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Determinants of Smallholder *teff* Producer Farmers Market Participation in Merhabete District, Amhara Region, Ethiopia

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Abstract: Teff production contributes significantly to the economy in terms of cash income and food security, especially for the smallholder teff producers in rural areas of Ethiopia. This study examined Smallholder Teff producer Farmers Market Participation in Merhabete district with the objectives of identifying factors influencing teff market participation and intensity of participation. Cross sectional data was used for the study. A two stage sampling procedure was used to draw 150 sample producers from four teff producer kebeles and semi-structured questionnaires were used to collect data. Secondary data sources were also used for the study. Double hurdle model was used to identify factors influencing market participation decision and intensity of participation in teff market. The result of the first hurdle confirmed that participation decision was positively affected by frequency of extension contact, land allocated for teff, productivity of teff and teff production experience; whereas family size, and non-farm income influenced teff market participation decision negatively. The second hurdle indicated that intensity of teff market participation positively and significantly affected by land allocated for teff, productivity of teff, teff production experience and numbers of equine owned. The study indicated government and other stakeholders need to strengthen market oriented teff production, agricultural input or service delivery, increasing frequency of extension contacts, land intensification, family planning, and involvement in facilitating transportation services.

Keywords: Merhabete District, Double Hurdle, Market Participation, Intensity of Participation

1. Introduction

In Ethiopia, in 2016/17 production year, the total grain production reached 290.38 million quintals (Qt), of which cereals production accounted 87.42% [1]. Thus, cereals including *teff*, barley, maize, wheat and sorghum are the most important crops for Ethiopian agriculture [2]. The land productivity of these cereals is 24.84% [1].

Cereal accounts for 60, 80, 40 and 60% of rural employment, total cultivated land, a typical household food expenditure and total caloric intake, respectively; its contribution to national income is also large [3]. Hence, the government gives attention to the subsector to increase production and marketing through accelerated investment in infrastructure and adoption of better seed varieties and fertilizer technology. From the demand side, cereals are the most important diets for Ethiopian families. In particular, *teff*, wheat, maize and sorghum are the most staple food items. The calorie intake of *teff* decline as one moves from lower to higher quintiles' of the wage distribution [4].

Scientifically *teff* is called *Eragrostis tef (Zucc.)* and is believed to have originated in Ethiopia [5]. It is comparatively resistant to many biotic and abiotic stresses and can be grown under different agro-ecological conditions ranging from lowland to highland areas [6].

Teff is the most important cereal in terms of both production and consumption in Ethiopia. It is witnessed that *teff* production increases in rapid rate in recent times. It is

estimated that annual *teff* production is increasing by 11%. It is believed that 6% of this production growth contribute to increased productivity while the rest was attributed to expansion in area cultivated for *teff* [7]. The national production and productivity of *teff* in 2016/17 production season in the country is 50.2 million Qt and 16.64Qt per ha, respectively [1]. *Teff* is produced mainly in Amhara and Oromiya region, which together accounted 84 and 86% of the total cultivated area, respectively [8].

Because of its high market price, *teff* accounts the largest share of the total value of cereal production and it is one of the most important crops for farm income and food security in Ethiopia [9]. Due to its farm operations such as soil planning, weeding, and harvesting, *teff* production is highly labor-intensive with limited availability of suitable mechanical technology. Generally, it is most important crop by area planted and value of production, and the second most important cash crop after coffee [10]. generating almost 500 million USD incomes per year for local farmers [11].

In anticipation of the 1998 war between Ethiopia and Eritrea, Eritrea was one of the major destiny markets for *teff* traders in major production areas. But now it is exported to different countries mainly to the Middle East, North America and to many European countries where Ethiopians or Ethiopian origin live [9].

The Amhara region *teff* production is 19.32 million Qt and its productivity is 16.99 Qt per hectare [1]. North Shewa zone, one of among11 zones of Amhara region, total *teff* production is 2.68 million Qt. It is the second among *teff* producing zone of Amhara region by its *teff* productivity (17.80 Qt per hectare) next to east Gojam (19.23 Qt per hectare). From this, we can see that North Shewa zone is a potential area for production of *teff*. Based on [12], North Shewa zone is one of the most important *teff* producing zones in ANRS.

