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Full Length Research Paper

Dynamics and determinants of rural-urban migration in Southern Ethiopia

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This study examined the central characteristics of migrants and determinants of rural-urban migration in Southern Ethiopia based on snow ball sampling and a survey of 665 sample migrants using descriptive and econometric analysis. The results of this study showed that 76.2% of the migrants left their home at age ranges between 15 and 25 years. Similarly, it was found that 48% of the migrants were attending junior education level, while 28 and 13% of the migrants were attending secondary and primary education levels, respectively. Moreover, 80% of migrants in the study area were not married as at the time of their migration. In addition, the study found that the main reasons for rural-urban migration in the study areas were better jobs opportunities in the urban areas (44%), rural poverty (26%), search for further education (10%), starting new business (8%), to be free from restrictive culture (8%) and better urban services (4%). The regression analysis of the Probit model indicated that age, years of schooling, relatives at receiving areas, monthly income at sending areas and family size significantly affect rural-urban migration. Policies aimed at reducing rural-urban migration should focus on creating viable farm and non-farm activities for rural unbanked youth.

Key words: Rural-urban migration, push and pull factors, probit model, Ethiopia.

INTRODUCTION

According to UNDESA (2015), the number of international migrants reached 244 million in 2015. But the same report revealed that a considerably higher number of migrants, about 740 million, are engaged in intra migration (moved within their countries), mainly from rural to urban areas or from one rural area to another. Moreover, the Department for International Development of the United Kingdom Government (DFID) estimated that in sub-Saharan Africa (SSA) about 50 to 80% of each rural household has at least one migrant member (DFID, 2004). In some rural areas of developing countries, remittance from rural-urban migrants has overtaken agriculture as the main source of income for rural households (UNDP, 2009; Faye, 2012).

Today, almost half of the world's population lives in cities and the number of people living in urban areas

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has risen steadily by around 1 million people every year (Bahns, 2005). According to a report from the United Nations Population Division (2003), the urban population is estimated to grow at 1.8% per annum, while total population rate is projected to be 1% annually. This would result in an urban population of 5 billion people (61%) by 2030. The rural population on the other hand is expected to decrease from 3.3 to 3.2 billion people between the year 2003 and 2030.

Many developing countries in the world are currently experiencing an unprecedented rate of urbanization. It is also clear that, unlike the experience of currently developed countries, the process of urbanization presently taking place in developing countries is not in consonance with rapid industrialization. Rather, it is the consequence of growing population pressure on land in the rural areas (Kasahun, 2000). In line with this, Todaro (1976) reported that the major sources of the growth of urban population in developing countries will not only be natural population increase but also the continuing migration of rural people to the urban centres.

According to UN Report on Demography (2003), migration is a spatial mobility of people by changing their usual place of residence to another destination. Migration may involve either crossing boundaries of countries which in this regard is termed as international migration or movement within the country's boundary (internal migration). Internal migration consists of rural-rural, rural-urban, urban-urban, and urban-rural migration and the concern of this paper is rural-urban migration among the different internal migration types.

All types of internal migration are common in Ethiopia. Among them, rural-rural migration takes the lion share of internal migration in both 1999 and 2007 national household survey. The next highest is rural-urban migration which accounts for 24.8 and 32.5% of the overall migrants in the year 1999 and 2007, respectively. Among the different forms of internal migrations, the most threat to the economy for the less developing countries comes from rural-urban migration, because migration is undertaken from the place where job creation is easy (agriculture) to others where job creation is difficult (industry and service sectors). Furthermore, the burden of rural-urban migration is more severe in less developing countries since migration rates are beyond job creation in the cities (Shamdin, 2005).

The total population of Ethiopia was 22.45 million in 1961 where only 2.39 million lived in urban areas, while the remaining 20.05 million lived in country sides. However, the total population of Ethiopia became 35 million (30.77 million rural and 4.23 million urban) in 1980 and 81.91 million in 2011 (68.66 million in rural and 13.25 million in urban). That means, between 1981 and 2011, the urban population of Ethiopia increased by 203%, while the rural population increased by 117% (Central Statistical Authority (CSA), 2013). This rapid increase in urban population relative to rural population is due to the fact that rural-urban migration has depopulating effects on rural areas and increases the growth rate of urban population.

As far as rural-urban migration is concerned, problems related with it are the rate, concentration and composition of the migrants (Beylee et al., 1996). With regard to the rate, in the year 1994 to 2007 in Ethiopia, the average annual increase in the rate of rural-urban migration was 5.68% whereas for the same period, the migration increase rate for Southern Nations Nationalities People Regional (SNNPR) state was equal to 7.28% which is higher than the national average. This high rate of rural-urban migration depletes the educated labor force of the rural areas in addition to the problem it creates in urban areas such as increased crime, unemployment, cost of provision of public goods and demand for housing. The 2005 labor force survey of Ethiopia vividly indicated that unemployment within the migrants was 38.28% but for the same period unemployment for the non-migrants is equal to 22.2%. This directly signals that the miseries of unemployment are stronger on migrants than the non-migrants.

CSA (2007) report indicated that from the overall rural-urban migrants, those below the age of 17 accounts for nearly 32.2% of the migrants. Since these migrants have to avail themselves in the labor market to get income for survival, the rural-urban migration trends are neatly contributing to the exploitation of child labor (Kobzar et al., 2015; Potts, 2013a; De Brauw et al., 2013a; Gibson and Gurmu, 2012; Morrissey, 2011; FAO, 2016a, b).

Although understanding the determinants of migration from rural to urban area is indispensable for policy formulation, researches in the area are few. The study conducted by Montira (2010), Birhanu (2017), Arzaghi and Rupasingha (2013), Omonigho (2013), Zainab (2004), Feleke (2005), and Tumbe (2015a) found that individual-level characteristics such as gender, age, and years of schooling and household characteristic such as family size are the determinants of migration decisions. Moreover, Srinath (2010) and World Bank (2008) assessed the relative significance of push or pull factors in explaining the rural-urban migrations.

In recent years, the rate of rural-urban migration has become alarming as more people drift into the urban centres from the rural areas. It is against this backdrop that the present study examined the central characteristics of rural-urban migrants and the determinants of rural-urban migration in Southern Ethiopia using descriptive and micro econometric modeling.

In line with the aforementioned general objective, the present study was specifically devoted to describe the socio-economic characteristics of rural-urban migrants, identify the various economic activities of rural-urban migrants at receiving areas, and assess the determinants of rural-urban migration in the study areas using the Probit model.

RESEARCH METHODOLOGY

Description of the study areas

SNNPR is located in the Southern and Southwestern part of Ethiopia. Astronomically, it roughly lies between 4°.43 and 8°.58 north latitude and 34°.88 and 39°.14 east longitude. It is bordered with Kenya in south, the South Sudan in southwest, Gambella region in northwest and surrounded by Oromia region in northwest, north and east directions. According to CSA (2013), the total population of the region was 17,403,000 and only 14.7% of the population in the region lives in urban areas. Compared to other regions in Ethiopia, SNNPR is the least urbanized region in Ethiopia.

The total area of the region is estimated to be 109,015 km^2 which constitutes 10% of the total areas of the country. The average population density of the region is 154 persons/km^2 which makes the region one of the most populous parts of the country (CSA, 2013). Among all Ethiopian regions, southern region is known for its ethnic and cultural diversity. Out of the country's 85 ethnic groups, about 56 ethnic groups live in South Ethiopian region. It is due to this fact that the region is commonly referred to as a "mosaic of peoples". These varied ethnic groups are classified into the Omotic, Cushetic, Nilo-Sahara and Semitic super language families, among which Omotic and Cushetic are the most populous and diversified ones with the largest area coverage in the region, respectively. Based on ethnic and linguistic identities, the region is at present divided into 15 zones sub-divided into 131 Woredas, 4 special Woredas and 22 town administrations. According to CSA (2013) report, there are 334 urban and 3,678 rural kebeles in the region.

The amount, duration and intensity of rainfall in the region vary considerably. It generally decreases from west and northwest to south-eastward. The main dry season is shorter in Southern Ethiopia conversely the main rainy season is larger in west and south west. For the last three decades, the mean annual rainfall of the region ranges from the lowest, about 400 mm to over 2200 mm, according to CSA (2013) report. The mean annual minimum temperature of the region varies from 10.5 to 11.7°C in the extreme highlands, while the mean annual maximum temperature of the region ranges from 30.0 to 32.6°C in the lowland part of the region. The region has very diverse agro ecological zones ranging from hot arid and semi-arid climate in the southern most parts (57.4%) to a tropical humid type in the high lands of the north and northwest (8.6%) and intermediate between these extremes; the climate is defined to be tropical sub-humid type (34%) of the region that is moderately suitable for settlement and crop production.

According to CSA (2013) report, SNNPR state is known by its coffee production which represents about 44.2% of the total production in Ethiopia. Farmers in the region had an estimated total of 7,938,490 head of cattle (20.5% of Ethiopia's total cattle), 3,270,200 sheep (18.8%), 2,289,970 goats (17.6%), 298,720 horses (19.7%), 63,460 mule (43.1%), 278,440 asses (11.1%), 6,586,140 poultry (21.3%), and 726,960 beehives (16.7%). Among this total population of the region, 2,075,332 were migrants (14% of the total population). The rural-urban migrants in the region in 1994 was 281,686 while this figure increased to 702,880 in 2007 and further increased to 913,477 in 2013 according to CSA data. Moreover, from the total migrants in the region in 2007, rural-urban migrants accounts for 34% of the total migrants.

