THE EFFECTS OF TANZANIAN MAIZE EXPORT BANS ON PRODUCERS' WELFARE AND FOOD SECURITY

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Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2016 AAEA Annual Meeting, Boston, MA, July 31 – August 2, 2016.

ABSTRACT

The Tanzanian government has banned the exportation of maize on several occasions since the 1980s. The government argues these bans ensure an adequate domestic food supply and help stabilize consumer prices. While low domestic prices benefit urban consumers, the bans negatively affect farmers' and traders' incomes by hindering their access to lucrative prices in international markets. Because the bans are often ad hoc and impromptu, the policy causes market uncertainty which may have long-run implications for future food security and trading opportunities. This study uses cross-sectional household data from 244 randomly selected households collected in October and November of 2015 from the Mufindi district of Tanzania, a key maize producing region, to analyze the policy's effects on agricultural production decisions, farmers' responses to price risks generated by the export bans, the implications of the bans on long-run food security, and the effects of the bans on engagement in agricultural activities and investment. While none of the respondents indicate that they stopped producing maize because of the bans, 43 percent indicated that they decreased maize production and started growing other crops. Approximately 63 percent of respondents now produce maize only for household consumption. The survey findings indicate maize farmers are affected by export bans through lower prices and unpredictable markets. The bans caused some farmers to incur negative profits while others were unable to pay inputs suppliers. The bans also reduced investment in maize farming businesses. The majority of respondents indicated that they would reduce acreage allocated to maize production but continue producing maize to meet household consumption needs if the bans are reinstated.

I. Introduction

Despite the significant contribution of agricultural exports to the Tanzanian economy, the Tanzania government has banned the exportation of maize on several occasions since the 1980s. The main goals of the export bans are to stabilize domestic food prices and to ensure domestic food security. However, these bans have a tendency of favoring domestic consumers by lowering prices while hurting domestic producers and traders by hindering their access to lucrative prices in international markets. Prior research found that these export bans lowered producer prices by 7 to 26 percent, depending on the region of the country, and hence decreased maize farmers' profitability and reduced their incentives to produce maize (Diao et al., 2013). Because the bans are often ad-hoc and impromptu, the policy causes market uncertainty which might have long-run implications for future food security and trade opportunities.

Around 65 percent of Tanzania households grow maize, including a large proportion of Tanzania's poorest households, making maize a key market for poverty reduction efforts (Zorya and Mahdi, 2009). This indicates that any policy reform related to maize will have significance implications for households' income and welfare of the maize growers.

While several studies analyze the effects of export restriction policies on the implementing country's economy, farmers' welfare and domestic food security using aggregate data, few studies analyze the impacts of export bans using household survey data. Therefore, this study uses cross-sectional household data collected from maize producers in the Mufindi district of Tanzania to analyze how the export bans policy affects farmers' production decisions, to gain a better understanding of how farmers respond to price risks generated by the export bans, to

determine the effects of the bans on engagement in agricultural activities and investment, and to determine the implications of the bans on long-run food security.

The study finds that farmers are negatively affected by the export ban policies; as a result of the bans, maize farmers received lower prices, had lower profits or suffered losses, while others were unable to purchase inputs for maize production in the subsequent seasons**.** As response to export bans, maize farmers responded by reducing maize production and shifting production to other crops like potatoes, tomatoes, sunflowers, and beans. Collectively, the reduction in maize production resulted in an overall decline in commercial maize production and hence has the potential to affect the country's long-run food supply and may contribute to long-run food insecurity as maize is a staple good.

II. Tanzanian maize export ban policies

Export ban policies are widely used by nations whenever they experience or expect food shortages in their domestic markets. The Tanzanian government began implementing maize export bans in the 1980's. Since then, the Tanzanian government has engaged in a back and forward pronouncement of bans, lifting, and re-imposing the maize export bans. These bans are implemented in an attempt to ensure the domestic food supply and protect Tanzanian citizens from international food price hikes. However, these impromptu ad hoc bans leads to market uncertainty. The export bans are implemented through a direct government gazette notice prohibiting exportation of maize for a given period of time by eliminating the issuance of new export permits and also withdrawing export permits already given to traders. When the export bans are in place, maize transit to neighboring countries like Zambia, Congo DRC, Kenya, Uganda, Malawi, Rwanda, Burundi and Mozambique is restricted for particular time period.

The Tanzania export ban policy was first put into place in 1980s prior to the country engaging in trade liberalization policies. The 1980's export ban was formally lifted in 1999. Despite Tanzania's national trade policy for a competitive economy of 2003, which promotes regional and multilateral trade, export bans were re-imposed again in 2003 by withdrawing all maize export permits as well as denying the issuance of new permits. The export ban continued to January 2006 when it was lifted for only two months to allow traders to sell the surpluses they were holding. In March 2006, the export ban was lifted before it was reintroduced in January 2008. The 2008 export ban was lifted in October 2010 (World Bank, 2009; Barrero-Hurle, 2012; Ahmed et al, 2012). In May 2011, the Tanzanian government once again banned the exportation of maize. Following the ban, domestic maize prices fell by 30 percent in some areas while prices in the neighboring countries remained high (Kagira, 2011). The ban was lifted in October 2011 after complaints from farmers and traders. From July 2003 to October 2011 the Tanzanian government imposed export bans on maize for approximately 72 months limiting exportation to neighboring countries (Porteus, 2012; Dabalen and Paul, 2014).

