Smallholders' agricultural commercialisation, food crop yield and poverty reduction: Evidence from rural Burkina Faso

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Abstract

This paper analyses the extent to which an increase in food crop yield strengthens the relationship between agricultural commercialisation and rural poverty reduction in Burkina Faso. Based on data collected in 2011 from a sample of 1 178 smallholder farm households in rural Burkina Faso, a logit model, which includes an interaction term between crop commercialisation index and food crop yield, is estimated. The results show that, at a low yield of food crops, commercialisation can result in welfare loss, while the intensity of crop supply becomes a crucial factor of poverty reduction with a high level of yield. This suggests that structural transformation of the agricultural sector in Sub-Saharan Africa has the potential to bring about significant growth in rural income, particularly when staple crops are the driver of this transformation. Therefore, to enhance the contribution of agricultural commercialisation to poverty reduction, policy should also be designed to promote the growth of food crop yield.

Key words: agricultural commercialisation; food crop yield; poverty, Sub-Saharan Africa

1. Introduction

Promoting commercialisation in agriculture is viewed as inherent to the development process if the sector has to play an active role in economic growth and poverty reduction in developing countries (Pingali & Rosegrant 1995). In fact, market-oriented smallholder farming represents the most effective way to strengthen the linkages between technology, productivity and poverty reduction (De Janvry & Sadoulet 2009). Past studies also stress that agricultural commercialisation can affect the overall rural economy by inducing higher expenditure on the part of commercial farmers on labour, as well as higher demand for products and services from the rural non-farm sector (Mellor & Malik 2017; Papaioannou & De Haas 2017).

However, the literature highlights numerous cases of the perverse effects of commercialisation, particularly among the poorest smallholder farmers (Muriithi & Matz 2014; Carletto *et al*. 2017). This happens when the lack of access to credit and off-farm opportunities leads farmers to act irrationally by selling at low prices in the post-harvest season and buying at high prices in the dry season (Stephens & Barrett 2009). In addition, high exposure to food price volatility can hurt the welfare of smallholders who are involved in non-food cash crop production (Fafchamps 1992; Wood *et al*. 2013). Furthermore, a case that is rarely subject to empirical investigation is the fact that agricultural commercialisation that consists of promoting high-value crops may not induce significant income growth among farm households when staple crop yield is low (Diao *et al*. 2006; Dzanku 2015a). However, this may highlight the importance of food crop growth in strengthening the relationship between agricultural commercialisation and rural poverty.

The agricultural sector in Burkina Faso is characterised by a predominance of food crops, which occupy 60% of the arable land. Cotton, the main cash crop, is cultivated by about two million households and represents roughly 18% of the country's export revenue (OECD 2013). Policymakers face numerous challenges in promoting farm households' participation in agricultural output markets in Burkina Faso. Thus, as in many other African countries, past agricultural policy reforms consisted primarily of promoting export crop production. In general, these policy reforms did not provide substantial benefit to poor farm households. Birner and Resnick (2010) note that, in many cases, the overall response of the sector to these policy reforms is low, as export crops have benefitted more from trade and markets than food crops. The result has been a worsening of income disparity in rural areas because households in the most favoured areas, with better access to markets, benefit more than the rural landless and poor, who are mainly food crop producers. In addition, it is argued that, in many African countries, services such as input and extension supply and credit support have disappeared due to reforms undertaken under the Structural Adjustment Programme (SAP) (Alene *et al*. 2008). Consequently, despite market liberalisation, the majority of farm households in rural Africa still do not participate in agricultural markets, and most of the participants are not able to generate a significant market surplus for sale.

Kaminski (2011) further notes that the spill-over effects of cotton production in Burkina Faso have been powerless to structurally transform the economy because production growth was based less on productivity gained than on the accumulation of production factors like land and labour. Furthermore, high transaction costs and low structural support for food crop production have reduced many smallholder farmers' incentive and ability to produce for markets as far as food and non-food crops are concerned. The Comprehensive African Agricultural Development Programme (CAADP), adopted at the summit of the New Partnership for Africa's Development (NEPAD) in Maputo in 2003, suggested allocating at least 10% of national budgets to the agricultural sector within five years in order to achieve at least 6% growth in the sector and to meet the objective of halving the incidence of poverty, as formulated in the Millennium Development Goals (MDG). In response to this commitment, Burkina Faso has allocated on average 12% of its public budget to agriculture since 2009 and has achieved a growth of 5.2% in the sector between 2009 and 2011 (OECD 2013). However, the OECD (2013) stresses that most of the investment is concentrated in the cotton sector, while private investment in agriculture remains limited. Therefore, the effect of agricultural growth on poverty reduction has been lower than expected. This situation also shows the importance of supporting food crop productivity growth as part of promoting agricultural commercialisation to induce significant poverty reduction among smallholder farm households. Yet empirical studies that highlight how the performance of food crop production can enhance the benefits of smallholders' market integration are lacking.

