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Agricultural Policy Research in Africa

EFFECTS OF COMMERCIALISATION ON SEASONAL HUNGER: EVIDENCE FROM SMALLHOLDER RESETTLEMENT AREAS, MAZOWE DISTRICT, ZIMBABWE

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ACRONYMS

A1	a category of smallholder farming introduced in Zimbabwe following the post 2000 Land Reforms
AME	adult male equivalent
APRA	Agricultural Policy Research in Africa
FAO	Food and Agriculture Organization of the United Nations
HCI	household commercialisation index
IDS	Institute of Development Studies
IMR	inverse Mill's ratios
LPM	linear probability model
LSCF	large-scale commercial farms
ME	marginal effect
SSA	sub-Saharan Africa
SD	standard deviation

EXECUTIVE SUMMARY

Agricultural transformation towards intensive commercial production is a key facet of the current development strategies pursued by African governments, aimed at improving welfare outcomes of farm households, such as food security and poverty. However, there is concern that increased commercialisation, especially through tobacco production, may have resulted in increased food and nutrition insecurity in the smallholder farming sector. This study examined the impacts of cash crop and food-based commercialisation pathways on seasonal food insecurity in rural households of Mazowe district, a hotspot of commercialisation.

This paper took advantage of data from two rounds of surveys conducted in 2018 and 2020 of smallholder farmers settled post the 2000 Zimbabwe Land Reform Programme. Utilising the panel nature of the data, the results from the study show that commercialisation reduces the likelihood of falling into lean season hunger from November to May, and more importantly, the impact is greater for households that are asset-poor. Results also reveal that tobacco and food commercialisation significantly reduce the likelihood of falling into lean season hunger, but soyabean commercialisation does not show significant effect on lean season hunger. Further, the results show tobacco commercialisation has a significantly higher effect on lean season hunger mitigation than food commercialisation, as well as other lean season mitigatory measures such as growth in household enterprises, regular off-farm income or remittances. Descriptive results point to timing of tobacco sales during the peak of the lean season as a key factor in its effectiveness to counter seasonal hunger. Findings in this study are in line with literature and anecdotal evidence that highlight the importance of participating in food and cash crop markets for reducing hunger, and improving food security at the household level.

National development strategies that aim to improve food security and reduce hunger at the household level should focus on improving the efficiency of staple food markets to incentivise cash crop commercialisation of smallholder agriculture. Further, strategies for improving food and cash crop marketing should be targeted at improving smallholder farmers' access to markets.

1 INTRODUCTION

There is broad agreement that most African countries cannot 'significantly reduce poverty, increase per capita incomes, and transform into modern economies without focusing on agricultural development' (Diao et al., 2007). Most agricultural production in sub-Saharan Africa (SSA) is undertaken by smallholder farmers, a significant number of whom practice low intensity semi-commercial agriculture. Cash crop farming geared towards sale for further processing and value addition rather than household consumption of agricultural products, is widely regarded as the central thrust of such an agricultural revolution (von Braun and Kennedy, 1986; Maxwell and Fernando, 1989; FAO, 2014). However, the smallholder farmers in SSA that are expected to lead this agricultural revolution constitute the majority of the most food-insecure and undernourished in the sub-continent and the numbers of these smallholder farmers have actually been increasing (Foley et al., 2011). Hence, policy interventions to transform agriculture through commercialisation must be accompanied by measures to also improve the food and nutrition security of farmers.

Agricultural transformation towards intensive commercial production is a key facet of the current Zimbabwe national economic development plan – the National Development Strategy: 2020-2025. Under the strategy, agriculture plays a key role in generating foreign currency from exports of industrial crops such as cotton, sugar and tobacco as well as horticulture and tree crop commodities (fruits and nuts). Agriculture is expected to contribute to import substitution through production of grain and oilseed crops such as soyabeans and sunflower for cooking oil expression and supply of oilseed cake to pork and poultry industry. The Government of Zimbabwe has provided subsidised credit and incentivised the private sector to enter into contracting arrangements with farmers to boost production of these commercial crops.

Apart from tobacco production, the above policy interventions have largely benefited large-scale producers, despite smallholder farmers being significant contributors of targeted commercial crop value chains. The ranks of smallholder farmers have grown since the land reform of 2000 to include 146,000 farm families in so-called A1 resettlement areas (Scoones et al., 2018). With more fertile soils than the communal farming areas they farmed prior to 2000, this class of smallholder farmers is becoming a significant supplier of marketed crops contributing 36 per cent of all soyabeans, 26 per cent of all maize and constituting 41 per cent of registered producers of flue-cured tobacco that earned Zimbabwe US$782 million in the 2020 season (TIMB, 2020; Government of Zimbabwe, 2021).

Despite the above stated importance of the smallholder sector in national economic development, there are concerns that an increase in commercialisation, especially through tobacco production, may have resulted in increased food and nutrition insecurity in smallholder farming sectors of Zimbabwe. It has been noted that the increasing number of smallholder farmers specialising in growing tobacco has contributed to the structural maize production deficit faced in Zimbabwe (FEWSNET, 2014). Following a normal rainy season during 2017/2018, Zimbabwe experienced two successive droughts in the 2018/2019 and 2019/2020 agricultural seasons, resulting in large-scale crop failures. An estimated 5.5 million rural people in the country were food insecure, particularly during the peak of the 2019/20 lean season (Zimbabwe Vulnerability Assessment Committee, 2020). Of these, 3.8 million were deemed in need of food assistance.

In spite of the above concerns, however, there are some studies in Zimbabwe that provide evidence of a positive correlation between commercialisation and household food security. For example, in their cross-sectional survey of cotton commercialisation in Gokwe, northern Zimbabwe, Govereh, Jayne and Nyoro (1999) found a positive correlation between cotton and maize productivity, a key indicator of food security. In another cross-sectional study, Rubhara et al. (2020) observed a positive effect of tobacco commercialisation on dietary diversity in households in A1 resettlement areas of the Shamva district.

Whether commercialisation positively impacts food insecurity is therefore an empirical question that depends on the geographical area, crop choice, and local food market conditions. Most studies that explore the determinants of food insecurity use cross-sectional

data and then infer causal relationships between commercialisation and food security – from the food security outcomes of households that exhibit different degrees of commercialisation. Using panel data, we can observe these changes directly without the additional assumption. We can also reduce potential bias by using a fixed-effects estimator which controls for unobserved household characteristics that do not change over time, but that could impact food and nutrition insecurity.

Our study utilised a two-wave panel dataset of A1 resettled farmers collected in 2018 (soliciting information on the 2016/2017 production season) and 2020 (soliciting information on the 2019/2020 production season) in Mazowe district, a region that is a hotspot of production for commercial maize, soyabeans and tobacco. The objective of this study is to understand how commercialisation pathways affect seasonal food insecurity and hunger in rural households of Mazowe district smallholder farming areas. We explore this question by focusing on smallholder farmers resettled in former large-scale commercial farms (LSCF) in the Mazowe District of Zimbabwe where farmers grow two main cash crops, tobacco and soyabeans, and there is widespread marketing of several surplus food crops dominated by maize (Mutyasira and Sukume, 2020). Straddling a normal rainy season and two successive drought years, our panel dataset provides an opportunity to assess the impacts of commercialisation on food security under varying season quality helping us also to infer the effects of commercialisation orientation on food security resilience.

The remainder of the paper is structured as follows: Section 2 reviews the literature our study relates to. Section 3 presents the data we used, while Section 4 outlines our data analysis strategy. Section 5 reports our empirical results and Section 6 outlines our conclusions.

2. LITERATURE REVIEW OF RELATIONSHIPS BETWEEN COMMERCIALISATION, FOOD INSECURITY AND NUTRITION SECURITY

Empirical evidence points to multiple avenues through which cash crop production can affect food and nutrition security of smallholder households. Due to the diverse nature of cash crop production processes and the heterogeneity of households with regards to factor endowment and accessibility of input and output markets, the impacts of commercialisation on farm households cannot be predetermined. By far the greatest incentive to commercialise is the potential for generating cash income which can be used for purchasing food and other household needs. In their study of smallholder contract vegetable producers in Madagascar, Minten, Randrianarison and Swinnen (2009) found that income from contract crops represented 50 per cent of household income and 66 per cent of farmers identified high and stable income as the main motivation for contract participation. Increased household income and income stability under commercial crop farming can free up resources for households to allocate to health and medical needs (Okello, 2010). However, cash crop production with inadequate safeguards on utilisation of agrochemicals can have negative impacts on health as Mithofer, Waibel and Asfaw (2010) found in their study of horticulture in Kenya.

Cash crop production can increase food security by increasing food availability either through household production or by increasing the income available to purchase food (World Bank, 2005). Household food availability can increase when higher productivity produces more food or decreases the household's need to sell the household food output for cash. In their study in Madagascar, Minten, Randrianarison and Swinnen (2009) found that smallholders producing vegetables under supermarket supply contracts had an average lean period of 1.7 months compared to the regional average of 4.4 months.

A number of studies have demonstrated that cash crop production can increase food productivity through three main ways (Strasberg et al., 1999). In a situation of poorly-developed farm credit markets, income earned from commercial production can help farmers buy productivity-enhancing inputs such as improved seed, fertilisers and agrochemicals. When commercial production is supported by input credit outgrower arrangements, some inputs can be reallocated to staple food production as Minten, Randrianarison and Swinnen (2009) found in their study on horticulture farmers under supermarket contracts in Madagascar. In addition, they found capacity training of contracted farmers helped them to better manage their food enterprises. Cash income also allows the household to invest in multi-purpose assets, such as tractors or draught animals that can increase productivity across crops. Govereh and Jayne (2003) found that cotton-producing smallholder farmers in Zimbabwe were twice as capitalised, more likely to adopt animal tillage and more likely to be grain-sufficient than non-cotton growers.