Following many complaints from farmers about the losses resulting from the policy and also concerns from bilateral and multilateral trade ratifications with the East African countries and Southern Africa Development Community (SADC) countries, the Tanzania government pledged not to re-impose the export bans policy (Makame, 2013; Barrero-Hurle, 2012). The government has committed itself to discontinuing the export ban policy to foster relations with the East Africa Community and other trading partners.

III. Why countries use export bans

The years 2007-2008 witnessed rapid increases in the world prices of many agricultural commodities including maize prices, causing countries to adopt various policies to ensure stable prices and food security in their countries (Kompas at el, 2010); Baylis et al, 2013; Mitra and Josling, 2009; Abbott, 2011). Some of the countries implemented policies to stabilize their production, while others like India, Russia, Ukraine, Vietnam and several Sub-Saharan Africa countries implemented policies to control exports of food crops, such as maize, wheat and rice, to regulate the domestic food supply. Any country with a significant share of its population being food insecure or bearing a high risk of becoming so faces strong pressure to intervene in domestic food markets to avoid these problems (Anania 2013). These interventions are mainly through export restrictions through export bans, export taxes, export quotas or complications in export procedures so as to minimize or discourage exportation.

The main reason for the bans is to protect domestic consumers from price hikes in international markets. Countries impose export bans to insulate the domestic markets from international price volatility and ensure the commodity is available in the domestic market at a price lower than the world price (Baylis et al. 2013). Although this might be beneficial in protecting domestic consumers, it harms producers by reducing their profitability. For countries like Tanzania, where most of the citizens are farmers, the decline in prices also has the potential to negatively affect household welfare.

IV. Illegal trade

While the Tanzanian government expected the maize export bans to work effectively, the export bans lead to illegal and unrecorded movement of maize across the borders. This illegal trading

activity can be observed by examining the differences between the Tanzanian exports records and those of the importing countries (Makame, 2013; Barreiro-Hurle, 2012). For example, a study conducted by USAID Feed the Future Sera Project in 2011, using transactions records from the corresponding official border posts, found discrepancies in the records of offical Tanzania exports relative to Tanzania's trading partners' imports.

Table 1: 2011 Tanzania maize and rice exports against trading partner's imports in tones.

Tanzania Exports to:	Maize		Rice	
	Reported Exports	Reported Imports	Reported Exports	Reported Imports
Uganda	30	234	7,743	27,338
Rwanda	1,830	11,042	23,985	24,228
Kenya	1,012	79,073	2,622	10,475
Burundi	-	4,719	155	5,877
Total	2873	95,089	35,914	69,327

Source: USAID Feed the Future Sera Project (2012)

In 2011, the export bans were in place for most of the year with exception of few months, therefore the majority of the exportation was illegal. As previously stated, the export ban caused the domestic maize prices to fall to about 30 percent, while in other East African countries the price remained high (Kagira, 2011). The high prices in other East African countries influenced traders to use illegal routes to evade the borders authorities to access the higher prices in these foreign markets. When export bans are in place, farmers sell their maize to middlemen at a low price while the middlemen sell the maize at higher prices in foreign markets. Thus, these illegal exports are not beneficial to producers or the government. The illegal exportation is conducted by the middlemen and grain traders and therefore they are ones benefiting from the illegal exportations. (Wilson and Lewis, 2015; Barreiro-Hurle, 2012)

V. Previous studies on export bans

Countries impose export restrictions to achieve goals such as food security and to stabilize domestic food prices by limiting the transmission of price movements in international markets to domestic markets (Anania, 2013). Previous studies on the export bans shows that agricultural export bans have had detrimental impacts on producers' welfare and are not an effective policy to adopt when a country wants to achieve long run food sufficiency and security. These studies show that export bans have little impact on suppressing price increases and reducing price volatility.

Mitra and Josling (2009), using a regression model estimated the short run demand and supply of rice under an unrestricted export scenario and export ban scenario for 2008. In 2008, India banned the exportation of rice. In their study, they used 2005 world prices, and domestic and world consumption quantities to simulate the 2008 scenario. The study found a decline in domestic producer prices and increases in both domestic and world consumer prices causing threats to the food security of poor Indians; the opposite of the policy's intention. They further showed a net welfare loss to both Indian rice consumers and producers due to the tendency of traders to store the crops as result of export bans.

Diao et al. (2013) used a Computable General Equilibrium (CGE) model to analyze the impacts of maize export bans on agricultural growth and household welfare in Tanzania. Using Tanzania 2007 National Household Budget Survey (HBS) data, they simulate both an export ban and unrestricted export scenarios. The study found that the export bans have negative effects on producer's prices by lowering maize prices about 7-26 percent, depending on the region of the

country analyzed, and also has detrimental effects to the return to factors of production such as rural labor wages and hence increased poverty throughout the country.

