



MALAWI

STRATEGY SUPPORT PROGRAM | WORKING PAPER

SEPTEMBER 2021

Are the drivers of production and sales of maize, groundnut, and soyabean by farming households in Malawi changing?

Analysis of recent household surveys

Aubrey Jolex and Todd Benson

CONTENTS

Abstract	1
Introduction	2
The importance of increased commercialization for agricultural and rural economic development	Error!
Bookmark not defined.	
Factors that affect the commercial orientation of farmers	3
Determinants of changes in the commercial orientation of farmers	4
The crops	5
Which households produce maize, groundnut, and soyabean in Malawi?	8
Are the drivers of production and commercialization of maize, groundnut, and soyabean in Malawi changing?	16
Insights for strengthening value chains for maize, groundnut, and soyabean in Malawi	20
References	Error! Bookmark not defined.

TABLES

Table 1: National production and yields of maize, groundnut, and soyabean in Malawi, annual average for 2013/14 to 2019/20	5
Table 2: Production of maize, groundnut, and soyabean by households that produce any crops, 2019/20	8
Table 3: Potential factors driving production and sales of maize, groundnut, and soyabean by farming households, 2019/20, descriptive statistics	12
Table 4: Assessment of factors driving any changes in production and sale of maize and groundnut and production of soyabean between 2016/17 (IHS4) and 2019/20 (IHS5) using a pooled dataset in a logistic analysis with survey round (IHS5=1) interactions for each explanatory variable, results presented as odds-ratios	18

FIGURES

Figure 1: Suitability maps for production of maize, groundnut, and soyabean in Malawi under improved traditional management	7
Figure 2: Malawi – Agricultural development domains by district	10

Figure 3: Household and contextual factors associated with all maize production and sales in 2019/20, results of logistic analysis, plots of odds-ratios with 95 percent confidence intervals 13

Figure 4: Household and contextual factors associated with groundnut production and sales in 2019/20, results of logistic analysis, plots of odds-ratios with 95 percent confidence intervals 15

Figure 5: Household and contextual factors associated with soyabean production in 2019/20, results of logistic analysis, plots of odds-ratios with 95 percent confidence intervals..... 16

ABSTRACT

By directing increasing shares of their farm production to the market and, thereby, realizing greater incomes, farming households can accelerate local rural economic development. In this study, we examine household and spatial factors that may drive smallholder farming households in Malawi to produce and sell maize, groundnut, and soyabean. Two cross-sectional analyses are done using household level data from rounds of the Malawi Integrated Household Survey (IHS). First, using data for farming households from the fifth IHS (2019/20) in a series of weighted logistical models, we examine which of a set of household and spatial level factors are associated with a household producing each of the three crops. For maize and groundnut, we extend the analysis by similarly identifying the factors associated with whether a producing household sells any of their maize or groundnut, and if, they do, whether they sell more than half of their harvest. The second analysis consists of replicating the logistical models for production and sales using household data from the fourth IHS (2016/17) and comparing those results to the results obtained from the fifth IHS. This is done to identify whether any drivers of the production and sale of the three crops are changing over time.

Overall, only a few factors are consistently associated with a farming household choosing to produce a particular crop or to sell part of their production of the crop. We also see limited changes between 2016/17 and 2019/20 in the drivers of the production and sale of these crops. However, the strength of the positive associations between landholding size and the commercial production of the three crops intensified between the two surveys. This suggests that as landholdings become smaller with continuing population growth, commercial production will increasingly be limited to those households with the largest landholdings. Government and other stakeholders in rural economic development can consider the evidence from these analyses in developing strategies to foster greater diversity in employment in rural economies across Malawi away from agriculture, while nonetheless promoting increased production by those smallholders in a position to participate profitably in the value chains for these crops.

INTRODUCTION

We examine selected household and spatial factors that may drive participation by smallholder farming households in commercial value chains for maize, groundnut, and soyabean. Being crops that are not perishable and can be easily managed within their value chains, these crops have been identified as priority crops for agricultural development in Malawi. By directing increasing shares of their farm production to the market and, thereby, realizing greater incomes, smallholder farming households can significantly accelerate local agricultural and rural economic development. The increased income of these progressively more commercially oriented farmers increases their demand for the goods, services, and labor that can be supplied by other, often poorer, households in their community, expanding local non-farm employment opportunities and raising incomes for those other households (Mellor 2017; Haggblade, Hazell, and Reardon 2007). Appropriately targeting agricultural development efforts towards commercially oriented farming households has important second-round economic development benefits in their communities, benefits which cannot be achieved without properly identifying such households. In this paper, the potential is assessed for where and for what type of smallholder farming households the increased production of maize, groundnut, and soyabean might be promoted.

The importance of farming households selling a greater share of their agricultural production and relying much more on the market to meet their dietary and other needs is recognized in the principal development statements of the country, which look at the development of Malawi's agriculture, rural communities, and the national economy. The Malawi 2063 Vision explicitly notes that complementing agricultural productivity with progressive and extensive agricultural commercialization can result in significant boosts to household incomes and spur economic growth. The current master development framework of the government, the third Malawi Growth and Development Strategy, has as a key dimension facilitating the creation of new structured markets and promoting regional and global exports of value-added agricultural commodities. Central to the National Agriculture Strategy of 2016 is the realization of agricultural transformation in order to significantly increase the incomes, food security, and nutritional status of all Malawians.

After considering the agro-ecological suitability of different areas in Malawi for production of maize, groundnut, and soyabean, two sets of econometric analyses are done using household level data from the last two Malawi Integrated Household Surveys (IHS), the IHS4 of 2016/17 and the IHS5 of 2019/20.

Using the IHS5 data set, we first examine which among a set of potential drivers of households choosing to produce maize, groundnut, or soyabean are significant. For maize and groundnut, we then go on to examine what factors may drive households to decide to sell part of their harvests and, if they do so, what factors might drive those households to sell more than half of their harvest.

The second analysis combines data from both rounds of IHS to examine whether these drivers of production and commercialization of maize, groundnut, and soyabean changed in any way between the two survey rounds.

These analyses are done to generate evidence on where and which farming households might grow maize, groundnut, and soyabean on a commercial basis across Malawi. While overall we find from our research that the drivers of participation by smallholder farmers in these value chains has not been changing in recent years, government and other agricultural stakeholders can consider the information provided in developing strategies to foster greater participation by smallholders in the value chains for these crops. This could be done through direct support to households with characteristics that would indicate, based on the analysis, that they are likely to be able to successfully engage in the commercial production of one of them. Alternatively, targeted investments in the specific value chains either upstream

around input supply or downstream to improve and expand the marketing and processing of the crops could be done to improve the incentives for commercial production of these crops by farming households. Such investments would modify the set of drivers that motivate participation by these households in these value chains.

The importance of increased commercialization for agricultural and rural economic development

Commercially oriented smallholder farming as a pathway to sustainably increasing income, improving livelihood security, and attaining a decent standard of living has been widely discussed (Devaux et al. 2009; Fan et al. 2013; Ricketts et al. 2014). Smallholder farms constitute over 70 percent of farms in Africa, with most smallholder farming households being poor and food insecure (Ricciardi et al. 2018; Onyutha 2018). Nonetheless, smallholder-led approaches to economic development, particularly in rural areas, are argued by many to hold the best prospects for realizing rural economic development, structural transformation of national economies, and significant poverty reduction in Africa (Stoian et al. 2012; van Loon et al. 2020).

Factors that affect the commercial orientation of farmers

A range of studies have sought to identify factors that affect the commercial orientation of smallholder farmers. The factors considered include, among others, individual and household characteristics, access to institutional services, level of local investment in rural infrastructure and markets, and agro-ecological variables. Among individual and household characteristics, education plays an important role in enabling farmers to make informed decisions to enhance productivity and possibly guide a transition from subsistence to commercially oriented farming practices (Gebremedhin & Tegegne 2012; Fischer & Qaim 2012). Improved literacy and numeracy influences skills acquisition and enhances access to and use of information, which encourages greater market participation (Arslan & Taylor 2009). Age may also foster or limit commercial production – studies have shown that older farmers are less commercially oriented, in part due to problems with mobilizing labor (Gebremedhin & Tegegne 2012; Kahan 2013).

In a situation of imperfect agricultural factor markets for labor, land, livestock, and farm equipment, ownership of such factors affects efficiency and productivity (Sadoulet & de Janvry, 1995, Gebremedhin & Tegegne 2012). For example, when land markets are imperfect, as in Malawi, smallholders with larger landholdings generally are more commercially oriented (Muyanga & Jayne 2019). Hence, household endowments of relevant factors for agricultural production are expected to positively affect the level of commercial orientation of smallholder farmers.

Beyond individual and household characteristics, infrastructural investments, such as improved physical marketplaces, enhanced communication, or denser and higher-quality road networks, can encourage farmers to move towards commercial agriculture (Gabre-Madhin 2001; Barrett 2007; Pender & Alemu 2007; Alene et al. 2008; Fan et al. 2013). Institutional services can increase the benefits and reduce the probability of adverse consequences from commercialization processes. These services can improve farmer skills and knowledge, connect farmers to markets and to improved agricultural technology, and reduce the severity of input supply and other finance-related constraints farmers face (Lerman 2004; Omiti et al. 2009; Olwande et al. 2015).