However, under-developed markets for food in most SSA rural farming areas lead households to perceive specialisation in commercial crops to be a risky livelihood strategy. For example, Lukanu et al. (2004) found most non-food commercialised smallholders in their Mozambique study areas persisted in growing some food crops due to poor food availability or high prices, particularly in the November to February lean season and during years of poor harvests. Studies in Southern Africa by Jayne (1994) and Govereh, Jayne and Nyoro (1999) demonstrate that farmers are less willing to abandon food crops the higher the cost of acquiring staple foods relative to the producer price of a cash crop. Thus, interventions that improve the efficiency of staple food markets will incentivise commercialisation of smallholder agriculture (Poulton et al., 2010). On the other hand, income from commercial production may largely fall under the control of men – putting women in households at a disadvantage – and, due to the importance of women in decisions concerning food acquisition and preparation, can negatively affect food and nutrition security. If access to commercial crop production opportunities is linked to having a male in the household, female-headed households lack access to the opportunities (Jayne, Mather and Mghenyi, 2010).

Finally, cash crop production – if done at sufficient scale within a region – can generate extra spillover effects through generation of economic opportunities

for all farmers in that region, regardless of participation in the commercial crop (Govereh and Jayne, 2003). If cash crop production is very labour intensive, it can offer casual on-farm wage opportunities for resource-poor farmers. Alternatively, cash crop production can stimulate investment in service industries as well as processing industries leading to greater rural economic growth and strengthened rural non-farm sectors and related off-farm employment opportunities (Govereh and Jayne, 2003). In a wide literature review, Davis (2003) found that employment in the rural non-farm economy was responsible for between 40 and 60 per cent of incomes and jobs in almost every one of the 55 studies of rural economies surveyed. Thus, complementary investments and policies to support such agricultural commercialisation induced industries such as in education and rural infrastructure, including transport, communication and market infrastructure are a promising area for intervention (Pingali, Khwaja and Meijer, 2005).

One understudied topic is the link between seasonal hunger and commercialisation. Vaitla, Devereux and Swan (2009) define seasonal or lean season hunger as the period preceding harvest when household food stocks from the previous production season begin to run out due to low production levels, inadequate storage facilities, and/or high food prices as regional food stocks dwindle. In countries with large smallholder-dominated farming sectors, seasonal hunger can be very wide-spread and persistent across years. For example, Fink, Jack and Masiye (2018) found that over 80 per cent of households in Zambia run out of maize before their next harvest.

Seasonal hunger can have significant negative impacts on smallholder farming households. Christian and Dillon (2018) provide evidence to show that repeated exposure to seasonal hunger can result in stunted growth and lower adult educational attainment in rural households. Some studies provide evidence of households choosing to provide more food to male children relative to females during hunger seasons (Behrman, 1988), disadvantaging development of the girl child. To cope with food shortages, households may seek off-farm work to the detriment of own farm work and productivity (Fink, Jack and Masiye, 2018) or sell productive livestock and other assets to raise money for food, limiting their ability to grow their farming enterprises (Zug, 2006; Rademacher-Schulz, Schraven and Mahama, 2014; Mayanja et al., 2015). Anderson et al. (2018) also observed households in Malawi resorting to harvesting crops prior to maturity, leading to reduced overall staple crop yields and thereby deepening food scarcity.

Farm diversification, including enterprises that generate food outputs or cash income staggered across the year, has been observed as a key strategy for mitigating lean season hunger (Maxwell, 1996; Devereux, 2009; Rademacher-Schulz, Schraven and Mahama, 2014). In the case of cash crop production, however, there has been divergent views on their effect on ameliorating seasonal food scarcity. Fleuret and Fleuret (1980) provide evidence of cash crop specialisation leading to households being vulnerable to lean season hunger. Instead, steadier income flows from regular, non-farm employment, especially in the absence of viable saving options, can help overcome the challenges of the lean season when compared to income earnings from cash crop production, which tends to be concentrated during a limited time, as observed in Malawi (Masanjala, 2006). However, as Govereh and Jayne (2003) found, cash crop production can boost food crop output and reserves through productivity spill-over effects. Further, if cash crop sales occur during the lean season, they can help households mitigate hunger season food scarcity (Kuma et al., 2018).

3 RESEARCH QUESTIONS

This study focuses on seasonal hunger as the most prevalent form of food insecurity. Moreover, chronically food-insecure households are also most likely to be food insecure during the hunger season. In particular, the study attempts to answer the following questions:

- How prevalent is seasonal hunger in the smallholder resettlement scheme in Mazowe District?
- Does commercialisation in general mitigate or increase seasonal food insecurity?
- Does marketable crop choice or pathway matter for the effects of commercialisation on seasonal food insecurity?
- Are there differences in effects between average households and resource-poor households?

4. DATA AND VARIABLES

4.1 Study area and sampling

To answer the above questions, the study used a balanced panel data set collected in March to April 2018 (reflecting the 2016 to 2017 growing season) and December 2020 (reflecting the 2019 to 2020 growing season) in the post-2000 smallholder resettlement of Mvurwi and Concession regions of Mazowe District. The study adopted a cluster sampling design in which 18 villages (resettlement schemes) – 7 in Concession and 11 in Mvurwi – were randomly selected and all households in the schemes were targeted for interview. Each A1 scheme represents a former LSCF, subdivided under the post-2000 land reform programme such that, each household was allocated about 5ha of land to pursue agricultural livelihoods.

We selected the Mvurwi area to represent the northern part of the district and this area had a higher population of A1 farmers than the southern parts of Mazowe. The area has sandy soils suitable for tobacco production. We chose 11 farming schemes (former LSCF) in this area; selection of these schemes was conducted in a way to provide a geographical representation of the area. In the southern part of the district, we selected the Concession area, particularly the area in the eastern part. This is because the western part of the region is populated by larger A2 farms which were not the population of interest for this study. Concession has fewer A1 farms than Mvurwi and is characterised by red clay soils that are suitable for soyabean and maize production. We selected seven farming schemes in Concession which represented a sufficient geographical spread in the area.

Prior to 2000, the Mvurwi and Concession areas were occupied by large-scale, mainly white commercial farmers involved in mixed farming activities. However, after 2000, most of the study area farms were acquired and subdivided into small (about 5ha) to medium scale (30 to 100ha) units. The A1 smallholder resettlement areas have been a focus for agricultural commercialisation over the past 17 years. Since 2007, there has been rapid growth in tobacco production as the dominant commercial crop among the resettled farmers. This has occurred through engagement with various marketing arrangements, including through contract farming and direct sales via auction floors (Scoones et al., 2018). While tobacco has remained central to the patterns of commercialisation, farmers also engage in other value chains such as maize, soybeans, and horticultural crops. Mvurwi has seen increased participation of smallholder farmers in tobacco production while in Concession, soyabean has emerged as a key cash crop. In both areas, maize cultivation for food and sale plays a dominant role in the agricultural system. Mvurwi and Concession have high levels of participation of private-sector contracting companies, bulk traders, and aggregators (for maize, soyabeans and horticulture products); links to auction markets (for tobacco); and spot markets locally (for horticulture and maize).

Data was collected on 620 households and the list of farming schemes in the first survey in 2018. The total number of households interviewed in each scheme is shown in Table A1 in the Annex. In a follow up survey in 2020, 555 households were interviewed. A total of 533 households had matched responses across the two survey waves. Like the 2018 survey, the 2020 questionnaire gathered information on the production and marketing of various crops, on agricultural production, household demographics, land ownership and use, household assets including livestock and agricultural assets, off-farm income, food security indicators, remittances, market access and market characteristics, access to credit, and women's empowerment. We use this information to create our main outcome variable and explanatory variables of interest.

4.2 Food security outcome variables

Our food security outcome indicator was lean season hunger incidence, and we used information on the number of months during the lean or hunger season where households reported not having enough food to satisfy their needs. In Zimbabwe, this spans six months prior to the main food harvest period which begins in May. Based on this metric, we deduced four categories of increasing lean season food insecurity security: k = 1 for households reporting no shortage

during the six-month lean season (food secure); k = 2 for households reporting shortages in 1–2 months of the lean season (mild insecurity); k = 3 for households reporting shortages in two months of the lean season (moderate insecurity), and k = 4 for households reporting shortages in three or more months of the lean season (severe insecurity).

4.3 Commercialisation indices

Our main food-insecurity determinants of interest were indicators of commercialisation. The most commonly used measure of commercialisation is that of the degree of output market participation. In this study, we adopted variants of the indicator suggested by von Braun, Bouis and Kennedy (1994) in which crop output market participation is calculated as the proportion of the value of crops sold to the total household agricultural income (i.e., the value of livestock sales and home consumption plus total value of crop production). For each household i, we computed four types of crop output market participation, namely gross commercialisation(Com_i), tobacco ($TbCom_i$), soyabean ($SyCom_i$) and food crops ($FoodCom_i$):

$$TbCom_i = \frac{P_{i,tob}S_{i,tob} * 100\%}{Livestock\ Income_i + \sum_{k=1}^{K} P_k Q_{i,k}}$$

$$SyCom_i = \frac{P_{i,soy}S_{i,soy} * 100\%}{Livestock\ Income_i + \sum_{k=1}^{K} P_k Q_{i,k}}$$

$$FoodCom_i = \frac{\sum_{j}^{J} P_{i,j}S_{i,j} * 100\%}{Livestock\ Income_i + \sum_{k=1}^{K} P_k Q_{i,k}}$$

$$Com_i = \frac{\sum_{k}^{K} P_{i,k}S_{i,k} * 100\%}{Livestock\ Income_i + \sum_{k=1}^{K} P_k Q_{i,k}}$$

Where S_{ik} is the quantity of output *k* sold by household *i* evaluated at the median community level price (P_k). Q_{ik} is the total quantity of output *k* produced by the household and *i* and *j* are food crops sold in markets. Table 4.1 summarises the number and proportions of our sampled households participating in tobacco, soyabean and food marketing.

