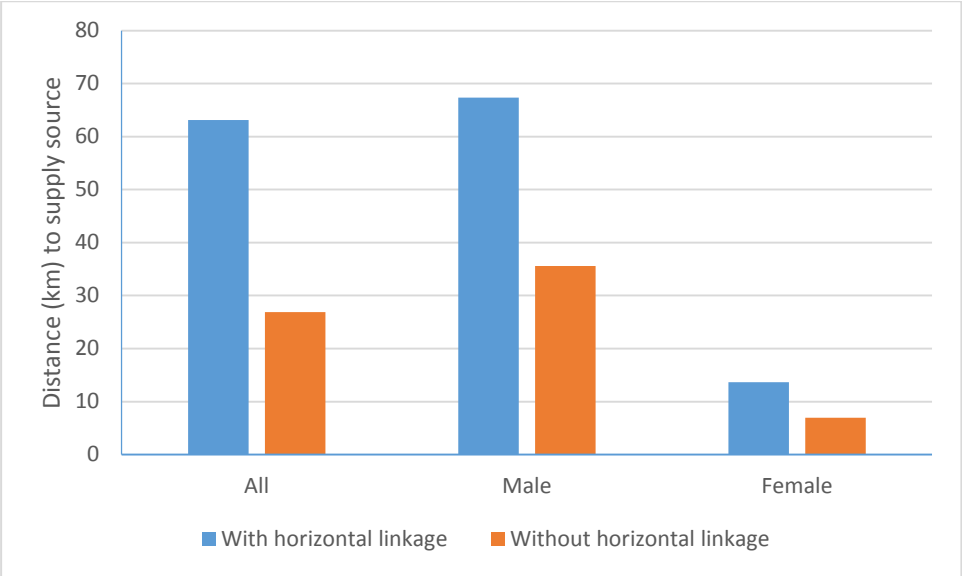
Agricultural traders with internet connectivity are likely to have lower costs of collection and analysis of market intelligence (Aker and Mbiti 2010). However, there is no statistically significant difference between the cost of communication for agricultural traders using and those not using internet (Table 3). This could be due to the larger information collection for traders with internet connectivity for commercial and non-commercial use. Surprisingly, transportation costs of agricultural traders with horizontal linkage are significantly higher than those without horizontal linkage. A reverse causality could drive this result – i.e., traders facing high transaction costs are likely to form horizontal linkages. This is supported by the fact that all agricultural traders with horizontal linkages shared transportation vehicles. The justification for sharing transportation is driven by much longer distances of the supply source for both male and female traders with horizontal linkage (Figure 3). Distance to supply source for both female and male traders with horizontal linkages is more than twice the distance of traders without horizontal linkages. This further justifies the need to invest in promoting horizontal linkages to reduce transaction costs.

Table 3: Agricultural trader transaction costs with & without horizontal & vertical linkages & internet use

Type of practice	Type of cost	Without	With	Paired test
		Weekly cost (TZS)		
Internet use	Communication cost	5896.581	6820.03	0.659
Horizontal & vertical linkage	Transportation cost	273311.4	68381.25	0.678
Horizontal linkage	Transportation cost	22865.72	71237.01	0.001

Vertical linkage	Transportation cost	37952.86	33121.95	0.790

Figure 3: Horizontal linkage, distance to supply source & transport sharing among agricultural traders, Dodoma and Morogoro



Crop commercialization, horizontal/vertical linkages and household welfare

Using the Trans-SEC household survey data, we compare commercialization and crop and household income of farmers with and without social capital. We calculated crop income as the value of all crops produced and agricultural income as value of crops and livestock products produced. Total household income includes agricultural income, non-farm income and remittances.

Table 4 presents paired t-test comparisons of outcomes between households with and without vertical and horizontal linkages. Horizontally linked households have significantly higher (at p=0.01) crop commercialization than those without. While differences in income indicators are not significant, commercialized households have significantly higher incomes than less-commercialized households. Hence, horizontal linkages may be related to household income by increasing commercialization. In terms of vertical linkages, there is a direct significant differences to non-vertically linked households (at p = 0.01) in terms of all the income variables (Table 4).

