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Determinants of Market Participation Among Pearl Millet Farmers in Dioila Cercle, Mali

Modibo Guindo Bett K. Hillary Amadou Guindo Assoumane Maiga Lassina Diakite
Department of Agricultural economics and agribusiness management, Egerton University
P.O Box 536-20115, Egerton, Kenya

Abstract
In recent years, governmental and non-governmental organizations in Mali have given more attention to agricultural market development to meet consumers demand. This demand marks a model of mass consumption which is related to an increase of the population. Thereby, different programs have been developed to target agricultural value chains and market linkages. The main purpose of this paper was to assess the emerging marketing value chain of pearl millet in Dioila cercle among farmers. The survey was conducted in seven villages. Primary data was collected through face-to-face interviews using semi-structured questionnaires and secondary data obtained from the National Office of Trade and Competition, National Office of Market Observatory, and Organization for Consumers in Dioila. The characterization of farmers was done using descriptive statistics. To measure market participation among farmers, Heckman two-step model was used. The finding was that 212 out of 292 of sampled farmers were participating in pearl millet market. Farmers were in three groups (small, medium, and large scale) of production according to the size of land allocated to that crop and at different level of commercialization 57%, 38%, 7% respectively. Each of them was operating individually in three types of markets. Only 4.25% of participating households were female headed and 42.45% of sampled farmers' wives were homeworkers. In addition, farmers were not receiving any kind of support for pearl millet production. Therefore, households' quantity harvested, storage conditions, selling to regular buyers, and to wholesalers increased farmers' likelihood to participate in market while households' consumption and membership to cereal cooperative decreased their level of participation. Farmers were still practicing the traditional system of production, more land allocated to pearl millet production and labour for weeding were likely to increase their yield; whereas education of the farmer and labour used for land preparation adversely affected the quantity harvested.
Keywords: Heckman two-step model, pearl millet farmers, market participation

1. Introduction

Pearl millet is high value crop that is widely grown around the world as cereal or grain crops for both food and feed use. It has become a favoured crop due to its excellent nutritional qualities and its short growing period under high temperature. In terms of millet nutritional property, it is superior to rice and wheat highly consumed. In all over the world, there are 6,000 varieties of millet with different colours as pearl millet, finger millet, proso millet, foxtail millet, and others (Mordor, 2017). Pearl millet has varied fork nomenclature: bajra (India), gero (Nigeria), hegni (Niger), sanyo (Mali), dukhon (Sudan), and mahangu (Namibia) (Andreas, 2015). Millet production sector can contribute and boost major continental priorities in intra-Africa trade, investment, sustainable development, rapid industrialization, economy diversification, creating jobs, and human security.

According to Mordor (2017), the last decade was marked by an exceeded exportation of millet in term of value. The United Stated is the most dominant player in the millet exportation to Canada, Russia, and UK with 41,000 tonnes totalling USD 59 million followed by India and China. In African country, Ethiopia is fastest grower of seeds. According to ICRISAT (2016), Africa continent contributed only 2% between 2009 and 2011 in international millet trade. Millet can be used to address is the way forward for countries like India and Sub Saharan countries in Africa, where nutritional quality of food is still a challenge. India has the highest demand in millet grains and globally largest producer, followed by Nigeria, Niger, China, and Mali (Mordor, 2017).

In Africa, the demand for food and the pressure on water resources are increasing. Pearl millet is shelf life increase in efficiency of water use in production which is predicted to drive the market during the next few years. According to ICRISAT (2016), finger millet grows well in eastern Africa and pearl millet in the west. The continent has greater potentiality to participate in international trade exchange. The wind of investment is toward African farmers' participation in agricultural trade development (OECD, 2016).

Over the last decade, countries which have increased investments in agricultural products commercialization particularly millet have realized reductions in poverty and increase their share in both local and international markets. These countries are a fact: Ghana, Zambia, Togo, Burkina Faso, Mali, Burundi, Niger, Malawi, Congo, Ethiopia and Senegal. By the year 2050, the population in African countries will reach two billion people, therefore crops commercialization will be the driving force to face challenge to feed the increased population such as create wealth, and conserve resources for future generation of which, majority will be women and youth (Chimatiro, 2013). Crops commercialization is everyone business because the independence of our

countries depends on it, which allows us to escape from the agony of food insecurity.