Kompas et al. (2010) used 2006 Vietnamese Household Living Standard Survey (VLHSS) data to examine the Vietnamese government's policy response limiting exports in response to dramatic increases in world rice price of in 2008. The authors used a bottom-up multi-regional CGE model of income and expenditure from VLHSS sample data and conducted a policy simulation for two scenarios. The first policy scenario is with unrestricted exportation assuming the domestic price responds to world market prices and the second scenario is with export ban where the domestic prices are controlled. The study found that an export ban generates limited short run regional benefits to poor and rural households, although it also resulted in declines in total rural savings. The study further indicated that the free trade scenario would generate the largest increase in welfare as measured by rice producing household savings.

In response to 2007/2008 food crisis both Russia and Ukraine imposed market interventions to control wheat exports. Russia used taxes, while Ukraine banned exportation. Russia ban the exportation of wheat again in 2010 to 2011 due to a decline in grain production as a result of bad weather in 2010. Goetz et al. (2010) analyze the impact of export bans on wheat markets during the food crisis in Russia and Ukraine using a Markov–Switching vector error correlation model on observed market prices of wheat for consumers, growers and exports from 2005 to 2009. The authors found that the temporary export restrictions induced negative effects on wheat markets in these countries by increasing instability. The policy pushed the growers' prices below their long run equilibrium level thus leading to forgone investment in wheat production.

The findings of Goetz et al. (2010) are also supported by Welton (2011), who used descriptive statistics to analyze the 2010-2011 domestic and world monthly wheat prices data after the Russia wheat export ban. Welton found that the export ban had little impact in reducing Russia domestic consumer prices due to hording of cereals by both farmers and trade speculators and also lead to a decline in Russia's domestic wheat supply. Therefore the finding suggested that export bans are poor strategies for managing domestic food prices and might result in unintended consequences for the domestic and international economies as it exacerbates problems created by interruptions in food production and may reduce the incentives for domestic producers to produce.

Chapoto and Jayne (2009), using ARCH models and descriptive statistics, examined the amplitude of price instability and unpredictability between countries with government intervention in maize marketing and external trade such as export ban, quasi state operations and state restrictions to stabilize prices relative to those with open trade policies in maize markets. The study divided countries in two groups: those with trade barriers (Tanzania, Malawi, Zambia and Kenya) and those with liberalized maize markets (Uganda and Mozambique). The study used 1985-2008 maize time series data collected by National Information System for each country and found that countries with trade barriers, like Tanzania with ad hoc export bans, have higher levels of price volatility, unpredictability and uncertainty. Unstable prices and market unpredictability have long run effects on producers' and traders' decision-making since it is difficult for them to predict future cross-border policies.

Ngaruko, Bushesha and Pallangyo (2014) used descriptive statistics to identify trade impediments and marketing transaction costs in maize and rice in Tanzania. Using producer survey data they found that export bans and other trade restrictions scare away private investors

in the food sub-sector. These restrictive policies reduce incentives to invest in the food sub-sector, leading to sluggish growth in food production.

A study by Anania (2013) found that both food price levels and volatility have important effects on food security as they affect incomes and purchasing power. The study's findings suggest countries can improve their food security by stabilizing domestic prices of staples commodities that are important to the diet of the poor. It is therefore important for the government to pursue policies which favor poor consumers by offering lower food prices.

Although it is important to pursue policies to protect poor domestic consumers as suggested by Anania (2013), low prices induced by trade interventions such as export ban policies decreases producers' welfare, especially the welfare of those who depend heavily on the intervened crop as a main source of income to sustain their livelihoods. It is therefore important for the governments of these countries to strike a balance between policies that benefits consumers while minimizing the impacts on producers' welfare; this becomes even more difficult when producers are also consuming the regulated product for their own consumption.

VI. A theory of farm household behavior

Tanzania farm households are both production and consumption units. These households consume part of their production while the surplus is sold to the market. The households also consume other goods from the market which they do not produce. Thus, a household production model will be used to analyze the household production-consumption relationship and responses to changes in agricultural policies and prices.

This study employs the household production model proposed by Becker (1965) but, following Barnum and Squire (1978), modifies Becker's model to allow the households to sell surplus

production to the market. The model considers both the production and marketing of the surplus. In the model, the household's members have the choice of allocating household labor to produce products for consumption and sale or allocating household labor time to being employed in either agricultural or non-agricultural sectors to earn a wage. These wages can then be used to buy the goods which are not produced by the household. It is also possible for the household to purchase labor for production if the amount of labor required for household production exceeds the amount of labor which can be provided by the household members. We assume that the household is composed of both individuals who can provide labor and individuals who are dependents (individuals below 7 years old).

The household members can also choose to allocate time to leisure activities. The price of leisure is determined by the wages which could be earned if the leisure time was substituted for labor time. The amount of time dedicated to leisure activities also depends on the prices of products produced by the household as well as the prices of market products. It is assumed that higher wages lead to less time spent on leisure. Higher prices of market goods might also lead to a reduction of leisure time so as to earn more income to meet the household's needs and achieve satisfaction.

The household is assumed to be maximizing both utility and profit. The household maximizes its utility of consumption of agricultural commodities produced by the household, market goods and leisure time given the household's characteristics such as household size, number of dependents, level of education of household members, etc.