4.4 Other control variables

The other control variables that were collected in our surveys were household characteristics, economic and farm characteristics of the household, and location indicators.

Age of household head: Conventional wisdom is that as people get older, they gain more experience, so a household with an older household head might have higher farm productivity, which in turn could lead to a higher seasonal food security status. We also expect older household heads to have adult offspring, which are a potential source for remittances; and older households have usually accumulated more productive assets.

Gender of the household head: Female-headed households are generally hypothesised to prioritise food and nutrition security in their food expenditure decisions. However, if women are heading households due to divorce or death of working husbands, they are more likely to lack resources and income to mitigate lean season hunger.

Total remittances and pension receipts: Households with greater access to non-farm income from pensions and remittances are expected to better overcome income deficits due to bad agricultural seasons than those without.

Education: The education level of the household head could influence the food security status through better nutrition knowledge. In addition, highly educated household heads might also be more able to do off-farm work which also influences the food security status.

Household size: Larger families with more mouths to feed, and especially those with young children or elderly members who usually do not generate much income or food themselves, might be more likely to have a lower food security status. To account for the different age and gender structure of families, we used the Food and Agriculture Organization of the United Nations (FAO's) adult male equivalent (AME) standardisation measure based on dietary energy needs (Fiedler et al., 2008). Under the measure, male and female children in the age categories less than one-year old, one to three-

Table 4.1: Households participating in various commercialisation pathways in 2017 and 2019

Harvest season	Participants in tobacco marketing	Participants in soyabean marketing	Participants in food marketing
2017 (N=620)	411 (66%)	198 (32%)	530 (85%)
2020 (N=539)	332 (62%)	89 (17%)	383 (71%)

Source: Authors' own

Table 4.2: Overview of the proportion variables used in the analysis

Variable	Survey wave	Whole sample (N=1,028)				Asset-poor sub-sample (N=493)			
		Proportion	Std. err.	[95% CI]		Proportion	Std. err.	[95% CI]	
Male-headed= 1	2017	82%	2%	78%	86%	79%	2%	74%	84%
	2019	80%	2%	75%	85%	75%	3%	67%	81%
Monogamously married= 1	2017	77%	2%	73%	81%	75%	3%	68%	81%
	2019	73%	2%	69%	78%	67%	4%	59%	75%
Seasonally food secure= 1	2017	49%	3%	43%	56%	38%	4%	30%	46%
	2019	49%	2%	44%	54%	39%	3%	34%	46%
Mildly seasonally food insecure= 2	2017	37%	2%	32%	43%	44%	3%	38%	50%
	2019	32%	2%	29%	36%	38%	3%	33%	44%
Moderately seasonally food insecure= 3	2017	8%	1%	5%	11%	10%	2%	6%	15%
	2019	12%	1%	10%	16%	13%	2%	9%	19%
Severely seasonally food insecure= 4	2017	6%	1%	4%	8%	9%	2%	5%	14%
	2019	7%	1%	5%	9%	9%	1%	7%	12%

Notes: Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

year old, four to six-year old and seven to nine-year old are equivalent to 0.27, 0.45, 0.61 and 0.73 of a male adult, respectively. Male household members in the age categories 10 to 12-year old, 13 to 15-year old and 16 to 19-year old are equivalent to 0.86, 0.96, 1.02 and 1.00 of a male adult, respectively. Female household members in the age categories 10 to 12-year old, 13 to 15-year old and 16 to 19-year old are equivalent to 0.78, 0.83, 0.77 and 0.73 of a male adult, respectively.

Asset holdings: Assets are likely to influence a household's productivity and thereby the food security status of the household. Value of productive and consumption assets based on the replacement cost were used to represent household asset holding. Consumption assets are included as they can be sold off during hunger season to smooth consumption.

Market access: Access to markets, in addition to influencing commercialisation decision, affect the ability of highly commercialised households to use income flows from cash crop sales to purchase food. We used two measures of market access. One was self-reported distance to nearest markets – in our case, the towns of Mvurwi and Concession.

Food production diversity: A variable related to cash crop commercialisation and its relationship to seasonal food insecurity is food production diversity. We used a count of food crops and livestock species produced by the household as a measure of food production diversity. Diverse food crops are hypothesised to offer a broad variety of home-grown food with differing maturity profiles, helping to increase the supply of food during the lean season. We also included a count of livestock species produced by the household as they can provide animal-source foods such as milk, eggs and meat, as well as cash during the lean season.

Table 4.2 and 4.3 show descriptive statistics of the variables used in our analysis.

Table 4.3: Overview of the continuous variables used in the analysis

	Survey wave	Whole sample (N=1,044)				Asset-poor sub-sample (N=670)			
		Mean	Std. err.	[95% CI]		Mean	Std. err.	[95% CI]	
Household head years of schooling	2017	8.89	0.15	8.58	9.20	8.57	0.18	8.19	8.94
	2019	9.15	0.16	8.81	9.50	8.82	0.18	8.45	9.19
Acres cropped	2017	10.65	0.83	8.89	12.41	8.70	0.69	7.25	10.15
	2019	4.01	0.25	3.49	4.54	3.41	0.15	3.08	3.74
Gross commercialisation index (%)	2017	75.40	1.18	72.91	77.89	72.90	1.41	69.93	75.86
	2019	67.23	1.61	63.84	70.62	63.10	3.09	56.59	69.61
Tobacco commercialisation index (%)	2017	41.79	3.97	33.42	50.16	41.28	3.76	33.35	49.21
	2019	40.44	4.25	31.47	49.40	41.72	3.99	33.30	50.14
Food commercialisation index (%)	2017	25.75	2.15	21.21	30.29	23.52	2.12	19.05	27.99
	2019	18.69	2.01	14.46	22.93	16.26	1.93	12.19	20.33
Soyabean commercialisation index (%)	2017	7.86	2.60	2.37	13.35	8.10	2.52	2.78	13.42
	2019	8.10	3.18	1.39	14.81	5.12	1.85	1.22	9.02
Value of crop harvest (US$)	2017	7,982.08	404.85	7,127.93	8,836.23	5,736.61	227.44	5,256.75	6,216.47
	2019	3,931.40	209.89	3,488.56	4,374.24	3,199.05	154.01	2,874.12	3,523.99
Production assets (US$/AME)	2017	364.38	53.02	252.51	476.25	120.63	5.51	109.01	132.25
	2019	242.60	39.01	160.29	324.91	125.19	16.12	91.18	159.19
Total assets (US$/AME)	2017	927.10	95.31	726.02	1,128.19	209.60	6.59	195.70	223.50
	2019	709.36	78.40	543.94	874.78	339.95	64.61	203.64	476.26
Tropical livestock units	2017	5.80	0.47	4.81	6.78	4.44	0.45	3.49	5.38
	2019	5.37	0.56	4.19	6.56	4.35	0.59	3.11	5.59
Annual casual wage (US$/AME)	2017	31.26	11.82	6.33	56.19	35.28	15.17	3.27	67.29
	2019	8.85	2.82	2.91	14.79	9.56	2.97	3.29	15.83
Annual income from household enterprises (US$/AME)	2017	70.58	11.13	47.10	94.06	34.42	5.40	23.02	45.82
	2019	38.19	5.41	26.79	49.60	31.47	5.93	18.95	43.99
Annual safety net receipts (US$/AME)	2017	5.53	0.61	4.25	6.81	5.18	0.55	4.02	6.35
	2019	4.79	0.66	3.39	6.19	5.33	0.83	3.58	7.08
Annual income from regular employment (US$/AME)	2017	131.43	29.26	69.70	193.16	91.23	18.56	52.08	130.39
	2019	41.17	8.75	22.71	59.64	33.75	8.23	16.39	51.10
Annual remittance receipts (US$/AME)	2017	25.84	3.17	19.14	32.53	25.29	3.22	18.50	32.08
	2019	6.48	1.36	3.61	9.36	6.53	1.96	2.40	10.66
Count of food crops and livestock species	2017	3.91	0.15	3.59	4.23	3.73	0.13	3.46	4.00
	2019	4.00	0.12	3.75	4.25	3.92	0.12	3.67	4.17
Household size	2017	6.14	0.15	5.83	6.46	6.19	0.15	5.87	6.50
	2019	6.24	0.13	5.98	6.51	6.24	0.13	5.97	6.52
Household AME	2017	4.83	0.10	4.62	5.04	4.84	0.12	4.59	5.09
	2019	5.01	0.09	4.81	5.20	4.98	0.10	4.76	5.20

Notes: Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

5. DATA ANALYSIS

5.1. Gross commercialisation effect on seasonal hunger

To investigate the effect of commercialisation pathways on lean season food security, we followed the approach by Muriithi (2013) where the impact assessment is:

$$Y^*_{it} = \theta_t + \boldsymbol{x_{it}\beta} + Com_{it}\boldsymbol{\gamma} + T\alpha + M + \mu_{it}, \cdot i = 1,2, \ldots . N \quad (1)$$

Where Y^*_{it} is a latent variable representing lean season food consumption for I^{th} household at time t; x_{it} represents a vector of observable factors outside of commercialisation indices which are likely to impact food security (Including the gender of household head, dependency ratio, household size, education level of household head and highest education level in the household, remittances, non-agricultural income activities, land size and quality, rainfall and household shocks); Com_{it} is a measure of commercialisation (i.e., the value of crops sold as a percentage of the value of harvest of all crops and livestock) for household i during the year t; M_i represents a vector of time-invariant unobservable variables; β and γ are parameters representing the impact of observable variables on lean season food security, while μ_{it} it is the error term.