Agricultural products commercialization plays an important role in contributing to food security and economic development in Sub-Saharan Africa (SSA). Across the continent, success has been achieved in different countries with stable political conditions and economic growth. Markets development expansibility suggests that appropriate governance systems, institutional capacities, structural and sectorial policies can work together to improve agricultural products value chains on a sustainable basis (OECD, 2016). Furthermore, the sector provides employment to over a half of SSA's population. Notably, commercialization is the main source of livelihood in the rural areas. It is crucial to note that the sector is dominated by smallholder farmers operating individually, producing for their own food security and marketing purposes (Rahut, 2015). However, low improvement has been observed in production factors such as labour and land (Chimatiro, 2013). According to MAFAP *et al.* (2013), more studies should be done to promote commercialization of staple food. In West Africa, millet is the main staple food produced by most farmers, it is a strategic crop for food security (APARISI1, 2013). Africa is the origin and a major producer of millet. Millet ranks second with 19,998,008 hectares of land allocated to its production after maize (34,075,972 hectares) with an annual productivity of 16,008,838 tonnes in 2012 (Harold, 2015).

As in many countries, agriculture remains a primary source of income. Belieres (2014) mentioned that 75% of the Malian's population depends mainly on agriculture for food security and livelihoods. The sector contribution to the country's GDP moved from 38% in 2013 to 41 % in 2015 (World Bank, 2015). Mali is ranked fourth largest producer of pearl millet with 6.4% after Nigeria (41%), Niger (16%) and Burkina Faso (7%) among the West African countries (FAO, 2015). Previous studies by International Crops Research Institute for the Semi-arid Tropics (ICRISAT) on pearl millet have recommended increases in production and market access, but a few have expounded on the subject matter.

2. Methodology

2.1 Study area and sampling technique

Dioila cercle is the basin of cereals production in the midst of Koulikoro Region. The area is located $12^0$29'N and $6^0$48'W with a total area approximatively of 12,794 km^2. This study was conducted in villages highly involved in pearl millet, sorghum, and maize production. Multi-stage sampling procedure was used. The first stage involved purposive selection of seven villages in Dioila cercle. The areas were selected purposively based on quantities and number of pearl millet farmers. Finally, a simple random sampling was used to select 292 farmers with the formula of Yamane Taro in seven villages. Primary data was collected using semi-structured questionnaires.

2.2 Method of data analysis

Stata version 12 was used to process data. Descriptive statistics and Heckman two stage model were used together to analyse data. T-test and chi square indicators were employed to determine the relative difference between market participants and non-participants.

To determine the extent of millet market participation and factors influencing, the Heckman two-step model was used. The decision on whether participate in the market or not and level of involvement were estimated independently. First, is whether a farmer participates in pearl millet market or not then secondly the extent of participation (based on the proportion of quantity sales). The percentage of output sales is qualified on the participation decision to the market. The Heckman two-step model procedure is a process for correcting sample selectivity bias with widespread usage of (Geoffrey, 2013). The first step is a selection equation of estimation using a probit model. That model predicts the probability of whether a farmer participates or not in the market as shown.

$$\mathrm{pr}(Z_i = 1 \mid w_i, \alpha) = \Phi(h(w_i, \alpha)) + \varepsilon_i \quad (1)$$

Where; Z_I is indicator variable equal to the unity of pearl millet market participant that takes the value of 1 if the marginal utility the farmer *i* get from participating in the marketing of pearl millet is greater than zero, and zero otherwise. Φ is the standard normal cumulative distribution function, and w_i is a vector of factors affecting the decision of participation, α is a vector of coefficients to be estimated, and $\varepsilon_i$the error term assumed normally distributed.