The model assumes the amount of land is fixed in the short-run; however, the farmer can reallocate his land to the various crops he grows to maximum expected profits which are

influence by export ban policies. This model is adapted from Barnum and Squire (1978); however we extend their model to allow for the production of multiple commodities as well as price risks due to policy uncertainty. The farmer attempts to mitigate the risks associated with changes in government policies, which affect prices, by changing his allocation of land to various crops based on policy expectations and price expectations.

We assume the farm household is rational and maximizes utility subject to its multiple product production function, time constraint and a budget constraint. Specifically, the household's utility maximization problem is:

(1) $Max\ E(U) = E[U(L, C, M;\ a_i)],\ i = 1, \dots, I$

(2) $s.t.\ F = F(Z; D, X, A),$

(3) $T = H + L + D$; and

(4) $qM + pC = wH + R + pZ - rX$

Where $U = U(L, C, M;\ a_i)$ represents the household's utility from the consumption of leisure L, goods produced on the farm C, and market goods M for a given set of household characteristics a_i. $F = F(Z; D, X, A)$ is the multiple product production function that transforms labor D (both family and hired), a vector of inputs X and a vector of land allocation in acres A into a vector of outputs Z. Let T represent the total household time available for labor. Let H represent the net quantity of labor time sold by the household if H>0 and net quantity of labor time purchased by the household if H<0. Let p be a vector of prices of Z, which is a random variable taking different values based on whether or not export bans are imposed, q be a vector

of prices of M, w be the wage rate, and r be a vector of input the prices. R is other income (outside of wages earned and sales of D) and φ is rental rate of land per acre.

Let total household income equal the sum of income from household labor sold to in the labor market, other income and total revenue from agricultural goods produced by the household minus total variable production costs. This is consistent with Becker's concept of full income. Assuming the household produces and consumes K products with J variable inputs, then full income is as follows:

(5) $$I = wT + R + \sum p_k F_k - \sum wD_k - \sum r_{jk} X_{jk} - \sum \varphi A_k$$

Using full income, the household budget constraint becomes:

(6) $$qM + \sum p_k C_k + wL = wT + R + \sum p_k F_k - \sum wD_k - \sum r_{jk} X_{jk} - \sum \varphi A_k$$

The left hand side of (6) is total household expenditures, while the right hand side is the household's full income. When leisure is included on left-hand side of the equation, it is the opportunity cost equivalent of the household offering labor to earn income (wL). Production revenue and production costs can be written as a function of labor, land, and variable inputs to derive the profit function. In household production theory, the household maximizes utility given the profit from the products produced by the household as well as income earned from other activities. Therefore, household expenditures will depend on the profitability of the products produced. To mitigate the losses from farming, households may reallocate more factors of production to a crop with a higher expected profit.

(7) $$Max\ \mathcal{L} = E[U(L, C_k, M;\ a_i)] + \lambda(wT + R + \sum p_k(F_k - C_k) - \sum wD_k - \sum r_{jk} X_{jk} - \sum \varphi A_k - qM - wL)$$

Let $F_k = F_k(D_k, X_{k,} A_k)$ be the production function associated with the production of the kth crop, where D_k is time allocated to the production of the kth crop, X_k is a vector of the J inputs

allocated to the production of the kth crop, and A_k is the land allocated to the production of the kth crop. For simplicity, we assume that the per acre of rental rate of land is the same regardless of what is produced on the land and the rate wages is the same regardless of the labor activity. Assume further that $\sum A_k = \bar{A}$ is a total land holding of farm including rented acreage and that $\sum D_k = \bar{D}$.

Without loss of generality, assume that the household produces two goods using two inputs—land and labor. The standard first order conditions of the producer's profit maximization indicate that the value of marginal product is equal to input price; thus, $p_1 MPP_{D_1} = w = p_2 MPP_{D_2}$ and $p_1 MPP_{A_1} = w = p_2 MPP_{A_2}$. The rate of product transformation (RPT) can be obtained by rearranging these first order conditions:

(7) $$RPT_{F_1 F_2} = \frac{MPP_{D_1}}{MPP_{D_2}} = \frac{MPP_{A_1}}{MPP_{A_2}} = \frac{p_2}{p_1}$$

The equation shows the rate of product transformation, which is ratios of the marginal product of the input used in production of the two goods, is inversely related to products price ratio and is the same for both inputs. The RPT provides information about the tradeoff between employing the next unit of the input in the production of the first good in terms of the production of the second good. Equation (7) indicates an increase in price of one of the two products will cause the household to reallocate the input to the production of the commodity that experienced the price increase and away from the other commodity (Debertin, 2012). Therefore, if an export ban on maize is expected, which will lead to lower maize prices, farmers will reallocate their land and labor to the production of other crops to maximize their profits and mitigate potential price risk associated with the policy. The lower expected price for maize may induced some households to reduce their production of maize such that the amount produced just meets the household's

consumption needs while others households may leave the industry and buy the maize from the market. The summation of all households' responses may lead to a decrease in aggregate food production in the country as whole.

VII. Sampling methodology

The study was conducted in the Mufindi district of Tanzania. The Mufindi district is within the southern highlands region of the country which is the largest maize production and surplus production zone, according to Tanzania National Bureau of Statistics. The southern highland region sells maize to deficit regions within the country and also exports maize to neighboring countries. This study area was purposively selected to ensure the study captured the population most affected by maize export ban policies. Cross-sectional survey data were collected in October and November of 2015 from 250 maize producing households in 10 villages. The villages were purposively selected to ensure coverage of the whole district. From each village, 25 maize farming households were randomly selected from a list of farming households. The respondents were the individuals responsible for making farming and marketing activities decisions in each of the randomly selected households. Cleaning the data resulted in 244 usable observations.