The objective of this paper is therefore to fill this gap by analysing the effect of food crop yield on the link between agricultural commercialisation and rural poverty in Burkina Faso. The assessment of agricultural commercialisation in most studies was based on a restrictive definition that subjectively distinguished adopters and non-adopters of a given list of cash crops, and consequently provided evidence that was not comparable across countries. To avoid this crude dichotomous definition of agricultural commercialisation, Von Braun (1995) suggests an assessment based on the proportion of output that households sell with respect to the quantity harvested, regardless of the type of crops. The estimation of the level of agricultural commercialisation of famers in this study follows this more general definition of Von Braun (1995). Therefore, the study will help understand how the welfare of smallholders is influenced by their level of integration into markets, regardless of the type of crops involved and how food yield affects this relationship.

The layout of the paper is as follows. The next section presents the theoretical foundation of the study. The third section deals with the conceptual framework. The fourth section presents the empirical methods. The fifth and sixth sections present the results and the conclusion of the study respectively.

2. Theoretical framework

The theoretical foundation of the study is based on Minten and Barrett (2008) and Dzanku (2015b), who developed a partial equilibrium model to highlight the role of the commercial orientation of farm households, technological change and food crop productivity in alleviating rural poverty. The model defines two types of households in rural areas. The first group includes farmers with productive asset endowment (land and livestock) who generally generate positive marketable surplus. As net food sellers, the income of this group depends on the level of productivity and market prices. The second group covers farmers with limited assets who do not produce enough food for their own consumption. This group may include the rural landless, those employed in the nonfarm sector, or unskilled labour who draw an important part of their income from agricultural wages (off-farm).

The net effect of productivity growth due to technological change on crop income is positive if, and only if, the absolute value of elasticity of output with respect to technological change, which is positive, is greater than the elasticity of price with respect to technological change, which is negative. However, the extent of price reduction due to technological change depends on the size of the market (i.e. the demand) to which the farmers have access. The more the crop is marketable and the more the various markets are accessible to farmers, especially in urban areas, the less the effect of price would be compared to the effect of productivity increase, and then the net sellers will experience a higher income. However, when markets are highly segmented, crop price will be highly sensitive to an increase in local productivity, and this effect on price will tend to be greater than the production effect of technological innovation, and may, at least in the short run, decrease the income of net food sellers. Concerning the second group, i.e. off-farm workers and net food buyers, the effect of productivity growth due to technological change on their net income will be positive. This is because technological change in agriculture would have a positive effect on the dynamics of rural nonfarm activities and lead to an increase in the wage rate (Minten & Barrett 2008). In addition, the price fall due to productivity growth will be profitable for net buyers of food. The conclusion is that productivity growth will always have a positive effect on the welfare of net buyers of crops. For crop sellers, the more the markets are integrated, the less the price reduction will be and the more will be the positive effect of productivity growth and market participation on welfare.

3. Conceptual framework

Based on the theoretical framework and previous studies, this conceptual framework emphasises the drivers of agricultural commercialisation and its effects on the rural economy (Figure 1). The drivers include community characteristics such as the availability of rural infrastructure and accessibility to urban areas and markets. The improvement of physical infrastructure and household access to information would positively affect the household level of commercialisation by reducing transaction costs (Renkow *et al*. 2004) and speeding up price adjustment across markets (Aker 2010). In addition, adequate policies and institutional arrangements, combined with the development of rural infrastructure and services, improve access to markets and strengthen the linkages between urban and rural areas. The other drivers of agricultural transformation include sound macroeconomic and trade policies, which make agricultural markets profitable for smallholders (Von Braun 1995). This macroeconomic framework and national agricultural policies, combined with the physical accessibility of rural areas, would determine the level of adoption of innovations by farm households and technological change in the rural economy.