Table 4: Social capital, commercialization and household welfare in Dodoma and Morogoro

Source/type of income (US$/year)				

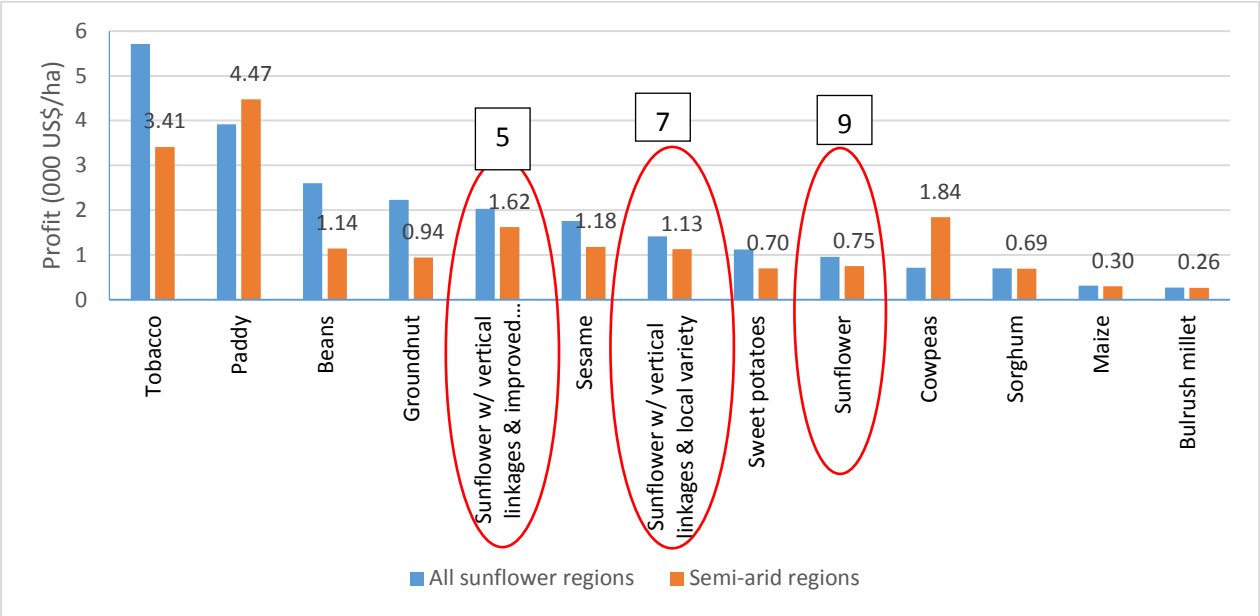
	Crop	Agriculture	Household	Per capita	Crop commercialization
Has horizontal linkage?					
Yes (n=182)	643	781	1,149	317	37.2%
No (n=717)	569	674	1,163	287	29.5%
T-Test (P-value)	0.524	0.407	0.941	0.473	**0.003**
Has horizontal linkage (collective marketing)?					
Yes (n=38)	600	1003	993	315	43%
No (n=854)	583	682	1,168	292	31%
T-Test (P-value)	0.941	0.215	0.631	0.785	**0.0175**
Vertical linkages (specific buyer)?					
Yes (n=39)	959	980	1,315	448	36%
No (n=857)	567	680	1,148	285	31%
T-Test (P-value)	**0.089**	0.239	0.641	**0.055**	0.3511
Commercialized crop production? (yes if sale ≥ 50% of production)					
Yes (n=271)	1,343	1,422	1,915	507	
No (n=601)	265	394	855	203	
T-Test (P-value)	**0.000**	**0.000**	**0.000**	**0.000**	

Source: Trans-SEC household survey (2013)

Simulating the impacts of vertical/horizontal linkages on comparative advantage of crops: The case of sunflower

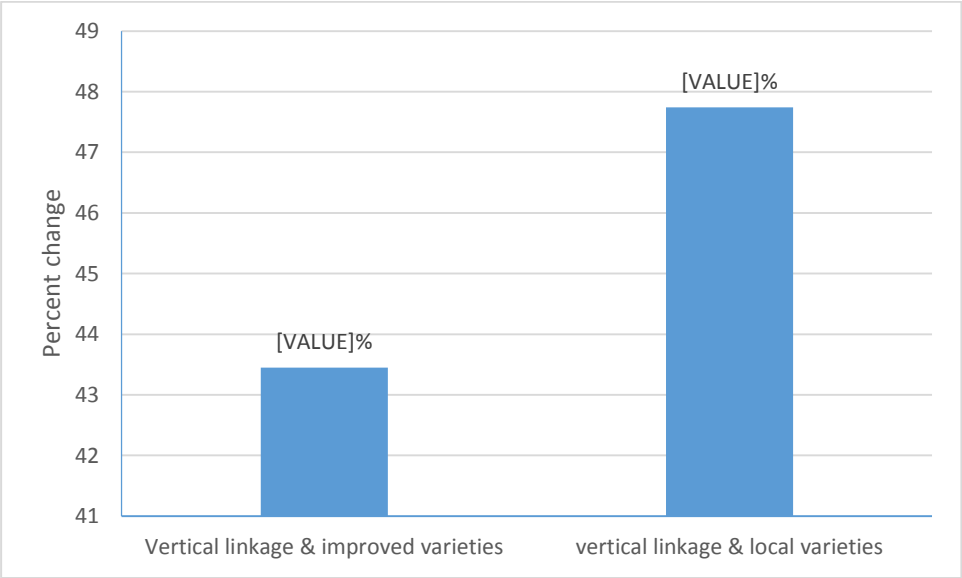
An important question is whether social capital will increase the comparative advantage of crops production over other commodities. We use sunflower as a case study crop to answer this question. Under its current low yield, sunflower is the ninth most profitable crops both across the entire country and in the semi-arid areas, where it is most grown (**Figure 4**).