However, Y^*_{it} is not observed. What is observed are assessments of the adequacy of food in the six-month lean season by senior women in sampled households. So, the latent variable Y^*_{it} becomes the ordered food security indicator Y_{it} via the thresholds

$$\tau_{ik} \text{ such that } Y_{it} = k \text{ if } \tau_{ik} < Y^*_{it} \leq \tau_{(ik+1)} \text{ with } k = 1, \ldots, K.$$

We then estimate this ordered logit model using the STATA fixed-effects ordered logit function (**feologit**) proposed by Baetschmann et al. (2020). The fixed-effects ordered logit model assumes that the time-varying unobservable error terms are independent and identically distributed with standard logistic cumulative density function, hence the name of the model. Thus, the probability of observing outcome k for individual i at time t is

$$P(Y_{it} = k) = \Lambda(\tau_{ik+1} - \boldsymbol{x_{it}\beta} - Com_{it}\boldsymbol{\gamma} - T\alpha - M_i) - \Lambda(\tau_{ik} - \boldsymbol{x_{it}\beta} - Com_{it}\boldsymbol{\gamma} - T\alpha - M_i) \quad (2)$$

Applying the fixed-effects ordered logit model on equation 2 is likely to lead to biased estimates of the effects of commercialisation on food security as choice to participate in commercialisation is non-random. Households self-select themselves into commercialisation based on their personal human resource endowments, motivation and/or ease of access to particular markets, among other factors. To mitigate possible selection bias, we adopt the Heckman framework for panel data which involves estimating equations for determinants of commercialisation using the Probit model and predict inverse Mills' ratios ($\hat{\lambda}_{it}$) (see Muriithi (2013). Thus

$$\Pr(Com_{it,j} > 0 | Z_{it}) = \phi(\boldsymbol{Z_{it}\Psi_{jt}}), \quad (3)$$

and

$$\hat{\lambda}_{it,j} = \frac{\phi(\boldsymbol{Z_i\hat{\Psi}_{jt}})}{\Phi(\boldsymbol{Z_i\hat{\Psi}_{jt}})},$$

Where $\phi(.)$ and $\Phi(.)$ are normal probability density and cumulative distribution functions; j is commercialisation pathway (i.e., tobacco, soyabean or food); and Z_{it} contains x_{it} and other variables (w_{it}) that affect commercialisation but not food security outcome Y^*_{it}. The predicted inverse Mills ratios (IMR) are then included in equation (2), such that;

$$P(Y_{it} = k) = \Lambda(\tau_{ik+1} - \boldsymbol{x_{it}\beta} - Com_{it}\boldsymbol{\gamma} - \hat{\lambda}_{it}\boldsymbol{\delta} - T\alpha - M_i) - \Lambda(\tau_{ik} - \boldsymbol{x_{it}\beta} - Com_{it}\boldsymbol{\gamma} - \hat{\boldsymbol{\lambda}}_{it}\boldsymbol{\delta} - T\alpha - M_i) \quad (4)$$

Inclusion of the IMR in 4 provides consistent estimates of commercialisation effects assuming a valid exclusion restriction of the selection model variables can be identified. Identification involves inclusion of some variables hypothesised to be statistically associated

with commercialisation (tobacco-, soyabean- or food-based commercialisation) but not with the outcome of interest (seasonal food security indicator). In a spatial context, feasible instruments include the values of the endogenous variables in spatially adjacent zones (Walker et al., 2011). In our context, it is apparent that the adoption behaviour of spatially adjacent zones correlate with each other, as they share similar environmental and market characteristics. A key observation in our case is that the key commercialisation crops tend to be concentrated in particular areas due to soil suitability, history of production, existence of pools of labour experienced in managing particular crops and market access. For example, soyabeans tend to be concentrated where we have loamy to clay soils while tobacco is more suited to sandier soils. Tobacco requires labour that is highly skilled in curing and grading and hence, schemes in the Mvurwi area – where there is a long history of tobacco growing, including pre the Fast Track Land Reform period and which have inherited labour compounds – are predisposed to choose tobacco-based commercialisation. Thus, production concentration of the commercial crop within each A1 scheme emerged as a key instrumental variable for inclusion in equations 3.

Statistically significant coefficients δ on the predicted IMR terms in equation 4 would imply that commercialisation index is endogenous and would also correct for the resulting bias. Insignificant predicted IMR terms would fail to reject the null hypothesis of exogeneity of the commercialisation indices, implying that the fixed-effects model without correcting for selection bias (i.e., equation 2 which excludes IMRs) would result in consistent estimates.

5.2. Effect of commercialisation pathway on seasonal hunger

To answer the research question of impact of the commercialisation pathway on seasonal food insecurity, we replace the gross commercialisation index (Com_{it}) in equations 2 and 4 by tobacco ($TbCom_{it}$), soyabean ($SyCom_{it}$) and food crops ($FoodCom_{it}$) commercialisation indices. This enables us to estimate impacts of tobacco- , soyabean- and food-based commercialisation pathways through fixed-effects ordered logit using equation 5 or its variant correcting for selection bias using equation 6.
Fixed-effects model:

$$\begin{aligned} \mathrm{P}(Y_{it} = \mathrm{k}) = \boldsymbol{\Lambda}(\tau_{\mathrm{ik+1}} - \boldsymbol{x_{it}\beta} - TbCom_{it}\boldsymbol{\gamma_{tb}} - SyCom_{it}\boldsymbol{\gamma_{sy}} \\ - FoodCom_{it}\boldsymbol{\gamma_{fd}} - T\alpha - M_i) - \boldsymbol{\Lambda}(\tau_{\mathrm{ik}} - \boldsymbol{x_{it}\beta} - TbCom_{it}\boldsymbol{\gamma_{tb}} \\ - SyCom_{it}\boldsymbol{\gamma_{sy}} - FoodCom_{it}\boldsymbol{\gamma_{fd}} - T\alpha - M_i) \end{aligned} \quad (5)$$

Fixed-effects correcting for selection bias:

$$\begin{aligned} \mathrm{P}(Y_{it} = \mathrm{k}) = \boldsymbol{\Lambda}(\tau_{\mathrm{ik+1}} - \boldsymbol{x_{it}\beta} - TbCom_{it}\boldsymbol{\gamma_{tb}} - SyCom_{it}\boldsymbol{\gamma_{sy}} \\ - FoodCom_{it}\boldsymbol{\gamma_{fd}} - \hat{\lambda}_{it}\boldsymbol{\delta} - T\alpha - M_i) - \boldsymbol{\Lambda}(\tau_{\mathrm{ik}} - \boldsymbol{x_{it}\beta} - \\ TbCom_{it}\boldsymbol{\gamma_{tb}} - SyCom_{it}\boldsymbol{\gamma_{sy}} - FoodCom_{it}\boldsymbol{\gamma_{fd}} - \hat{\boldsymbol{\lambda}}_{it}\boldsymbol{\delta} - T\alpha - M_i) \end{aligned} \quad (6)$$

5.3. Resource poverty and effects of commercialisation on seasonal hunger

To answer the question of whether the effect of gross commercialisation or commercialisation pathway on lean season food insecurity differs between poor and well-off households, equations 2, 4, 5 and 6 above were estimated over the whole sample, as well as on sub-samples of asset-poor households. The definition of poor households was taken to be households with per AME total asset value at or below the median of the sample during 2017.

6 EMPIRICAL RESULTS

6.1. Prevalence of seasonal hunger

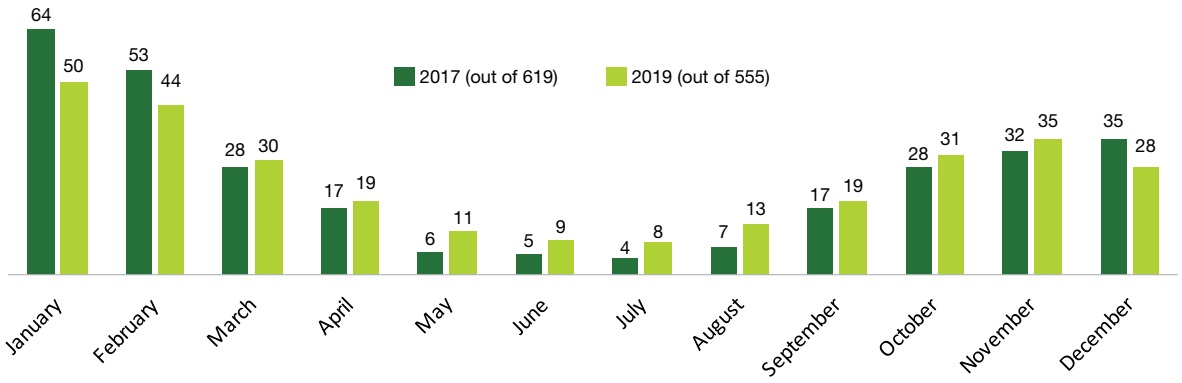
Despite being in an agro-ecologically rich region, there is significant incidence of inadequate food provisioning in the Mazowe A1 resettlement areas, especially during the period prior to harvest. Graph 1 below reports percentages of sampled farming households that reported not having enough food by month in the two survey waves. In the 2017 production season, 64 per cent of households reported food shortages during January, 53 per cent during February and 28 per cent during March. In the 2019 production season, 50 per cent of households reported food shortages during January, 44 per cent during February and 30 per cent during March.