On the other hand, farmers' resource allocation to different activities, including subsistence, commercial and nonfarm activities, depends on various factors such as their initial asset endowment, agroclimatic conditions and the availability of technology that they can afford. Thus, farm households that are located in more suitable agroclimatic zones would be more productive and more likely to allocate more resources for commercial farming. Also, asset holdings such as land and agricultural

equipment, as well as access to inputs, will improve the extent of households' agricultural commercialisation.

Increased agricultural commercialisation may directly affect productivity by increasing specialisation when numerous markets are accessible to farmers. In addition, commercial orientation is generally an avenue for farmers to get better access to modern inputs, because households that are more commercially oriented would be more willing to adopt yield-enhancing technology than subsistence farmers (Govereh & Jayne 2003). Thus, this will result in higher crop productivity. There may also be a bidirectional relationship between agricultural commercialisation and farm productivity in that an increase in productivity raises households' market surplus and can lead to a higher level of commercialisation (Rios *et al*. 2009; Bekele *et al*. 2010).

A higher level of agricultural commercialisation of smallholders and improved yield will increase rural income and reduce the incidence of poverty. Thus, acting as a vehicle for improved technology adoption and technological change, market participation increases productivity, resulting in lower food prices, which benefits the net buyers of food and off-farm workers. Productivity growth will result in increased demand for labour and in higher wage rates, while the increase in expenditure on rural non-traded goods increases opportunities for nonfarm employment among rural workers (Minten & Barrett 2008; Mellor & Malik 2017). Therefore, agricultural commercialisation and productivity growth would result in income growth, both for households that are commercialising their crops, and for households that are supplying their labour. This will result in a reduction in poverty and improved food security among rural households, while income gain can, in turn, improve farm households' asset accumulation and resource allocation towards commercial farming. The long-run effect would be a specialised farm household production system and increased crop diversification at the national level (Timmer 1997).