Finally, agro-ecological factors can also affect the commercial orientation of smallholder farmers. Local soil and climate conditions may be ill-suited for producing crops that offer significant returns in the market, posing a significant challenge to smallholders seeking to increasingly participate in local markets. As maize, groundnut, and soyabean are primarily cultivated as rain-fed crops, climate change-induced shocks, such as erratic rainfall and increased severity and incidence of both dry spells and floods, may increase production risks for smallholders (Papaioannou & de Haas 2017). These changes in local production conditions may render too risky the commercially-focused agricultural activities many might otherwise pursue (Gutu, Emanu, & Ketema 2012; Boka 2017).

Determinants of changes in the commercial orientation of farmers

Factors that may influence smallholder farming households to increase the degree of commercial orientation in their agricultural production have been examined by researchers. Mixed findings have been obtained on whether the characteristics of the heads of farming households are important drivers of whether households increase their engagement in commercially oriented production. Associations between the age of the household head and level of market engagement vary by study locale (Minot et al. 2006; Mathijs & Noev 2002), although generally households with older heads of household are found not to change their level of commercial orientation. In contrast, households with male heads are more likely to respond to commercial opportunities and increase their output for market sale (Cunningham et al. 2008; Hill & Vigneri 2014). Conceptually, we might assume that a more educated household head will enable a household to more profitably engage with markets. However, across a range of studies, increased educational attainment of the head is not uniformly associated with a greater propensity to engage in commercial agricultural production –both no associations (Lerman 2004; Minot et al. 2006) and strong associations (Fischer & Qaim 2012) have been observed.

Household characteristics can be important determinants of smallholder households adopting a more commercial orientation in their farming. Fredriksson et al. (2016) suggest that the propensity for a household to do so decreases with increasing household size and dependency ratios. Subsistence production can be seen as a higher priority when the number of consumers per worker within the household is higher, as production will be directed preferentially towards household consumption rather than markets (Minot et al. 2006). In contrast, having off-farm income sources can be an important driver of farming households adopting a more commercial orientation in their farming. Such off-farm income reduces a household's reliance on own-production for its food consumption, while also mitigating risks to household welfare by diversifying the income sources it relies upon.

Adoption of improved agricultural technologies is important in transforming smallholder households from a subsistence to a commercial orientation, as most such technologies provide or safeguard higher production levels (Awotide, Karimov, & Diagne 2016). Whether using commercial inputs for particular crops is profitable will depend on prices in local input and output markets, so market strengthening is a necessary component of any efforts to increase the share of smallholder farmers engaged in commercial production. Similarly, institutional factors, such as access to credit and agricultural extension services can play critical roles in transforming subsistence focused smallholders to commercial producers (Omiti et al. 2009; Olwande et al. 2015).

THE CROPS

Almost all farming households in Malawi grow maize, as it is the most important staple in most food systems across the country. Given the significant demand for maize, producers also can readily sell some of their production to meet household cash needs. Groundnut is similarly both commonly consumed by producers, whilst also being sold. In contrast, soyabean is primarily grown for sale for industrial processing or for production of livestock feed, as few households are familiar with how it can be processed at household level for own dietary consumption. Most of the sales of the three crops are to domestic buyers. However, all three crops are also in demand in the regional export markets. Although less so than in the past, Malawian groundnut is also exported internationally for confectionery use.

Both maize and groundnut have been produced in Malawi for several generations. Soyabean is a more recent introduction into local smallholder farming systems. All three crops have benefitted from the work of agricultural researchers to develop more suitable varieties for Malawi's growing conditions.

- ▶ Groundnut is produced for both confectionery purposes and the production of cooking oil for both the domestic market and to meet export demand. Chalimbana is a confectionery variety that has long been produced and remains common. Higher yielding groundnut varieties with greater disease resistance, such as CG7, have also been taken up by farmers. However, most farmers rely on local varieties that are recycled annually, growing them without inorganic fertilizer.
- ▶ While a potentially attractive commercial crop for smallholder farmers, being a nitrogen-fixing legume, the production of soyabean also has been promoted over several decades as valuable for maintaining the quality of farm soils. Improved high-yielding soyabean varieties have been disseminated, with many offering some resistance to crop diseases. Most require inoculation with rhizobial soil bacteria to achieve high levels of nitrogen fixation and yield, so both government agencies and private agricultural input firms supply inoculum. However, given the added complexity of inoculation in soyabean production, providing soyabean farmers with the information they require to successfully produce the crop is critical.



Annual production and yield levels for these crops in recent years are shown in Table 1.

Table 1: National production and yields of maize, groundnut, and soyabean in Malawi, annual average for 2013/14 to 2019/20

	Maize	Local maize	Improved maize	Groundnut	Soyabean
Production, mt	3,205,000	260,000	2,945,000	340,000	140,000
Yields, kg/ha	1,870	680	2,220	920	1,040
Potential yields, kg/ha	7,000	3,000	7,000	2,500	4,000

Source: Production and actual yields based on analysis of annual data from Agricultural Production Estimates System, Ministry of Agriculture. Potential yields from MoAFS (2012). 'Improved maize' includes both open pollinated varieties (OPVs) and hybrids.

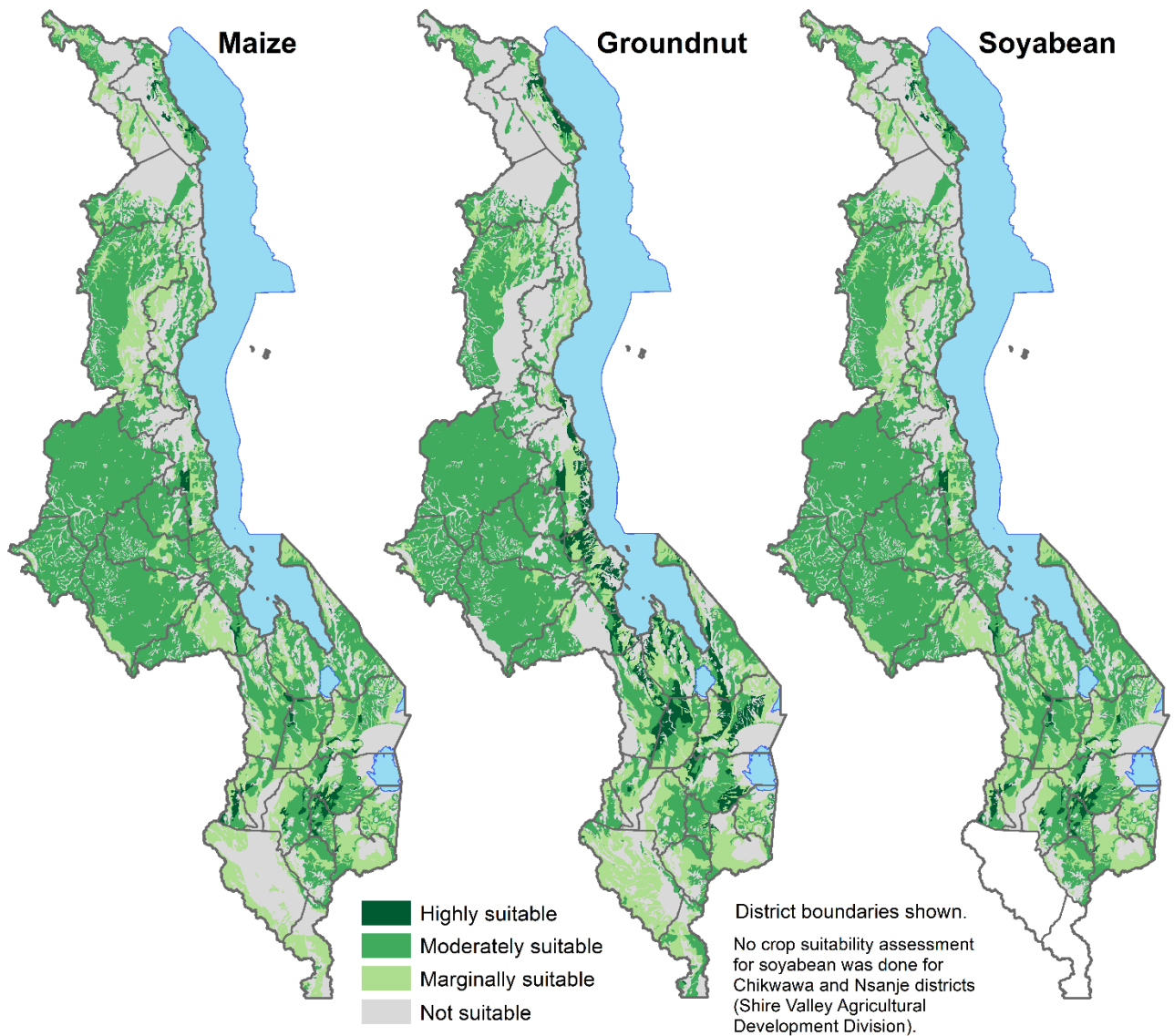
Figure 1 shows crop-specific suitability maps for maize, groundnut, and soyabean production across Malawi.¹ Generally we find that these crops are relatively well suited across the country. The areas around Lake Chilwa and in the Lower Shire Valley that are subject to flooding and the Rift Valley escarpments in the transition zones from the mid-altitude plateau areas to the lakeshore are the principal areas where none of the crops are likely to do well. Most areas of the mid-altitude plateau are well suited for the production of the three crops. For some parts of the lakeshore (and Upper Shire Valley), groundnut is highly suitable, while in other lakeshore areas groundnut production is expected to be quite marginal. Based on the agro-ecological averages used in the suitability analysis, the lakeshore is judged in general to be moderately suited for maize and soyabean production, with some areas found to be better suited.