6.2. The longitudinal fixed-effects models relating gross commercialisation to seasonal hunger

Does gross commercialisation affect lean season food security? Do the effects differ between poor and the whole sample of poor and non-poor households? This section tackles these questions. Results in Table 6.1 summarise the coefficients of the estimated fixed-effects ordered model for impact of gross commercialisation on lean season food insecurity. Results in columns 1 and 2 report estimates based on the whole sample while those in columns 3 and 4 report estimates based on a sub-sample of asset-poor households. Asset-poor households are defined as households with total assets valued at less than US$300 per AME during the 2017 survey wave. Specifications in columns 2 and 4 include IMR for selection into tobacco, soyabean and food commercialisation to account for possible selection bias. The IMRs are deduced from Probit models of selection into tobacco, soyabean and food marketing reported in Table A1 in the Annex. Coefficients on the IMR in column 2 are all insignificant, indicating no selection bias across the whole sample. This implies results in column 1 which do not include IMRs give consistent estimates for the whole sample model. However, the soyabean IMR reported in column 4 are significant, implying the model indicates selection bias and incorporation of IMRs gives consistent estimates for the asset-poor sample.

Based on the whole sample, results in Table 6.1 show that the following household and farm characteristics have statistically significant correlations with movement out of seasonal food insecurity: being a male-headed household ($p<0.01$), high gross area cropped ($p<0.01$), high gross commercialisation ($p<0.1$), and high value of remittances ($p<0.05$). Based on the asset-poor sub-sample of households, the results in the table further show that a household being male-headed ($p<0.01$) and with gross commercialisation ($p<0.1$), income from household enterprises ($p<0.1$), income from regular employment ($p<0.1$) and value of remittances ($p<0.01$)

Figure 6.1 Percent of sampled households reporting inadequate food provisioning by month in 2017 and 2019



Source: Authors' own, using data from Zimbabwe APRA survey, 2017 and 2019

Table 6.1: Fixed-effects ordered logit model of impact of gross commercialisation on lean season food insecurity

Variable	1 All households, lean season hunger – fixed effects	2 All households, lean season – fixed effects and correcting for selection bias	3 Asset-poor households, lean season hunger – fixed effects	4 Asset-poor households, lean season – fixed effects and correcting for selection bias
Household head gender (male=1)	-2.898***	-2.995***	-2.905***	-3.421***
	(0.599)	(0.585)	(0.890)	(0.861)
Household head years in school	-0.00255	-0.0140	0.0938	0.0826
	(0.0742)	(0.0722)	(0.0860)	(0.0820)
Area cropped (acres)	-0.0241***	-0.0281***	-0.00358	-0.0672
	(0.00829)	(0.0103)	(0.0340)	(0.0564)
Gross commercialisation index (%)	-0.00739*	-0.00646	-0.0110*	-0.0110*
	(0.00393)	(0.00398)	(0.00644)	(0.00590)
Casual labour wages (US$/AME)	0.000477	0.000324	0.000505	0.000194
	(0.000639)	(0.000658)	(0.00129)	(0.00143)
Household enterprise income (US$/AME)	-0.000224	-0.000262	-0.00211	-0.00277*
	(0.000476)	(0.000488)	(0.00134)	(0.00151)
Value of safety net receipts (US$/AME)	0.0102	0.00945	0.00103	-0.00812
	(0.00930)	(0.00927)	(0.0137)	(0.0152)
Regular employment income (US$/AME)	-0.000356	-0.000372	-0.00132	-0.00177**
	(0.000617)	(0.000658)	(0.000877)	(0.000826)
Remittance income (US$/AME)	-0.00805**	-0.00879**	-0.00751**	-0.0104***
	(0.00327)	(0.00344)	(0.00345)	(0.00334)
Count of food crops and livestock species	-0.0962	-0.148	-0.0599	-0.191
	(0.0986)	(0.164)	(0.0859)	(0.175)
Household size (AME)	0.127	0.0937	0.161	0.108
	(0.0880)	(0.0846)	(0.119)	(0.111)
Survey year dummy (2019=1)	-0.306**	-0.144	-0.130	-0.124
	(0.149)	(0.238)	(0.202)	(0.287)
tob_imr (tobacco IMR)		-0.343		-0.268
		(0.771)		(0.877)
food_imr (food IMR)		-0.399		-1.287
		(0.760)		(1.155)
soya_imr (soyabean IMR)		-0.206		-1.243*
		(0.481)		(0.716)
Wald Chi2, Prob>Chi2	0.000	0.000	0.000	0.000
Observations	666	642	472	450

Notes: Sample is restricted to households who appeared in both rounds. All estimates include household fixedeffects. Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

have statistically significant correlations with movement out of seasonal food insecurity.

The above indicate that an increase in gross commercialisation has a positive effect on mitigating food insecurity but does not provide economic significance for the impact relative to the other covariates that showed statistically significant effects on escaping seasonal hunger. To gain insight on such effects, we estimated marginal effects at the sample means (see Annex Tables A3 and A4) and simulated the impact of changing each of the statistically significant variables by one standard deviation. To make the effect of household head gender comparable to the other continuous variables, we multiplied the marginal effects by a standard deviation increase in proportion of male-headed households. These results are presented in Table 6.2.

Results based on the whole sample show that a standard deviation increase of one in the gross commercialisation index, our main explanatory variable, causes a 0.21 per cent increase in the probability of the household being food secure and a 0.07 per cent decrease in the probability of falling into the severe lean season hunger category. Results based on the asset-poor sample show that a standard deviation increase of one in the gross commercialisation index causes a 0.35 per cent increase in the probability of the household being food secure, and a 0.07 per cent decrease in the probability of falling into the severe lean season hunger category. Thus, our estimates indicate that commercialisation reduces the likelihood of falling into lean season hunger, and more importantly, the impact is greater for poor households.

However, the impact of gross commercialisation on lean season hunger is dwarfed by other covariates. Increasing by one standard deviation the proportion of male-headed households, area cropped, regular non-farm employment income and remittances have greater impact on seasonal food insecurity mitigation (Figure 6.2). This result makes intuitive sense since gross commercialisation reflects income generation from crop sales that happen outside the lean season, while non-farm income sources, such as remittances and regular employment income come into the household during leans season months and hence, directly help mitigate lean season hunger (Maxwell, 1996; Devereux, 2009). Food crop and livestock diversity, surprisingly, did not show significant effects on lean season hunger severity in both samples – contrary to findings in the literature (Rademacher-Schulz, Schraven and Mahama, 2014).

6.3. Longitudinal effects of commercialisation pathways on lean season hunger

This section answers the dual questions of 'Does it matter for lean season hunger whether commercialisation is food-based or cash crop based?'

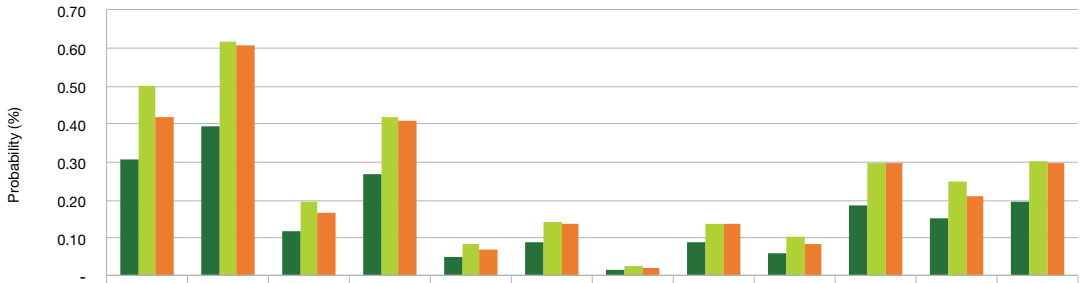
Table 6.2: Effects of gross commercialisation on lean season food insecurity

Variable	Effect	Standard error of covariate	% increase in probability of being in food security category a			
			Secure	Mild insecurity	Moderate insecurity	Severe insecurity
Proportion of male-headed households	Effect in whole sample	0.02	1.22***	-0.30***	- 0.50***	-0.42***
	Effect in asset-poor sample	0.02	1.62***	-0.39***	-0.62***	-0.61***
Area cropped (acres)	Effect in whole sample	0.83	0.48***	-0.12***	-0.20***	-0.16***
	Effect in asset-poor sample	0.69	1.09	-0.27	-0.42	-0.41
Gross commercialisation index (%)	Effect in whole sample	3.970	0.21*	-0.05*	-0.08*	-0.07*
	Effect in asset-poor sample	3.760	0.37*	-0.09*	-0.14*	-0.14*
Household enterprise income (US$/AME)	Effect in whole sample	11.13	0.06	-0.01	-0.02	-0.02
	Effect in asset-poor sample	5.40	0.35*	-0.09*	-0.14*	-0.14*
Regular income (US$/AME)	Effect in whole sample	29.26	0.25	-0.06	-0.10	-0.08
	Effect in asset-poor sample	18.56	0.78*	-0.19*	-0.30*	-0.30*
Remittance income (US$/AME)	Effect in whole sample	3.17	0.61**	-0.15**	-0.25**	-0.21**
	Effect in asset-poor sample	3.22	0.79***	-0.19***	-0.30***	-0.30***

Notes: Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

Figure 6.2. Reduction in probability of falling into food insecurity from a standard deviation increase of one in gross commercialisation: whole compared to asset-poor sample



	Male-headed		Cropped acres		HCI (%)		Household enterprise/AME		Regular income/AME		Remittances/AME	
	Whole	Poor	Whole	Poor	Whole	Poor	Whole	Poor	Whole	Poor	Whole	Poor
Mildly insecure = 1-2 months	DEFD.	DEFG.	DEBC.	DECH.	DEDI.	DEDG.	DEDB.	DEDG.	DEDJ.	DEBG.	DEBI.	DEBG.
Moderate insecure = 3 months	DEID.	DEJC.	DECD.	DEKC.	DEDL.	DEBK.	DEDC.	DEBK.	DEBD.	DEFD.	DECI.	DEFD.
Severe insecure > 3 months	DEKC.	DEJB.	DEBJ.	DEKB.	DEDH.	DEBK.	DEDC.	DEBK.	DEDL.	DEFD.	DECB.	DEFD.