From equation below:

$$Z_i^* = \alpha * w_i + \mu_i \quad (2)$$

Where; Z_i^* is the latent level of utility that a farmer gets from participating in the market, $u_i \sim N(0, 1)$ and,

$$Z_i = 1 \text{ if } Z_i^* > 0$$

$$Z_i = 0 \text{ if } Z_i^* > 0$$

In the second stage, an additional regressor in the sales equation is included to correct for potential selection bias. This regressor is the Inverse Mills Ratio (IMR) computed as:

$$\lambda = \frac{\varphi(h(w_i, \sigma))}{\varphi(w_i, \sigma)} \quad (3)$$

Where; ϕ is the normal probability density function. The second-stage equation is given by:

$$E = (Y_i \mid Z = 1) = f(x_i, \beta) + \lambda \frac{\varphi(h(w_i, \sigma))}{\varphi(w_i, \sigma)} \quad (4)$$

Where; E is the expectation operator, Y is the (continuous) proportion of millet sold, x is a vector of independent variables affecting the quantity of millet sold, and β is the vector of the corresponding coefficients to be estimated.

So Y_i can be expressed as following:

$$Y_i^* = \beta' x_i + \gamma\lambda_i + \mu_i \quad (5)$$

Where: $u_i \sim N(0, \sigma_u)$

Y_i^* is only observed for those farmers who participate in the marketing ($Z_i = 1$), in which case $Y_i = Y_i^*$.

The model can thus be estimated as follows:

The first step of deciding whether to participate or not is specified as:

$$P_{(0,1)} = \beta_0 X_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \mu \quad (6)$$

Where; 1 denotes participant and 0 indicates non-participant, β_0 is a constant, $\beta_{1...n}$ are parameters to be estimated X_{is} are the vector of explanatory variables. The second stage, a decision on the extent of pearl millet marketing is estimated by using an OLS as follows:

$$Y = \beta_0 X_0 + \beta_1 X_1 + ... + \beta_n X_n + \mu \quad (7)$$

Where; Y denotes the proportion of millet sales, β_0 is a constant, $\beta_{1...n}$ are parameters to be estimated X_{in} is the vector of explanatory variables.

3. Results and discussion

3.1 Socio-economics characteristics in relation to pearl market participation

The result on household head gender, marital status, and age is shown in table 1. Approximatively, 96% of sampled households were male-headed. This indicates that women were disadvantaged in pearl millet production and marketing because of cultural barriers and unequal distribution of resources. Females are related to constraints and access to opportunities in many developing countries. In rural areas, males confine females to household duties as a reason for excluding them from agricultural practice (Monimart, 2006). Males having higher access to resources and information that increases their chance to participate in pearl millet market participation. In addition, Siziba *et al.* (2011) argued that in Sub-Saharan Africa (SSA), male headed are dominant in cereal market. However, it was observed by (Byron, 2014) in Zimbabwe that female headed households are likely to participate in soybean market. Males headed household are the one managing farms resources and revenues while an important element of agriculture development strategies in low income countries relies on females (IMF, 2013).

The age of the household was found to be significantly associated with market participation at 5% level. Majority of market participant were between ages of 31 to 60 years old. This implies that farm households in that region can be described as relatively young and within active economic population. In the tradition of context, age is relevant in term of decision and responsibilities. It is within this range of age that small household heads' decisions can be considered when it is come to main household decision making on farm management or market participation. Younger farmers have adequate resources to produce more for commercialization and they have high mobility to carry out a better supervision. They were also being more flexible to new market requirements and innovative than older farmers. IFM (2015) found that younger farmers have more experience of market, easy access to credit and farm input that increase the commercialization of production surplus. Older farmers are reluctant in adopting new technologies and they might be perceived to be risks averse. This finding is consistent with (Musah, 2014) who found that older farmers are more concerned about food security and do not want to take risk of draining their maize banks.

Table 1: Households' head gender, marital status, and age in (%)

Variables	Non-Participant	Participant	Chi^2	P-value
Household Head Gender (%)				
Female	1.25	4.25	1.575	0.209
Male	98.75	95.75		
Household Head Marital status (%)				
Married	100	99.06	0.759	0.383
Widowed	0	0.68		
Household Head Age (%)				
18-30	0	0.94		
31-40	5	17.45		
41-50	35	35.85	11.313**	0.046
51-60	32.50	29.72		
61-70	20	11.79		
71-80	7.50	4.25		

*Note: *, **, *** represents significance levels at 10%, 5%, and 1% respectively*