VIII. Results

Summary statistics

Table 1 provides a summary of the study respondents' characteristics and their household characteristics. About 59 percent of the respondents are male. The average household size is 5.28 people, while, on average, 3.98 persons within each household are above the age of seven and thus it was assumed these individuals can provide labor within and outside the household. On

average, about 49 percent of the total household labor time is spent on agricultural activities, while approximately 51 percent of total household labor time is spent on all other labor activities. The average annual household income is 5.2 million Tanzanian shillings (TSh) per year, although it varied across villages and depends greatly on the main source of income; the average annual household income among survey respondents is greater the household average income of 1.8 million TSh for the nation (NBS, 2015). The average value of the assets owned by the households is 17.5 milion TSh and varies across the villages. Approximately 83 percent of respondents had only a primary education, 11 percent had completed secondary education or higher, while 6 percent of respondents had no formal education.

Table 1. Household characteristics by village

Village	Age	Male	Household Size	Number of laborers in the household	Percentage of total household labor time spent in agriculture	Income (in millions of TSh)	Assets (in millions of TSh)
Bumilayinga	38.304	0.565	4.435	2.957	0.550	6.425	13.981
	(2.435)	(0.106)	(0.382)	(0.222)	(0.026)	(3.875)	(3.426)
Ikimilinzowo	40.581	0.839	5.226	3.516	0.512	4.923	13.753
	(2.172)	(0.067)	(0.337)	(0.274)	(0.023)	(1.304)	(3.511)
Ikongosi	41.960	0.640	5.440	4.240	0.492	3.040	12.257
	(1.781)	(0.198)	(0.388)	(0.384)	(0.027)	(0.391)	(3.592)
Isalavanu	40.211	0.632	4.368	3.105	0.507	8.647	18.255
	(3.021)	(0.114)	(0.335)	(0.314)	(0.035)	(5.396)	(11.771)
Itimbo	42.429	0.238	5.286	3.905	0.489	4.189	14.372
	(2.350)	(0.095)	(0.421)	(0.308)	(0.039)	(1.074)	(4.006)
Lugoda	41.704	0.481	5.037	3.778	0.490	4.914	10.371
	(2.399)	(0.098)	(0.348)	(0.339)	(0.031)	(1.140)	(2.789)
Mwilavila	48.292	0.500	6.083	4.667	0.476	4.662	12.602
	(2.152)	(0.104)	(0.485)	(0.402)	(0.032)	(1.136)	(1.838)
Mwitkilwa	47.481	0.741	5.481	4.741	0.437	6.189	32.152
	(2.671)	(0.086)	(0.428)	(0.394)	(0.033)	(1.404)	(5.485)
Nundwe	43.870	0.609	5.522	4.304	0.481	8.022	42.453
	(1.591)	(0.104)	(0.402)	(0.263)	(0.029)	(2.901)	(8.806)

Ukemele	42.250	0.500	5.750	4.375	0.477	1.987	6.266
	(1.742)	(0.104)	(0.271)	(0.300)	(0.037)	(0.548)	(1.408)
All villages	42.758	0.586	5.283	3.975	0.490	5.215	17.542
	(0.738)	(0.032)	(0.124)	(0.109)	(0.010)	(0.687)	(1.716)

Note: Data were collected from the Mufindi district in Tanzania. Standard errors are in parentheses.

On average, respondents operate 4.6 acres of land, of which 2.64 acres, on average, are used for maize production, as shown in table 2. All respondents reported growing maize last season. On average, the respondents' households produced 2.54 tones of maize last season and sold 1.61 tones of maize last season. The average maize price is 38, 627 with little variation across villages.

Table 2. Summary statistics on total acreage, maize production, maize acreage and prices.

Village	Total Acreage	Maize Acreage	Maize Production (100kg bags)	Maize Sold (100kg bags)	Maize Price (TSh/100kg bag) (in thousands of TSh)
Bumilayinga	4.315	2.370	28.296	19.709	37.333
	(1.659)	(0.483)	(10.630)	(10.488)	(0.987)
Ikimilinzowo	5.774	3.774	32.613	21.919	36.348
	(0.864)	(0.524)	(7.224)	(7.206)	(0.740)
Ikongosi	3.960	2.110	15.016	7.520	37.738
	(0.337)	(0.235)	(2.076)	(1.616)	(1.132)
Isalavanu	6.289	2.908	46.168	35.053	39.294
	(2.696)	(0.963)	(22.141)	(22.453)	1.659)
Itimbo	3.857	2.024	16.667	8.095	36.666
	(0.616)	(0.131)	(3.202)	(2.921)	(1.037)
Lugoda	5.704	3.130	33.941	24.130	42.952
	(1.280)	(0.420)	(7.123)	(6.864)	(1.038)
Mwilavila	3.231	2.210	27.767	16.833	36.052
	(0.378)	(0.177)	(4.764)	(4.143)	(0.680)
Mwitkilwa	4.991	2.648	19.611	11.944	40.286
	(0.463)	(0.235)	(3.410)	(3.146)	(1.152)
Nundwe	4.804	2.533	19.652	9.609	41.167
	(0.771)	(0.239)	(3.240)	(2.691)	(1.722)
Ukemele	3.083	2.271	15.188	7.417	38.333
	(0.535)	(0.356)	(5.518)	(4.484)	(1.037)
All Villages	4.625	2.639	25.382	16.122	38.627
	(0.341)	(0.138)	(2.529)	(2.471)	(0.376)

Note: Data were collected from the Mufindi district in Tanzania. Standard errors are in parentheses.