Sampling techniques and sample size

There are 15 zones in SNNPR state and from these migration data for four cities in the region, namely, South Omo, Sheka, Daworo, and Siltie could not be obtained. Similarly, no population data was gotten for two zones, Kefa and Benji Magi. Therefore, the selection of the sample cities was restricted to nine zonal cities depending on the proportion of rural-urban migrants. The total population and the rural-urban migrants in SNNPR state were 17,403,000 and 913,477, respectively according to CSA (2013). Accordingly, depending on the proportion of migrants in each zonal city, four zonal cities were selected as a sample for the present study and the total number of rural-urban migrants from the four selected sample zonal cities is 137645. The present study depends on the sample determination method used by Srinath (2010) to determine the sample size for this study. Accordingly, a total sample size of 665 rural-urban migrants was selected from the four zonal cities. According to Srinath (2010), a sample size for the primary survey for migration is given by:

$$n = \frac{P}{Q} X \frac{1}{e^2}$$

The proportion of rural-urban migrants in each town is given by 'P' which can be used to obtain sample size directly. If P is the proportion of rural-urban migrants, Q=1-P gives the proportion of non-migrants in each town.

For this study, the probability of committing type I error is set at 10%. Based on the formula, the sample size for each sample town is determined as shown in Table 1. There are 11 Kebeles in Arba Minch City and depending on the proportion of rural-urban migrants in each kebele, four kebeles were selected for this study, namely, Woha Minch, Menaharia, Woze and Doysa kebele. Hawassa city, the capital city of SNNPR state, has 32 kebeles and purposively depending on concentration of rural-urban migrants, 5 kebeles, namely, Chefe Cote Jebisa, Gemeto Gale, Dame, Hixata and Giwia were included in this study. Similarly, there are 11 kebeles in Woliata Soddo city and purposively four kebeles, namely, Wado, Gido, and Selam and Gebeya were selected for this study. But there are only 8 kebeles in Hosiana city and 3 kebeles namely, Shitduna, Jalo Narmo and Bobicho were selected purposively depending on the concentration of rural-urban migrants.

Finally, while collecting data, snow ball sampling method was used to obtain sample migrants from each kebele. In this method, an actual snowball growth was thought of, and the initial participant will lead to the next participant and accumulating more along the way through ways of networking of which more participants would be appropriate for the study. Snowball samples are particularly useful in hard-to-track populations, in populations of interests such as truants, drug users and migrants.

Specification of probit model

The human capital theory predicts that individuals move or migrate from sending area to receiving area so as to maximize their life time money. That means, they make a cost benefit analysis and decide to migrate if their expected discounted net-benefit from migration is positive. Thus, a rational individual would migrate if the present value of the expected income gain exceeds the cost of relocation. That means, an individual will migrate if the discounted net benefit from migration, V(0), is positive.

$$V(0) = \sum_{t=0}^{n} [P(t)Yu(t) - Yr(t)]\, e^{-it} dt - C(0) \quad (1)$$

However, the New Economics of Labor Migration (NELM) shifts the decision unit from the individual to the family. Moreover, for social capital theory, migration is caused by social networks between the place of origin and the destination. So, the theoretical frame work for the present study uses the basic Todaro migration equation which can be written as:

Table 1. Sample zonal cities and sample size determination from each sample city.

Sample city	Rural-urban migrants	Proportion of migrants (P)	Proportion of non-migrants (Q)	P/Q	$(\frac{P}{Q} X \frac{1}{e^2})$
Hosiana	23953	0.6	0.4	1.5	150
Hawasa	63175	0.683	0.315	2.15	215
Sodo	24874	0.60	0.40	1.5	150
A/ Minch	25643	0.6	0.4	1.51	150
Total sample size from the four sample zonal cities			665		

Source: CSA (2013).

$$m = F\left(\frac{Eu}{Lu}, W, Z\right) \quad (2)$$

Therefore, according to Equation 2, the revised Todaro (1969) migration model, rural-urban migration, depends on income differential between the receiving and sending areas (W), urban job opportunities ($\frac{Eu}{Lu}$), other factors such as social networks, family size, etc. This means, Equation 2 is the amalgamation of the human capital theory, the New Economics Labor Migration theory and the social capital theory of migrations.

To separate the purely push from the purely pull factors, the present study generates the dependent variable Yi for each individual migrant, where Yi = (Number of pull reasons for migration chosen) / (Total number of reasons for migration chosen). Hence, the variable Yi varies from 0 to 1, with the value 0 indicating that the individual's reasons for migration are only push in nature and with the value 1 referring to only pull factors. Finally, in order to understand the factors which determine the extent of push versus pull factors in migration, the present study used the Probit regression model where the dependent variable is dichotomous which assumes value of 1 if Yi≥0.5 and 0 if Yi<0.5. Thus, an explicit migration model which helps in the present study to assess the determinants of rural-urban migration in the study areas is specified as follows:

$$M = \beta 0 + \beta 1AGE + \beta 2SEX + \beta 3Y_{UR} + \beta 4MRST + \beta 5EDUC + \beta 6DSKM + \beta 7LS + \beta 8RLU + \beta 9FS + \beta 10INFR + Ui \quad (3)$$

where AGE, SEX, YR, MRST, EDUC, DSKM, LS, RLU, FS and INFR refer to age at migration, sex of migrant, urban-rural monthly income differential in birr, marital status of migrant, years of schooling at migration, distance from sending areas in kilometers, land size of migrant's family, relative at receiving areas, family size of migrant's family and access to information at sending areas, respectively.

The dependent variable (M) is binary which takes 1 for migrants mainly who migrated due to pull factors and 0 for migrants who migrated mainly due to push factors. The human capital theory predicts that education affects migration positively, but education might also increase earning at home. Thus, it is not clear a priori whether it will increase or decrease migration. Therefore, the sign of the coefficient of education is indeterminate. Age, distance from sending areas, marital status (1 for married and 0 for unmarried) and land size of migrants' family are expected to affect rural-urban migration negatively. Similarly, the coefficient of sex (1 for male and 0 for female) is expected to affect rural-urban migration negatively, because females are generally less mobile than their male counterparts.

According the New Economics of Labor Migration theory, family size of migrant's family affects migration positively and therefore the coefficient of family size is expected to have negative sign. A dummy variable showing whether someone has a relative at the destination is included as a proxy for household level network. Having a member of the household in receiving areas will increase the probability of rural-urban migration. Finally, data collected from primary sources using structured questionnaires were analyzed using descriptive statistics and Probit regression via some statistical softwares like SPSS and Stata.

RESULTS AND DISCUSSION

In this section, both descriptive and Probit results are presented and discussed. The descriptive analysis employs the tools such as measures of central tendency, dispersion, percentage, graphics and frequency distribution. Econometric analysis was used to identify relevant socio-economic and institutional factors that cause rural-urban migration in the study area. So, this part of the study was devoted to answering the basic objectives of the study using both descriptive and Probit data analyses.

Socioeconomic characteristics of sample migrants

As presented in Table 2, the ages of the majority of the rural-urban migrants in the study area were between 15 and 25 years. That means, about 212 (32%) of them left their homes when their age range was between 15 and 18 years, while 172 (26%) of the migrants left home when their age range was between 19 and 21 years. As shown in Table 2, most 384 (58%) of the rural-urban migrants left home when their age range was between 15 and 21 years. The results of this study is also in line with economic theory which predicts that most migrants in developing countries leave home between the ages of 13 and 17 (Thorsen, 2012). Moreover, this result is also in agreement with the study conducted in Ethiopia by Kelil(2015) who found that majority of migrants were among the age group of 16 to 18 years. This implies that rural-urban migration is age selective and the propensity for rural out migration decreases with age in country side

Table 2. Age, marital status and education background of rural urban migrants.

Age distribution of migrants			Educational background of migrants		
Age of migrants	**Number of migrants**	**Percentage**	**Level of education**	**Number of migrants**	**Percentage**
Less than 11	8	1	Illiterate	24	4
11 - 14	72	11	1 - 4	84	13
15 -18	212	32	5 - 8	322	48
19 - 21	172	26	9 - 10	188	28
21 - 25	123	18	11 - 12	26	4
Greater than 25	78	12	13 - 16	21	3
Total	-	665	100	665	100
Marital status	Single	Married	Divorced	Widowed	Total
Migrants	558	90	12	5	665
Percentage	84	13	2	1	100

Source: Field Survey (2016).

(Awumbila et al., 2015; Msigwa and Mbongo, 2013; UNICEF, 2014; International Labor Organization (ILO), 2014; Charles-Edwards, 2014; Nauman et al., 2015; Cortina et al., 2104; Ginsburg et al., 2014).

This implies that agricultural production in particular and rural economy in general has been losing productive labor forces and this may in turn affect the production and productivity of agricultural sector unless government takes corrective measures to reverse the current wave of youth rural-urban migration. It is important to create attractive and innovative job opportunities in country sides for youth, landless and disadvantaged groups of communities.

As revealed in Table 2, 322 (48%) of the rural-urban migrants attained their junior education level (5-8), while 188 (28%) and 84 (13%) of them were attending secondary (9-10) and primary education (1-4), respectively. But, only 24 (4%) of the migrants did not attend school before migration. This implies that more educated and young individuals are more likely to out migrate from the country sides in the study areas. Thus, the rate of rural-urban migration is higher for young and relatively more educated persons in the study areas. This result is in line with the findings of Henok (2017), Akhter and Bauer (2014), Ferrone and Giannelli (2015), Herrera and Sahn (2013), Osawe (2013), Gray and Mueller (2012), Ferrone and Giannelli, (2105), Tigau et al. (2015), Kusumawardhani (2012), and Bhagat (2014).

As also presented in Table 2, majority 558 (84%) of the migrants in the study areas were unmarried and 90 (13%) and 12 (2%) of them were married and separated from their partners as of the time of their migration, respectively. This may be due to the fact that at the time of their migration, the ages of most of the migrants 292 (44%) were less than 18 years and this may further imply that single individuals are more mobile than married ones in the study areas. Therefore, marital status of an individual affects the probability of his/her out migration since unmarried persons have lesser responsibility compared to the married ones. So, being unmarried increases the probability of rural out migration in the study areas and this result is in agreement with the study conducted by Kebede (1994).