Household size was generated by adding the number of male and female in the family. Farmers secured first household food consumption then sold the surplus of the production to market. It has been long established that households' consumption are closely related to the changes in its size and composition over life cycle. The consumption across periods in which families size keep on changing can affect their economy and change scale of production (life-cycle, 2013). Since the household size is determined the pattern of consumption, the larger the family the more the quantity consumed of pearl millet increase. In the study, sampled farmers had large households from grandparents to great grandchildren. In addition, Muricho (2015) argued that households are at the centre of social and economic processes, since decisions about living arrangements, education and health care, labour force participation, consumption, and household saving so a bigger household is likely to sell less because its production could be more targeting home consumption than market. That phenomenon is attributed to the fact that traditional families keep males at home for cultural issues for farm related labour requirement thereby, that increase families size and number of consumers. Those facts compromise the future production potential and increase food insecurity.

Table 2: Household size and pearl millet quantities consumed

Variables	Non-Participant	Participant	T-test	P-value
Household size (persons)	20	18	0.961	0.3371
Household Consumption (Kg)	1230.21	755	3.929***	0.0001

*Note: *, **, *** represents significance levels at 10%, 5%, and 1% respectively*

There were available lands for production. The availability of land matters to increase pearl millet production and intensify the commercialization. With an overall land size of 13.45 hectares (Table 3), farmers had shown they could invest, and invest well with government or private support. A great potential of production lay on land, labour, and rain fed. According to Djire *et al.,* (2012), the land tenure is insecure and farmers should access to leases for new land area.

The result shows a significant difference at 5% level. The land size allocated to pearl millet production depended on farmers' labour available, consumption, and decision to grow other cash crops. In addition, as farmers were not receiving any kind of support for that crop production; they could not afford to get large land size for millet production. Pearl millet was not the only crop grown by farmers. They were more focused on crops which they received support to produce. The quantities harvested depended not only on the land size but also on attention needed during the cultivation process. However, an increase of land size exposed farms at the borders of forest to production constrains and marketing (for example birds and other wild animals).

Table 3: Total land size and allocated to pearl millet production (Hectares)

Variables	Non-Participant	Participant	T-test	P-value
Household Total Land Size	14	13.45	0.353	0.724
Household Pearl Millet land	3.12	2.56	2.311**	0.021

*Note: *, **, *** represents significance levels at 10%, 5%, and 1% respectively*

In this study, the sampled farmers were divided into three groups according to the land size allocated for pearl millet of production, namely "Small-scale farmers" (having between 0.25 to 2.5 hectares), "Medium" (having between 2.6 to 4.9 hectares), and for "Large" (having 5 hectares and more). There was a significant relationship between farm size and market participation at 1% level as shown in Table 4.

Table 4: Scale of farmers

Scale of pearl millet producers	Market Participation				Total	
	Non participant		Participant			
Small scale	42	52%	122	57%	164	56%
Medium scale	24	30%	80	38%	104	36%
Large scale	14	18%	10	5%	24	8%
Total	80	100.00%	212	100.00%	292	100%

Pearson chi^2 = 12.7867 Pr = 0.002

*Note: *, **, *** represents significance levels at 10%, 5%, and 1% respectively*

3.2 Factors influencing pearl millet market participation

To determine factors influencing emerging pearl millet market, a probit model was used in the first step of Heckman two-step equations. The dependent variable market participation was generated based on the quantity sold (0 for non-participant and 1 for participant). Scale of the farmers according to the land size, pearl millet quantities consumed by household, quantities harvested, storage, collaboration period with regular buyers, selling to wholesalers, and members of cooperative were found significant and influence farmers' decisions to participate in pearl millet market at different significant levels. The Lambda was significant at 1% level, which suggests that the error term in the selection and the outcome equation are positively correlated. This implies that unobserved factors that influence pearl millet market participation are more likely to be associated with high scores on the dependent variables. The significance of Lambda justified the use of the model. Continuous variables were put into linear form so as to capture all the information for lower and higher numbers.