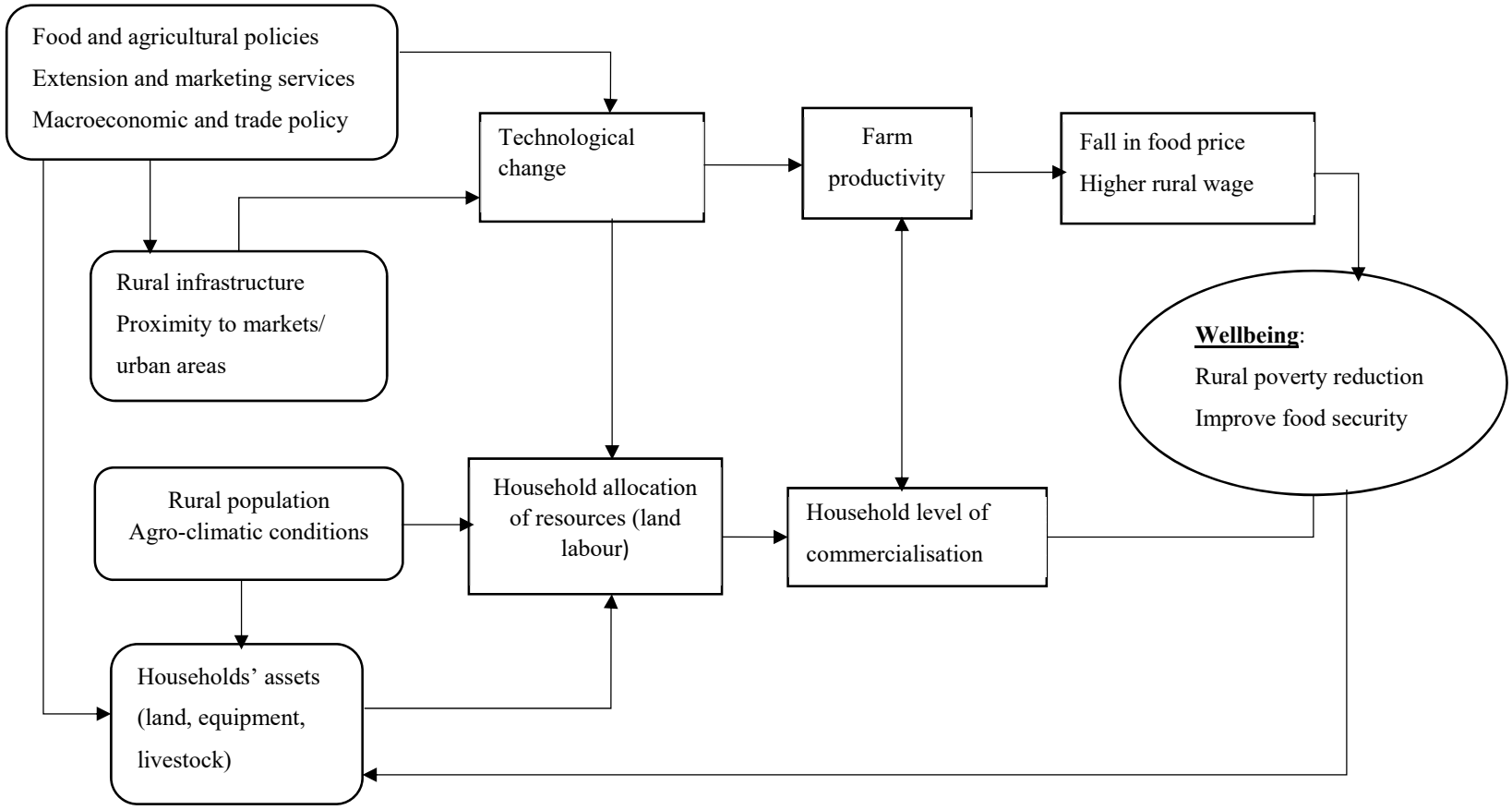

Figure 1: Agricultural commercialisation – Determinants and effects on the rural economy
Source: Author's own construction

4. Empirical method and data source

4.1 Empirical method

Based on a consumer choice theory, a consumer i chooses a bundle of goods that maximise the utility function, $U(q)$, subject to a budget constraint, $y_i = p.q$. At the optimal level, if U^* is the maximum value of utility achieved, then y_i necessarily represents the minimum cost to reach U^*. Therefore, y_i denotes the household cost or expenditure function, which can be used as a measure of wellbeing. Thus, including household characteristics in order to capture the differences across households, and following Deaton (1997), y_i can be expressed as:

$$y_i = p.q = e(p, x, U^*), \tag{1}$$

where p and q represent the vectors of price and quantity of goods consumed respectively, $e(.)$ is an expenditure function, and x denotes household characteristics (composition, size, etc.).

Based on this theory, to estimate the extent to which agricultural commercialisation and food crop productivity affect poverty among smallholder farm households, a discrete choice model of household poverty status is specified: Let w_i^* be a latent variable representing unobserved household poverty status (or wellbeing) as a function of food crop productivity $yield_i$, household crop commercialisation index CCI_i, and a set of exogenous factors x_i.

$$w_i^* = X_i\beta + \varepsilon_i \tag{2}$$

$$w_i^* = \alpha_0 + \alpha_1 CCI_i + \alpha_2 ln(yield_i) + \alpha_3 \ln(yield_i) * CCI_i + x_i\gamma + \varepsilon_i \tag{3}$$

α and γ denote the vectors of unknown parameters to be estimated, and ε_i denotes the error terms. The observed household position – as poor or not – is described by a discrete variable w_i, taking the value 1 if the household consumption expenditure is below the poverty line, z, and zero otherwise. Hence,

$$w_i = \begin{cases} 1 & if\ w_i^* < z \\ 0 & Otherwise \end{cases} \tag{4}$$

As regards the binary nature of the poverty indicator, a logit regression model is applied. The logit model is formulated as follows:

$$p_i = Pr(w_i^* < z) = Pr[w_i = 1|X_i] = \frac{exp(X_i\beta)}{1+exp(X_i\beta)} \tag{5}$$

In the literature, coefficients of the Logit model are commonly interpreted in terms of their marginal effects on the odds ratio rather than on the probability itself. Thus, from (5), we can write

$$\frac{p_i}{1-p_i} = exp(X_i\beta) \leftrightarrow ln\left(\frac{p_i}{1-p_i}\right) = X_i\beta \tag{6}$$

$$\leftrightarrow ln\left(\frac{p_i}{1-p_i}\right) = \alpha_0 + \alpha_1 CCI_i + \alpha_2 ln(yield_i) + \alpha_3 \ln(yield_i) * CCI_i + x_i\gamma + \varepsilon_i \tag{7}$$

Here, p_i represents the probability of being poor (i.e. $w_i = 1$). The ratio $\frac{p_i}{1-p_i}$, called odds ratio or relative risk, measures the probability that $w_i = 1$ relative to the probability that $w_i = 0$ (Cameron & Trivedi 2005). It follows that a one-unit increase in a given regressor, X_j, affects the odds ratio (i.e.

the relative probability of being poor) by $exp(\beta_j)$, ceterus paribus. Thus, after the estimation of the logit model, the estimated coefficients of the model and the coefficients of the odds ratio are directly reported.