¹ These maps were developed from output from the Land Resources Evaluation Project (LREP), which ran from 1988 to 1992. LREP was a joint government of Malawi, United Nations Development Programme (UNDP), and Food and Agriculture Organization (FAO) project that involved a close reconnaissance of the agro-ecological resources of Malawi. Extensive field work was done to map the soils across the country at the relatively detailed scale of 1:250,000 (1 cm = 2.5 km). Weather data was analyzed to generate averages for various indicators for use in mapping the agro-climatological zones of Malawi at the same geographic scale.

The soils and agroclimate maps developed were then overlaid to develop a 'land unit' map for Malawi. Each land unit is defined by a unique combination of relatively homogeneous soil and climate properties within its boundaries. These land units were then used with information on the optimal soil and climate conditions for growing a range of rainfed agricultural crops, as well as irrigated rice and tree species, to undertake a spatial suitability analysis for the production of each in each land unit.

For detail on LREP and the crop suitability maps produced by the project, see Benson, Mabiso, and Nankhuni (2016):

Figure 1: Suitability maps for production of maize, groundnut, and soyabean in Malawi under improved traditional management



Source: Benson, Mabiso, and Nankhuni (2016).

Based on recent spatially disaggregated production data from the Agricultural Production Estimates System of the Ministry of Agriculture and Food Security, actual patterns of production and productivity for these crops can be sketched.

- ▶ Maize is grown in all districts of the country, but the most intense production is found in the mid-altitude plateau. Highest average yields of maize are found in districts in the Lilongwe-Kasungu plain of the Central region, the upland districts in the Northern region, and in parts of the Shire Highlands of the Southern region. Maize productivity levels on the lakeshore plain and the Lower Shire Valley are lower. Nonetheless, significant amounts of maize are still produced in these agro-ecologies. Even in the Lower Shire Valley, where maize production is riskier than elsewhere due to more common droughts and floods, among all rainfed crops, annual production of maize is the largest. Significant amounts of irrigated maize are also produced there.

- ▶ The districts central to production of groundnut in Malawi overlap many of those that are dominant for maize production – the districts in the mid-altitude plateau of the Central and Northern regions running from Mzimba south to Ntcheu. Groundnut is also commonly produced in other upland districts elsewhere, as well as some along the southern lakeshore. The crop is not commonly grown in either the Upper or Lower Shire Valley.
- ▶ Soyabean production is more spatially concentrated than groundnut production. The government’s crop estimates indicate that more than 85 percent of all soyabean produced in Malawi is grown in the mid-altitude plateau between Mzimba district in the north and Dedza in the south.

Given the general agro-ecological suitability of most land in Malawi for production of maize, groundnut, and soyabean, the principal spatial constraints to smallholder farmers engaging in their commercial production are more likely to be linked to the costs producers would face in order to profitably sell their crops. However, the results of the crop suitability analyses mapped in Figure 1 may also fail to accurately reflect all of the production constraints that farmers face in growing these crops. This is particularly likely to be the case for farmers farming along the lakeshore and in the Shire Valley who face greater risks related to drought and floods in the production of these crops than is evident in the results of the spatial crop suitability analysis.

WHICH HOUSEHOLDS PRODUCE MAIZE, GROUNDNUT, AND SOYABEAN IN MALAWI?

Analysis of the nationally representative IHS5 survey data from 2019/20 shows that 92 percent of all farming households in Malawi produce maize, 27 percent produce groundnut, and 16 percent produce soyabean (Table 2). For those that grow, the area that farmers devote to each crop is 0.7 hectares for maize and about a hectare each for groundnut and soyabean. With the average cropland holding of farming households estimated at 0.69 hectares from the IHS5, it is clear that production of groundnut and soyabean is more likely to be done by those with larger land holdings. Households with smaller land holdings, while likely to allocate much of it to maize, are less likely to produce groundnut and soyabean on their limited farmland.

Table 2: Production of maize, groundnut, and soyabean by households that produce any crops, 2019/20

	Maize (all)	Local maize	Improved maize	Groundnut	Soyabean
Produce [crop], % of households engaged in crop agriculture	92.3	53.2	45.4	26.8	15.6
Change since 2016/17, percentage point	+1.1	+10.0	-4.8	+11.9	+5.8
If produce [crop], average cropped area under [crop], ha	0.72	0.66	0.81	0.98	1.11
Sold [crop], % of [crop] producers	21.1	15.3	24.8	57.5	82.9
Change since 2016/17, percentage point	+5.1	+3.9	+6.1	+0.3	+0.7
If sold any [crop], share of [crop] harvest sold, %	32.3	29.9	36.3	60.6	81.9
Change since 2016/17, percentage point	-2.3	-2.7	-1.5	+1.5	+3.9
If sold any [crop], sold more than half of crop, % of [crop] sellers	20.3	15.4	24.0	67.4	91.4
Change since 2016/17, percentage point	-2.8	-5.1	-1.3	+0.4	+1.5

Source: Author’s weighted analysis of 2019/20 (IHS5) and 2016/17 (IHS4) Malawi Integrated Household Surveys.

Note: Observations of survey sample households that engage in crop agriculture: IHS5: 8,943; IHS4: 9,716.

Maize is primarily grown for own consumption, while groundnut is grown both for household use and for sale. Only 21 percent of maize producers sell any of their maize harvest, whereas around 57 percent of groundnut farmers do so. Moreover, if a farmer sells part of their groundnut crop, they report selling a substantial share of about 60 percent. Of maize producers who sell some of their harvest, the average share of their harvest sold is about one-third. Only one-fifth of maize sellers sell more than half of the maize they harvested.

In contrast, virtually all soyabean produced is sold. The patterns in the values presented in Table 2 that suggest that some soyabean produced is not sold almost certainly reflects IHS5 sample households that produced soyabean but had not yet sold their harvest at the time they were interviewed for the survey – there is little evidence in the IHS to indicate that households are retaining soyabean for their own use.

Trends in these patterns of production of these crops for own use or for sale did not change much between the IHS4 of 2016/17 and the IHS5 of 2019/20. The most notable changes seen in Table 2 are that there has been an increase in the share of maize producers selling some of their crop (but the share of their maize harvest that they sell dropped slightly), and a more substantial increase in the shares of farming household producing groundnut or soyabean.²

Table 2 does not provide insights into the household characteristics and contextual factors that are driving the engagement of households in the production and possible sale of maize, groundnut and soyabean. To explore these factors, we undertake three crop-specific logistic regression analyses:

- ▶ Using the IHS5 sample of all crop-producing households, we first examine factors that are associated with a farming household producing maize, groundnut, or soyabean, respectively.
- ▶ We then examine for the sub-samples of all maize producing households and all groundnut producing households in the IHS5, factors that are associated with selling some of their production of those crops.

We do not conduct this analysis for soyabean, as it is exclusively produced for sale. We assume that the decision by a farming household to produce soyabean is primarily driven by commercial consideration, since own consumption is generally not an option for soyabean.

- ▶ Finally, for the sub-samples of households in the IHS5 that sold some of their maize and for those that sold some of their groundnut, we analyze the factors associated with those that sold more than half of their production of these crops, respectively.

The dependent variables for all of these analyses are dummy (0/1) variables, for which logistic regression analysis is appropriate. We report our logistic regression results as odds-ratios.³

We use the same explanatory variables in all three models.⁴ Most of these also are dummy (0/1) variables.