Table 3 shows the percentage of total acreage allocated to each crop. In all villages, the majority of agricultural land is allocated to maize production. Apart from maize and beans which is produced in every village, other crops are grown depending on the weather of the area, farmer experience and market.

Table 3. Percentage of acreage allocation to different crops

	Percentage of Total Acreage in:					
Village	Maize	Sunflower	Beans	Potatoes	Tomatoes	Other Crops
Bumilayinga	0.665	0.024	0.066	0.091	0.014	0.151
Ikimilinzowo	0.690	0.075	0.138	-	0.052	0.045
Ikongosi	0.508	-	0.077	0.258	0.003	0.154
Isalavanu	0.675	0.009	0.075	0.081	0.093	0.067
Itimbo	0.606	-	0.021	0.300	0.007	0.066
Lugoda	0.716	0.063	0.097	0.042	0.050	0.032
Mwilavila	0.718	0.156	0.088	-	0.004	0.034
Mwitkilwa	0.513	-	0.228	0.113	-	0.146
Nundwe	0.553	-	0.240	0.157	-	0.049
Ukemele	0.706	0.074	0.090	0.014	0.010	0.106
All Villages	0.635	0.042	0.115	0.100	0.023	0.084

Note: Data were collected from the Mufindi district in Tanzania.

Table 4 summarizes household income from various sources by village. On average, the contribution of maize sales to household income is 14 percent but varies across villages. Although the majority of total acreage is allocated to maize production as seen in table 3, only a fraction of income is obtained from maize production. If households are able to obtain higher income from other crops, businesses or from wages, this may have future implication for how households allocate their labor time and land to maize farming activities. Farmers may reduce

maize production as the model in the previous section indicates since rational profit maximizers will diverts their resources the production of crops or activities which maximize full household income.

Table 4. Percentage of households' income sources by village.

Village	Wages/ Salary	Maize	Other Crops	Business	Livestock	Other Income
Bumilayinga	0.331	0.155	0.171	0.213	0.012	0.118
	(0.068)	(0.040)	(0.050)	(0.062)	(0.005)	(0.046)
Ikimilinzowo	0.099	0.159	0.223	0.337	0.145	0.037
	(0.034)	(0.037)	(0.050)	(0.064)	(0.043)	(0.022)
Ikongosi	0.237	0.102	0.312	0.223	0.055	0.071
	(0.065)	(0.022)	(0.051)	(0.053)	(0.021)	(0.032)
Isalavanu	0.252	0.184	0.268	0.221	0.055	0.020
	(0.080)	(0.048)	(0.063)	(0.069)	(0.023)	(0.020)
Itimbo	0.295	0.076	0.283	0.237	0.051	0.058
	(0.082)	(0.021)	(0.070)	(0.071)	(0.0293)	(0.026)
Lugoda	0.229	0.184	0.137	0.336	0.061	0.053
	(0.062)	(0.048)	(0.041)	(0.061)	(0.028)	(0.021)
Mwilavila	0.185	0.165	0.100	0.466	0.066	0.018
	(0.065)	(0.045)	(0.033)	(0.075)	(0.025)	(0.007)
Mwitkilwa	0.209	0.131	0.203	0.312	0.036	0.109
	(0.046)	(0.026)	(0.040)	(0.066)	(0.019)	(0.033)
Nundwe	0.151	0.098	0.231	0.336	0.092	0.093
	(0.058)	(0.021)	(0.042)	(0.067)	(0.046)	(0.045)
Ukemele	0.209	0.128	0.180	0.232	0.161	0.091
	(0.070)	(0.024)	(0.054)	(0.066)	(0.051)	(0.038)
All Villages	0.214	0.139	0.209	0.295	0.075	0.067
	(0.020)	(0.011)	(0.016)	(0.021)	(0.011)	(0.010)

Note: Data were collected from the Mufindi district in Tanzania. Standard errors are in parentheses.

Table 5 shows the average prices of other crops grown in the region. All prices are for a 100 kg bag. Beans, peas, wheat and millet have higher prices compared to other crops. In addition table 5 presents a summary of the average price of inputs, including wages, rental rates, fertilizer prices, other chemicals prices, and seed prices.