Table 5: Factors influencing pearl millet market participation

Variables	Coefficient	Standard Error	P-Value
Log Household size	-0.214	0.293	0.465
Access to Info On Market	0.865	0.651	0.184
Scale1_small scale	2.939	0.720	0.000***
Scale2_medium scale	2.052	0.507	0.000***
Log Quantity Consumed by HH	-0.620	0.205	0.003***
Log Quantity Harvested	2.108	0.396	0.000***
Price Set by buyer	-0.238	0.300	0.427
Chemical used to store	0.652	0.297	0.028**
Regular relationship (in Year)	1.381	0.301	0.000***
Problem In Marketing	-0.319	0.607	0.599
Wholesalers	2.034	0.632	0.001***
Retail	-0.438	0.619	0.479
Cereal group Membership	-1.308	0.388	0.001***
Stalk Sold	0.850	1.112	0.445
Constant	-15.604	3.484	0.000
Mills			
Lambda	-0.6357005	0.1161345	0.000
Rho	-1.00000		
Sigma	0.63570055		

*Note: *, **, *** represents significance levels at 10%, 5%, and 1% respectively*

Table 5 shows that small size and large farms are based on different view point of commercialization. This finding contradicted Rao (2007) who found that large scale farmers are more efficient in production and commercialization than small-scale farmers. Also, Barrett (2008) argued that household with small land are almost always net buyers in the market, but the probability of making net buyers declines steadily as a household's land holding increase. Therefore, in this study context farms at border the forest or in the forest could not increase their land size because of birds and some wild animals since they were no fences, and some production constraints such as type of weeds which cannot be controlled by farmers. In addition large-scale farmers were focused on industrial crop production and in return buying pearl millet for household consumption.

In terms of household quantity consumed, pearl millet is a staple crop more of the output is stored for household consumption. Higher household consumption lowers the probability to participate in pearl millet market because households decide to sell when they cannot consume all they produced. The influence of household consumption on pearl millet market participation was found negatively related to farmer's decision to participate in market at 1% significance level. This observed result is consistent with Musah (2014) who found that households with larger family sizes were less likely to sell. This confirms Siziba (2011) findings that households with large family fail to produce marketable surplus beyond their consumption. In their cultural

context, female get married from 18 years old and above and male around 20 years old. Male when they get married, they stay in parents' house to make it larger but the main head of the household is the decision maker, hence increase in the household consumption. The larger the household the lower the level of participation decrease. This is because small household size is not pressured by the need of to produce more food for large family consumption, hence a willingness to try out new technology. However, this was interesting and consistent with many past studies since pearl millet is much labour intensive. But Rao (2007) found that small scale household sell more than 50% of their harvest then later on buy the same products in return for household consumption.

Quantity harvested was found to positively and significantly influence the probability to participate in the market. Farmers with a good harvest were more likely to increase their quantity sold by 2.10%. This finding is consistent with Otieno (2009) who detected that increases in agricultural output intensify market participation which could lead to market oriented. Increases of farmers' output enhance their chance to step out of poverty and improve their likelihood to increase income from increased market participation. The result is confirmed by Sebatta (2014) who argued that having other sources of food from households' farm different from potato ensures surplus of potato did not adversely affect the staple food quantity harvested.

Farmers using storage chemicals were more likely to participate in the market as compared to those who did not. The conservation of pearl millet required a good condition because of the high value of the product in vitamin that attracted insects. Farmers were using chemical product named "Rambo", one sachet for a bag of 100kg. Conservation under chemical increases the probability of farmers to raise their decisions of participation by 0.65%. That could be explained by the fact that just after the harvest period farm gate price of pearl millet come down to the lowest level 125 XOF. This finding is consistent with Payne (2011) who argued the best method of production of pearl millet in West Africa depends on the availability of suitable storage facilities. Majority of farmers who sold immediately after harvest were not using storage chemical. Immediate sales after harvest also were mainly influenced by the need to repay loans taken to grow cotton by social need and financial crisis.

Over time farmers and buyers developed informal buyer-seller relationship based on trust. That relationship is important for the development of social capital. The development of social networks can give rise to virtuous cycle encouraging more relationship building, reciprocity and trust and in the process bring about an improvement in pearl millet channels and market. Communication and cultural similarity tend to enhance long-term seller-buyers relationships. Such relationship support exchange of other services, for example farmer can receive loans from buyer and repay in-kind or in monetary form. Such relation can act as barrier for competitors to enter the market. The benefits of farmers and buyers relationship can differ from one relationship to another. The result indicates a significant level at 1% of collaboration period. With collaboration and facilities, different stakeholders can work on different innovation ideas. Farmers with regular buyers are more likely to participate in pearl millet commercialization at 1.38%. Most traders keep partnerships with farmers to maintain supply continuity and farmers can get capital for their production inputs and marketing securities.