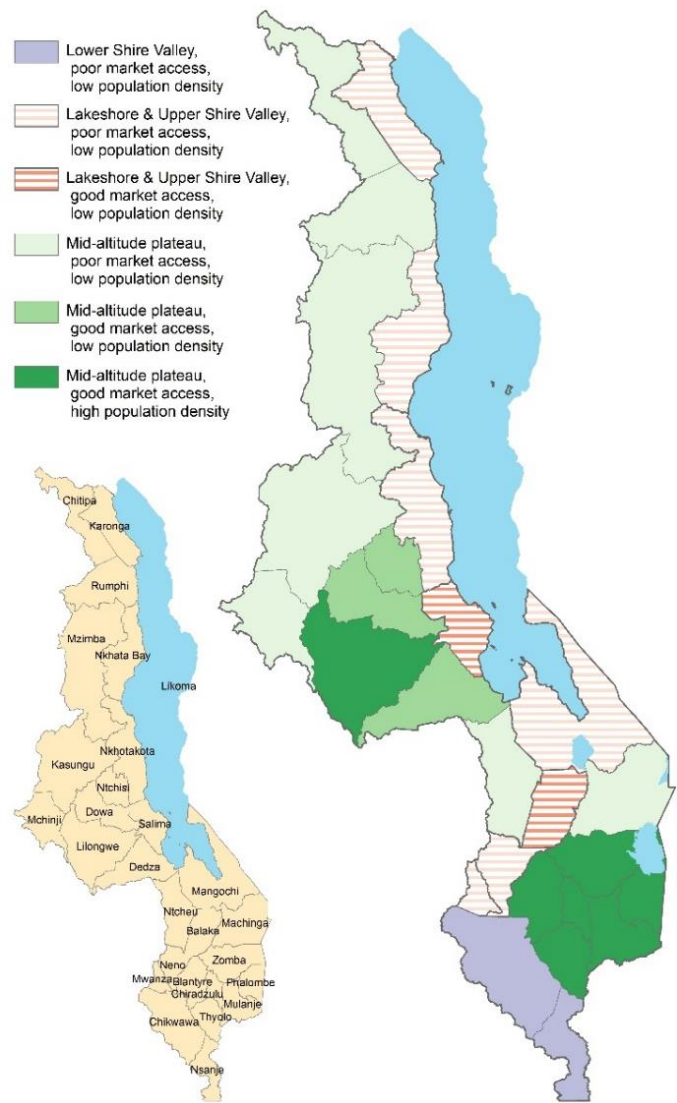
² We see in Table 2 that the share of farming households producing local maize rose between 2016/17 and 2019/20, while the share producing improved maize fell. This likely reflects the reduction in the number of farming households benefiting from the Malawi Farm Input Subsidy Program in 2019/20 relative to 2016/17, which reduced access to hybrid maize seed for many.

³ The odds-ratio is the chance of the dependent variable changing from 0 to 1 as a result of a one-unit positive change in the explanatory variable. A statistically insignificant odds-ratio is one – that is, a one-to-one or even chance. Odds-ratios less than one indicate an inverse relationship between the independent and dependent variables, while those greater than one suggest a direct relationship.

⁴ An exception is that a variable on the use of improved maize seed is included in the analyses of maize sales.

- ▶ **Household demographic characteristics** – household size, share of household members that are workers, whether the head is a woman, and the age of the head (less than 35 years, 35 to 64 years (base category), and 65 years or older).
- ▶ **Maximum educational attainment within the household** – no education, some primary education (base category), and secondary level or higher.
- ▶ **Agricultural production characteristics** – total cropped area for household, whether household hired-in labor, whether household hired-out any of its labor (*ganyu*), amount of livestock owned, and use of improved maize seed (only in the analyses of maize sales).
- ▶ **Non-farm livelihoods, credit** – household member has wage employment, household has a non-farm economic enterprise, and member received a loan of any sort in past year.
- ▶ **Relative dependence on market for consumption** – share of maize reported consumed by the household in the week prior that was purchased.
- ▶ **Agricultural development domains** – All districts of Malawi have been assigned to one of six domains that reflect variation in agricultural commercialization potential

Figure 2: Malawi – Agricultural development domains by district



Source: Benson, Mabiso, and Nankhuni (2016).

across Malawi as defined by agro-ecological conditions, market access, and population density (Figure 2).⁵

Descriptive statistics for these explanatory variables are presented in Table 3 for all farming households in the IHS5 sample.

The results of the three logistic analyses for maize are presented in Figure 3 as plots of the odds-ratio for each explanatory variable together with their 95 percent confidence intervals. Those explanatory variables for which the plot of the confidence interval of the odds-ratio does not cross the 1.0 odd-ratio line are statistically significant (at the 5 percent level) factors associated with a household engaging in maize production, making some sales of the maize they produce, or, if they sold any of their maize, selling more than 50 percent of their production, respectively.

The results for the three logistic analyses for groundnut are presented in Figure 4, and the single analysis on production of soyabean is presented in Figure 5.

⁵ The development domains are defined at district-level based on the intersection of three agro-ecological zones – Lower Shire Valley (less than 250 m elevation), Lakeshore (and upper and middle Shire Valley – 250 to 650 m elevation), and Mid-altitude plateau (and highlands – above 650 m elevation); two levels of market access (median travel time to one of the four major urban centers of Malawi of less than or more than two hours); and two levels of population density (district median less than or more than 250 persons per sq. km.). See Benson, Mabiso, & Nankhuni (2016).

While the full combination of the three factors theoretically would allow for 12 (3x2x2) types of development domains, Malawi has only six.

Table 3: Potential factors driving production and sales of maize, groundnut, and soyabean by farming households, 2019/20, descriptive statistics

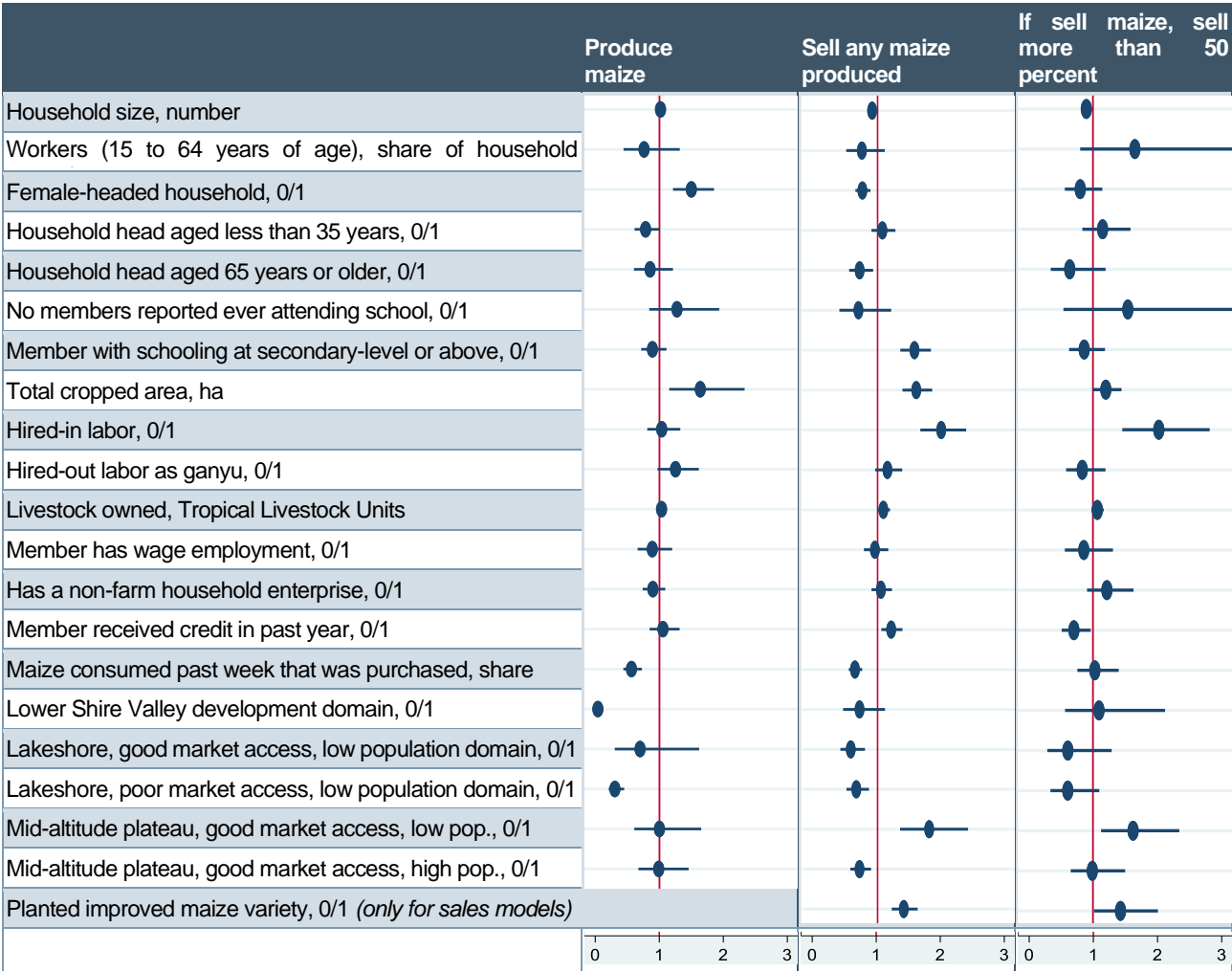
Type of variable	Variable	Mean	Standard error
Demographic	Household size, number	4.55	0.028
	Workers (15 to 64 years of age), share of household members	0.518	0.0033
	Female-headed household, 0/1	0.328	0.0066
	Household head aged less than 35 years, 0/1	0.319	0.0058
	Household head aged 35 to 64 years, 0/1 [base]	0.534	0.0062
	Household head aged 65 years or older, 0/1	0.147	0.0046
Education	No members reported ever attending school, 0/1	0.033	0.0026
	Member with some primary schooling, 0/1 [base]	0.612	0.0077
	Member with schooling at secondary-level or above, 0/1	0.355	0.0081
Agriculture	Total cropped area, ha	0.691	0.0128
	Hired-in labor, 0/1	0.210	0.0059
	Hired-out labor as ganyu, 0/1	0.745	0.0069
	Livestock owned, Tropical Livestock Units	0.285	0.0135
	Planted improved maize variety, 0/1	0.454	0.0087
Non-farm	Member has wage employment, 0/1	0.142	0.0060
	Has a non-farm household enterprise, 0/1	0.359	0.0083
	Member received credit (of any sort) in past year, 0/1	0.304	0.0068
Market dependence	Maize consumed in past week that was purchased, share	0.467	0.0135
Development	Lower Shire Valley development domain, 0/1	0.050	0.0027
	Lakeshore, good market access, low population domain, 0/1	0.054	0.0039
	Lakeshore, poor market access, low population domain, 0/1	0.134	0.0050
	Mid-altitude plateau with poor market access, low population density, 0/1	0.125	0.0065
	Mid-altitude plateau, good market access, low pop., 0/1	0.363	0.0081
	Mid-altitude plateau, good market access, high pop., 0/1	0.274	0.0082

Source: Analysis of IHS5. Observations: 8,943 farming households.