Source: Authors' own

and 'Do commercialisation pathways mitigate lean season hunger for asset-poor households?'. Table 6.3 summarises the coefficients of the estimated fixed-effects ordered model for impact of tobacco, soyabean and food commercialisation indices on lean season food insecurity. Columns 1a and 2a report estimates based on the whole sample, while columns 3a and 4a report estimates based on a sub-sample of asset-poor households during 2017. Specifications in columns 2a and 4a include IMR for selection into tobacco, soyabean and food commercialisation to account for possible selection bias. As in the case for the gross commercialisation index model, coefficients on the IMR in column 2a are all insignificant, indicating that there is no selection bias issue for the whole sample estimates and hence, results reported in column 1a give consistent estimates. But the soyabean IMR reported in column 4a is significant, implying specification in column 4a gives consistent estimates for the asset-poor sample.

Based on the whole sample of households, results in Table 6.3 show that a household being: male-headed ($p<0.01$) and with gross area cropped ($p<0.01$), tobacco and food commercialisation ($p<0.1$), and value of remittances ($p<0.05$) have statistically significant correlations with movement out of seasonal food insecurity. Based on the asset-poor sub-sample, the results in the table further show that a household being male-headed ($p<0.01$) and with tobacco commercialisation ($p<0.05$), food commercialisation ($p<0.1$), income from household enterprises ($p<0.1$), income from regular employment ($p<0.05$) and value of remittances ($p<0.01$) have statistically significant correlations with movement out of seasonal food insecurity

The above indicate that increased tobacco and food commercialisation have positive effects on mitigating food insecurity but do not provide economic significance for impacts relative to the other covariates that showed statistically significant effects on escaping seasonal hunger. To gain insight on such effects, we estimated marginal effects at the sample means (see Annex Tables A5 and A6) and simulated the impact of changing each of the statistically significant variables by one standard deviation. Again, to make the effect of household head gender comparable to the other continuous variables, we multiplied the marginal effects by a standard deviation increase in proportion with male-headed households. These results are presented in Table 6.4 and Figure 6.3.

Table 6.4 shows that results based on the whole sample show that a standard deviation increase of one in tobacco commercialisation index causes a 0.80 per cent increase in the probability of the household being food secure, and a 0.53 per cent decrease in the probability of falling into the severe lean season hunger category (i.e., greater than 3 months deprivation during the lean season). A standard deviation increase of one in food commercialisation increases the probability of the household being food secure by 0.53 per cent, and decreases the probability of the households falling into the severe lean season hunger category by 0.18 per cent.

Results based on the asset-poor sample show that a standard deviation increase of one in tobacco commercialisation index causes a 1.41 per cent increase in the probability of the household being food secure. It also leads to a 0.53 per cent decrease in the probability of households falling into the severe lean season hunger category. A standard deviation increase of one in food commercialisation index causes a 0.84 per cent increase in the probability of the household being food secure, and a 0.32 per cent decrease in the probability of the households falling into the severe lean season hunger category. Changes in soyabean

Table 6.3: Fixed effects ordered logit model of effects of commercialisation pathway on lean season hunger

Variable	1a All households, lean season hunger – fixed effects	2a All households, lean season – fixed effects and correcting for selection bias	3a Asset-poor households, lean season hunger – fixed effects	4a Asset-poor households, lean season – fixed effects and correcting for selection bias
Household head gender (male=1)	-2.755***	-2.853***	-2.468***	-3.060***
	(0.601)	(0.610)	(0.892)	(0.926)
Household head years in school	-0.00505	-0.0156	0.0830	0.0716
	(0.0720)	(0.0715)	(0.0848)	(0.0764)
Area cropped (acres)	-0.0237***	-0.0281***	-0.000640	-0.0658
	(0.00806)	(0.00992)	(0.0318)	(0.0563)
Tobacco commercialisation index (%)	-0.00844*	-0.00469	-0.0185***	-0.0158**
	(0.00452)	(0.00500)	(0.00589)	(0.00713)
Food commercialisation index (%)	-0.0106*	-0.0101	-0.0166*	-0.0168*
	(0.00636)	(0.00635)	(0.00989)	(0.00920)
Soyabean commercialisation index (%)	-0.00500	-0.00625	-0.00483	-0.00727
	(0.00716)	(0.00878)	(0.00772)	(0.00844)
Casual labour wages (US$/AME)	0.000239	0.000332	4.01e-05	-6.57e-05
	(0.000897)	(0.00105)	(0.000932)	(0.00106)
Household enterprise income (US$/AME)	-0.000231	-0.000290	-0.00192	-0.00271*
	(0.000481)	(0.000511)	(0.00136)	(0.00157)
Value of safety net receipts (US$/AME)	0.0105	0.00952	0.000277	-0.00880
	(0.00901)	(0.00864)	(0.0139)	(0.0158)
Regular employment income (US$/AME)	-0.000345	-0.000346	-0.00158*	-0.00191**
	(0.000639)	(0.000647)	(0.000902)	(0.000920)
Remittance income (US$/AME)	-0.00788**	-0.00870***	-0.00668*	-0.00970***
	(0.00323)	(0.00325)	(0.00344)	(0.00331)
Count of food crops and livestock species	-0.0868	-0.147	-0.0466	-0.179
	(0.0974)	(0.163)	(0.0813)	(0.178)
Household size (AME)	0.132	0.0923	0.181	0.123
	(0.0876)	(0.0851)	(0.127)	(0.115)
Survey year dummy (2019=1)	-0.318**	-0.136	-0.125	-0.105
	(0.156)	(0.229)	(0.210)	(0.302)
tob_imr (tobacco IMR)		-0.334		-0.300
		(0.791)		(0.929)
food_imr (food IMR)		-0.478		-1.402
		(0.726)		(1.190)
soya_imr (soyabean IMR)		-0.186		-1.239*
		(0.499)		(0.738)
Wald Chi2, Prob>Chi2	0.000	0.000	0.000	0.000
Observations	666	642	472	450

Notes: Sample is restricted to households who appeared in both rounds. All estimates include household fixedeffects. Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

Table 6.4: Effects of tobacco and food commercialisation on lean season food insecurity

Variable	Effect	Standard error of covariate	% increase in probability of being in food security category a			
			Secure	Mild insecurity	Moderate insecurity	Severe insecurity
Proportion of male-headed households	Effect in whole sample	0.02	1.16***	-0.29***	-0.48***	-0.40***
	Effect in asset-poor sample	0.02	1.45***	-0.35***	-0.55***	-0.54***
Area cropped (acres)	Effect in whole sample	0.83	0.47***	-0.12***	-0.19***	-0.16***
	Effect in asset-poor sample	0.69	1.07	-0.26	-0.41	-0.40
Tobacco commercialisation index (%)	Effect in whole sample	3.970	0.80*	-0.20*	-0.33*	-0.27*
	Effect in asset-poor sample	3.760	1.41**	-0.34**	-0.54**	-0.53**
Food commercialisation index (%)	Effect in whole sample	2.15	0.54*	-0.14*	-0.22*	-0.18*
	Effect in asset-poor sample	2.12	0.84*	-0.21*	-0.32*	-0.32*
Household enterprise income (US$/AME)	Effect in whole sample	11.13	0.06	-0.02	-0.03	-0.02
	Effect in asset-poor sample	5.40	0.35*	-0.09*	-0.13*	-0.13*
Regular income (US$/AME)	Effect in whole sample	29.26	0.24	-0.06	-0.10	-0.08
	Effect in asset-poor sample	18.56	0.84**	-0.20**	-0.32**	-0.32**
Remittance income (US$/AME)	Effect in whole sample	3.17	0.60	-0.15	-0.24	-0.21
	Effect in asset-poor sample	3.22	0.74**	-0.18**	-0.28**	-0.28**

Notes: Marginal effect at the sample average of a standard error increase of one in covariate (i.e., ME x SD) x 100%. ME in feologit are obtained using post estimation logitmarg in STATA

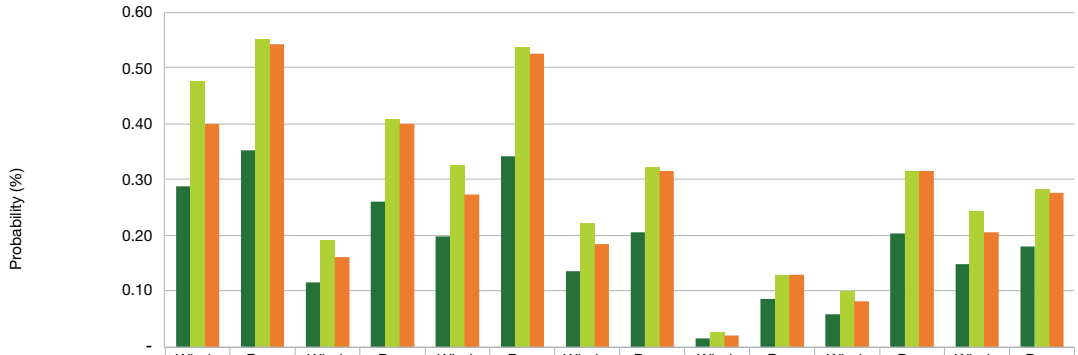
Source: Authors' own

commercialisation showed insignificant effects on lean season hunger in both the whole sample as well as the asset-poor sub-sample.