Therefore individuals who are young, educated and unmarried tend to be more mobile; they seek works that match their age, higher skills and experiences and which pay return on education costs incurred. Besides, out of the total sampled rural-urban migrants, 213 (32%) were female migrants while the remaining 452 (68%) were male migrants as can be seen from Table 4 and this result is in line with the study conducted by Tumbe (2015b). As can be seen from the results in Table 3, the average age of rural-urban migrants is 19.87 which coincide with the age of high school completion for students; the mean years of schooling of the rural-urban migrants was 7.37 years.

The mean years of male and female migrants in the study areas were closely related and the difference is statistically insignificant. The data also revealed that females move shorter distances than their male counterpart in the study areas. The mean distances travelled by male and female in kilometers, as evidenced from Table 3, were 80.50 and 63.08 and the difference is also statistically significant at 5% level of significance.

These findings are also in line with the Ravenstein's laws of migration which states that females appear to pre-dominate among short distance migration which means females are more migratory than males within the place of their birth, but males more frequently venture beyond.

Distance from urban areas and decision to migrate of rural-urban migrants

This study also found that most of the rural-urban

Table 3. Mean difference test for some continuous variables categorized by gender.

Variable	Mean		Mean difference	Total mean	t-value	P-value
	Male	Female				
Age at migration	20.01	19.54	0.4822	19.87	1.126	0.1302
Distance (km)	80.50	63.08	17.43	74.92	2.031	0.0213
Income	1863.2	1463.1	400.1	1734.9	2.572	0.0052
Education at migration	7.32	7.46	-0.1486	7.37	-0.584	0.7202
Experiences	2.826	2.390	0.4355	2.6867	3.5	0.0002
Working hours	10.249	10.389	-0.1407	10.294	-0.719	0.7641
Food expenditure	710.55	498.66	211.893	648.51	5.70	0.000
Remittance	50.377	32.854	17.522	44.764	2.237	0.0128
Savings	305.7	187.56	118.142	266.97	2.515	0.0065

Years of migration	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Male migrants (452)	7	43	79	86	100	75	62
Female migrants (213)	1	22	16	38	51	60	25
Total migrants (665)	8	65	95	124	151	135	87

Source: Field Survey (2016).

Table 4. The distribution of the causes of rural-urban migration in the study areas

Causes of migration	Arba Minch		W/Soddo		Hosiana		Hawasa		Total
	Number	%	Number	%	Number	%	Number	%	
Better jobs	98	65	43	29	63	42	91	42	295
Poverty	18	12	69	46	44	29	45	21	176
Join relatives	2	1	0	0	0	0	1	0	3
Education	11	7	13	9	11	7	26	12	61
Urban services	0	0	9	6	2	1	9	4	20
Start business	12	8	6	4	18	12	16	7	52
Culture	7	5	9	6	10	7	27	13	53
Others	2	1	1	1	2	1	0	0	5
Total	150	100	150	100	150	100	215	100	665

Source: Field Survey (2016).

migrants came from nearby woreda, kebeles and villages in the study areas. So, distance from sending areas increases the cost of rural-urban migration and may reduce the wave migration. As evidenced from Figure 1, 385 rural-urban migrants came from a radius of 50 km around their destination (zonal cities) but the number of migrant decreases as distance from sending areas increases with only about 132 and 124 rural-urban migrants coming from distances of 51-100 and 101-200 km, respectively in the study areas.

By implication, rural-urban migration is negatively related with distance and this finding is in line with the study conducted by Lu and Qin (2014). As revealed in Table 3, it seems that rural-urban migration increases with the passage of time in the study areas. The rural-urban migrants in 2016 was 87 and this is due to the fact that, in this period only six months were covered by the survey since the data were collected in this period.

According to the Harris Todaro rural-urban migration theory, the causes for rural-urban migration are economic factor and the decisions to out migrate from rural areas are made by considering the cost and benefits of migration at individuals' level. But, according to the New Economics Labor Migration (NELM) theory, people act collectively not only to maximize income, but also to minimize risks and the constraints created by a variety of market failures, including lack of credit, insurance, and labor markets (Stark, 1991).

Moreover, social capital theory or network theory insists that relatives or friends at receiving areas increase the rate of rural-urban migration by decreasing the cost of migration, providing more information and increasing the

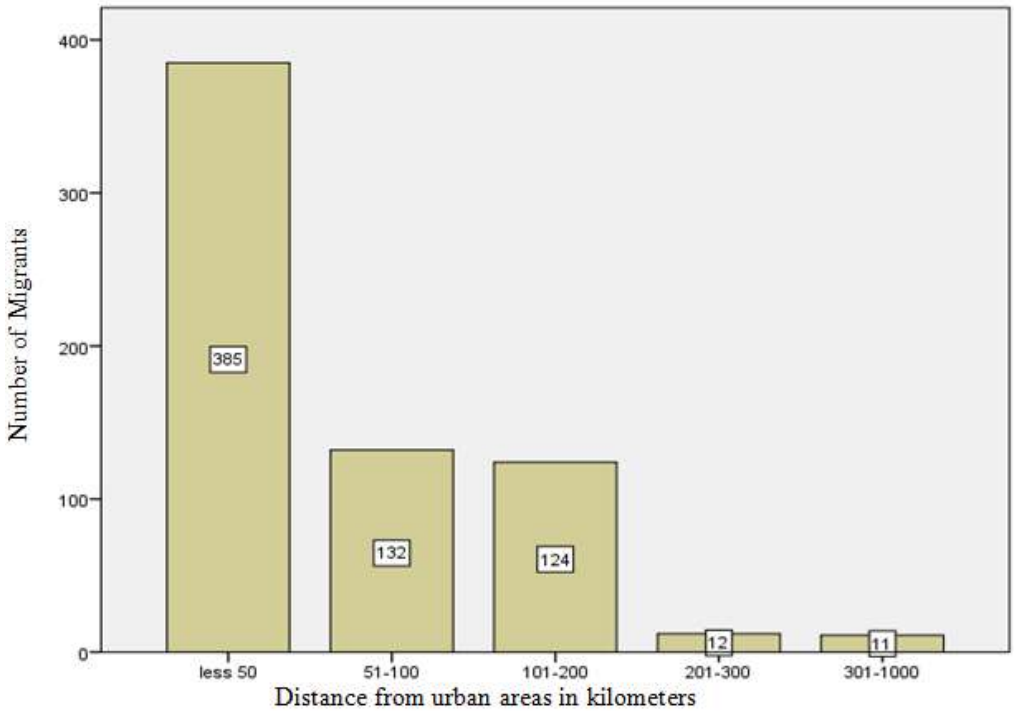

Figure 1. The distribution of the number of rural-urban migrants by distances they traveled.

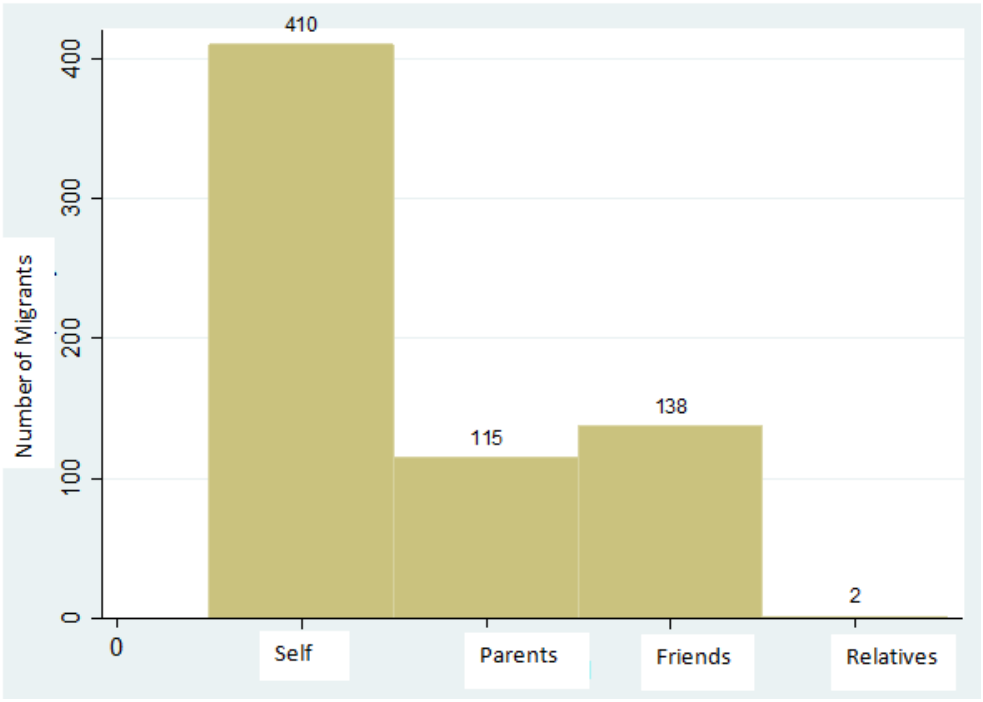

Figure 2. The Distribution of rural-urban migrants by the decisions to migrate.

benefits of rural-urban migration. Figure 2 revealed the relative importance of the various theories of migration in explaining the migration phenomenon in the study area.

As witnessed from Figure 2, the rural-urban migration in the study areas are more explained by Harris Todaro rural-urban migration theory as 410 (62%) of the migrants

reported that they migrated from rural areas by their own decisions. Besides, 138 (21%) and 115 (17%) of the total migrants in the study areas reported that they migrated from their place of origin by the decisions of friends and parents, respectively. Thus, the decisions to out migrate from country side in the study areas are primarily made by individual migrants, while the roles of parents in inducing rural out migration of family members are still higher than that of friends and relatives. This finding is also in agreement with the results obtained by Gerritsen et al. (2013), Habtamu (2015), and Young (2013).