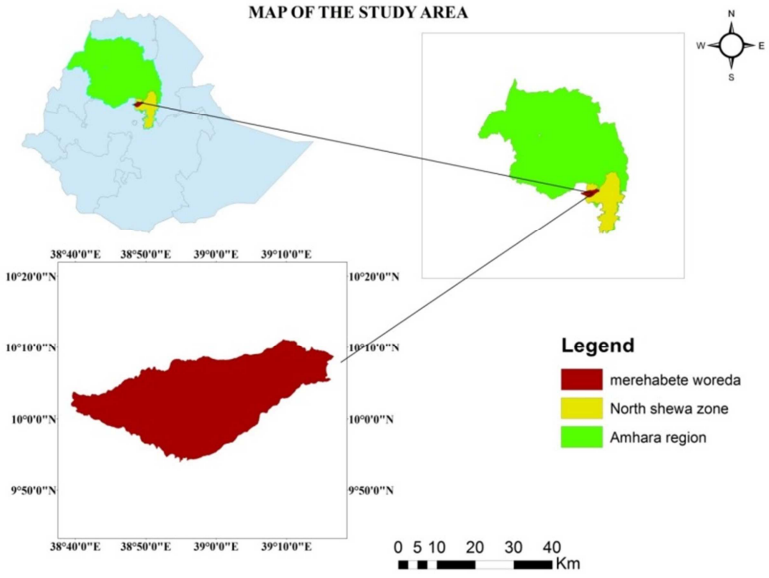
Merhabete district, one of the 23 districts in North Shao zone, is a high potential area for production of *teff* and other cereal crops. According to agricultural and natural resource office of the district, the major crops grown in the area were *teff,* sorghum, maize and wheat for both household consumption and marketing in 2016/17 production season. Hence this study was designed to identify *teff* market chain actors and their roles, analyze the structure, conduct and performance of *teff* market, and identify factors affecting producers' market participation decision in *teff* marketing and intensity of participation in the study area using data obtained from *teff* producers and other market participants (wholesalers, rural collectors, and retailers) in Merhabete district of North Shewa zone, ANRS, Ethiopia.

Teff is selected for this study because it is primarily grown and marketed by smallholder farmers in the study area and is produced for both consumption and marketing. Merely, the supply of *teff* in the study area is subjected to a seasonal variation where surplus supply at harvest is the main feature. *Teff*, sorghum, and wheat are the major cash crops grown in the study area predominantly for market but priori is given to *teff*. Therefore, there is a need to use a market chain analysis to fully understand and resolve the problem of *teff* markets at all levels. Nevertheless, there is no such work which attempts to await into the whole view of the marketing chain of *teff i*n the study area. This makes a vital task of *teff* market chain analysis in the study district.

2. Research Methodology

In this chapter, study area descriptions, data types and sources, tools used to analyze collected data, model speciation test, and definition of variables and working hypothesis are presented and discussed.

2.1. Description of the Study Area



Source: Adapted from GIS, 2017

Figure 1. *Geographical location of the study area.*

Merhabete district is one of the 105 districts in the Amhara region of Ethiopia. The area coverage of the district is 1,058.19 km^2 and an altitude of 1911.5 meters. It is 181km away from Addis Ababa (capital city of Ethiopia).

2.2. Data Sources, Types and Methods of Data Collection

Both primary and secondary source of data were used in this study. Primary data were collected from *teff* producers using a semi-structured questionnaire which is developed, modified, evaluated and pre-tested before the final data collected. Both qualitative and quantitative types of data were collected using primary source of data. A total of 8 enumerators, who are a BSc graduated students were selected, trained and employed for data collection. Secondary data sources were collected from published and unpublished documents of both qualitative and quantitative types of data.