The marginal effect of agricultural commercialisation on the logarithm of the odds ratio is:

$$\frac{\partial ln\left({}^{p_i}/_{1-p_i}\right)}{\partial CCI_i} = \alpha_1 + \alpha_3 ln(yield_i) \quad (8)$$

In this specification, the overall marginal effect of agricultural commercialisation on households' welfare depends on the level of food crop yield because of the presence of an interaction term between commercialisation index and yield. However, in a nonlinear model, the interaction effect will not be just equal to α_3, and the effect of the commercialisation index would be different from $\alpha_1 + \alpha_3 ln(yield_i)$, as it would be in the case of a linear model. Ai and Norton (2003) show that there is a difference between the magnitude of the interaction effect and the marginal effect, α_3, of the interaction term in the nonlinear model and suggest a method to estimate the marginal effect of the interaction term in the logit and probit model. Thus, following their method, which is developed further in Norton *et al*. (2004), the interaction effect and its distribution in the sample are re-estimated for a robustness check.

4.1.1 Measurement of household poverty status

Data on households' consumption expenditure on food and non-food items, including self-consumption, is used to compute the poverty status of each household. Per capita household expenditure is calculated in adult equivalents using the OECD scale-equivalence method. The OECD equivalence scale is expressed as follows (World Bank 2014):

$$AE = 1 + 0.7 * (N_{adults} - 1) + 0.5 * N_{children}, \quad (9)$$

where AE denotes household size in adult equivalents, and N_{adults} and $N_{children}$ denote the number of adults (15 years old and more) and children (0 to 14 years old) in the household respectively. Total expenditure is then divided by the equivalence scale to obtain per capita household expenditure.

The Foster-Greer-Thorbecke (FGT) poverty measure was used to evaluate the incidence of poverty (Foster *et al*. 1984). Thus, the well-known FGT classes of poverty measures are expressed as follows:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{H}\left[\frac{z-y_i}{z}\right]^\alpha, \quad (10)$$

where N is the number of individuals in the sample, z is the poverty line, y_i is the per capita consumption of household i, H is the number of poor people in the sample (i.e. households with consumption expenditure that is below the poverty line, z), and α is a parameter of poverty aversion. If $\alpha = 0$, then $P_\alpha = H/N$ represents the headcount index or proportion of households that are poor in the sample. If $\alpha = 1$, then P_α is the poverty gap index, that is a measure of the depth of poverty or the mean distance between the poor and the poverty line. If $\alpha = 2$, P_α represents a measure of severity of poverty reflecting the degree of inequality among the poor.

The poverty line, z, defines the minimum amount required for an adult to satisfy his basic daily needs. In this case, z represents the minimum level of consumption (or income) required per adult and per year to satisfy his basic needs, which include food and non-food goods, along with services such as education, healthcare and clothing. In Burkina Faso, the national poverty line was estimated at

130 735 FCFA per adult and per year in 2011.[1] Therefore, this poverty line was used to identify the poor and non-poor households in the sample.

4.1.2 Explanatory variables

Agricultural commercialisation is measured at the household level as the proportion of crop sold with respect to crop harvested, following Pingali and Rosegrant (1995), Strasberg *et al*. (1999) and Von Braun (1995). The crops included are limited to rain-fed food and non-food crops produced in Burkina Faso. For the computation of food crop yield, only sorghum, millet and maize are considered. These crops represent the most important food crops produced by farm households in the country. Following Carter (1997), food crop yield is measured in terms of sorghum equivalent. Other control variables include the dependency ratio, measured by the number of active persons (15 to 64 years old) to inactive persons (younger than 15 and older than 64 years), non-farm income per adult measured in 1 000 FCFA, distance to the nearest market measured in kilometres, and a binary variable (taking the value 1 if the roads are bad all the time) to capture the existence or not of all-weather roads that link the village to the nearest city.

4.2 Data source and descriptive statistics

The data used in this study come from a survey undertaken in rural Burkina Faso in 2011 by the Department of Economics of University Ouaga II on a sample of 1 178 farm households selected across the entire country. Two-stages and randomised sampling approaches were used to select the sample to be surveyed. In the first stage, villages were selected across the 13 regions according to the representativeness of each region in the country, making a total of 270 villages. Within each village, households were stratified according to their ownership and use of animal traction and randomly selected within each stratum. Finally, the total sample size was 1 178 households distributed across 270 villages in the 13 regions of the country.