Table 5. Average crop prices and input prices

	Average price (in thousands of TSh.)	Minimum (in thousands of TSh.)	Maximum (in thousands of TSh.)
Beans	157.398 (0.402)	150	170
Sunflowers	45.369 (0.296)	39	55
Potatoes	55.816 (0.330)	48	65
Tomatoes	56.758 (0.393)	48	65
Peas	157.373 (0.3300	150	165
Wheat	144.59 (0.821)	125	165
Millet	154.693 (0.334)	150	165
Maize	38.627 (0.376)	24	70
Rent (per acre)	42.77 (0.439)	25	50
Wage (per day)	4.32 (0.062)	2	7.5
Fertilizer (50kg bag)	58.28 (0.609)	35	76
Seeds (1kg bag)	4.0955 (0.017)	3	5
Other Chemicals (1acre pack)	4.938 (0.303)	1	35

Note: Data were collected from the Mufindi district in Tanzania. Standard errors are in parentheses.

We also asked respondents about their awareness of the export bans policy; approximately 93 percent of respondents reported they were aware of the export bans. Those with awareness of the bans were asked to rank to what extent they were affected by the bans. Approximately, 68 percent reported they were negatively affected by the bans, 14 percent were not affected and 18 percent were neither affected nor not affected (neutral). Of those affected by the bans, 30 percent

suffered a loss, 21 percent reported lower profits due to low prices, 21 percent were not able to buy the necessary inputs for the next season, and 10 percent were not able to sell all of their maize due too few buyers. Of those affected by the bans, 20 percent reduced maize production, 34 percent now produced only for household consumption, 19 percent stored maize to wait for the government to lift ban, and 23 percent shifted to the production of other crops like beans, potatoes, sunflowers and tomatoes. The survey results also indicate that 66 percent of the respondents were not satisfied with income generated from maize production and only 12 percent were satisfied while 22 percent were neither satisfied nor dissatisfied (neutral).

Respondents were also asked about their price expectation for maize for the next season. About 63 percent indicated that they expect maize prices to increase, 23 percent indicated that they expect maize prices to decrease and the remaining 14 percent reported they expect prices to remain unchanged or were not sure. Despite 63 percent of respondents indicating that they expect maize prices to increase next season, only 43percent of the survey respondents expect to allocate more land for maize production next season. Approximately 63percent of the respondents indicated that they now grow maize only for their own consumption, while the remaining 37 percent grow maize as source of income.

Maize production function

To gain a better understanding of maize production in the region, a Cobb-Douglas production function is estimated. Village level effects are included to allow for differences across villages. Table 6 presents the estimation results. It is assumed that maize production is a function of fertilizer, other agricultural chemicals, land, and labor. Fertilizer is measured in 50 kilograms bags, seed in kilograms, chemicals in acre packs, land in acres, and labor in days. Maize production in Tanzania is labor intensive. The model was estimated in double logarithm form

such that coefficient estimates can be interpreted as elasticities. A Hausman test indicates that random effects are preferred to fixed effects; thus the result presented in table 5 were estimated using a random effects model. Labor, fertilizer, and land are significant variables in determining the quantity of maize produced per acre. Holding fertilizer, seeds, chemicals and land constant as labor dedicated to maize production increases by 1 percent, on average maize production increases by 0.34 percent. If other variables are held constant and fertilizer application increases by 1 percent, on average, maize production increases by 0.49 percent. Also, if other variables are constant, when the area for maize production increases by 1 percent, on average, maize production increases by 0.48 percent. Adding the three output elasticities together, we obtain 1.31 the value of returns to scale indicating maize production has increasing return to scale. While the elasticity of fertilizer is rather larger, many maize farmers are reluctant to buy fertilizer from private agro-dealers as they are uncertain of future maize price and fertilizer is expense (Wilson and Lewis, 2015). Instead these farmers wait for the government to subsidized fertilizer. Generally the subsidies are inadequate and not supplied in time.

Table 6. Maize production function estimates

	log(maize)
log(Labor)	0.341**
	(0.143)
log(Fertilizer)	0.487***
	(0.074)
log(Seeds)	0.050
	(0.095)
log(Chemicals)	0.121
	(0.079)
log(Acres)	0.479***
	(0.123)
Constant	0.549
	(0.567)
Hausman p-value	0.6032

Note: Data were collected from the Mufindi district in Tanzania. Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses.

We also model the percentage of total land allocated to maize production as a function of household characteristics, the extent to which the household was affected by maize export bans, input prices, and output prices of maize and other agricultural crops. In table 7, model 1 shows the percentage of acreage allocated to maize production increases with the age of the respondent and household size. The percentage of acreage allocated to maize production decreases with an increase in the number of labors in the household (individuals seven years old or older) and increases in the price of other crops like tomatoes. There is a negative relationship between the respondent's expectation of maize prices in the next season and maize acreage allocation; respondents who expect maize prices to increase next season allocate significantly less acreage to maize production. An increase in land rent rates has a negative impact on the allocation of acreage for maize production. Also being male has a negative relationship with maize acreage allocation.

Using a logit regression analysis, we also estimated the impacts of previous export bans and price expectations on the likelihood the farmer will increase acreage allocated to maize production next season. The dependent variable takes the value of 1 if the respondent plans to increase maize acreage in the next season and 0 otherwise. These results are also presented in table 7. The results show that age, primary education, number of labors in the household, and household income are negatively related to the likelihood of allocating additional acreage to maize production in the next season. Male respondents are more likely to increase acreage next

season. Larger households are also more likely to increase maize acres during the next season. Respondents who face higher maize prices are also more likely to increase maize acres during the next season.