The above estimates indicate that food and tobacco-based commercialisation reduce the likelihood of falling into lean season hunger, and more importantly, the impact is greater for asset-poor households. More importantly, Figure 6.3 indicates that tobacco commercialisation's impact on lean season hunger, particularly in the asset-poor sub-sample, is comparable to the effects of being male-headed, but dwarfs the impact of other policy relevant possible lean season mitigatory covariates – including crop production area expansion, food commercialisation, household enterprises, regular employment and remittances. Tobacco commercialisation is 24 per cent, 40 per cent, 75 per cent, 40 per cent and 47 per cent more effective in mitigating lean season hunger than crop production area expansion, food commercialisation, increasing household enterprises, regular employment and remittances, respectively.

The possible explanation of the significant effect of tobacco commercialisation on lean season hunger is that tobacco sales, which in Zimbabwe start around March and thus occur in the middle of the lean season, provide participating households with income to bridge lean-season food shortages. At the other extreme, most soyabean sales are during the food harvest and sales period of June to August. Food commercialisation could be considered a reflection of surplus food requirements to meet household needs. That is, high food commercialisation is more likely to be among households that have enough food stocks from own production than those without. This observation is supported by descriptive statistics from the sample which shows that in the 2017 survey wave, 45 per cent of food-secure households were among food sellers compared to 30 per cent among non-food sellers.

Figure 6.3. Reduction in probability of falling into food insecurity category from a standard deviation increase of one in tobacco, food and soyabean commercialisation indices: whole compared to asset-poor sample



	Whole	Poor	Whole	Poor	Whole	Poor	Whole	Poor	Whole	Poor	Whole	Poor	Whole	Poor
	Male-headed		Cropped acres		HCI tobacco (%)		HCI food (%)		Household enterprise/AME		Regular income/AME		Remittances/ AME	
Mildly insecure = 1-2 months	0.29	0.35	0.12	0.26	0.20	0.34	0.14	0.21	0.02	0.09	0.06	0.20	0.15	0.18
Moderate insecure = 3 months	0.48	0.55	0.19	0.41	0.33	0.54	0.22	0.32	0.03	0.13	0.10	0.32	0.24	0.28
Severe insecure > 3 months	0.40	0.54	0.16	0.40	0.27	0.53	0.18	0.32	0.02	0.13	0.08	0.32	0.21	0.28

Source: Authors' own

7 CONCLUSIONS

Agricultural transformation towards intensive commercial production is a key facet of the current development strategies aimed at improving welfare outcomes of farm households, such as food security and poverty. Smallholder farmers who form an integral part of the agricultural transformation process constitute the majority of the most food-insecure and undernourished in SSA, and their numbers have been increasing. Any strategies to transform agriculture through commercialisation must also be accompanied by measures to improve food and nutrition security of smallholder farmers. In Zimbabwe, the smallholder farming sector is important in national economic development and there is concern that increased commercialisation, especially through tobacco production, may have resulted in increased food and nutrition insecurity in the smallholder farming sector. This study examined the impacts of commercialisation and commercialisation pathways adopted on seasonal food insecurity in rural households of Mazowe districts.

Empirical results from the study show that commercialisation reduces the likelihood of falling into November to May lean season hunger, and more importantly, the impact is greater for households that are asset-poor. Results also reveal that tobacco and food commercialisation significantly reduce the likelihood of falling into lean season hunger but soyabean commercialisation does not show significant effect on lean season hunger. Further, the results show tobacco commercialisation has a significantly higher effect on lean season hunger mitigation than food commercialisation as well as other lean season mitigatory measures such as growth in household enterprises, regular off-farm income or remittances. Descriptive results point to timing of tobacco sales during the peak of the lean season as a key factor in its effectiveness to counter seasonal hunger. Findings in this study are in line with literature and anecdotal evidence that highlights the importance of participating in food and cash crop markets for reducing hunger, and improving food security at the household level.

National development strategies that aim to improve food security and reduce hunger at the household level should thus focus on improving the efficiency of staple food markets to incentivise cash crop commercialisation of smallholder agriculture. Strategies for improving food and cash crop marketing should be targeted at improving smallholder farmers' access to markets.

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ANNEX

Table A1: List of schemes and total sample in 2017

Region	Scheme	Sample
Concession	A of Cranham Extension	39
	Cranham Extension	7
	Ardura	29
	Barwick M	27
	Falling Waters	26
	Glegrey	48
	Glendevon	32
	Total	208
Mvurwi	Blighty	30
	Chipanza	33
	Edmonston	26
	Forrester J	27
	Forrester K	33
	Four Streams	45
	Lucknow Estate	37
	Lucknow Extension	34
	Omeath B	64
	Omeath E	31
	Stockbury	52
	Total	**412**
Total sample	Effect in whole sample	**620**

Source: Authors' own

Table A2: Panel probit models of self-selection into tobacco, soyabean and food commercialisation

Variable	1 Tobacco selection	2 Soyabean selection	3 Food selection
Area cropped	0.0234	0.0589***	0.0995***
	(0.0167)	(0.0160)	(0.0213)
Tropical livestock units	0.0303*	0.0108	0.0150
	(0.0163)	(0.0125)	(0.0128)
Household head gender (male=1)	1.230***	-0.305	-0.422**
	(0.295)	(0.224)	(0.169)
Household head age	-0.0425***	-0.00353	-0.00521
	(0.00963)	(0.00709)	(0.00498)
Household head years in school	-0.0774**	0.0222	0.0368*
	(0.0353)	(0.0313)	(0.0217)
Rainfall (mm)	0.00153*	0.000603	-0.000297
	(0.000897)	(0.000830)	(0.000633)
Median distance to tarred road (km)	-0.00369	0.0180	-0.0134
	(0.0240)	(0.0176)	(0.0143)
Median maize price in scheme (US$/mt)	1.049	2.405	-0.669
	(2.005)	(1.748)	(1.387)
Median soyabean price in scheme (US$/mt)	0.344	-0.830	-0.790
	(0.886)	(0.874)	(0.691)
Median tobacco price in scheme (US$/kg)	-0.139	-0.565**	-0.237
	(0.282)	(0.249)	(0.193)
Maize area in scheme/area cropped in scheme	-0.402	0.0268	2.485***
	(0.902)	(0.788)	(0.649)
Soyabean area in scheme/area cropped in scheme	0.795	4.280***	-0.155
	(0.676)	(0.644)	(0.472)
Tobacco area in scheme/area cropped in scheme	6.416***	0.0355	0.135
	(0.987)	(0.553)	(0.443)
Value of total assets per AME (US$/AME)	0.000115	-8.76e-05	2.39e-05
	(7.54e-05)	(6.03e-05)	(6.77e-05)
Soil (1=sandy, 2=sandy loam, 3=loamy, 4=clayey)	-0.455***	0.281*	0.0412
	(0.174)	(0.156)	(0.115)
Casual labour wages (US$/AME)	-0.00162	7.33e-05	0.00141
	(0.00138)	(0.000490)	(0.00108)
Household enterprise income (US$/AME)	0.000128	-0.00108**	0.000591
	(0.000498)	(0.000453)	(0.000505)
Value of safety net receipts (US$/AME)	-0.00885	-0.0150**	0.00778
	(0.00650)	(0.00750)	(0.00548)
Regular employment income (US$/AME)	-0.000466*	-4.23e-05	0.000259
	(0.000240)	(0.000226)	(0.000229)
Remittance income (US$/AME)	0.000290	-0.00173	0.000576
	(0.00132)	(0.00136)	(0.00100)
Count of food crops and livestock species	-0.0245	0.0659	0.330***
	(0.0716)	(0.0643)	(0.0566)
Constant	-1.617	-2.676**	-1.293
	(1.263)	(1.069)	(0.789)
Wald chi2(22)	83.21	88.05	95.26

Prob > chi2	0.000	0.000	0.000
Observations	1,026	1,026	1,026
Number of hh_id	533	533	533

Notes: Sample is restricted to households who appeared in both rounds. Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)
Source: Authors' own

Table A3: Odds ratio and marginal probability effects of gross commercialisation on lean season hunger prevalence for all households

Independent variable		Lean season food insecurity category			
	Odds ratio	1=Secure	2=Mildly insecure	3=Moderately insecure	4=Severely insecure
Household head gender (male=1)	0.0551***	0.691***	-0.172***	-0.283***	-0.237***
	(0.0330)	(0.143)	(0.0355)	(0.0584)	(0.049)
Household head years in school	0.997	0.00061	-0.00015	-0.00025	-0.00021
	(0.072)	(0.0177)	(0.00439)	(0.00723)	(0.00607)
Area cropped (acres)	0.976***	0.00576***	-0.00143***	-0.00235***	-0.00198***
	(0.00809)	(0.00198)	(0.000491)	(0.000809)	(0.000679)
Gross commercialisation index (%)	0.993*	0.00176*	-0.00044*	-0.00072*	-0.0006*
	(0.00391)	(0.000939)	(0.000233)	(0.000384)	(0.000322)
Casual labour wages (US$/AME)	1.0005	-0.00011	2.82E-05	4.65E-05	0.000039
	(0.00064)	(0.000153)	(3.78E-05)	(6.24E-05)	(5.23E-05)
Household enterprise income (US$/AME)	0.9998	5.34E-05	-1.3E-05	-2.2E-05	-1.8E-05
	(0.000476)	(0.000114)	(2.82E-05)	(4.65E-05)	(0.000039)
Value of safety net receipts (US$/AME)	1.0103	-0.00244	0.000604	0.000996	0.000836
	(0.0094)	(0.00222)	(0.000551)	(0.000907)	(0.000761)
Regular employment income (US$/AME)	0.9996	0.000085	-2.1E-05	-3.5E-05	-2.9E-05
	(0.000617)	(0.000147)	(3.65E-05)	(6.02E-05)	(5.05E-05)
Remittance income (US$/AME)	0.992**	0.00192**	-0.00048**	-0.00078**	-0.00066**
	(0.00324)	(0.000781)	(0.000194)	(0.000319)	(0.000268)
Count of food crops and livestock species	0.908	0.022955	-0.0057	-0.00938	-0.00788
	(0.0900)	(0.0235)	(0.00584)	(0.00962)	(0.00808)
Household size (AME)	1.13562	-0.03035	0.00753	0.012405	0.0104
	(0.0999)	(0.021)	(0.00521)	(0.00858)	(0.0072)