Farmers selling to wholesalers were able to get high price. Wholesalers had a positive and significant influence on farmers' decision to participate in pearl millet market at 1% level. Different channels were used by farmers in the study area as farmers to consumers, farmers to brokers, farmers to retailers, farmers to wholesalers. Wholesalers market easily flow out famers' product and could increase market participation. A percentage increase of wholesalers market could bring a chance to farmers to raise their quantity sold by 2.03%. Farmers received higher prices when they sold directly to wholesalers. That is because wholesalers used to buy large quantity of pearl millet at fair price. These results are similar to the findings of Jagwe (2011) who reported that wholesalers of banana in Rwanda, Burundi, and Democratic Republic of Congo handle the largest volume of banana. This indicated that it is good for farmers to sell their product to wholesalers to get higher gross margin from their pearl millet. In the study areas, wholesalers play a central role in marketing system and can be the way out for rural farmers to move out of poverty by increasing their income and improving their livelihood (IFD 2003). The intensification of market participation depends not only on the price but also quantity sold by farmers according to channel used. The result stands with Gebremedhin (2007) finding that wholesalers were important wheat buyers for small-scale farmers in Ethiopia.

Membership to cereal cooperative was found statistically significant at 1% level. This is because pearl millet was not among cooperative cereal selected, so farmers were not receiving support or selling their output to the cooperative. The cooperative was providing farmers with seeds except millet in return they sold the harvest to the cooperative. Farmers appreciate more the aim of that cooperative because of low transaction cost, high price, easy access to farm inputs, easy access to information, and training. According to Jawge *et al.* (2010) who argued that producers groups in Burundi could be good platforms for social capital formation hence promoting their market participation decisions. Klaus (2009) also argued that membership to a group increases the bargaining power of farmers in price and access to market information in their areas of operation.

3.3 Factors influencing pearl millet output sold

To determine factors influencing the extent of pearl millet market, log ordinary least square (OLS) regression was estimated in the second step of the Heckman outcome equation. The inverse Mills ratio estimated from the first equation was added to the second equation as an independent variable to capture the selection bias effect. Linear function was used on continuous variable to capture small and large number (quantity sold, number of men in the household, total farm equipment, millet land size, labour for land preparation, labour for seed, labour for weeding, and labour for harvesting). The variable was found to be statistically significant at 5% level justifying existence of self-selection and the use of the model. The results are presented in Table 6, five variables were significantly found to influence the extent of market participation.

Table 61: Factors affecting the quantity lies on the market

Variables	Coefficient	Standard Error	P-Value
Number of Men in HH	0.1481887	0.1126703	0.188
HH Head' wife as Farmer	0.2065692	0.2003508	0.303
HH Head' wife as Homework	0.2858493	0.2021999	0.157
Traditional Education of HH head	-0.2134379	0.1242774	0.086*
Primary Education of HH Head	-0.1908008	0.2035726	0.349
Contact with Extension Officers	-0.4730639	0.2509215	0.059**
Total Farm Equipment	0.1153476	0.0974803	0.237
Pearl Millet land size	0.3405622	0.0903862	0.000***
Total labour for land preparation	-0.2306661	0.1289164	0.074*
Total labour for seeding	0.2302064	0.102639	0.025**
Total labour for weeding	-0.0490737	0.115863	0.672
Total labour for harvesting	-0.0449184	0.1117202	0.688
Help Received for production	-0.0537129	0.1425539	0.706
Constant	6.954563	0.3770083	0.000

*Note: *, **, *** represents significance levels at 10%, 5%, and 1% respectively*