Table 7. Regression coefficient estimates of maize acreage allocation and logit marginal effects estimates of expectation on maize acreage allocation.

	Model 1 Percentage of maize acres Coefficient	Model 2 Increase maize acreage Average marginal effects
Age	0.003**	-0.005*
	(0.001)	(0.003)
Education - primary	-0.020	-0.329***
	(0.060)	(0.123)
Education - secondary or higher	0.010	-0.140
	(0.074)	(0.162)
Male	-0.078**	0.146**
	(0.031)	(0.064)
Household size	0.033***	0.046*
	(0.012)	(0.027)
No. of Labors in the Household	-0.030**	-0.077**
	(0.014)	(0.032)
Expects Maize Prices to Increase	-0.054*	0.129*
	(0.029)	(0.066)
Price of Maize	0.025	0.015*
	(0.019)	(0.009)
Extent Affected by Bans-neutral	0.049	0.116
	(0.047)	(0.112)
Extent Affected by Bans -affected	-0.058	-0.010
	(0.036)	(0.088)
Price of Beans	0.011	
	(0.011)	
Price of Sunflowers	-0.013	
	(0.014)	
Price of Potatoes	-0.003	
	(0.005)	
Price of Tomatoes	-0.015**	
	(0.007)	
Price of Wheat	-0.009	
	(0.007)	
Maize Rent	-0.004*	
	(0.002)	

Maize Labor Wage	0.025	
	(0.019)	
Maize Fertilizer Price	-0.001	
	(0.001)	
Maize Seeds Price	0.104**	
	(0.055	
Maize Chemicals Price	0.001	
	(0.003)	
Assets		0.001
		(0. 002)
Income		-0. 010**
		(0.005)
Maize Income Satisfaction-neutral		0.177*
		(0.087)
Maize Income Satisfaction-satisfied		0.072
		(0.097)
Constant	0.090	
	(0.807)	

Note: Data were collected from the Mufindi district in Tanzania. Income, assets, input prices and output prices are in 1,000 of TSh Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses.

Since many respondents indicated that they no longer produce maize for sale, we analyze the factors effecting whether the household grows maize for sale using a logit analysis. The dependent variable takes the value of 1 if the respondent grows maize for income and 0 otherwise. The results are presented in table 8. Respondents who indicate that they were negatively affected by the maize export bans are approximately 23 percent less likely to produce maize for income purposes. Also, households that own more land are less likely to produce maize for income generation, while household with higher incomes are also less likely to produce maize for sale. Maize prices are positively related to growing maize for sale; as maize prices increases so does the motivation to produce maize for income generation. If the price of maize increases by 1,000 TSh, the likelihood that the household produces maize for income

increases by 2 percent. Since lower maize prices discouraged to the production of maize for income generation, this implies maize export bans which lead to lower maize prices decrease the amount of maize that is produced and can be sold to urban consumers and regions which are not suitable for maize production.

Table 8. Logit coefficient and average margins of motivation of growing maize for income

	Motivation of growing maize	Average marginal effects
	Coefficient	dy/dx
Age	-0.004	-0.001
	(0.019)	(0.003)
Education - primary	-0.522	-0.073
	(0.925)	(0.122)
Education - secondary or higher	-0.975	-0.142
	(1.113)	(0.157)
Male	0.497	0.072
	(0.411)	(0.058)
Household Size	0.052	0.008
	(0.108)	(0.016)
Number of Dependents	-0.239	-0.035
	(0.182)	(0.026)
Total Acreage	-0.307**	-0.045***
	(0.106)	(0.015)
Assets	0.029***	0. 004***
	(0.010)	(0. 001)
Income	-0.091*	-0.013**
	(0.048)	(0. 007)
Extent Affected by Bans - neutral	0.109	0.011
	(0.832)	(0.086)
Extent Affected by Bans- affected	-1.589**	-0.229***
	(0.623)	(0.075)
Price of Maize	0.146***	0.022***
	(0.050)	(0.007)
Cons	-3.6328	
	(3.045)	
Number of obs.	228	228
Log likelihood	-77.65	

Note: Data were collected from the Mufindi district in Tanzania. Maize prices are in 1,000 TSh. Asterisk (*), double asterisk (**), and triple asterisk (***) denote 10, 5, and 1 percent significance levels, respectively. Standard errors are in parentheses.

Conclusion

Maize export bans lower the prices farmers receive, and thus hurts maize farmers' profitability. As a result, farmers' welfare declines. Households that are highly dependent on maize as a source of income are affected more by lower maize prices. Moreover, maize export bans discourage farmers from producing maize for income generation. Although farmers are affected by the policy and are not satisfied with the income generated from maize sales, the respondents to our survey did not stop producing maize as a result of the export bans; instead, they reduced their production to level of their households' level of consumption. However, if rural producers produce for only household consumption, then this may negatively impact urban consumers in terms of supply and prices. Our survey results also indicate that farmers are shifting away from maize production to the production of crops with higher returns like tomatoes, potatoes, peas and sunflower. The shift to the production of other crops as well as the reduction of maize production to household consumption levels has implication for the Tanzanian food supply and food security since maize is the country's staple food. As a result, the export bans policy may have the opposite effect of what the policy intend; in long-run maize prices might be higher as a result of a lower aggregate maize supply.

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