2.3. Sampling Technique and Sample Size Determination

Two stage sampling technique was employed to draw a sample from *teff* producers. First, *teff* producing kebeles were identified and then four *teff* producer kebeles were selected randomly. Using PPS technique sample *teff* producers were selected from each selected sample kebeles. Finally, a total of 150 sample *teff* producers were randomly selected from four kebeles. The four Kebeles were Buyo-Gedejewa (44), Remeshit-Workamba (40), Amden-Lijiagba (36), and Geb-Zemoy (30).

Table 1. *Number of sample respondents taken from each kebeles.*

Type of grain	Name of selected kebeles	No of *teff* producing HHs	No of sample HHs taken
	Buyo-Gedejewa	458	44
	Remeshit-Workamba	416	40
Teff	Amden-Lijiagba	375	36
	Geb-Zemoy	312	30
	Total	1,561	150

2.4. Methods of Data Analysis

Both descriptive statistics and econometric model were used for data analysis.

2.4.1. Descriptive Statistics

Descriptive statistics like mean, standard deviation, t-test and x^2 *–test* were used in this study.

2.4.2. Econometric Model Specification

Limited dependent models like Heckman two-stage models, double-hurdle model and restrictive Tobit model have been used to study crop market participation [13]. Since the mills lambda is insignificant (0.235) in this case Heckman is not appropriate for the data set of this study. Therefore, the most restrictive Tobit model and double hurdle model were compared, and finally double hurdle model found appropriate for the data set using model specification test (Tobittest (LR) =2*(llprobit+lltruncreg-lltobit)).

Among the models, the standard censored Tobit model is more appropriate than OLS estimates for corner solution outcomes that assume constant relative partial effects for a pair of explanatory variables. To overwhelm the restrictive assumptions of Tobit model, the current double-hurdle model come to be popular as explained above in the analytical methods part. This model was proposed by Cragg as an alternative to the selectivity model[14]. The first hurdle involves the decision of whether or not to sell *teff* whereas the second hurdle concerns the level of *teff* sales the producer chooses [15]. It indicates that a producer makes two decisions with respect to sale an item. Therefore, in double hurdle model, there are no restrictions regarding the elements of explanatory variables in each decision stages. The participation and quantity of *teff* sales equation are written as:

$$d_i^* = X_{1i}\alpha + \mu_i \quad (1)$$

$d_i = 1$ if $d_i^* > 0$, $d_i = 0$ otherwise

Where i represents the i^{th} household head, x_{1i} representing vector of factors influencing the participation decision, α represent vector of parameter estimates represent a random error term that is assumed to be normally distributed as N(0, 1), d_i* representing a latent participation variable and we can observe a binary value of

$$di = 1 \text{ if } d_i^* > 0,\ d_i = 0 \text{ if } d_i^* \le 0,\ y^*_i = x_{2i}\beta + \nu_i \quad (2)$$

We observe yi if: $yi = yi^* if\ \ yi^* > 0$ or $di = 1$, or $= 0$ otherwise

Where $yi*$ represent a latent supply variable, x_{2i} representing vectors of factors affecting the sales market decision, β and νi are error terms and assumed to have independence between them. If the two decisions made independently by individuals the error terms are assumed to be normally distributed as N (0, 1) [16].

Table 2. *Description of variables and working hypothesis.*

Variables	Description	Types	Values	Expected sign participation decision	Expected sign intensity of participation
TSOLD	*Teff* market participation	Dummy	1=Yes,0=No,		
QtTS	Quantity of *teff* sold	Continuous	Quintal		
Sex	Sex of household head	Dummy	1=male, 0=female	+	+
Famsza	Family size of household head	Continuous	Adult equivalent	-	-