Causes of rural to urban migration in the study areas

At the time of data collection, migrants were provided with open ended questions that contain statements on the reasons why they left their place of origin. In response to this question, migrants identified some reasons which they assumed are responsible for rural out migration in the study areas. As evidenced in Table 4, 295 (44%) of the rural-urban migrants in the study areas reported that better jobs opportunities at the urban areas was the first reason for their leaving their places of origin, while 176 (26%) of them reported rural poverty (lack of farm land, crop failure, large family size, lack of employment) as the reason for leaving their homelands. Similarly, from the total sample of 665 rural-urban migrants in the study areas, 61, 53, 52 and 20 rural-urban migrants identified better education services at urban areas, free from cultural restriction, start new business at receiving areas and better urban infrastructure as the reasons for their rural out migration.

The lives and livelihoods of majority (80%) of the population of Ethiopia were married with agricultural production as the sole business and this sector does not provide satisfactory employment opportunities in the rural economy for adult, young, adolescent and children due to the fact that the sector was highly characterized by land degradation, deforestation, backward farming activities, land fragmentation due to population pressure, natural calamities, etc. But in receiving areas, urban centers, there is a relatively greater concentration of job opportunities due to the expansion of the construction sectors, informal business, establishment of few industries and some infrastructural investments. So, the rural people come to the cities in search of employment. As can be seen in Table 4, about 295 (44%) respondents consider the search for better jobs as the first reason of rural out migration.

Lack of job opportunity is much related with poverty. If a person has a job, he may get income and thus, he will pay for food, shelter and cloth. But Ethiopia is the second populous country in Africa with the majority of the population living in rural areas. So, population pressure is one of the major problems of Ethiopia. In rural areas, there are many families with large family members. It becomes difficult to provide those additional family members with food and shelter. Hence because of large number of family members, many people migrate to cities and live separately.

Rapid population growth and the prevailing inheritance law are also creating wide landlessness in rural areas. Therefore, landless people migrate to cities in search of employment and this result is in line with the study conducted by Akram (2015), WFP (2015), Berhanu (2012), Gray and Mueller (2012), De Brauw et al. (2013a) and Patra (2013). As shown in Table 4, the main reason for rural out migration in Woliata Soddo town is the push factor in sending areas, poverty (46%) followed by search for better jobs opportunity (29%) in receiving areas. This may be due to the fact that from the 15 zones in SNNPRS, Woliata Soddo zone is known by high population density, low agricultural productivity, large family size, and greater rural poverty. But rural-urban migrants in Arba Minch, Hosiana and Hawasa cities were pulled towards receiving areas by better job opportunities relative to rural areas, relatives at urban areas, better education facilities, urban services and the existence of informal sectors to start new business in urban centers. In other words, the causes of rural-urban migration in the study areas are mainly economic factors and this is in line with the Harris Todaro model of rural -urban migration. The non-economic factors which include joining relatives at urban areas, free from cultural restrictions and obligations in sending areas and urban services or facilities are less important in inducing rural-urban migration in the study areas as confirmed in Table 4.

Economic activities of migrants at sending and receiving areas

Economic theory predicts that, pre-migration occupation is one factor inducing rural-urban migration. Rural farmers may out migrate as a result of shortage or lack of farm land, crop failure as well as the need for other better opportunities in receiving areas, while students may out migrate from their homeland as a result of school dropout, failing national examination and lack of employment opportunities. The result in Table 5 shows that, the main occupations of rural-urban migrants at sending areas are students 385 (59%), farm workers 210 (32%), unemployed 57 (7%) and housewife 15 (2%). This implies that the main sources of rural-urban migrants are school drop outs in rural areas, no agricultural lands, unemployed youth and households with large family members. A study conducted by Mutandwa et al. (2011) in Rwanda demonstrates that unemployed and underemployed people are significantly more likely to migrate than employed ones.

The chance of getting jobs in receiving areas by itself depends on the level of education and age of the

Table 5. The occupation of rural urban migrants at sending and receiving areas.

Occupation at receiving areas			Occupation at sending areas		
Occupation	**Number of migrants**	**%**	**Occupation**	**Migrants**	**%**
Construction workers	155	23	Students	385	59
Shoe shining	98	15	-	-	-
Coffee vending	66	10	-	-	-
Hotels and Café waiters	98	15			
Retailer trade	92	14	Farm Workers	210	32
Beauty salon	22	3.3			
Barber	18	2.7			
Students	9	1	-	-	-
Lottery sellers	10	2			
Metal and wood work	28	4	Unemployed	57	7
Office workers	12	2			
Unemployed	12	2	-	-	-
House workers	10	2			
Daily laborers/porters	29	4	House Wife	15	2
Others	6	1			
Total	665	100	Total	665	100

Source: Field Survey (2016).

migrants, existence of relatives at urban areas, years of stay at urban areas and particular skill of migrants. Those migrants with longer stay in urban area (experience), relatives in receiving areas and longer years of schooling have greater chance of getting urban jobs as predicted by migration theory. In other words, new arrived migrants, migrants with no relatives and migrants with lower years of schooling have lesser chance of getting urban jobs and they mostly engage in other activities such as coffee vending, shoe shining, daily laborers, lottery selling, etc.

The major occupation of the migrants at receiving areas, as indicated in Table 5, are construction workers (23%), hotel and café waiters (14%), shoe shining (15%), coffee vending (15%), beauty salon (3.3%), and male barber (2.7%).

Therefore, it seems that the rural-urban migrants are engaging mostly in service sectors in the study areas and the finding is in agreement with the study conducted by Bezu and Holden (2104) and Potts (2013b).

Regression results of the probit model

Different literatures about the determinants of rural-urban migration state that attributes like age, sex, educational level, family size, and urban-rural income differential determine the migration decision of an individual at sending areas (Linger, 2008). The econometric model regressed the push versus pull factors as being dependent on various demographic and economic characteristics as presented in Table 6. The dependent variable is dichotomous which assumes value of one for migrant whose migration decision was made mainly and purely due to pull factors and value of zero for migrant whose migration decision was made mainly and purely due to push factors as explained in the methodological part of this paper.

As evidenced from Table 6, the explanatory variables are age, gender, years of schooling, gender, marital status of migrants at sending areas, distance from sending area, existence of relatives at receiving areas, urban-rural monthly income differential, family and land sizes of the parents of migrants and access to information about receiving areas. According to the result of this study, the less educated are more likely to be pushed out of rural areas, whereas the better educated would be pulled towards urban areas and this is significant at 10% level of significance.

The coefficient of gender is negative and statistically insignificant in affecting rural-urban migration, the push versus pull factors. Though statistically insignificant, this implies that male migrants are more likely to be pulled either by marriage, by the attraction of job opportunities, or higher expected income in urban areas, while women are more likely to be pushed out of the rural area, may be due to the non-availability of jobs, family size or lack of adequate income. As can be seen from Table 6, the coefficient of years of schooling is positive and statistically significant at 10% level. This is in line with the prediction of economic theories and it shows that more educated migrants are more likely to be pulled toward urban areas due to its networks, access to information, income earning opportunities, and availability of jobs. In other words, the less educated individuals are more likely

Table 6. The coefficients and marginal effects of probit regression.

Explanatory variable	Coefficients of probit model	Marginal effect after probit	Z-value	P-value
Age at migration	-0.0216	-0.0081	-1.83	0.068*[2]
Sex of the migrants	-0.1014	-0.0383	-0.93	0.353
Years of schooling at migration	0.0284	0.0107	1.69	0.092*
Marital status	-0.0408	-0.0153	-0.31	0.755
Distance from sending areas	0.0040	0.00015	0.80	0.421
Relatives at receiving areas	0.1801	0.0682	1.65	0.098*
Difference between Y_U and Y_R[3]	0.0010	0.00004	2.68	0.007**
Family size	-0.0401	-0.0151	-1.81	0.071**
Land size	-0.0796	-0.02992	-1.02	0.308
Access to information	-0.1155	-0.04287	-0.90	0.366
Constant	0.5328			
-	Variance inflating factor =1.13, Pseudo R^2=0.330, LR Chi-square (10)=29.49, Prob>χ^2= 0.0010			

[2]In regression analysis, *, ** and *** refer to the variable is statistically significant at 10, 5 and 1% level of significance, respectively. [3]In this model, Y_U and Y_R refer to monthly income of migrants at urban and rural areas in Ethiopian Birr , respectively. Source: Field Survey (2016).

to be pushed out of the rural areas. Therefore, education is one of the relevant factors in accounting for rural-urban migration in the study areas. Regarding the coefficient of family size of the parents of the migrants, there is negative and statistically significant relationship between family size and the dependent variable, the pull versus push factors. That means, higher family size in rural areas induces rural out migration due to push factors or large family size induces push out of the rural area, as predicted by economic theory, holding other things constant.

The members of large family size can be pushed out of rural areas due to the lack of adequate income caused by the non-availability of non-agricultural jobs. Larger households are more likely to resort to migration. As the size of the family increases, its per capita income decreases and family members may migrate to seek work elsewhere. According to Thorat et al. (2011), an increase of one unit in family size produces an increase of 8.7% in the probability of migrating. In addition, study conducted by Agesa and Kim (2001) in Kenya revealed that households with large family sizes or numerous dependents are more likely to consider rural urban migration as alternative livelihood strategies.

Similarly, the surveys conducted in Ghana, Burkina Faso, Senegal and Nigeria under the African Migration Project found that the larger the household, the greater the probability that a household member emigrates (Ratha, 2011). The urban-rural monthly income differential positively and statistically significantly affects rural-urban migration, the pull versus push factors at 1% level of significance, and this study is also in agreement with Harris-Todaro model of rural-urban migration.