The descriptive statistics of the sample indicate no significant difference in household poverty status between sellers and non-sellers of crops (Table 1).

This may be due to the influence of other factors, such as food crop yield, in the linkage between poverty and commercialisation. Therefore, to obtain a significant relationship, there is a need to control for these factors. The econometric method used in the empirical section would thus be more convenient to assess this relationship.

[1] This amount represents about 262 USD per adult and per year, or 0.71 USD per adult and per day.

Table 1: Descriptive statistics of variables

Variables	All sample N = 1 178	Non-sellers (1) N = 523	Sellers (2) N = 655	Differences (1)-(2)
Household size	8.805	8.228	9.266	-1.04***
	(4.024)	(3.873)	(4.085)	(-4.43)
Dependency ratio (dependent/active)	1.563	1.525	1.592	-0.067
	(0.846)	(0.849)	(0.843)	(-1.35)
Farm size/worker (ha/adult)	1.158	0.987	1.295	-0.31***
	(0.584)	(0.560)	(0.566)	(-9.33)
Fertiliser use (kg/ha)	11.24	4.783	16.40	-11.61***
	(34.50)	(29.60)	(37.18)	(-5.82)
Per capita food expenditure (1 000 FCFA)	10.99136	11.03484	10.95664	0.0781**
	(0.018)	(0.027)	(0.024)	(2.133)
Food crop yield (kg/ha)	540.59	469.52	597.34	-127.81***
	(9.901)	(12.23)	(14.51)	(-6.526)
Per capita non-farm income (1 000 FCFA)	74.54	57.87	87.84	-29.97
	(15.27)	(4.63)	(27.21)	(-0.97)
Binary variables				
Poverty status (1 = poor)	0.69	0.67	0.70	-0.021
	(0.021)	(0.020)	(0.018)	(-0.811)
Gender of household head (1 = man)	0.95	0.946	0.96	-0.0199*
	(0.20)	(-0.22)	(0.18)	(-1.68)
HH is in nonfarm activities (1 = yes)	0.510	0.524	0.499	.024
	(0.500)	(0.500)	(0.500)	(0.84)
HH has access to credit (1 = yes)	0.29	0.18	0.38	-0.20***
	(0.45)	(0.38)	(0.48)	(-7.67)
Village characteristics				
Bad road (1 = yes)	0.303	0.237	0.355	-0.118***
	(0.013)	(0.018)	(0.018)	(-4.43)
Distance to nearest market (km)	7.186	6.661	7.606	-0.9444***
	(6.235)	(5.398)	(6.805)	(-2.58)
Cereal price (FCFA/kg)	131.7	133.8	130.0	3.787***
	(18.41)	(18.63)	(18.07)	(3.52)

Note: *, ** and *** indicate the levels of significance of the corresponding coefficients at 10%, 5% and 1% respectively. Standard deviations are reported in parenthesis, except for the difference test, where t-statistics are reported.

Farmers participating in the market therefore have significantly higher food crop yield than full subsistence farmers. This may be related to the fact that, in Burkina Faso, fertiliser and credit schemes are most often designed for farmers who are engaged in the commercial system. Also, the estimated average yield in the sample, of 0.5 ton/ha, is lower than the average yield of cereal crops in sub-Saharan Africa, which is about 1 ton/ha. This difference can be related partly to the low use of modern inputs by farm households in Burkina Faso, which is estimated at 11 kg/ha. This estimate is particularly lower among farm households that do not participate in the markets. However, based on the descriptive statistics, the relationship between commercial farming and household welfare is not strong.

5. Results and discussion

The logit estimation results of the effect of agricultural commercialisation and food crop yield on rural poverty are reported in Table 2, which also reports the corresponding coefficients of the odds ratio. The interaction term between the crop commercialisation index and food crop yield is included in the regression to highlight the influence of food crop yield in the relationship between crop commercialisation and poverty among smallholders.

The findings show that the coefficients of both the crop commercialisation index and the interaction term between food crop yield and commercialisation index are statistically significant, at 5%.