Note: Tropical Livestock Unit = sum of livestock owned by household assigning a value of 0.8 for an ox or bull; 0.7 for any other adult head of cattle; 0.3 per calf; 0.6 per donkey; 0.2 per pig; 0.1 per goat or sheep; and 0.01 per bird of any poultry type, rabbit, or guinea pig.

We see in Figure 3 that only a few of the demographic characteristics considered are associated with maize production or sales. Female-headed households are significantly more likely than male-headed households to produce maize but are significantly less likely to sell the maize they produce. The strong subsistence and weak commercial orientation of female headed households likely is in part explained by persistent gender disparities in market participation and access to productive resources. Households with heads aged less than 35 years are associated with lower propensity to produce maize. This finding is important as it shows the need to further document the challenges that the youth face while engaging in agriculture. On the other hand, households with heads aged 65 and older, are significantly less like to sell any maize that they produce. Larger households also are less likely than smaller households to sell any of the maize they produce or to sell more than half of their maize harvest.

Figure 3: Household and contextual factors associated with all maize production and sales in 2019/20, results of logistic analysis, plots of odds-ratios with 95 percent confidence intervals



Source: Analysis of IHS5.

Notes: 'Produce maize: Observations: 8,943 households; pseudo-R²: 0.207. 'Sell any maize produced': Observations: 8,091; pseudo-R²: 0.107. 'If sell maize, sell more than 50 percent': Observations: 1,860; pseudo-R²: 0.075.

Base categorical variables: age of household head – "Household head aged 35 to 64 years, 0/1"; maximum educational attainment within the household – "Member with some primary schooling, 0/1"; agricultural development domain – "Mid-altitude plateau with poor market access and low population density, 0/1".

Households with a member with secondary education or above are significantly more likely to sell any of the maize they produce. Households with no members with higher levels of education are (weakly) less likely to sell their maize. We surmise that more education enables maize producing households to have a better understanding of the dynamics of the market and, so, more willing to sell some of their output.

Households with larger cropland holdings are more likely to produce maize, selling some of the maize produced, and selling more than half of their maize harvest. Larger landholding size is the most consistent driver of commercial maize production in our models. Furthermore, households that hired-in labor are more likely to sell some of the maize produced or more than half of the maize produced. That a household hires-in labor for their farming appears to be an indicator that the household is at least somewhat commercially oriented in their production. Finally, farmers who use improved maize seed are more likely to both sell some of their maize and to sell a large share of their harvest.

Non-farm income sources, whether from wages or a household enterprise, are not significantly associated with maize production and sales decisions. Whether a household received any credit does not affect maize production, but those that received credit are significantly more likely to sell some of their maize harvest but are unlikely to sell more than half.

Households with purchased maize making up a significant share of the maize they consume are significantly less likely to grow maize or to sell any maize they produced than are household that rely more heavily on other sources (own production or gifts) for their maize. Understandably, increased dependency on the market for maize consumption does not drive household to engage in commercial maize production.

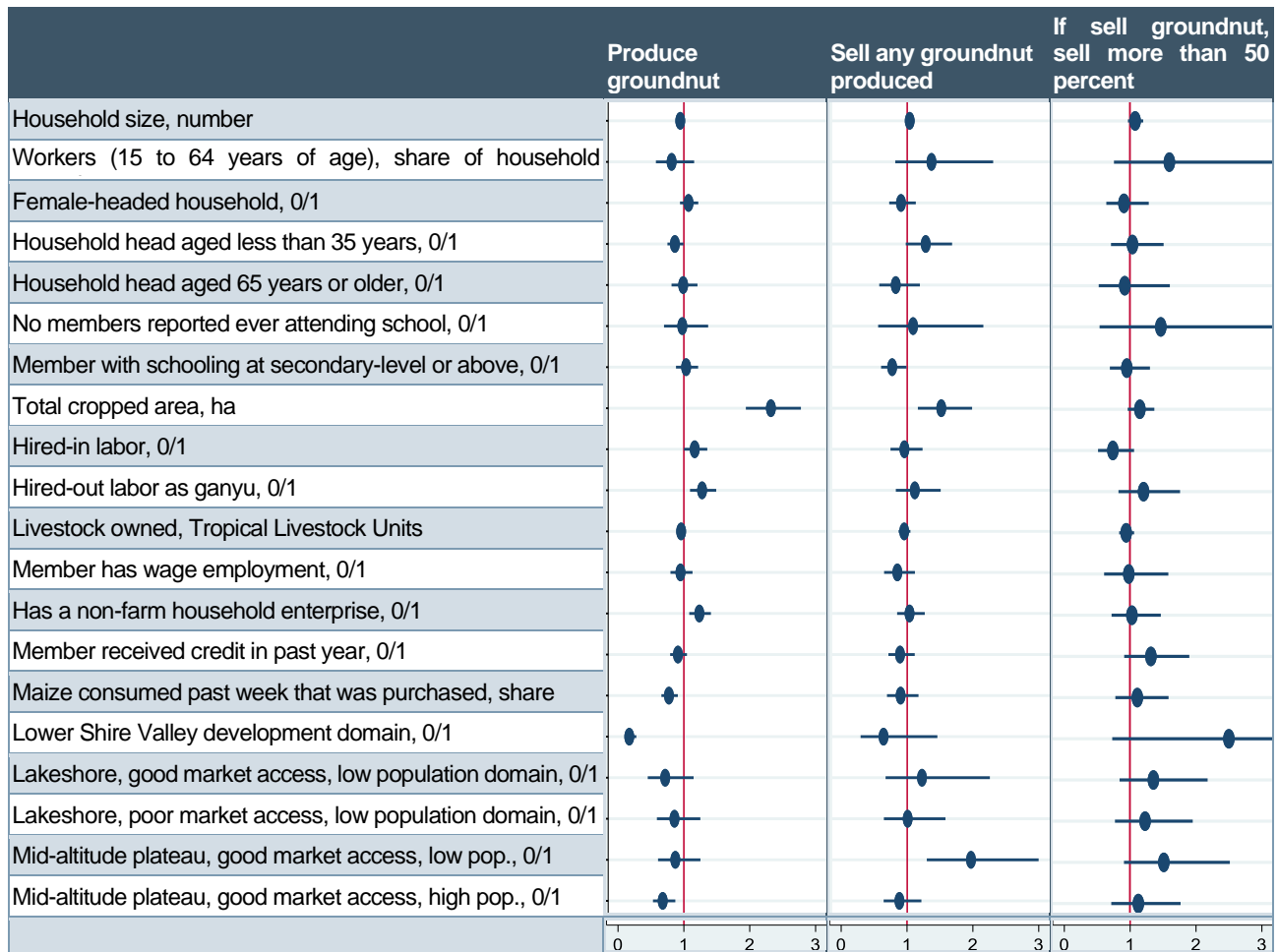
The model results for the six development domains suggest that agro-ecological, market access, and landholding factors are important both in determining where maize is produced and where it is produced for sale. Households in the Lower Shire Valley and along the lakeshore are either strongly or somewhat less likely to produce maize than households elsewhere. This confirms the patterns seen in Figure 1 and in the spatial assessment of production of the agricultural production estimates from the Ministry of Agriculture showing mid-altitude areas being best suited for maize. Relative to the base development domain of the mid-altitude plateau with poor market access and low population density, it is only farming households in the mid-altitude plateau with good market access and low population density that are significantly more likely to produce maize for sale and to sell a large share of their harvest. The better market linkages farming households in this domain have largely will account for their greater commercial orientation in maize production. Farming households in other zones are less likely to sell any of their maize production. This includes households in the mid-altitude plateau with good market access and high population density domain where we presume land pressures mean that crop land is more profitably used for other purposes than commercial maize production.

Turning to our results for groundnut in Figure 4, none of the household demographic characteristics are strongly associated with the production or the sale of groundnuts. However, household with younger heads are somewhat less likely to produce groundnuts than are other households but, if such households produce the crop, are more likely to sell part of their production than are other households, but not a large share. Educational attainment is not an important factor in groundnut production, although more educated producers are less likely to sell any of their harvest.