According to this theory, rural-urban migration is mainly due to the urban rural wage differentials and it predicts that lower rural wage relative to urban wage induces rural out migration. In line with network theory of rural-urban migration, the coefficient of relatives at receiving areas is positive and statistically significant at 10% level of significance. It implies that, rural dwellers with relatives in receiving area are more likely to be pulled towards urban centers, while those rural dwellers with no relatives in urban areas are more likely to be pushed towards urban center and it is also in line with the study conducted by Dolfin and Genicot (2010) and Angelucci et al. (2009).

Table 6 shows that the coefficient of distance from sending area is negatively related with the dependent variable, pull versus push factors. This implies that as distance from sending area decreases, migrants are more likely to be pulled towards urban areas, while migrants from remote rural areas are pushed from rural areas. This finding is in agreement with Ravenstein (1885) basic laws of rural-urban migration. The explanatory variables in the Probit model are also tested for existence of multicollinearity and the variance inflating factor is found to be 1.3, which implies that there is no problem of multicollinearity between explanatory variables. The overall test of significance using LR Chi square test revealed that, all explanatory variables jointly statistically significantly affect rural to urban migration at 1% level of significance. Finally, the pseudo R^2 of the Probit regression is 33% and it is not uncommon to see lower multiple coefficient of determination in binary regression.

CONCLUSION AND POLICY IMPLICATIONS

Like other developing countries, the rapid growth of rural-urban migration has been a common phenomenon in Ethiopia, and rural-urban migration is the most crucial

component of internal migration. The current rapid increases in the urban population relative to rural population is due to the fact that rural-urban migration has depopulating effects on rural areas and increases the growth rate of urban population.

According to the results of this study, rural urban migration in the study areas was age, education and marital status selective. Meaning most of the rural urban migrants in the study areas were younger, educated and unmarried. Most of the rural urban migrants left their home when their age ranges between 15 and 25 years. Similarly, about half of the rural-urban migrants in the study areas were attending their junior education at time of migration. Besides, more than 80% of the sampled rural-urban migrants in the study areas were unmarried at the time of migration. Therefore, more educated, unmarried and young people are more likely to leave country sides.

The main reasons for rural-urban migration in the study areas are better jobs opportunities at urban areas, rural poverty, search for further education, to start business, to be free from restrictive culture, urban services, etc. So, the causes for rural-urban migration in the study areas are mainly economic factors and this is in line with the Harris Todaro model of rural-urban migration.

The present study also revealed that, females move shorter distances than their male counterpart in the study areas and this is also in line with the Ravenstein's laws of migration which state that females appear to pre-dominate among short distance migration. The result of this study also witnessed that, rural-urban migration in the study areas are more explained by Harris Todaro rural-urban migration theory as about 410 (62%) of the migrants reported that they migrated from rural areas by their own decisions. This implies that, the decision to out migrate from sending areas is mainly made at individual level, while the roles of parents in inducing rural out migration of family members are still higher than that of friends and relatives.

Regarding the economic activities of rural-urban migrants at receiving areas, the study showed that the major occupations of the migrants at receiving areas are construction workers, hotel and café waiters, shoe shining, coffee vending, beauty salon, and male barber. Therefore, this study indicated that most of the rural-urban migrants in the study areas are engaging in service or informal sectors. Finally, the regression result of the Probit model revealed that age, years of schooling, existence of relatives at receiving areas, distance from sending areas, level of monthly income at sending areas and family sizes of the parents of migrants statistically significantly affect the rural-urban migration in the study areas, the push versus pull factors.

The root causes of rural out migration of people can be addressed by offering more and better on-farm and off-farm employment opportunities at country side. Then, the resulting reduction of rural poverty and improvement of food security may contribute to lesser rural-urban migration pressures in the study areas. Thus, agriculture and rural development programs should explicitly target rural youth to create viable on-farm and off-farm employment opportunities, which are productive, decent and in line with youth aspirations. Therefore, the expansion and development of small scale irrigation projects in migration-prone rural areas are vital in boosting agricultural productivity and production and can reduce wave of rural-urban migration. In addition, support to rural micro and small enterprises (MSEs), access land, availability of relevant education, better access to roads, provisions of credit to rural unbanked youth and linking farmers to markets can help reduce the wave of rural-urban migration.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Review

Why does food insecurity persist in Ethiopia? Trends, challenges and prospects of food security in Ethiopia

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This paper seeks an answer to why does food insecurity persists in Ethiopia with extensive review of literature? Nearly, one billion people globally are food insecure and food security challenges are widespread in the developing countries. Ethiopia has been renowned as a country of famine and food insecurity. During the period between 1958 and 1977 over 25 million people were affected, from 1974 to 1991, it was wracked by political instability, war, famine, and economic decline. Since1991, the country has shown commitment to achieve food security. As a result, there has been a reduction of food insecure people from 52 to 30% and the proportion of people living below the nationally defined poverty line from 44% in 2005 to 29.6% in 2011 although food insecurity remains a big challenge. The structural challenges that drive food insecurity are drought and low productivity due to limited use of agricultural technology. Macro-economic challenges like alarming food prices and unemployment determine the prospect of food security. Therefore, there is an urgent need to transform access to agricultural technology by farmers and employment opportunity. Finally, it was argued here that the government should invest on food to stabilize price and safeguard the poor.

Key words: Drought, food aid, famine, food price, food security, malnutrition.

INTRODUCTION

Conceptual background

In many documents, food security, hunger and malnutrition were used interchangeably, in spite of their very unique and different concepts. Conceptually, there are differences among the three concepts although they have close linkages. For instance, FAO reports on the state of food security present world hunger progress as an indicator of food insecurity (FAO, 2008). Since 1996 world food summit, food security was defined as "a situation when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their

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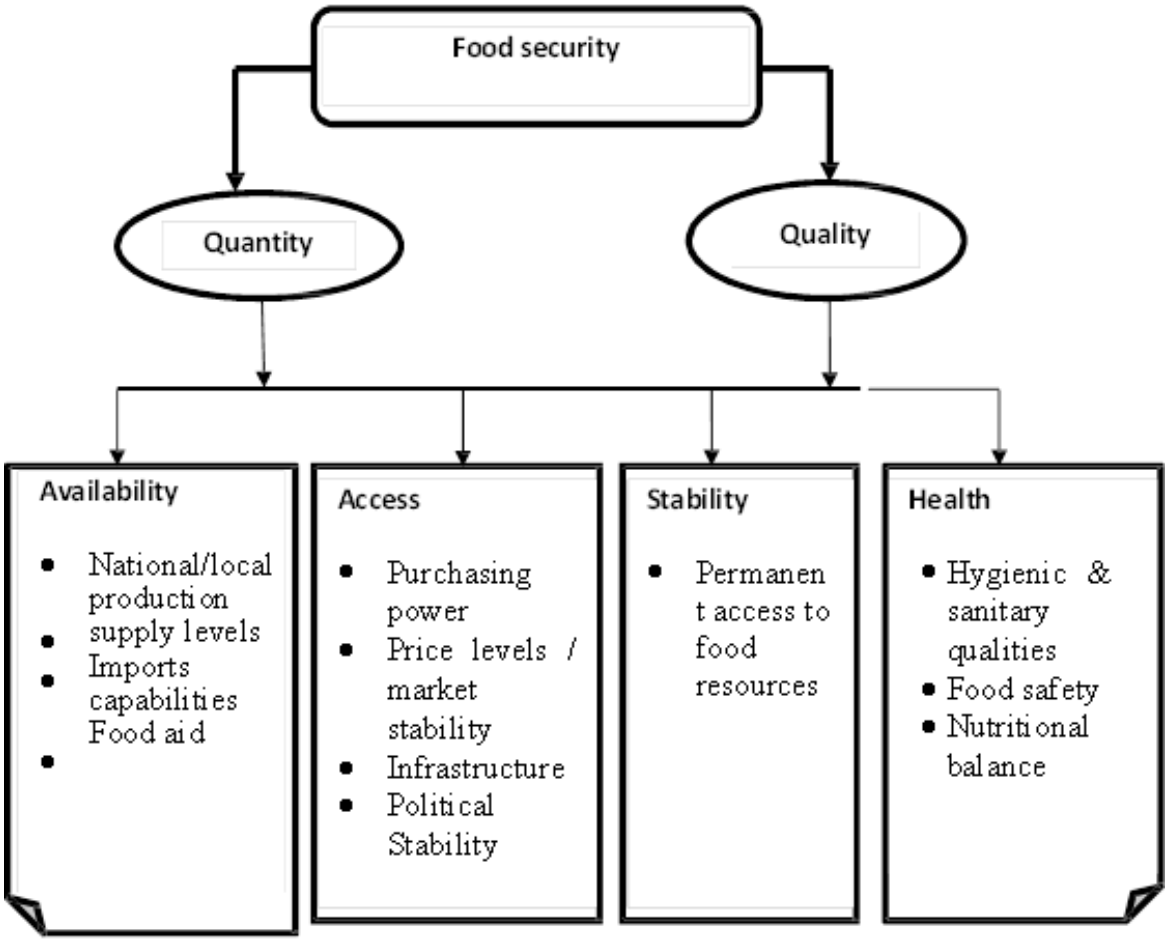

Figure 1. Dimensions of food security (Momagri, 2015).

dietary needs, and food preferences for an active and healthy life", where hunger refers to the body's way of signaling that it is running short of food and needs to eat something. FAO defines hunger as consumption of fewer than about 1,800 kcal per day (the minimum that most people require to live a healthy and productive life) (IFPRI, Concern, WHH, 2010). According to WFP, the average person needs approximately 2,100 kcal per day to maintain a normal, healthy body (WFP, 2012). Victims of hunger live on significantly less than 2,100 kcal per day for extended lengths of time. World Food Program defines hunger as a condition in which people lack the required nutrient–both macro (energy and protein) and micro (vitamins and minerals), for fully productive, active and healthy lives (WFP, 2009). On the other hand, famine refers to drastic loss of body weight, increase in morbidity and rise in death rates as a result of hunger (van Braun et al., 1993). On the other hand, malnutrition is health disorders due to too much or too little food energy or nutrients. Malnutrition includes over nutrition as well as under nutrition (Blössner and de Onis, 2005).