However, the marginal effect of the crop commercialisation index on the probability of being poor is positive, while the effect of the interaction terms is negative. This suggests that the overall effect of agricultural commercialisation on farm households' welfare and on their probability of being poor is ambiguous and depends on the level of food crop yield. In fact, at a low level of crop yield, an increase in agricultural commercialisation results in an increased probability of being poor. However, with a high level of food crop yield, an increase in the level of crop commercialisation reduces the probability of being poor.

Table 2: Logit estimation of the effect of agricultural commercialisation on rural poverty

Dependent variable: Poverty status – (w) = 1 if farmer is poor and 0 otherwise		
Variables	**Coefficients**	**Odds ratio**
Crop commercialisation index (CCI)	0.059** (0.028)	1.060** (0.029)
Log of staple yield	0.068 (0.153)	1.071 (0.163)
CCI*Log of staple yield	-0.009** (0.004)	0.991** (0.004)
Dependency ratio	0.152* (0.085)	1.165* (0.098)
Per capita nonfarm income	-0.007*** (0.001)	0.993*** (0.001)
Distance to market	0.033** (0.015)	1.034** (0.016)
Bad roads	0.609*** (0.190)	1.838*** (0.349)
Constant	0.208 (0.926)	1.232 (1.140)
Observations	1,178	1,178
Wald chi^2 (7)	82.37	
Prob > chi^2	0.000	
Pseudo R^2	0.0823	

Note: *, ** and *** indicate the levels of significance of the corresponding coefficients at 10%, 5% and 1% respectively. Robust standard errors adjusted for the 217 village clusters are reported in brackets.
Source: Results from the author's model

However, Ai and Norton (2003) showed that the coefficient of the interaction term estimated in the nonlinear model may not correctly identify the interaction effect. They suggested a method for estimating the marginal effect of the interaction term for the particular case of logit and probit models. Based on their method, and following the computation package they offered later in Norton *et al*. (2004), the correct interaction term effect is estimated and reported in Table 3. Furthermore, the distribution of the interaction effect as a function of the predicted probability of the observations in the sample is presented in Figure 2(a) and 2(b). However, with regard to the distribution of the interaction effect in Figure 2(a), the correction of the marginal effect of the interaction terms does not differ much from the first estimation. Thus, the results reported in Table 2 adequately capture the influence of the interaction terms and highlight the importance of increasing food crop yield in enhancing the poverty reduction effect of agricultural commercialisation.

This means that agricultural commercialisation would reduce rural poverty if smallholders can achieve a high level of food crop yield. In contrast, in the context of low performance in food crop production, participation in agricultural commercialisation may result in a welfare loss. When farm households face a low yield of food crops, an increased level of commercialisation may increase the risk of food shortage. Furthermore, high exposure of farmers to food price fluctuations in the context of low yield may also have a detrimental effect. In contrast to some recent studies, which found no strong evidence of a positive relationship between agricultural commercialisation and welfare among smallholder farmers (Carletto *et al*. 2017), this study considers that, because food crops represent the

predominant crops produced by the majority of smallholders in Burkina Faso, it is likely that the level of yield plays a crucial role in the effect of participation in agricultural commercialisation on poverty.

Table 3: Estimation of the interaction effect and z-statistics based on Norton *et al.* (2004)

Variable	Observations	Mean	Std dev
Interaction effect	1 178	-0.0018**	0.000437
Standard error	1 178	0.000854	0.000208
Z-statistics	1 177	-2.11324	0.248174

Source: Results from the author's model

(a) **(b)**

Figure 2: Distribution of interaction effect (a) and Z-statistic (b) as a function of the predicted probability

Source: From author's own estimation

Thus, the effect of agricultural commercialisation on poverty reduction among smallholder farmers is closely linked to the level of the yield of food crops. Therefore, successful agricultural transformation requires both the involvement of smallholders in the process and significant support for the growth of food crop yield to raise the poverty-reduction effect of increased participation in output markets by smallholders. Furthermore, this finding supports the results of various studies that show the high potential of food crops in reducing poverty among farm households in many African countries (Al-Hassan & Diao 2007; Diao & Pratt 2007; Mellor & Malik 2017). Dutilly-Diane *et al.* (2003) indicated that the activity choice of farm households in Burkina Faso is influenced by their performance in food production, thereby explaining the persistence of subsistence food crop production, which most often takes place at the expense of non-food production for markets. Similarly, in a study on Ghana, Dzanku (2015a) found that promoting agricultural commercialisation through the increased adoption of high-value crops may fail to produce the expected outcome in the context of the low productivity of staple crops.