Variables	Description	Types	Values	Expected sign participation decision	Expected sign intensity of participation
EDU	Educational status of household head	Dummy	1=Literate, 0=Otherwise,	+	+
TPEXP	*Teff* production experience	Continuous	Year	+	+
CP	Current market price	Continuous	Birr		+
LATT	Land allocated for *teff*	Continuous	Hectare	+	+
Extnc	Extension contact with agents	continuous	Frequency of extension contacts	+/-	+/-
Productivity	Productivity of *teff* production	continuous	Quantity produced per land to *teff*	+	+
INF	Income from non-farm activity	continuous	Birr	+/-	+/-
QCR	Quantity of credit received	continuous	Birr	+/-	+/-
PTLM	Perception about lagged market price	Dummy	1=high. 0=otherwise	+	
PTNM	Proximity to the nearest market	continuous	Km	-	-
NEOW	Ownership of equine	Continuous	Head count	+	+
TNOX	Ownership of oxen	continuous	Head count	+	+

3. Results and Discussion

This chapter presents the results and discussions on the core findings of the study. Thus, it is organized in to two sections. The first section provides descriptive analyses on the socio demographic characteristics of sampled households, major market chain actors and their roles, and the structure, conduct and performance of market. The second section is about econometric analysis in factors affecting *teff* market participation and intensity of market participation using double hurdle model.

3.1. Descriptive Statistics

3.1.1. Demographic and Socioeconomic Characteristics of teff Producers

In order to design an appropriate research and development initiative one needs to understand the basic characteristics of the decision-making unit. Descriptive statistics of the household demographic characteristics, socio-economic and institutional variables which were believed to influence decision making were assessed and the following results were obtained.

3.1.2. Demographic Characteristics of teff Producers

Table 5 below presents the mean differences of *teff* market participants and non-participants with respect to age, family size and *teff* production experience. The mean age of *teff* market participants was 67 years; while non-participants was 46 years. This indicates that it helps them to be participant since it increases their production and marketing experiences.

Table 3. *Demographic characteristics of sample teff producers.*

Items	Participants (n=90)		Non-Participants (n=60)		
	Mean	Std. Dev.	Mean	Std. Dev.	t-value
Age(year)	46.91	14.60	45.60	13.73	-0.58
Family size(Adult equivalent)	3.38	0.86	3.80	1.09	3.92***
Teff production experience(year)	25.79	14.18	20.92	10.45	2.66***

*** Significant at 1% significance level
Source: Survey data, 2017

The mean household members in adult equivalent among participants was 3 persons, while 4 persons among non-participants. The two groups were statistically different on the basis of family size at 1% significance level. The mean farming experience of *teff* market participants was 5 years more than their counterparts, this indicates that market participants were more experienced than their counterparts in *teff* production. The two groups were statistically different in terms of *teff* production experience.

Table 4. *Distribution of sample teff producers based on sex, marital and educational status.*

Variables		Participants (n=90)		Non-participants (n=60)		χ^2 value
		n	%	n	%	
Sex	Male	82	59.4	56	40.6	0.241
	Female	8	66.7	4	33.3	
Marital status	Single	6	6.7	2	3.3	
	Married	71	78.9	44	73.3	2.506
	Divorced	6	6.7	6	10	
	Widowed	7	7.8	8	13.3	
Educational status	Literate	22	51	21	49	1.962
	Otherwise	68	64	39	36	

Source: Survey result, 2017

Tables 7 below indicate sample household resources ownership in Merhabete District. *Teff* market participants had 2 times of their counterparts in terms of equine owned and it exhibited statistically significant (1% significance level) mean differences among this groups. On the basis of land allocated to *teff* market participants had 1.33 ha land allocated for *teff* since 2016/17 production season, while non-participants had 1.13 ha land allocated for *teff*. The two groups were statistically different at 5% significance level, implying that the more land. allocated for *teff* the more sample *teff* producers participate in the market since they expected to produce more, citrus paribus.