Hunger can lead to malnutrition, but it refers to under nutrition. It is similar to undernourishment, which is a situation where people whose dietary energy consumption is continuously below the minimum required for fully productive, active and healthy lives, and is related to poverty. For children especially, being hungry or malnourished means they can die from common infections or suffer poor health in the long run, limiting their ability to learn in school, work or progress (DFID, 2015). Potential consequences of food insecurity include hunger, malnutrition and negative effects on health and quality of life (Campbell, 1991). Famine and hunger are both rooted in food insecurity. [1]Chronic food insecurity translates into a high degree of vulnerability to famine and hunger. Figure 1 illustrates the various components of food security, along with the variants that influence it. There are quantitative and qualitative aspects of food security. Both dimensions

[1] Chronic food insecurity is a long-term or persistent inability to meet minimum food consumption requirements. As a rule of thumb, food insecurity lasting for at least six months of the year can be considered chronic (WFP, 2009).

Table 1. Summary of literature used.

Issues addressed	N	%
Causes and drivers of food insecurity	17.8	25
Policies, strategies and programs	15.7	22
Food aid interventions	08.1	12
Concepts and guidelines	08	12.1
The state and facts of food insecurity	18	27.3
Total	66	100

link to availability, access, utilization and stability of food security (Momagri, 2015).

Problem context

Ethiopia has been renowned by famine and food security for more than 200 years (Beyene, 2008). The country has faced three major famines in the 1970s, 80s and 90s due to severe drought (Berhanu, 2001). Another factor widely discussed as main reason for food insecurity is land tenure system. Prior to the 1974 revolution, Ethiopia's land tenure systems were grounded in the empire, tribal groups continued to use land and pasture under indigenous arrangements (Bruce et al., 1994). The 1975 land reform nationalized all land. In an initial phase lasting until 1978, it had a land- to-the-tiller character and land was distributed to poor farmers, but between 1978 and 1990, it increasingly stressed villagization and collectivization of production (Bruce et al., 1994). Further political instability, war and policy failure were the major causes of food insecurity in the country (Berhanu, 2004; FDRE, 2002). Although several factors are the drivers of food insecurity in Ethiopia low levels of farm technology, lack of employment opportunities and population pressure play a great role (FDRE, 2003). Currently about 30% Ethiopians are food insecure and Ethiopia is one of severe food insecure countries.

Objective of this paper

This paper is aimed at presenting a synthesis of available literature to give an insight into the trends, challenges and prospects of food security in Ethiopia. It discusses the past and expected future trends in food security. It also clarifies the misconceptions and makes information available for wider users. This paper attempts to answer two questions: Has the food security situation improved or worsened in Ethiopia? And why does food insecurity persist in Ethiopia?

MATERIALS AND METHODS

The paper is prepared through extensive literature review of 66 literatures on global and the Ethiopian food security context. The paper used document analysis as its main method of data collection and analysis. Relevant facts, hypothesis and conclusions; on trends, challenges and prospects of food security were analyzed. The literatures used are on five main areas: (i) Causes and drivers of food insecurity; (ii) Policies, strategies and programs on food security; (iii) Food aid interventions; (iv) Concepts and guidelines of food security; (v) The state of food security (Table 1).

TRENDS OF FOOD INSECURITY

Global trends

All through human history, we see the frequent occurrence of famine dating back to 400 B.C. But, the reasons for famine during this era are mainly related to poor technology and economic progress (WER, 2008). The most famous famines in history happened in different parts of the world; in Ireland in 1845 due to devastating fungal potato disease known as late blight of potato; North Korea suffered a tremendous famine from 1994 to 1998 due to misguided leadership and flooding. Russia was affected by famine in 1921 due to residual impact of World War I where farmers sacrificed their food to soldiers; the Bengal famine of 1443 and1770 due to drought and crop failure; Soviet Union famine within 1932 to1933 due to collectivization of land; Chinese famine from 1932 to 1933 due to harvest failures (Fitzgerrald, 2013). In many cases historical famines are mainly caused by policy failure followed by natural disasters. More than 70 million people died in famines during 20th century (Devereux, 2000).

However, many of the chronically food insecure countries like Ireland, and china have combated the problem through committed governance and development of the agricultural sector. For instance, due to commitment of the government in research and extension advancement, potato diseases were removed and finally food self-sufficiency ensured in Ireland. The Green Revolution brought modern science to bear on a widening Asian food crisis in the 1960s. It contributed and solved the food problem and it contributed to a substantial reduction in poverty and the launching of broader economic growth in many Asian countries (IFPRI, 2009).

Table 2. Trends of food insecurity in the developing world.

Developing region	No of food insecure people (millions)	Share of total food insecure population (%)							
		1969-71	1990-92	2008-10	2012-14	1969-71	1990-92	2010	2012-14
East Asia	4	75	268	123	161	52	32	18	20
South Asia	2	38	255	200	276	26	30	29	34.3
Sub-Saharan Africa	1	03	215	264	214	11	26	39	26.6
Latin America and Caribbean	5	3	64	40	37	6	8	6	4.6
Middle East and North Africa	4	8	37	53	13	5	4	8	1.6
Total	9	17	839	680	701	100	100	100	87.1

Source: FAO (1996, 2014); Max (2015).

Today, the world has more than enough food to feed everyone. But, nearly, one billion people globally are food insecure (DFID, 2015; FAO, 2014; USDS, 2009). Almost all of the worlds (98%) undernourished live in developing countries. In Asia and the Pacific, an estimated 642 million people; in Sub-Saharan Africa 265 million; in Latin America and the Caribbean 53 million; in the Near East and North Africa 42 million; and in developed countries 15 million people in total are suffering from chronic hunger (FAO, 2012).

In spite of a registered decline of a hungry people by 38 million between 1990 and 1995, the situation took a sharp turn to worse. The number of hungry people has risen by 18 million over 1995 to 1 9 9 7 (GAC, 2004). In sub-Saharan Africa (SSA) the number of undernourished has increased with 41%, from 169 million around 1990 to 239 million in 2010 (Hilderink et al., 2012). This situation is expected to worsen, and the number of food insecure people is likely to increase, as changes in extreme weather events, will negatively affect crop and animal yields and agro ecosystem resilience (GAC, 2004). Table 2 shows the global trends of food insecurity from 1969 to 2010 and SSA is the only region where the number of hungry people is rising from 1967 to 2010; slightly declining between 2010 and 2014; but projected to worsen (FAO, 2006). In East Asia, the figure is declining, while fluctuating in Latin America.

Ethiopian trends

Historical facts

For the past 200 years, Ethiopian history is punctuated by famine and food related crises can be traced as far back as 250 BC. During the period between 1958 and 1977 over 25 million people were directly affected by famine and drought. The country has been affected by severe food insecurity for several decades (Beyene, 2008). The country has faced three major famines in 1970s, 80s and 90s due to severe drought that significantly affected the country's food production. It was estimated that close to 58 million people were affected by famine between 1973 and 1986 (Berhanu, 2001).

The drought in Northern Ethiopia started in the late 1960s with a number of years with below average rainfall, reduced harvests and led up to the severe drought of 1973 to 1974 (Webb and Van Braun, 1990). In spite of food shortage and hunger incidence, the government ignored the situation and sold a large amount of cereals in stock on the export market (ODI, 2004) and this leads to devastating situations.

Another factor widely discussed as main reason for food insecurity is land tenure system. Prior to the 1974 revolution, Ethiopia's land tenure systems were grounded in the empire, tribal groups continued to use land and pasture under indigenous arrangements (Bruce et al., 1994). The 1975 land reform nationalized all land. In an initial phase lasting until 1978, it had a land-to-the-tiller character and land was distributed to poor farmers, but between 1978 and 1990, it increasingly stressed villagization and collectivization of production. The land reform abolished large-scale and absentee landlordism and the exploitation of the peasantry by the landed classes. But repeated redistributions of land created insecurity, and the reform was accompanied by the imposition of state marketing quotas, villagization, cooperativization, and a heavy tax burden (Bruce et al., 1994; Lindstrom and Betemariam, 1999). The government is often criticized for neglecting its country, and spending too much on the civil war.

From 1974 to 1991, Ethiopia was wrecked by political instability, war, famine, and economic decline. Several incidences of famines were reported since then. The most recent tragic famines were experienced in 1984/85 which caused the death of over 1 million people (Lindstrom and Betemariam, 1999; Webb and Braun, 1994 cited in Abonesh, 2006). Since 1980 Ethiopia has been in a food deficit, requiring food imports either as aid or purchased (Berhanu, 2004). When the new government came to power about in 1991, 52% of the Ethiopia's population was food insecure and below the national food poverty line (FDRE, 2002).