Notes: Sample is restricted to households who appeared in both rounds. All estimates include household and year fixed effects. Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)
Source: Authors' own

Table A4: Odds ratio and marginal probability effects of gross commercialisation on lean season hunger prevalence for asset-poor households

Independent variable		Lean season food insecurity category			
	Odds ratio	1=Secure	2=Mildly insecure	3=Moderately insecure	4=Severely insecure
Household head gender (male=1)	0.0327***	0.809***	-0.197***	-0.309***	-0.303***
	(0.0281)	(0.204)	(0.0496)	(0.0777)	(0.0762)
Household head years in school	1.086148	-0.01954	0.004763	0.007459	0.007315
	(0.0890)	(0.0194)	(0.00473)	(0.0074)	(0.00726)
Area cropped (acres)	0.935	0.0159	-0.00387	-0.00607	-0.00595
	(0.0528)	(0.0133)	(0.00325)	(0.00509)	(0.005)
Gross commercialisation index (%)	0.989*	0.00261*	-0.00064*	-0.001*	-0.00098*
	(0.00583)	(0.00139)	(0.00034)	(0.000532)	(0.000522)
Casual labour wages (US$/AME)	1.0002	-4.6E-05	1.12E-05	1.75E-05	1.72E-05
	(0.00143)	(0.000337)	(8.22E-05)	(0.000129)	(0.000126)
Household enterprise income (US$/AME)	0.997*	0.000655*	-0.00016*	-0.00025*	-0.00025*
	(0.00151)	(0.000357)	(0.000087)	(0.000136)	(0.000134)
Value of safety net receipts (US$/AME)	0.992	0.00192	-0.00047	-0.00073	-0.00072
	(0.0151)	(0.0036)	(0.000877)	(0.00137)	(0.00135)
Regular employment income (US$/AME)	0.998**	0.000418**	-0.0001**	-0.00016**	-0.00016**
	(0.000825)	(0.000195)	(4.76E-05)	(7.46E-05)	(7.31E-05)
Remittance income (US$/AME)	0.990***	0.00245***	-0.0006***	-0.00094***	-0.00092***
	(0.00331)	(0.00079)	(0.000193)	(0.000302)	(0.000296)
Count of food crops and livestock species	0.826	0.0451	-0.0110	-0.0172	-0.0169
	(0.145)	(0.0414)	(0.0101)	(0.0158)	(0.0155)
Household size (AME)	1.114	-0.0255	0.00622	0.00974	0.00955
	(0.123)	(0.0262)	(0.00639)	(0.010)	(0.00981)

Notes: Sample is restricted to households who appeared in both rounds. All estimates include household and year fixed effects. Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

Table A5: Odds ratio and marginal probability effects of commercialisation pathway on lean season hunger prevalence for the whole sample

Independent variable		Lean season food insecurity category			
	Odds ratio	1=Secure	2=Mildly insecure	3=Moderately insecure	4=Severely insecure
Household head gender (male=1)	0.0636***	0.657***	-0.163***	-0.269***	-0.226***
	(0.0382)	(0.143)	(0.0356)	(0.0586)	(0.0492)
Household head years in school	0.995	0.00121	-0.0003	-0.00049	-0.00041
	(0.0717)	(0.0172)	(0.00426)	(0.00703)	(0.0059)
Area cropped (acres)	0.977***	0.00566***	-0.0014***	-0.00231***	-0.00194***
	(0.00787)	(0.00192)	(0.000477)	(0.000786)	(0.00066)
Tobacco commercialisation index (%)	0.992*	0.00201*	-0.0005*	-0.00082*	-0.00069*
	(0.00448)	(0.00108)	(0.000267)	(0.000441)	(0.00037)
Food commercialisation index (%)	0.989*	0.00252*	-0.00063*	-0.00103*	-0.00086*
	(0.0063)	(0.00152)	(0.000377)	(0.000621)	(0.000521)
Soyabean commercialisation index (%)	0.995	0.00119	-0.0003	-0.00049	-0.00041
	(0.00712)	(0.00171)	(0.000424)	(0.000698)	(0.000586)
Casual labour wages (US$/AME)	1.0002	-5.7E-05	1.42E-05	2.33E-05	1.96E-05
	(0.000897)	(0.000214)	5.31E-05	(8.75E-05)	(7.34E-05)
Household enterprise income (US$/AME)	0.9998	5.51E-05	-1.4E-05	-2.3E-05	-1.9E-05
	(0.000481)	(0.000115)	(2.85E-05)	(4.69E-05)	(3.94E-05)
Value of safety net receipts (US$/AME)	1.011	-0.00252	0.000625	0.00103	0.000864
	(0.00911)	(0.00215)	(0.000534)	(0.000879)	(0.000738)
Regular employment income (US$/AME)	0.9997	8.23E-05	-2E-05	-3.4E-05	-2.8E-05
	(0.000639)	(0.000153)	(3.78E-05)	(6.23E-05)	(5.23E-05)
Remittance income (US$/AME)	0.992**	0.00188**	-0.00047**	-0.00077**	-0.00065**
	(0.00321)	(0.000772)	(0.000192)	(0.000315)	(0.000265)
Count of food crops and livestock species	0.917	0.0207	-0.00514	-0.00847	-0.00711
	(0.0893)	(0.0232)	(0.00576)	(0.0095)	(0.00797)
Household size (AME)	1.141	-0.0315	0.00781	0.0129	0.0108
	(0.01)	(0.0209)	(0.00518)	(0.00854)	(0.00717)

Notes: Sample is restricted to households who appeared in both rounds. All estimates include household and year fixed effects. Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

Table A6: Odds ratio and marginal probability effects of commercialisation pathway on lean season hunger prevalence for the asset-poor households

Independent variable		Lean season food insecurity category			
	Odds ratio	1=Secure	2=Mildly insecure	3=Moderately insecure	4=Severely insecure
Household head gender (male=1)	0.0469***	0.723***	-0.176***	-0.276***	-0.271***
	(0.0434)	(0.219)	(0.0534)	(0.0835)	(0.0819)
Household head years in school	1.074	-0.0169	0.00413	0.0064	0.00634
	(0.082)	(0.0181)	(0.0044)	(0.0069)	(0.00676)
Area cropped (acres)	0.936	0.0155	-0.00379	-0.00594	-0.00582
	(0.0527)	(0.0133)	(0.00325)	(0.00508)	(0.00498)
Tobacco commercialisation index (%)	0.984**	0.00374**	-0.00091**	-0.00143**	-0.0014**
	(0.00701)	(0.00169)	(0.000411)	(0.000643)	0.000631)
Food commercialisation index (%)	0.983*	0.00398*	-0.00097*	-0.00152*	-0.00149*
	(0.00901)	(0.00218)	(0.00053)	(0.00083)	(0.000814)
Soyabean commercialisation index (%)	0.993	0.00172	-0.00042	-0.00066	-0.00064
	(0.00838)	(0.002)	(0.000487)	(0.000762)	(0.000748)
Casual labour wages (US$/AME)	0.9999	1.55E-05	-3.79E-06	-5.93E-06	-5.82E-06
	(0.00106)	(0.000251)	(6.13E-05)	(0.000096)	(9.41E-05)
Household enterprise income (US$/AME)	0.997*	0.000641*	-0.00016*	-0.00024*	-0.00024*
	(0.00156)	(0.00037)	(9.02E-05)	(0.000141)	(0.000139)
Value of safety net receipts (US$/AME)	0.991	0.00208	-0.00051	-0.00079	-0.00078
	(0.0157)	(0.00373)	(0.00091)	(0.00143)	(0.0014)
Regular employment income (US$/AME)	0.998**	0.000452**	-0.00011**	-0.00017**	-0.00017**
	(0.000918)	(0.000217)	(0.000053)	(0.000083)	(8.14E-05)
Remittance income (US$/AME)	0.990***	0.00229***	-0.00056***	-0.00088***	-0.00086***
	(0.00328)	(0.000782)	(0.000191)	(0.000299)	(0.000293)
Count of food crops and livestock species	0.836	0.0424	-0.0103	-0.0162	-0.0159
	(0.149)	(0.0422)	(0.0103)	(0.0161)	(0.0158)
Household size (AME)	1.131	-0.0291	0.00709	0.0111	0.0109
	(0.130)	(0.0272)	(0.00664)	(0.0104)	(0.0102)

Notes: Sample is restricted to households who appeared in both rounds. All estimates include household and year fixed effects. Robust standard errors, clustered at the farm scheme level (we have 18 farm schemes) in parentheses (* p<0.10, ** p<0.05, *** p<0.010)

Source: Authors' own

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