Figure 4: Competitiveness of sunflower against other crops



Sunflower profit increases by 43% and by 48% when farmers use improved and unimproved varieties respectively (**Figure 5**). Simultaneously having vertical linkage increases the comparative advantage of sunflower to fifth position. Sunflower competitiveness in the semi-arid regions is much higher – 4th with improved variety and 6th with local varieties. The results underscore the importance of building the vertical linkage for sunflower production.

Figure 5: Impact of vertical linkage on sunflower profit – with and without improved variety



In summary, both horizontal and vertical linkages significantly increase crop commercialization and vertical linkage significantly increase crop comparative advantage, crop income and per capita household income. Yet, only a small share of farmers have horizontal or vertical linkages. The share of agricultural traders with horizontal and vertical linkages is greater but still small. Multivariate regression analysis will provide stronger

evidence of the impact of social capital as it will allow us to control for other factors that also affect the outcomes under investigation.

Econometric results

Impact of vertical/horizontal linkages on household welfare and food security

Table 5 to 8 present the results of the propensity score matching. As expected, Table 5 shows that farmers selling to grocery stores receive significantly higher crop prices, gross and net revenues than farmers not linked, which illustrates the potential impact of vertical linkage on farmer welfare. In addition, farmers vertically linked also have higher input expenditures, which could suggest that forward linkages among farmers are also enable them to participate in input markets (cf. Govereh et al., 1999).

Table 5: Impact of vertical linkage on crop farmer price and profit (matched groups)

Variable	Treated	Controls	ATT	S.E.
Average crop price (log of Tsh)	6.42	6.37	0.05***	0.02
Crop revenue (log of Tsh)	13.24	13.06	0.18***	0.07
Crop net revenue (log of Tsh)	13.02	12.88	0.13**	0.07
Crop net revenue (incl. Family labor costs) (log of Tsh)	12.56	12.30	0.26***	0.09
Input expenditures (log of Tsh)	8.21	6.12	2.08***	0.22

Notes: *,** & *** mean associated statistic is statistically significant at P=0.10, 0.05 & 0.01 respectively

Vertical linkage – selling to grocery stores

Source: National Panel Survey (NPS) 2012-13

In terms of horizontal linkages, Table **6** shows that having horizontal linkages as a farmer is significantly associated with higher prices and value of input purchased (Table **6)**. However, the model does not show significant differences between the matched groups in crop revenues and profits.

Table 6: Impact of cooperatives on price & profit – Matched groups

Variable	Treated	Controls	ATT	S.E.
Average crop price (log of Tsh)	6.57	6.39	0.18***	0.02

Crop revenue (log of Tsh)	13.50	13.40	0.10	0.09
Crop net revenue (log of Tsh)	13.32	13.18	0.13	0.09
Crop net revenue (incl. family labor costs) (log of Tsh)	12.79	12.63	0.16	0.14
Input expenditures (log of Tsh)	9.33	6.82	2.51***	0.32

Notes: *,** & *** mean associated statistic is statistically significant at P=0.10, 0.05 & 0.01 respectively

Source: National Panel Survey (NPS) 2012-13

Although there are no differences in incomes between farmers with and without horizontal linkages, having horizontal linkages is associated with higher commercialization (see descriptive section). As expected commercialized farmers received higher prices, profit and value of their purchased inputs is higher than that of non-commercialized farmers, suggesting a potential indirect benefit of horizontal linkages on household welfare through increasing commercialization (Table **7)**.