With regards to agricultural production characteristics, households with larger cropland holdings are significantly more likely to produce and sell groundnut. The strength of this relationship suggests that land constrained households are currently not able to engage in groundnut production, whether for own use or for sale. Households that rely on the market for much of the maize they consume, as with maize production, also are significantly less likely to produce groundnut.

Relative to those in the base development domain of the mid-altitude plateau with poor market access and low population density, households in the Lower Shire Valley and the mid-altitude with good access to markets and high population density domains are significantly less likely to engage in groundnut production. As with maize, it is only households in the mid-altitude plateau with good market access and low population density that are significantly more likely than households in the base domain to produce groundnut for sale and, if more weakly so, to sell a large share of their harvest.

Figure 4: Household and contextual factors associated with groundnut production and sales in 2019/20, results of logistic analysis, plots of odds-ratios with 95 percent confidence intervals



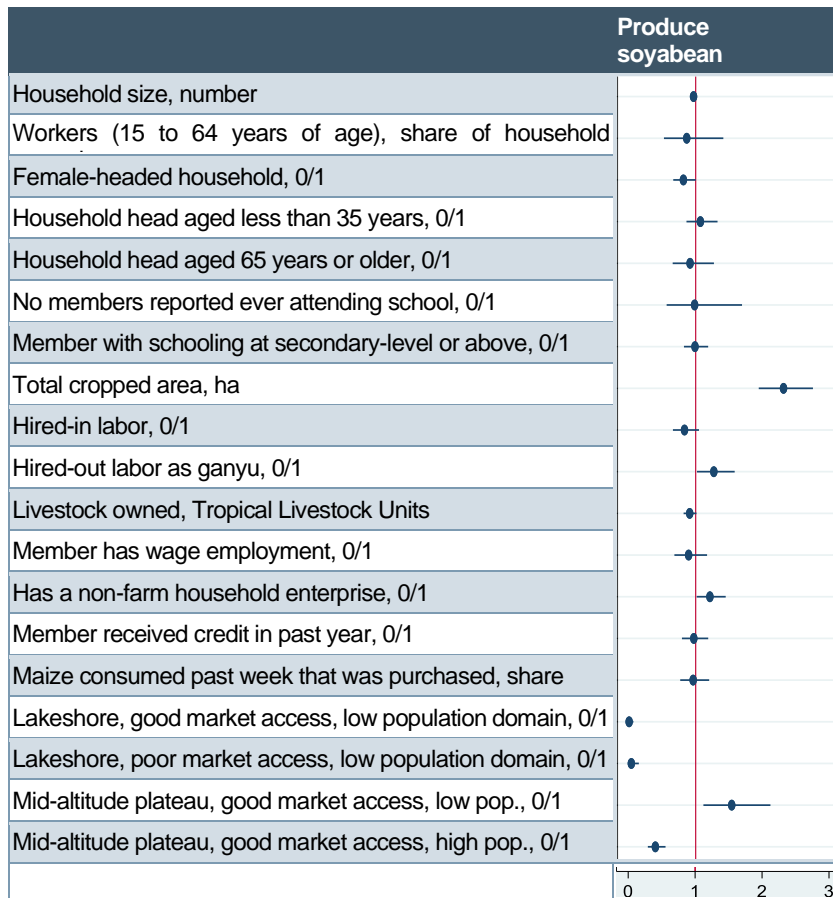
Source: Analysis of IHS5.

Notes: 'Produce groundnut': Observations: 8,943 households; pseudo-R²: 0.079. 'Sell any groundnut produced': Observations: 2,156; pseudo-R²: 0.039. 'If sell groundnut, sell more than 50 percent': Observations: 1,205; pseudo-R²: 0.021.

Base categorical variables: age of household head – "Household head aged 35 to 64 years, 0/1"; maximum educational attainment within the household – "Member with some primary schooling, 0/1"; agricultural development domain – "Mid-altitude plateau with poor market access and low population density, 0/1".

For soyabean (Figure 5), again, we assume that the decision by a farm household to produce soyabean is driven primarily by commercial objectives. However, few of the potential factors considered are shown to be associated with the decision by a household to produce soyabean. Only households with large cropland holdings and those in the mid-altitude plateau with good market access and low population density are significantly more likely than other households to produce soyabean. Households located along the lakeshore or in areas with higher population densities are unlikely to produce soyabean. Having sufficient cropland located within an agro-ecological zone well-suited for the production of soyabean enables such farm households to be reasonably confident of profitably producing the crop.

Figure 5: Household and contextual factors associated with soyabean production in 2019/20, results of logistic analysis, plots of odds-ratios with 95 percent confidence intervals



Source: Analysis of IHS5.

Notes: 'Produce soyabean: Observations: 8,368 households; pseudo-R²: 0.159.

Lower Shire Valley households dropped out of analysis, as no soyabean production recorded for any survey households in this development domain.

Base categorical variables: age of household head – “Household head aged 35 to 64 years, 0/1”; maximum educational attainment within the household – “Member with some primary schooling, 0/1”; agricultural development domain – “Mid-altitude plateau with poor market access and low population density, 0/1”.

ARE THE DRIVERS OF PRODUCTION AND COMMERCIALIZATION OF MAIZE, GROUNDNUT, AND SOYABEAN IN MALAWI CHANGING?

In order to determine whether the drivers of farming households engaging in the production and sale of maize and groundnut and the production of soyabean have changed in recent years, we conduct a Chow test-type analysis.

A Chow test assesses whether the model coefficients estimated using one set of data are equal to those estimated using another set. This involved combining the IHS4 data set of 2016/17 with the IHS5 data set of 2019/20 and conducting on the pooled data set analyses similar to the IHS5 models on production and sales presented in Figures 3 to 5. However, for the pooled data analysis we add to the models a survey round dummy variable (IHS5=1) and for each explanatory variable a second variable that is

interacted with the IHS5 survey round dummy variable. Statistically significant coefficients (here, odds ratios) on either the dummy variable or on the interacted explanatory variables would suggest that the drivers of farming households deciding to engage in the production and sale of the three crops has changed between 2016/17 and 2019/20.

Technically, a Chow test assesses whether the slopes and intercepts from the models derived from the two subsets of the data are the same. The null hypothesis is that the coefficients of the interacted parameters are independently equal to zero (or, in the case here of odds-ratios, 1.0). Rejection of this null hypothesis indicates that the two data subsets do not share the same slopes or intercepts and, hence, the parameters are changing.

Table 4: Assessment of factors driving any changes in production and sale of maize and groundnut and production of soyabean between 2016/17 (IHS4) and 2019/20 (IHS5) using a pooled dataset in a logistic analysis with survey round (IHS5=1) interactions for each explanatory variable, results presented as odds-ratios

Explanatory variable	(1a)		(1b)		(2a)		(2b)		(3a)		(3b)		(4a)		(4b)		(5a)		(5b)	
	MAIZE				GROUNDNUT				SOYABEAN											
	Produce		Sell produced		any Produce		Sell produced		any Produce		Sell produced		any Produce							
	Non-interacted variables	IHS5 interacted	Non-interacted variables	IHS5 interacted	Non-interacted variables	IHS5 interacted	Non-interacted variables	IHS5 interacted	Non-interacted variables	IHS5 interacted	Non-interacted variables	IHS5 interacted	Non-interacted variables	IHS5 interacted						
IHS5 survey round, 0/1	1.633	na	1.263	na	1.642	na	0.457	na	1.468	na										
Household size, number	1.037	0.980	0.907***	1.010	0.981	0.962	0.957	1.086	1.005	0.964										
Workers (age 15 to 64 years), share of members	0.652*	1.162	1.210	0.625*	0.920	0.880	1.129	1.224	0.852	1.023										
Female-headed household, 0/1	1.150	1.306*	0.780***	0.980	0.979	1.096	0.757*	1.191	0.773**	1.065										
Household head aged less than 35 years, 0/1	0.801**	0.977	1.141	0.942	0.733***	1.173	1.324	0.975	0.952	1.122										
Household head aged 65 years or older, 0/1	0.801	1.064	0.595***	1.212	1.195	0.828	0.605*	1.355	0.679**	1.353										
No members reported ever attending school, 0/1	0.942	1.354	0.795	0.885	0.907	1.076	0.758	1.441	0.841	1.171										
Member at secondary-level or above schooling 0/1	1.248*	0.713**	1.250***	1.256**	1.175*	0.881	0.591***	1.291	0.989	1.001										
Total cropped area, ha	1.581***	1.039	1.169***	1.368***	1.444***	1.633***	1.197	1.283	1.361***	1.664***										
Hired-in labor, 0/1	1.487**	0.697*	2.921***	0.680***	1.400***	0.835	1.532**	0.624**	1.238*	0.678**										
Hired-out labor as ganyu, 0/1	1.049	1.194	1.075	1.072	1.018	1.262**	1.175	0.953	1.272**	0.992										
Livestock owned, Tropical Livestock Units	0.978	1.057	1.069*	1.019	1.011	0.948	1.083	0.880	0.997	0.917										
Planted improved maize, 0/1			1.455***	0.966																
Member wage employment, 0/1	0.806	1.100	0.795*	1.205	0.856	1.107	0.653*	1.295	0.868	1.035										
Has a non-farm household enterprise, 0/1	0.870	1.031	0.893	1.178	1.225**	1.013	0.826	1.255	1.230*	0.979										
Member received credit, 0/1	1.039	1.015	1.465***	0.826	1.353***	0.671***	1.373**	0.646**	1.227*	0.793										
Maize consumed past week that was purchased, share	0.698***	0.802	0.653***	0.995	0.817**	0.939	0.756*	1.185	1.089	0.885										
Lower Shire Valley development domain, 0/1	0.061***	0.518*	0.771	0.935	0.133***	1.116	0.529	1.186	na	na										
Lakeshore, good market, low pop. domain, 0/1	0.835	0.833	0.524***	1.114	0.471***	1.506	1.008	1.222	0.042***	na										
Lakeshore, poor market, low pop. domain, 0/1	0.650*	0.461**	0.380***	1.762**	0.477***	1.790*	0.999	1.008	0.045***	1.634										
Mid-altitude plateau, good market, low pop., 0/1	1.196	0.836	1.797***	1.001	1.307	0.664	1.189	1.684	1.393*	1.090										
Mid-altitude plateau, good market, high pop., 0/1	1.120	0.882	0.736**	0.978	0.554***	1.210	0.995	0.882	0.495***	0.848										
Constant	14.50***	na	0.180***	na	0.198***	na	1.495	na	0.129***	na										
Observations and model performance	18,659 $F(41, 1364) = 12.79$ Prob > F = 0.0000		16,849 $F(43, 1351) = 22.51$ Prob > F = 0.0000		18,659 $F(41, 1364) = 10.49$ Prob > F = 0.0000		3,476 $F(41, 871) = 10.49$ Prob > F = 0.0000		16,790 $F(38, 1229) = 2.53$ Prob > F = 0.0000											