Table 5. *Sample household resource ownership in Merhabete District.*

Variables	Participant (n=90)		Non-participants (n=60)		
	Mean	Std. error	Mean	Std. error	t-value
Number of equine owned	1.8	1.31	1.13	0.95	-3.396***
Number of oxen owned	1.7	1.13	1.5	1.02	-1.318
Land owned(ha)	1.74	0.89	1.53	0.87	-1.463
Land rented in(ha)	0.42	0.54	0.35	0.55	-0.750
Land allocated for *teff*(ha)	1.33	0.72	1.13	0.57	-2.307**
Non-farm income(birr)	1600	4161.89	2481.25	4639.18	1.213

***, ** significant at 1, 5 percent, respectively
Source: Survey result, 2017

3.1.3. Access to Institutional Factors of teff Producers

As indicated in table 8 below *teff* market participants and non-participants were statistically different at 10% significance level on the basis of access to market information. Among non-participants 55% reported that there was no access to market information (like price information). While, among *teff* market participants, 64.4% reported that there was an access to market information in the study area during 2016/17 production season.

Table 6. *teff Producers access to market information and perception about lagged price.*

Items	Participant (n=90)			Non-participant (n=60		t/χ^2 value
		N	%	n	%	
Access to market information	Yes	58	64.4	27	45	5.543*
	No	32	35.6	33	55	
Perception about lagged price	High	25	27.8	24	40	2.445
	Otherwise	65	72.2	36	60	

* Significant at 10 % significance level
Source: Survey result, 2017

Table 9 below illustrates about sample *teff* producer respondents frequency of extension contact, current market price of *teff* and quantity of credit utilized during 2016/17 production season in the study area. Based on this *teff* market participants 15 days contact extension workers per year. *Teff* market participants and non-participants were significantly different at 1% significant level on the basis of frequency of extension contact. Market participants were sold *teff* in 2016/17 *teff* production year with an average of 1912.64birr per qt.

Table 7. *Sample teff producers' frequency of extension contact and current market price.*

Item	Participants (n=90)		Non-participants (n=60)		
	Mean	Std. Dev.	Mean	Std. Dev.	t- value
Frequency of extension contact(days per year)	15.54	6.83	11.38	5.53	-3.936***
Current market price(birr/ qt)	1912.64	62.89	--	---	-2.26***

***,* Significant at 1 and 10% significance level.
Source: Survey result, 2017.

3.1.4. teff Production and Consumption by Producers

Table 8 below predicts the production, productivity and consumption patterns of *teff* producers. The mean amount of *teff* produced by participants was 18.09qt per household within a year, while 9.05qt by non-participants per household. For the overall sample households' average amount of *teff* produced was 14.47qt per household. There was a significant difference between participants and non-participants in terms of amount of *teff* produced per household at 1% significant level. Productivity between the two groups was also significant at 1% significance level with a mean productivity of 18.9qt per ha of participants and 11.21qt per ha of non-participants.

Table 8. *Production, productivity, and consumption of teff among teff producers.*

Variable	Participant (n=90)		Non-participants (n=60)		Pooled sample (n=150)		
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	t-value
Quantity of *teff* produced(qt)	18.09	5.54	9.05	3.51	14.47	6.55	-11.223***
Productivity(qt/ha)	18.9	19.97	11.21	9.91	15.82	17.07	-2.763***
Quantity of *teff* sold(qt)	13.5	4.53	0	0	8.12	7.51	-23.082***

***significant at 15 significance level
Source: Survey result, 2017

The mean productivity of *teff* in the study area were 15.82qt per ha for the total sample *teff* producers, this is lower than North Shewa Zone *teff* productivity, which is 18 qt per ha. Market participants and non-participants were statistically significant at 1% significance level in terms of amount of *teff* sold. Amount of *teff* sold by participants were 13.5qt, on average. As indicated in table 8 above the average *teff* consumption of non-market participants was higher than participants. The two groups are statistically significant at 1% significance level.

3.2. Econometric Model Result

In this section factors that influence *teff* market participation and intensity of participation were analyzed and discussed.