Table 7: Impact of commercialization on average crop price and profit

Variable	**Treated**	**Controls**	**ATT**	**S.E.**
Average crop price (log)	6.46	6.39	0.07***	0.02
Crop revenue (log)	13.73	13.09	0.64***	0.05
Crop profit – pecuniary cost only(log)	13.52	12.92	0.60***	0.07
Crop profit (incl. Family labor costs) (log)	13.08	12.33	0.75***	0.09
Input purchase (log)	8.01	6.74	1.27***	0.24

*Notes: *,** & *** mean associated statistic is statistically significant at P=0.10, 0.05 & 0.01 respectively*

Source: National Panel Survey (NPS) 2012-13

In summary, the nationally representative NPS-data show that vertical and horizontal linkages significantly increase commercialization and household welfare outcomes. Likewise, the Trans-SEC household survey in Dodoma and Morogoro show that vertical and horizontal linkages significantly increase commercialization while vertical linkages increase crop income and per capita income. But horizontal linkage has a non-significant impact on crop and agricultural income and per capita income. This suggests that horizontal linkage may require additional services to have significant impact.

Drivers of horizontal and vertical linkages

Older and better educated farmers are more likely to have vertical and horizontal linkages (**Table 8**). The impact of education on social capital is consistent with Schulz (1982) who posits that education increases people's capacity to better analyze socio-economic environment. Larger families are less likely to have vertical linkages while households with large farm size or owning livestock are likely to have horizontal or vertical linkages, respectively. These results suggest that poorer farmers may be less likely to have horizontal or vertical linkages, justifying the need to target the poor in efforts to build horizontal and vertical linkages and reduce poverty.

Having non-farm activity decreases participation in both horizontal and vertical linkages, suggesting farmers with alternative livelihoods could have lower incentive to invest significantly in agricultural activities (**Table 8**). Mobile phone ownership increases likelihood to participate in horizontal linkages. Interestingly, the access to credit does not have a significant impact on any form of social capital investigated in this study. This suggests that financial capital is not a crucial factor in building social capital. As expected, farmers in remote areas are less likely to collectively market and establish vertical linkages than those closer to markets, which may be explained by the fact that farmers closer to urban markets are more aware of market opportunities and of the benefits of linking vertically and horizontally.

Table 8: Drivers of horizontal and vertical linkages in Tanzania – Probit model

	Vertical linkages (grocery sale)		**Horizontal linkages (cooperative marketing)**	
	MLE	**Robust Std. Err.**	**MLE**	**Robust Std. Err.**
Age head	0.038*	0.021	0.036**	0.014
Age head (squared)	0.000	0.000	0.000**	0.000
Female head	0.033	0.153	0.055	0.099
family size	-0.042*	0.022	-0.015	0.013
At least secondary education (hh-head)	0.440**	0.201	0.305**	0.148
Plot area owned & used (log)	0.099	0.066	0.166***	0.044
Own livestock	0.208*	0.120	0.093	0.085
Have non-farm activity	-0.319***	0.122	-0.252***	0.088
Have access to credit	0.217	0.302	0.417	0.257
Have mobile phone	0.187	0.124	0.158*	0.084

Have bicycle	0.072	0.128	0.155*	0.084
Receive agricultural extension services	0.231	0.167	0.331**	0.137
Received market advisory services	0.492*	0.277	0.592***	0.217
Distance district HQ (km)	-0.003***	0.001	-0.002***	0.000
Agro-Ecological Zones (cf arid & semi-arid):				
Tropic-warm/subhumid	0.399	0.401	0.862***	0.281
Tropic-warm/humid	-0.058	0.632	1.060***	0.407
Tropic-cool/semiarid	0.410	0.531	0.618*	0.330
Tropic-cool/subhumid	0.220	0.407	0.747**	0.288
Tropic-cool/humid	-0.467	0.558	0.872**	0.380
Constant	-2.895***	0.620		
Number	2316		2316	
Pseudo	0.105		0.101	
Wald χ^2	85.3		145.8	
Prob >χ^2	0.000		0.000	

Notes: *,** & *** mean associated statistic is statistically significant at P=0.10, 0.05 & 0.01 respectively

Source: National Panel Survey (NPS) 2012-13; Notes: NPS-sampling weights are used to estimate the probit model

For the agricultural traders, male agricultural business owners are more likely to have horizontal linkages than female owners (**Fehler! Verweisquelle konnte nicht gefunden werden.**). Agricultural traders operating in Dodoma are more likely to have only vertical and both vertical and horizontal linkages than those operating in Morogoro. The reason behind this pattern is unclear though it is likely that the selected villages in Dodoma are closer to a large city (Dodoma) than those in Morogoro. As expected wholesalers are more likely to have horizontal only and both horizontal and vertical linkages than retailers. This implies a potential collusion given the small number of wholesalers (Table 1**Fehler! Verweisquelle konnte nicht gefunden werden.**).