The education level of the household head was negatively and statistically significant at 10%. The result is consistent with Rahut (2015) arguing that poor farmer level of education and capital to respond quickly technological innovation and agricultural opportunities. That is explained by the fact that access to traditional education in those areas are easier than formal education because of distance from villages to school, cost of education, also traditional teachers are villages dwellers. They prefer sending kids to traditional school to learn Arabic and their culture than formal school. However, better educated household heads were more likely to participate in pearl millet market. Higher education levels give household heads the ability to perceive, interpret and respond to new information faster than the less educated household heads (Feder, 1987). It is also important in changing perception on farming and shaping farmers ability to be more innovative and critical when converting to new production and market requirements. This finding provides some evidence to support the idea that better educated households are able to take advantage of opportunities such as acquiring cheaper means of transport which agricultural markets provide them. Ricker (2010) argued that more educated household heads have more farming skills and are therefore expected to be more productive in agricultural activities as well as be more aware of the potential benefits of land investment. On the other hand, higher education levels of the household head exposed them to new ideas, farming skills and technologies which helped them to identify the potential benefits that can be derived from farming on land instead of renting it out. Previous study by Benjaminsen (2009) reported that education levels of the household head had a negative effect on agricultural land, implying imperfection in the market for human capital.

In the study areas, access to extension services decreased the probability of farmers' decision to participate in pearl millet market and this was significant at 5%. Extension services provide farmers with farming skills, knowledge, and agricultural market information. This finding is consistently similar to Hoang (2003), who argued that access to extension services had a negative impact on farmers' production when the extension officers do not know the social cultural behaviour of the people. This may due to extension services targeting areas where the marginal productivity of land is relatively low and perhaps the quality of information given is low or even outdated. On the other hand, access to extension services negatively influenced household's participation in agricultural production. Perhaps this is because extension services received by the farmers provided them with a good understanding on how to put their available land into productive use instead of wasting labour, and time to get low yield. However, Tikabo and Holden (2004) found that farmers who have access to extension services are more empowered on farming skills, information of new technologies and market information, which they use in understanding the dynamics in the agricultural market in terms of prices and productivity. It is supposed that such contacts prompt the farmer to take measures that would increase production.

Land size located to pearl millet production increased the quantity produced and was found significant at 1% level. Because of lack of support in the study area, farmers could not increase their land size allocated for pearl

millet production. This result is contrary with Andreas (2015) who found that pearl millet production yield does not depend on amount of hectares of cultivated land. High endowment in land located provides an opportunity to increase the quantity sold as well as increase of household income. That could allow farmers to invest in other agricultural activities and others off-farm activities.

In term of labour used for land preparation, farmers were still using traditional soil tillage practices using local fabricated ploughs and hand implements. The most widely used means for soil cultivation were ox-drawn iron ploughs. Land preparation was negative and significant at 10% level. Farmers had not adopted mechanization of agricultural practices due to varieties reasons, the most important ones being financial, economic, and socio-cultural factors. This finding is consistent with (Bajracharya, 2001), who found that traditional land preparation requires labour intensive and time consuming component. Labour contrast is interrelated with household risks in agricultural production and food security (Takane, 2008). Therefore, there are real advantage in utilising ideas of farm mechanization along with new technical advances and capital. The production could be greatly increased by a wider application of scientific methods of farming and the use of the production inputs of more advance areas. This however could call for extra effort and cash outlay by many farm operators.

Labour for weeding process is an essential part of pearl millet production to get highest yield result, hence selling large quantity. Weed management is an important component of plant protection improving the production potential of pearl millet. Empirical studies have shown that in general weeds cause 5% loss in crops production in most of the developed countries, 10% loss in less developed countries and 25% loss in least developed countries. Different methods of weeding were used by farmers included physical, mechanical, biological, cultural, and chemical. The minimum requirement for pearl millet weeding is two times and maximum 5 depending on the area and type of soil. As millet was not the only crop grown by some of farmers, they were using herbicides on the field before seeding to reduce weeding step and save time to focus on other cash crops. Labour for weeding was found positive and statically influenced the quantity sold at 5% level.

4. Conclusion

Farms operating in pearl millet production for commercialization under different and socio-economic conditions often more or less reflect the significant differences in production and economic results they had achieved. Those differences are attributed to the level of specialization, land size, intensification of production, household consumption, and support received for production. The results on Market participation showed moderate degree of pearl millet marketing among farmers that are getting priority in the development of Malian's economy but some of factors hinder their full participation in markets for transiting into commercial farming. They are constrained by number of marketing factors which make difficult to increase level of commercialization such as poor road infrastructure, poor organizational support, and quality of extension agents.