Table 9. *Factors influencing teff market participation and intensity of participation.*

Variables		Robust			Robust
	1st hurdle.	Std. Err.	Marginal Effects	2nd hurdle	Std. Err.
Sex	-0.62	0.52	-0.16	-0.02	1.19
Family size	-0.34***	0.12	-0.12	-0.51	0.55
Educational status(dummy)	0.55	0.34	0.19	-0.47	1.04
Land allotted to *teff*	1.49***	0.35	0.48	2.59***	0.48
Extension contact(frequency)	0.15*	0.09	0.05	0.54**	0.24
Productivity of *teff*	0.12***	0.03	0.03	0.14***	0.02
Teff production experience	0.06***	0.02	0.02	0.03	0.03
Non-farm income (log)	-0.07**	0.03	-0.02	-0.05	0.11
Amount of credit utilized (log)	0.04	0.04	0.01	0.09	0.12
Proximity to the nearest market	-0.18	0.13	-0.06	-0.12	0.36
Equines owned(number)	-0.05	0.12	-0.02	0.75**	0.37
Oxen owned(number)	0.03	1.93	0.01	0.11	0.40
Perception about lagged price (dummy)	-0.27	0.29	-0.09		
Current market price (logCP)				11.49	10.67
Constants	-2.63**	0.93		-80.79	79.79
Pseudo R^2	0.43				
Predicted value	0.75				
Wald/LR Chi square	45.23			60.07	
Log-likelihood	-57.41			-243.39	
Observation	150			90	

***, **, * significant at 1, 5 and 10 % respectively
Source: Model output, 2017

Selection model was not appropriate for this data set since IMR is insignificant (0.235) as indicated in appendix 2[29]. Whereas, Log likelihood ratio test was used to check the relevance of the Tobit model. Then, the double-hurdle model is tested against the Tobit specification

The LR test of the double-hurdle model was tested against the Tobit model specification using joint decision criteria of log likelihood test and AIC. The test statistic for log likelihood is (LR=110.70) which by far exceeds the critical $\chi 2$ value of 23.685 at 14 degrees of freedom and at 1% level of statistical significance in favor of the double-hurdle model. Finally, double hurdle model is appropriate for this data set.

The result of double hurdle model presented in table 9 above indicates factors affecting market participation decision and intensity of participation. If it is so significant variables of both hurdle 1(probit part) and hurdle 2 (truncated regression part) model outputs are discussed below separately.

3.2.1. Factors Influencing teff Market Participation Decision

The probit model performed well with a pseudo R^2 of 0.43. Out of 13 variables (3 dummy and 10 continuous) included in hurdle 1(probit model) 6 variables were significant. Output of double hurdle model (hurdle 1) showed that *teff* producers decision to participate in the *teff* market positively and significantly affected by land allocated to *teff* production, productivity of *teff (*qt per hectare*)*, *teff* production experience and frequency of extension contact. On the other hand family size and non-farm income negatively and significantly affected the probability of *teff*

producers' decision to participate in the *teff* market. The rest variables included in the first hurdle of this model have no effect in the participation of *teff* market. Under this part variables that affect *teff* market participation in the proposed study area are discussed.

Family size (Adult equivalent): Family size as expected had a negative and significant effect on the *teff* market participation decision at 1% significance level. The marginal effects of this variable indicate that an increase in adult equivalent in the family decreased the probability of *teff* producers' market participation by 12%. This implies that most of the family members are consumers than being workers; or their contribution as a labor in teff production is less than being consumers. Increase in the family size can lead to decrease in market participation level by 3% [17]. Family size decreases the likelihood of *teff* market participation by 2% [10].

Land allocated to *teff* production: As we expected land allocated to *teff* production affects *teff* market participation positively and significantly at 1% significant level. The more land allocated to *teff*, the larger outputs from that land and they expected to be participated in the market. The result shown that as the land allocated to *teff* production increases by one hectare, the probability of *teff* market participation increased by As farm size increased maize and *teff* market participation also increased, respectively% [10-18]. The likelihood of durum wheat was positively and significantly affected by land size [28].