Source: Author's weighted analysis of 2019/20 (IHS5) and 2016/17 (IHS4) Malawi Integrated Household Surveys.

Note: Observations of survey sample households that engage in crop agriculture: IHS5: 8,943; IHS4: 9,716. na = "not applicable"; Asterisks indicate statistical significance: * = $p < 0.10$, ** = $p < 0.05$, *** = $p < 0.01$.

The results of five Chow test analyses are presented in Table 4 – for production and for sales of maize and of groundnut and for production of soyabean. To simplify the presentation, we do not include the results on sales of maize or groundnut of more than half of the harvest, which were presented in Figures 3 and 4. The results of each model are presented in two columns. The first column (columns labeled (#a) in Table 4) has the results of the non-interacted variables, including the IHS5 survey round dummy variable, while the second column (labeled (#b)) presents the results for all explanatory variables interacted with the IHS5 survey round dummy variable. Asterisks are used to indicate odds-ratios that statistically are significantly different from 1.0.

In assessing whether overall the drivers of farm households engaging in the production and commercialization of these crops have changed recently, the most important result in each model is that for the IHS5 survey round dummy variable. For all five models, this is statistically insignificant, suggesting that the drivers have generally remained stable between the IHS4 and IHS5 survey periods.

The other results presented of each model should be relatively similar to, but not exactly like those presented in Figures 3 to 5. The reason that they will not be exactly the same is that the analyses here add information from the IHS4 sample households to supplement that from the IHS5 sample households that was used in generating the analytical results presented in Figures 3 to 5. Comparisons between the results in the columns labeled (#a) in Table 4 and those in the Figures reveal quite similar, if not wholly consistent, patterns in terms of the nature of the relationship (odds-ratio greater than or less than 1.0) between the potential drivers and the dependent variable, although there are some changes in the significance levels of some potential drivers. These constant relationship patterns also suggest that the drivers have remained stable between the IHS4 and IHS5 rounds.

Examining the results of the variables interacted with the IHS5 survey round dummy, which are presented in the columns labeled (#b) in Table 4, some variables in some models show significant differences between the two survey rounds. For example, the propensity of female-headed households to engage in maize production further intensified between the two survey rounds. However, in general, the demographic drivers for production and sale of maize, groundnut, and soyabean did not change. With regards to education levels in households, those with members with secondary education or above are shown in the second survey to be significantly less likely to produce maize, but, if they do produce the crop, further significantly more likely to sell some of their harvest. The rationale for this pattern of decisions in such household merits additional study.

For agricultural production characteristics, the strength of the associations between land holding size and the likelihood to sell maize, to produce groundnut, or to produce soyabean intensified between the two surveys. This suggests that as land holdings become smaller with continuing population growth, production of groundnut and soyabean and production of maize specifically for market sale will increasingly be limited to those households with the largest land holdings. The other agricultural driver showing consistent changes among the models is the importance of hiring-in of labor, while still significantly associated with production and sale of crops, it significantly diminished between the two survey rounds, except for groundnut production.

Of the other household characteristics examined, given the intensification in the importance of landholding size to the production and sale of the three crops, it is somewhat surprising to find no changes in the relationship between non-farm income sources, whether wage employment or household enterprises, and the dependent variables. One could assume that households increasingly will rely on

such livelihoods if they are unable to reliably engage in the production or sale of maize, groundnut, or soyabean to meet their dietary or income needs. However, we see no changes in the nature of the relationship between these factors and the dependent variables across all five models.

There are only a few changes seen in the strength of the associations between the dependent variables and the development domains. In general, agro-ecological, market access, and landholding factors guide decisions by farming households to engage in the production and sale of the three crops in 2019/20 as they did in 2016/17.

In summary, as is most evident in the Chow test analyses in the statistically insignificant coefficients for the IHS5 survey round dummy variables, beyond an increasing significance of landholding size constraints on commercial production, we find that the drivers of farming households in Malawi choosing to produce or sell maize or groundnut or to produce soyabean have not changed much in recent years. Motivating increased commercial crop production by smallholder farming households remains a challenge for both agricultural and rural economic development in Malawi.

INSIGHTS FOR STRENGTHENING VALUE CHAINS FOR MAIZE, GROUNDNUT, AND SOYABEAN IN MALAWI

This analysis suggests that increasing the production of maize, groundnut, and soyabean for sale by farming households in Malawi is linked to their landholding size – those with larger holdings are more likely to produce surpluses of maize and groundnut above household requirements or to grow soyabean. With the rural population of Malawi continuing to grow at over 2.5 percent per year, the average landholding will continue to get smaller. If increased commercialization of smallholder agricultural production is viewed as an important pathway to rural economic development in Malawi, it is likely farming households with larger landholdings, particularly in the mid-altitude plateau zones of the country, will be best positioned to serve as the engine of such economic development.

Agricultural commercialization efforts should target such farming households to improve their productivity and enhance the profitability of their farming. As their productivity increases, their farm production expands, and their incomes increase, they will demand more of the labor-intensive and generally non-marketable (outside of the local area) goods and services produced by their neighbors with smaller landholdings who are unable to successfully engage in commercial agricultural production while still meeting the food needs of their own households. This consumption linkage diffuses many of the economic gains these more commercial larger smallholders make from their more productive commercial farming to those other rural households, deepening local markets, accelerating local economic activities, and improving access to food for all in these communities.

We also consistently see that female-headed households are not engaged in commercial production of the three crops. Many households headed by women are likely to have insufficient land or labor to do so. However, efforts should be directed to female-headed households with sufficient land to build their knowledge base on how to productively and profitably grow these crops and to strengthen their market engagements so that they include commercial production of these crops among the livelihood strategies they pursue.

A somewhat unexpected finding from the crop-specific analyses was that education levels within the household is not a strong driver of either the choice to produce a crop or to sell a crop if produced. Although the IHS5 showed households with members with higher education are more likely to engage in the sale of their maize, households with no well-educated members are just as likely as those with such

members to produce the three crops. Consistently achieving higher levels of maize, groundnut, and soyabean productivity with improved technologies and obtaining greater commercial returns on that production in Malawi's markets should be expected to be a knowledge-intensive endeavor. That returns to household investments in education in agricultural production or marketing are not apparent in the analyses here suggests the production and profitability levels for most smallholder farming households in Malawi are likely far below their potential. Ensuring that agricultural extension systems, whether public or private, are effective in providing the knowledge needed to achieve higher production and profitability levels must be a policy priority in Malawi.

There are several directions that further research on the drivers of agricultural production and agricultural commercialization by farming households in Malawi could take. We note that the analyses here, based primarily on dummy variables, provides a basic first-cut analysis of these drivers. Increased use of continuous variables as both dependent and explanatory variables may well provide insights that cannot be obtained from the simpler analyses here. Secondly, the spatial constraints to production of the crops could be refined beyond the suitability analyses shown in Figure 1, which primarily are based on average climatic conditions. More attention to variability in rainfall and risks to production associated with that variability would provide analysts with a better understanding of the rationale of farming households in deciding whether or not to grow a crop and, if so, whether it makes any sense to produce a surplus for market sale.