Globally, the coefficients of most of the control variables have the expected signs. Thus, distance to market and lack of good roads increase the probability of being poor. Households living in rural areas that lack access to good roads or are far away from markets will face high transportation and input costs, as well as limited access to non-farm opportunities. This leads to a lower level of consumption and a higher likelihood of being poor than those households having access to markets or living in areas that are connected to urban areas by good roads. Numerous empirical studies have found a positive effect, through various channels, of rural isolation and bad transportation conditions on poverty in developing countries. Some examples of studies include Stifel and Minten (2016) in Ethiopia, Renkow *et al.* (2004) in Kenya, and Damania *et al.* (2016) in Nigeria.

In addition, access to nonfarm income significantly reduces the probability of being poor. This finding highlights the importance of nonfarm income in the livelihoods of rural households and how its

promotion can help alleviate rural poverty. Similar results were found by Savadogo *et al*. (1998) in Burkina Faso. Numerous studies also emphasise the role of the nonfarm economy for farm households in developing countries (Lanjouw & Lanjouw 2001; Tsiboe *et al*. 2016). Essentially, by improving farm households' access to food and modern technologies through reducing their liquidity constraints, nonfarm activities may have a positive effect on farm productivity and household welfare. Concerning household socio-economic characteristics, the results show that a high dependency ratio is associated with a higher probability of being poor. This means that households with a higher number of dependants relative to the number of active members are more likely to be poor.

The results indicate that an increase in agricultural commercialisation among smallholder farmers is more likely to reduce poverty when the yield of food crops is sufficiently high. This suggests that jointly promoting agricultural commercialisation and the growth of food crop yield represents a strategy that can adequately bring about significant poverty reduction among smallholders.

6. Conclusion

Promoting agricultural commercialisation has the potential to raise rural income and reduce poverty. However, the underperformance of food crop production may reduce the welfare effect of agricultural commercialisation policy, especially among smallholders. The effect of commercialisation in agriculture on rural poverty, and the extent to which this effect is influenced by the level of food crop yield, was therefore examined in this paper. Based on data collected from 1 178 farm households in Burkina Faso, the estimation results of a logit regression model show a significant influence of food crop yield on the sign and the magnitude of the effect of agricultural commercialisation on the likelihood of being poor. Indeed, for households with a low yield in food crops, the overall effect of an increase in the intensity of commercialisation is a reduction in welfare, while an increase in agricultural commercialisation in a context of high yield of food crops reduces the likelihood of being poor.

Due to the imperfection of food markets and the importance of self-consumption in sub-Saharan African countries, food crop productivity has a great influence on many farm households' activity choices and the profit gained from the various activities. These results therefore confirm the importance of supporting the growth of food crop yield for a more significant effect of investment in the agricultural sector on rural poverty reduction. Thus, there is a need for policymakers to jointly promote smallholders' market integration and food crop production for sustained income growth and poverty reduction in rural areas. This would not only increase the level of commercialisation of food crops, but also grant households the possibility of adopting high-value crop production according to their comparative advantage, without bearing a high risk of welfare loss due to food deficit and eventual price shocks. Also, with regard to rapid urbanisation and population growth resulting in a high demand for food crops, realising a surplus in food crop production increases the level of market participation of farmers, as well as their income. Therefore, improving farmers' access to the market by providing adequate infrastructure should be supported, as well as measures that ensure farmers' access to improved inputs and technologies that can potentially raise the level of food crop yield.

However, using cross-sectional data to assess the level of farm household level of commercialisation might not make it possible to identify the underlying factors behind the decision of each household to sell output. Thus, an important amount of crop sold by some households may not represent their level of commercialisation based on a decision of profit maximisation, but instead may be a result of distress sale, which can be exacerbated by a lack of credit access and nonfarm income. An analysis based on panel data therefore could adequately highlight the pattern of household commercialisation in sub-Saharan countries.

Productivity growth of food crops is often seen as having the highest potential to reduce rural poverty. However, how market development can promote farm household income and access to and diffusion of improved technologies among smallholders needs further exploration. Finally, there is a growing interest in promoting contract farming as a strategy to overcome rural market imperfection and increase smallholders' market integration and income. Thus, an empirical investigation would be important to highlight the potential contribution of contract farming to promoting smallholders' agricultural commercialisation in the context of African agriculture, which in many cases is dominated by subsistence farming.

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