Productivity of *teff*: As hypothesized, market participation of *teff* positively and significantly affected by productivity of *teff* at 1% significance level. The marginal effect implied that, a quintal per hectare increase in the production of *teff* increased the probability of market participation by 3%. Found that yield positively and significantly affected sesame extent of market participation in Diga district of Ethiopia [19]. Whereas, show that as land for grain crops increases yield also increased proportionately [20].

Teff production experience: The expected influence of experience in the production of *teff* was positive taking the presumption that as producers 'becoming more experienced in *teff* production they could acquire skills and hence produce Much and develop skills to participate in the market. This variable affects the likelihood of *teff* market participants at 5% significant level. The marginal effect showed that a one year increase in the experience of *teff* production increases the probability of participates in the market by 2%. As farming experience of maize increases market participation of this crop increased [21].

Non-farm income: As we hypothesized non-farm income affected the probability of market participation negatively and significantly at 5% significance level. Since they devote much of their time in non-farm activities, they did not carefully managed their farm from its preparation till harvesting (not harvested timely); it causes reduction in production. The marginal effect showed that as the income from non-farm activities increased by one birr the probability of market participation decreased by 2%. As non-farm income increased by one birr maize market participation decreased by 0.035% [22];

Extension contact (frequency): As a priori to the hypothesis this variable affects *teff* market participation at 10% significant level. The marginal effect showed that an extra day of extension visit would increases the probability of farmers' market participation by 5%. This indicates that frequent contact with extension agents improves ways of production that enhances production in turn their likelihood of market participation increased. Generally, they get up to date information on agricultural technologies like improved varieties, recommended uses of fertilizer, pesticides etc. and therefore increase market participation of *teff*. Frequent extension visit would increase the likelihood of red bean market participation in Alaba special district of Ethiopia [23].

3.2.2. Factors Influencing Intensity of teff Participation

The truncated regression model performed well and it was significant at 1% significance level. Out of 13 variables (2 dummy and 11 continuous) 4 variables were significant. The truncated regression (hurdle 2) part of double hurdle model indicate land allotted to *teff* production, frequency of extension contacts, productivity of *teff* (qt per hectare), *teff* production experience and number of equine owned were the most important determinants of intensity of *teff* participation in the market. All significant variables brought about our priori expectations and discussed below.

Land allocated for *teff* production: Land allocated for *teff* had a positive and significant effect on the intensity of *teff* participation at 1% significance level. As explained in the probit model result of land allotted for *teff* production, the more land allotted for *teff* results in more production and they decided to participate in the market; this in turn increases the amount of *teff* flow to the market, citrus paribus. The result of truncated regression model indicates that as land for *teff* increases by one hectare, *teff* supplied to the market increased by 2.6 quintal. Expanding the area under durum wheat increased the market supply. [24]. As land allotted to *teff* production increased market supply also increased [26]. As land allocated to maize increase market supply also increased [22].

Extension contact (frequency): Quantity of *teff* supplied to the market was influenced by frequency of extension contact with agents positively and significantly at 5% significant level. With an additional extension contact increased the intensity of *teff* market participation by 0.54 quintal, citrus paribus. Households contact with DAs increase the intensity of market participation in the durum wheat market [24].

Productivity of *teff*: This variable affected intensity of *teff* market participation positively and significantly at 1% significant level. For this particular study as indicated in above table 9 implies as the productivity of *teff* increased by one qt per hectare, intensity of *teff* participation increased by 0.14 quintal. The total factor productivity of *teff* affects the volume of *teff* sales in the market positively [25]. Productivity of land affects intensity of *teff* marketed positively and significantly [27].

Equine owned (number): ownership of equine positively

and significantly influenced the extent of *teff* market participation at 5% significant level. Thus, households having one more additional equine increase the extent of producers' *teff* market participation by 0.75 quintal. Ownership of equines as a means of transport increased extent of red bean and *teff* market participation because of equines reduce marketing costs, respectively [23].

4. Summary, Conclusions and Recommendations

4.1. Summary and Conclusions

Teff is the most important cereal crop in terms of food consumption and cash formation in Ethiopia. The study was conducted in Merhabete district ANRS 181 km from Addis Ababa (capital city of Ethiopia) on identifying determinants of *teff* market participation and intensity of participation.