5. Recommendation

More focus should be on women participation in staple food production and their market access to increase the market output. Farmers need support from production to the market access.

Marketing is vital in pearl millet development whereas the linkage of villages to local market is one of the biggest problems. So, agricultural marketing calls for considerable individual initiative, decision making and skill. Effective marketing structures are flexible in operation and allow much scope for local knowledge and experience.

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7. References

Akintayo, I. a. (2001). *Towards Sustainable Sorghum Production , Utilization , and Commercialization in West and Central Africa Vers une production , utilisation et commercialisation durables du sorgho en Afrique occidentale et centrale.* Lome: Towards Sustainable Sorghum Production, Utilization, and Commercialization in West and Central Africa Proceedings of a Technical Workshop of the West and

Central Africa Sorghum Research Network.

Andreas, J. (2015). Trends of pearl millet (Pennisetum glaucum) yields under climate variability conditions in Oshana Region ,. *International Journal of Ecology and Ecosolution (2)*, 49-62.

APARISI1, A. M. (2013). Impact of Mali's Food and Agricultural Policies: an assessment of public exnpenditure and incentives to production from 2005 to 2010 . *Rebuilding West Africa's food potential: Policies and market incentives for smallholder-inclusive food value chains*, 153-185.

Bajracharya, R. M. (2001). Land Preparation : An Integral Part of Farming Systems in the Mid-Hills of Nepal. *Journal of Science and Technology 3*, 15-24.

Byron, Z. M. (2014). Determinants of soybean market participation by smallholder farmers in Zimbabwe. *Journal of Development and Agricultural Economics 6 (2)*, 49-58.

CGIAR, F. (2012). Training Guide Gender and Climate Change Research in Agriculture and Food Security for Rural Development. *Food and Agricultural Organization of the United Stated Nations (FAO), 00153, Rome*, 1-127.

CPS, D. D. (2005). *Recensement général de l'Agriculture (RGA) - Campagne Agricole 2004-2005*. Mali.

FAO. (2015). FAO, Youth and Agriculture: Key challenges and concrete solutions, . *Food and Agriculture Organization Publications, Rome*.

Feder, G. J. (1987). Adoption of agricultural innovations in developing countries: a survey. *Economic Development and Cultural Change, 33*, 255-297.

Geoffrey, S. K. (2013). Determinants of Market Participation among Small-Scale Pineapple Farmers in Kericho County , Kenya. *Journal of Economics and Sustenaible Development (4),19*, 59-67.

Harold, M. (2015). Cereal Crops: Rice, Maize, Millet, Sorghum, Wheat. *Feeding Africa: An action plan for African Agricultural transformation*, 1-36.

ICRISAT. (2016). *Celebrating the International Year of Pulse* . International Crop Research Institute for Semi-Arid Tropics.

IMF. (2013). *Working Together to Rebuild Mali.* Washington, D.C. 20431: International Monetary Fund No. 13/111.

Kaminski, J. (2013). An assessment of sorghum and millet in Mali and implications for competitive and inclusive value chains. *Rebuilding West Africa's food potential: Policies and market incentives for smallholder-inclusive food value chains*, 481-501.

life-cycle, R. t. (2013). A. Bick, S. Choi. *Journal of Economic Dynamics and Control 37(12)*, 2998-3011.

Monimart, M. a. (2006). Landless women, hopeless women? Gender, land and decentralization in Niger. *Dryland issues paper 143, IIED, London*.

Mordor, I. (2017). Retrieved from https://www.mordorintelligence.com/industry-reports/global-plant-biostimulant-market-industry

Musah. (2014). effects of flood disasters on livelihood coping mechanism in Tolon/Kumbumgu district of northern region of Ghana. *International Journal of Agriculture Policy and Research vol.2 (1)*, 033-040.

OECD. (2016). Agriculture in Sub-Saharan Africa: Prospects and challenges for the next decade. *Agriculture Outlook, 181.*, 59-93.

Sloans Chimatiro, B. F.-D. (2013). Agriculture in Africa, Transformation and Outlook. *New Partenarship for African Development*, 3137-3146.

Takane, T. (2008). Labor use in smallholder agriculture in Malawi: six village case studies. *African Study Monographs 29(4)*, 183-200.