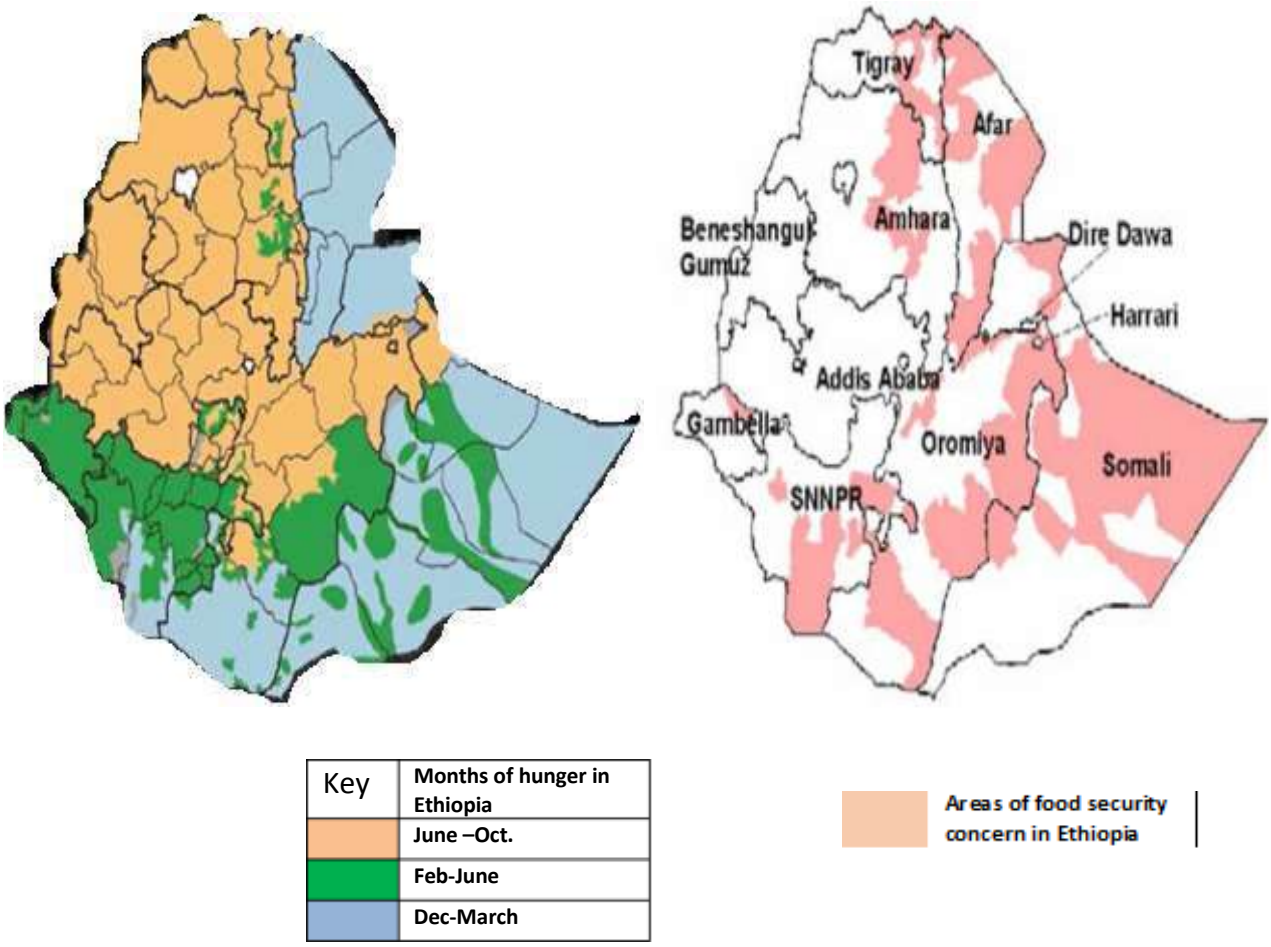

Figure 2. Areas and times of major food security in Ethiopia (Anderson et al., 2011).

Since 1998 the numbers of food aid beneficiaries in Ethiopia have fluctuated between 5 and 14 million every year (Devereux et al., 2006; UNHCR, 2010). In 1999/2000 another famine again was being reported by the world's media and the share of the draught affected population in Ethiopia rose from slightly over 8% in 1975 to 16% in 2003 (Berhanu, 2004). The famine of 2003 in Ethiopia was the worst famine since the mid-1980s. About one fifth of the population was affected and 13.2 million people survived on food aid. Every year an estimated 5 to 6 million people are considered chronically food insecure and between 2 and 7 million additional people have been deemed to be transitorily[2] food insecure.

Several factors are the drivers of food insecurity in Ethiopia including land degradation, limited household assets, low levels of farm technology, lack of employment opportunities and population pressure; adverse changes in climate, poor technology, and program implementation problems have resulted in serious and growing problems of food insecurity in Ethiopia (FDRE, 2003). Poor households are the most food insecure and they are highly prone to shocks. In many instances unemployed people, single-parent-headed households, elderly people living alone, and destitute and homeless people are food insecure in urban Ethiopia (Dermie et al., 2006).

As shown in Figure 2, areas of major food security concern continue to be the northern highlands, some parts of the south and east, and pastoralists in Afar and Somali Regions. In the chronically food insecure areas of central Southern Nations, Nationalities Peoples Regional States (SNNPR) the lowlands of Eastern Oromiya; southern and Central Tigray; Eastern Amhara Region; and the agro-pastoral low lands of Bale and Hararghe zones, severe food problems remain despite the ongoing food aid effort and improved rainfall conditions (FEWS NET, 2005). In spite of its persistence food shortage is severe in different regions of Ethiopia in different months of the year. On the other hand, majority of parts of Ethiopia experience food shortage during the months

[2] Transitory food insecurity is a short-term or temporary inability to meet minimum food consumption requirements, indicating a capacity to recover (WFP, 2009)

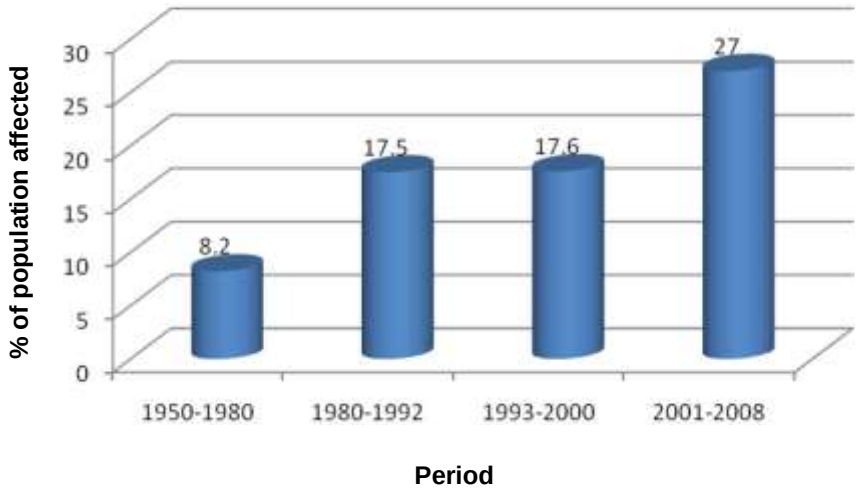

Figure 3. Trends of population affected (million) during major food crises in Ethiopia. Source: UNHCR (2010) and Coates et al. (2010) cited in McBriarty (2011).

Figure 4. Timeline of causes of food insecurity in Ethiopia. Source: FAO stat (2015b)

of June to October, while a significant number of areas also exposed to food shortage shocks during the months from February to June (Figure 2).

Figure 3 indicates the number of population affected during major food crises in Ethiopia. Historically the country is highly vulnerable to climatic hazards, particularly drought and floods. Each of the historical food crises are related to drought and absence of rainfall during the major growing seasons.

CAUSES AND CHALLENGES TO ACHIEVE FOOD SECURITY IN ETHIOPIA

During the socialist era (from 1974 to 1991) the state extracted produce of grains from the farmers under the quota regulation which requires farmers to sell certain quantity of their production to the state Agricultural Marketing Corporation for less than a market value.

Figure 4 summarizes the time line of causes of food insecurity and hunger in Ethiopia. One of the most important causes of famine and food insecurity is policy/governance failure (van Braun et al., 1993). Inadequate high-level political commitment and prioritization of the fight against hunger and malnutrition was the major challenges prior to 1990s.

There is no problem of underdevelopment that can be more serious than food insecurity (World Bank, 1986) that undermines people's health, productivity, and often their very survival (UNHCR, 2010). In the last decade, the country has experienced unprecedented economic growth. Nonetheless, food security remains a serious challenge. There is a question why one of the fastest growing countries in Africa remained to be one of the most food insecure countries. It has to be noted that economic growth is necessary but not sufficient to

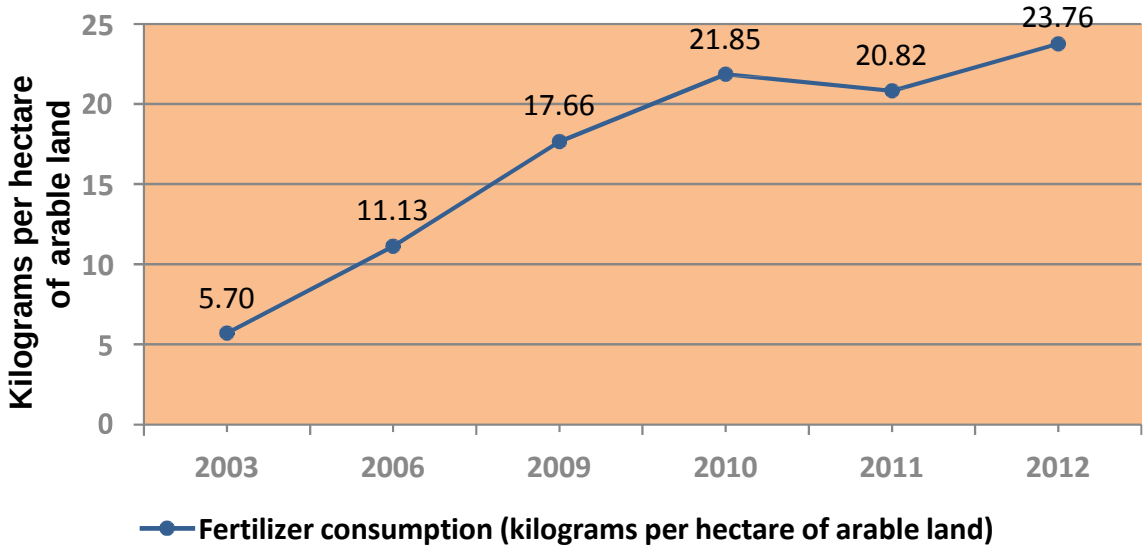

Figure 5. Fertilizer consumption in Ethiopia. Source: FAO stat (2015a) (from World Development Report, 2015).

accelerate reduction of hunger and malnutrition (FAO, 2012). That is why in spite of achieving a double digit Gross Domestic Product (GDP) growth and meeting MDG 1, poverty and food insecurity remain a big challenge in Ethiopia. Over 30% of the population is below the food poverty line, and nationally, 40% of households are food energy deficient (CSA, 2014). This part answers "why the country fails to end hunger despite all the acknowledged achievements?" and it highlights the major challenges hindering it to do so. In addition, it highlights the need to tackle these challenges in order to achieve food security in the coming decades.