ABOUT THE AUTHORS

Aubrey Jolex is a Research Analyst with the Malawi Strategy Support Program in the Development Strategy and Governance Division (DSGD) of the International Food Policy Research Institute (IFPRI), based in Lilongwe, Malawi.

Todd Benson is a Senior Research Fellow in DSGD of IFPRI, based in Washington, DC.

ACKNOWLEDGMENTS

Financial support for this study was provided by the Government of Flanders under the research project implemented by IFPRI-Lilongwe entitled "Enhancing the performance and inclusiveness of agricultural extension, markets, and cooperatives in Malawi". Additional funding was provided by the CGIAR Research Program on Policies, Institutions, and Markets. We are grateful to both institutions for their support.

REFERENCES

- Alene, A.D., V.M. Manyong, G. Omanyua, H.D. Mignouna, M. Bokanga, and G. Odhiambo. 2008. "Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya." *Food Policy*, 33 (4): 318-328.
- Arslan, A., and J.E. Taylor. 2009. "Farmers' subjective valuation of subsistence crops: The case of traditional maize in Mexico." *American Journal of Agricultural Economics*, 91 (4): 956-972.
- Awotide, B.A., A.A. Karimov, and A. Diagne. 2016. "Agricultural technology adoption, commercialization and smallholder rice farmers' welfare in rural Nigeria." *Agricultural and Food Economics*, 4 (3).
- Barrett, C. 2007. "Smallholder market participation: Concepts and evidence from eastern and southern Africa," *Food Policy*, 33 (4): 299-317.
- Benson, T., A. Mabiso, and F. Nankhuni. 2016. *Detailed crop suitability maps and an agricultural zonation scheme for Malawi: Spatial information for agricultural planning purposes*. Feed the Future Innovation Lab for Food Security Policy Research Paper 17. East Lansing, MI and Washington, DC, USA: Michigan State University and International Food Policy Research Institute.
- Boka, G.T. 2017. *Climate change challenges, smallholders' commercialization, and progress out of poverty in Ethiopia*. Africa Development Bank (AfDB) Working Paper Series no. 253. Abidjan: AfDB.
- Cunningham III, L.T., B.W. Brorsen, K.B. Anderson, and E. Tostão. 2008. "Gender differences in marketing styles." *Agricultural Economics*, 38 (1): 1-7.
- Devaux, A., D. Horton, C. Velasco, G. Thiele, G. López, T. Bernet, and M. Ordinola. 2009. "Collective action for market chain innovation in the Andes." *Food Policy*, 34 (1): 31-38.
- Fan, S., J. Brzeska, M. Keyzer, and A. Halsema. 2013. *From subsistence to profit: Transforming smallholder farms*. Food Policy Report 26. Washington, DC: International Food Policy Research Institute (IFPRI).
- Fischer, E., and M. Qaim. 2012. "Linking smallholders to markets: Determinants and impacts of farmer collective action in Kenya." *World Development*, 40 (6): 1255-1268.
- Fredriksson, L., A. Bailey, S. Davidova, M. Gorton, and D. Traikova. 2016. "Pathways to commercialization of semi-subsistence farms: Lessons learnt from rural transformation in central and eastern European countries." In *Proceedings of the Workshop "Rural transformation, agricultural and food system transition: Building the evidence base for policies that promote sustainable development, food and nutrition security and poverty reduction"*. Rome: FAO.
- Gabre-Madhin, E.Z. 2001. *Market institutions, transaction costs, and social capital in the Ethiopian grain market*. IFPRI Research Report 124. Washington D.C.: International Food Policy Research Institute.
- Gebremedhin, B., and A. Tegegne. 2012. "Market orientation and market participation of smallholders in Ethiopia: Implications for commercial transformation." Paper presented at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August 2012.
- Gutu, T., B. Emanu, and M. Ketema. 2012. "Analysis of vulnerability and resilience to climate change induced shocks in North Shewa, Ethiopia." *Agricultural Sciences*, 3 (6): 871-888.
- Haggblade, S., P.B.R. Hazell, and T.A. Reardon. 2007. *Transforming the Rural Nonfarm Economy: Opportunities and Threats in the Developing World*. Baltimore: Johns Hopkins University Press.
- Hill, R.V., and M. Vigneri. 2014. "Mainstreaming gender sensitivity in cash crop market supply chains." In: A. Quisumbing, R. Meinzen-Dick, T. Raney, A. Croppenstedt, J. Behrman, and A. Peterman, eds. *Gender in Agriculture*. Dordrecht: Springer. 315-341.
- Kahan, D. 2013. *Market-oriented farming: An overview*. Farm Management Extension Guide 1. Rome: Food and Agriculture Organization of the United Nations.
- Lerman, Z. 2004. "Policies and institutions for commercialization of subsistence farms in transition countries." *Journal of Asian Economics*, 15 (1): 461-479.
- Mathijs, E., and N. Noev. 2002. "Commercialization and subsistence in transition agriculture: Empirical evidence from Albania, Bulgaria, Hungary and Romania." Paper presented at the tenth EAAE conference, Exploring Diversity in the European Agri-Food System, Zaragoza, Spain, 28-31 August 2002.
- Mellor, J.W. 2017. *Agricultural Development and Economic Transformation: Promoting Growth with Poverty Reduction*. Cham, Switzerland: Palgrave Macmillan.
- Ministry of Agriculture and Food Security (MoAFS). 2012. *Guide to Agricultural Production and Natural Resources Management in Malawi*. Revised. Lilongwe: MoAFS
- Minot, N., M. Epprecht, T.T.T. Anh, and L.Q. Trung. 2006. *Income diversification and poverty in the northern uplands of Vietnam*: IFPRI Research Report 145. Washington, DC: International Food Policy Research Institute.
- Muyanga, M., and T.S. Jayne. 2019. "Changing farm structure in Africa." In R.A. Sikora, E.R. Terry, P.L.G. Vlek, and J. Chitja, eds. *Transforming Agriculture in Southern Africa: Constraints, Technologies, Policies and Processes*. London: Routledge. 32.
- Olwande, J., M. Smale, M.K. Mathenge, F. Place, and D. Mithöfer. 2015. "Agricultural marketing by smallholders in Kenya: A comparison of maize, kale and dairy." *Food Policy*, 52 (1): 22-32.
- Omiti, J.M., D.J. Otieno, T.O. Nyanamba, and E.B. McCullough. 2009. "Factors influencing the intensity of market participation by smallholder farmers: A case study of rural and peri-urban areas of Kenya." *African Journal of Agricultural and Resource Economics*, 3 (1): 57-82.
- Onyutha, C. 2018. "African crop production trends are insufficient to guarantee food security in the sub-Saharan region by 2050 owing to persistent poverty." *Food Security*, 10 (5): 1203-1219.

- Papaioannou, K.J., and M. de Haas. 2017. "Weather shocks and agricultural commercialization in colonial tropical Africa: Did cash crops alleviate social distress?" *World Development*, 94 (1): 346-365.
- Pender, J., and D. Alemu. 2007. *Determinants of smallholder commercialization of food crops: Theory and evidence from Ethiopia*. IFPRI Discussion Paper no. 745. Washington, DC: International Food Policy Research Institute.
- Ricciardi, V., N. Ramankutty, Z. Mehrabi, L. Jarvis, and B. Chookolingo. 2018. "How much of the world's food do smallholders produce?" *Global Food Security*, 17 (1): 64-72.
- Ricketts, K., C. Turvey, and M. Gomez. 2014. "Value chain approaches to development: Smallholder farmer perceptions of risk and benefits across three cocoa chains in Ghana." *Journal of Agribusiness in Developing and Emerging Economies*, 4(1): 2-22.
- Sadoulet, E., and A. de Janvry. 1995. *Quantitative Development Policy Analysis*. Baltimore: Johns Hopkins University Press.
- Stoian, D., J. Donovan, J. Fisk, and M.F. Muldoon. 2012. "Value chain development for rural poverty reduction: A reality check and a warning." *Enterprise Development and Microfinance Journal*, 23 (1): 54.
- van Loon, J., L. Woltering, T.J. Krupnik, F. Baudron, M. Boa, and B. Govaerts. 2020. "Scaling agricultural mechanization services in smallholder farming systems: Case studies from sub-Saharan Africa, south Asia, and Latin America." *Agricultural Systems*, 180.

The Malawi Strategy Support Program (MaSSP) is managed by the International Food Policy Research Institute (IFPRI) and is financially supported by USAID, FCDO and the Government of Flanders. This publication has been prepared as an output of MaSSP and has not been independently peer reviewed. Any opinions expressed here belong to the author and are not necessarily representative of or endorsed by IFPRI, CGIAR, the United States Government, the UK Government, or the Government of Flanders.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

A world free of hunger and malnutrition

IFPRI is a CGIAR Research Center

IFPRI Malawi, Area 14 Office, Plot 14/205, Lilongwe, Malawi | Mailing Address: PO Box 31666, Lilongwe 3, Malawi

T +265-1-771-780 | Email: IFPRI-Lilongwe@cgiar.org | <http://massp.ifpri.info>

© 2021, copyright remains with the author(s). All rights reserved.