Agricultural traders with storage facilities are more likely to have vertical linkages. This result demonstrates that traders with vertical linkages are more advanced with facilities that enhance their efficiency. Having many languages reduces the propensity to have vertical linkage – an aspect that suggests that multilingual agricultural traders are not taking advantage of language multiplicity to make more connection. However, multilingual

attributes may not be a big advantage in Tanzania given that almost all Tanzanians speak Swahili.

Consistent with Table 3, higher transportation costs increases propensity to have horizontal linkage. This underscores the importance of investing in building social capital among traders as part of efforts to promote development of efficient agricultural marketing. As expected, use of internet connectivity also increases the probability to have horizontal linkage. Being a wholesaler increases the likelihood to have both horizontal and vertical linkage. This underscores the need to take advantage of the sunflower production and processing that will require both linkages to develop efficiently.

Table 9: Drivers of horizontal & vertical linkages among agricultural traders, clustered robust probit model

	Horizontal linkages	**Vertical linkages**	**Horizontal & vertical linkages**
	Clustered robust MLE[a]		
Male ag business owner	0.592**	-0.100	-
Dodoma region (cf Morogoro)	0.001	0.389**	0.777*
Type of trader (Wholesaler (cf retailer)	0.774***	0.400	1.377***
Level of education of ag trader (cf no formal education)			
• Primary education	0.615	-0.550	-0.096
• Post-primary education	0.205	0.095	-
Age of ag trader	-0.002	-0.006	-0.002
Have storage facility	-0.003	0.496*	0.569
Number of languages spoken by ag trader	0.038	-0.366***	-0.085
Distance (km) to supply source of major commodity	0.001	-0.001	-0.003
Distance (km) to nearest town	0.002	0.003	0.001
Communication cost(TZS) per week	$-5.21e^{-06}$	$2.63e^{-05}$*	$3.62e^{-05}$
Transportation cost (TZS) per week	$3.75e^{-6}$*	$-3.94e^{-07}$*	$-4.49e^{-07}$
Uses internet to get market information	0.414*	-0.122	-0.233
Constant	-2.206***	-0.382	-2.524**

[a] MLE = Maximum Likelihood Estimation, clustered at village level.

Notes: *,** & *** mean associated statistic is statistically significant at P=0.10, 0.05 & 0.01 respectively

Conclusions and policy implications

Tanzania is among many other sub-Saharan Africa (SSA) which are reviving cooperatives that built effective horizontal and vertical linkages and provided value chain services to their members spanning from production, processing, marketing and input credit services. Recent developments in policy reforms to promote cooperatives, growing supermarkets and urbanization are providing opportunities for reinventing the cooperatives in SSA, where only about 7% of farmers are cooperative members. They also provide opportunities for building economies of scale and lowering transaction costs by pooling resources. Our study shows that horizontal and vertical linkages increase producer prices and competiveness of crops, income and consumption expenditure. This suggests the need to direct more resources to building horizontal and vertical linkages through farmer and agricultural trader groups and cooperatives. Currently, Tanzania is promoting cooperatives but budget allocation to its development remain quite limited. For example, in 2010/11 agricultural budget, only 2% of the TZS 258 billion went to cooperative development (Policy Forum, 2011). Horizontal linkages could be built more effectively using grassroot organizations like MVIWATA and NGOs which have been shown to successfully promote collective action in rural areas.

One of quick win strategies that could be used to build effective horizontal and vertical linkages is start with high value crops that are in high demand in urban areas and by local grocery stores. Experience in Uganda (Kaganzi et al 2009), Kenya (Neven et al 2009) and elsewhere have shown that the high profit that farmers get for collectively marketing high value crops lead to very strong and sustainable farmers groups. Our results further show that starting such groups with the youth will lead to quick win – an aspect that could be used to promote horizontal and vertical linkages at a broader level. This is especially important given the impact of mobile phones have greatly improved financial services in rural areas.

There is need of increasing research in edible oil in order to produce varieties with high yield and high oil content in order to take advantage of the growing processing sector. Additionally, there is need of developing a much efficient seed multiplication system by promoting participation of the private sector in order to overcome the current low production of domestically developed varieties. This requires removing the current restriction on private sector producing the locally bred varieties. Quality declared seeds (QDS) initiatives will also greatly enhance seed production – especially for crops like cassava which are not easily marketed through the traditional input markets or recyclable varieties (e.g. open pollinated or self-pollinated crops) which the private dealers may not fetch greater profit.

In summary, there is a big opportunity for developing horizontal and vertical linkages and the result will greatly enhance efforts to reduce poverty – especially in dry areas where severity of poverty is high.

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