Data was collected from 150 households using a structured questionnaire. The sample *teff* producer households were drawn from four *teff* producer kebeles in Merhabete district. All sample households were *teff* producers; from these, 60% were *teff* market participants out of 150 producers, the rest were non-participants. Therefore, the double hurdle model was used to analyze determinants of *teff* market participation and intensity of participation through log likelihood ratio test.

Out of 150 total respondents, 91.1% male headed and 8.9% female headed households were market participants, while 93.3% male headed and 6.7% female headed were non-market participants. The mean age of market participants was 46.91 years and 45.6 years for non-participants. The mean *teff* production experience of market participants was 25.79 years and 20.92 years for non-participants. The total amount of *teff* produced by sample *teff* producers was 2171qt, of which 1215.75qt was supplied to the market.

Based on double hurdle model result market participation decision of *teff* producers was positively and significantly affected by frequency of extension contact, land allocated to *teff* production, *teff* production experience, and productivity of *teff* (qt/land); negatively and significantly by family size and non-farm income. Whereas, extent of *teff* market participation was positively and significantly influenced by land allocated to *teff* production, frequency of extension contact, productivity and number of equine owned. Producers' participation decision and extent of market participation jointly affected by land allocated to *teff* production, productivity of *teff*, and extension contact.

Overall econometric analysis showed a number of variables affected market participation and intensity of *teff* participation in the study area and all significant variables were consistent with the priori hypothesizes given.

4.2. Recommendations

Based on the findings of this study, the following recommendations (policy implications) are forwarded to increase market participation of producers in *teff* markets.

The results of econometric analysis indicate that *teff* producers' participation decision positively and significantly affected by *teff* production experience. *Teff* producers need to be encouraged to participate in *teff* production and subsequently to market participation so that new idea is injected to the system. They have to stay in *teff* production to increase their participation in the *teff* market. *Teff* producers need training from government related to production and market information for understanding of the business, so that their *teff* market participation in the market increases.

Family size negatively and significantly affected *teff* participation decision, indicates that most family members were consumers than being workers. Strengthening family planning programs is advisable to reduce the average family size in the long-run and they need to make their family labor productive according to the types of work they can perform in their available time, in turn their *teff* market participation increased. This might be done through health offices, especially by regional health offices.

Income from non-farm activities negatively and significantly affected market participation of *teff*. From the result it is advisable that teff producers in the study area have to spend much of their time on *teff* farm activities than non-farm activities to increase their *teff* market participation. On the other hand, there is a need *teff* producers to allocate their time appropriately for non-farm income activities so as to get enough time of land for *teff* production, so that their *teff* market participation increases.

Land allocated for *teff* production positively and significantly affected both *teff* market participation and extent of market participation. It is obvious that land is the scarce but extremely important variable in the production of agricultural products. Since this variable has a positive effect, there is a need teff producers in the study area to shifting land to teff production than other crops, rent and search land lease if possible to increase their likelihood of *teff* participation and intensity of *teff* market participation to the market via increased production.

Productivity of *teff* positively and significantly affected both *teff* market participation and intensity of participation. There is a need to encourage innovations such as land use intensification policy of productivity increasing agricultural inputs (like improved *teff* varieties) per unit of land enables producers to produce marketable surplus of *teff,* so that both *teff* market participation and intensity of participation increases.

Extension contact affected positively and significantly both *teff* participation and intensity of participation. Efforts should be made to strength the linkage between research institute and district extension department so as to provide extension services on *teff* production and marketing. To do this employ sufficient development agents (DAs) per kebele to increase frequency of extension contact is advisable in the study. So that *teff* market participation and intensity of participation increase in the study area.

Numbers of equine owned affected positively and significantly intensity of *teff* participation. This result indicates that there needs an improvement in rural

infrastructure like road and transport facilities–in the study area, in turn intensity of *teff* participation increases.

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