Low use of farm technologies and weak innovation base

Food availability is a primary condition to food security. There is a consensus on that of the most critical drivers of food supply is the rate of growth of yields due to new science and technology. The major challenge to food security in Africa is its underdeveloped agricultural sector that is characterized by over-reliance on primary agriculture, low fertility soils; minimal use of external farm inputs, and environmental degradation (Mwaniki, 2006).

If we compare the rate of fertilizer use in sub- Saharan Africa with that of Asia; very little of the area under cultivation is fertilized. In Asia, fertilizer use has long been the norm (AHDR, 2012).For instance, fertilizer consumption in the SSA region averaged roughly 11 kg per hectare of arable land during 2006-08; while the world average was nearly 123 kg (Rosen and Shapouri, 2012). Crop yields in the Horn of Africa are among the lowest in the world (FAO, 2000). SSA agriculture including Ethiopia is characterized by non-mechanized, rain fed with little take-up of new technologies and innovations.

FAO expects that globally 90% (80% in developing countries) of the growth in crop production will come from intensification, in particular higher yields and increased cropping intensity (FAO, 2009). However, agricultural intensification and use of high yielder varieties are at infant stage. In Ethiopia, the production system is largely characterized by subsistence orientation, low levels of external inputs, dependency on rainfall, and limited integration into the market (Berhanu, 2006). For instance, in Ethiopia farmers have been using animal traction for plowing land if they are rich and own oxen; or hand plowing which is too traditional). Smallholder crop yields are below regional averages, the use of improved seeds, fertilizers, and pesticides remains limited; and only 6% of cultivated land is currently under irrigation. Maize production for instance in Ethiopia remains far below its potential due to the limited use of improved seeds, fertilizers and knowledge about best farming practices (Pavlovic, 2013).

Related to this is also limited technology uptake by farmers either due to lack of capacity (capital and skill) or less relevance of the technology available (e.g, only 25% of farmers able to purchase fertilizer, and improved seed; almost very few of smallholders' farmers able to purchase mechanized technology like tractor, combine harvester or more processing machines). For instance, Figure 5 shows the rate of fertilizer use has been increasing in Ethiopia. However, it is much less than the world average which was nearly 123 kg/ha in 2012 (Rosen and Shapouri, 2012).

A key challenge to reducing hunger and malnutrition is

ensuring that knowledge, technology and innovations that have been identified as effective reach those who need them. Translating research outputs into useful products and then ensuring that they reach those who need them is key (DFID, 2015). Innovation is also about getting existing technologies into use in more effective ways. Therefore, increased investment, and incentives are needed with regard to all enhancing smallholder access to agricultural technologies.

Climate related natural hazards: Drought

Food availability, access and stability are highly influenced by whether conditions like drought. Drought is the main natural hazard affecting Africa. It has been plagued by prolonged droughts followed by floods over the past 30 years (CAI, 2012). Large parts of the region are arid or semi-arid. The rainfall is low, unreliable and unevenly distributed and, although there have always been cycles of drought and flooding, there is evidence to suggest that the climate is becoming more unstable and the weather events more severe. In the Horn of Africa, about 42 droughts affected over 109 million people between 1980 and 2011. Over the last 10 years' period 47 million were affected by drought.

Drought remains the major natural hazard in Ethiopia. Since 1950, 12 major drought induced food security crises have occurred in the country. In Ethiopia drought is the most important shock that affects a large fraction of households every year and causes income and consumption shortfalls (IFPRI, 2013). There have been declines in rainfall between March and September from 1980 to the present (CSA, 2014). No doubt that heat increases and changes in normal rainfall patterns will cause drought, and flooding, and affect agricultural yields. For instance, a 10% decline in rain fall results in 4.4% falls in national production in Ethiopia (Webb et al., 1992 cited in van Braun et al., 1993).

Inadequate production and population growth

The main socio-economic factors that drive increasing food demand are population growth, increasing urbanization and rising incomes (FAO, 2009). Food availability at household and national level is determined by amount of production and size of people/ population. Population growth is often considered a prime cause of food shortage in the globe. Ensuring global food security will only become more challenging in the future as demand for food is projected to increase by 50% over the next 20 years (USDS, 2009). In Africa, between 1965 and 1990, agricultural production grew at an annual rate of 1.7%, while the population grew at an annual average of 2.8%. Food production has risen, but consumption has risen faster, largely because of population growth (AHDR, 2012). Providing adequate food for growing populations requires at least a comparable increase in food availability (Rosen and Shapouri, 2012).

Malthus argued, among other things, that populations tend to outstrip food supply because food supplies tend to grow arithmetically whereas populations tend to grow geometrically (APCSS, 1998). This is in line with Malthus' concept that a population growth is unilaterally dependent on its potential to produce food, which is a direct and inelastic function of the given natural resource endowment. With the rapid population growth of the past two decades, per capita food grain production has declined in Ethiopia (van Braun and Olofinbiyi, 2007). Most of Africa's famine prone countries have very high and even increasing population growth rates and rapidly growing labor forces (van Braun et al., 1993).

According to FAO (2000) during 1970 to 2000 per capita agricultural production (index) for Ethiopia has shown a steady decline; while population rises (McBriarty, 2011). It is also indicated in many food security documents food security problem will rise with growing population. The size of Ethiopian population was 40 million in 1984; it increased to 53.4 million in 1994 and further to 73.7 million in 2007. In 2012 the country's population size reached 84.2 million. In 2013 this population size has reached 85.89 (Figure 6) million as projected by the CSA (2014).

Market failure and alarming food prices

Food access is mainly determined by market situations. Market failure happens when free markets are "socially inefficient". A clear case of market failure emerges in situations where the costs society pays for a given activity are greater than the social benefits that activity brings (Rocha, 2006). It occurs when markets substantially and systematically fail to allocate resources to their most highly valued use (Rama and Harvey, 2009). This affects food supply chain and price.

Global agricultural commodity price increases were significant during 2004-06 (Maize prices rose 54%; wheat, 34%; soybean oil, 71 %; and sugar, 75%). Wheat prices have risen more than 35% since the 2006 harvest, while maize prices have increased nearly 28% (Rosen and Shapouri, 2008). In SSA, the alarming increase in food prices results from an increasing demand for food and the demand for fuel-crops, such as wheat, maize, sugarcane and oilseeds for the production of bio-fuels, bio-electricity, and bio-heat (Oritsejafor, 2010).

Poor households spend a high proportion (often over 80%) of their income on food and are therefore particularly vulnerable to adverse changes in the price of food. Rising food prices are likely to lead to higher poverty in Sub-Saharan Africa as the negative impact on

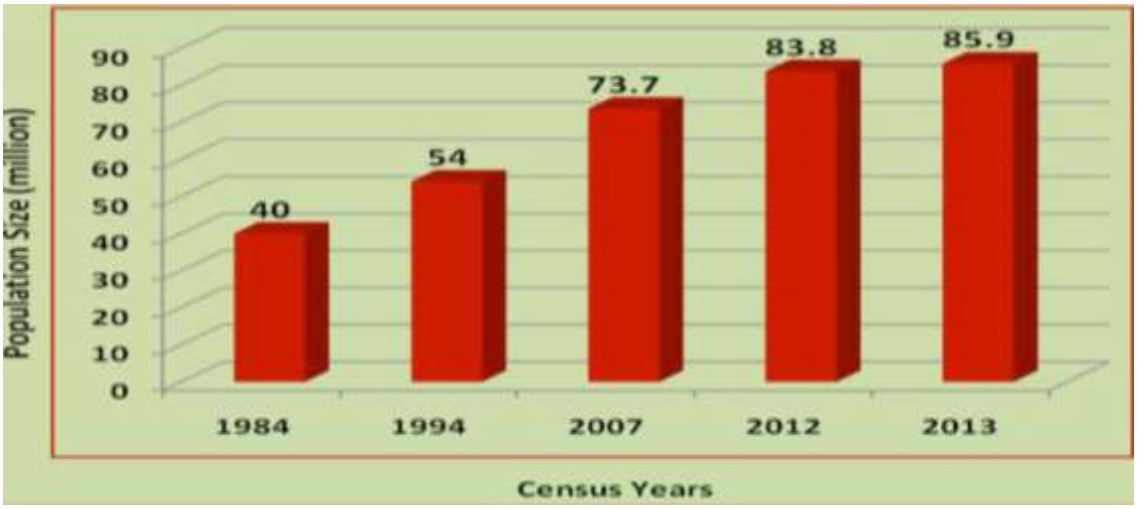

Figure 6. Trends of population growth in Ethiopia.

net consumers outweighs the benefits to producers. In Ethiopia the real problem is not problem of food availability, but food access and inability of the poor to afford food access.

In Ethiopia, food price increases are the most common shocks, experienced by 18% of households (CSA, 2014). Inaccessible production areas due to poor state of rural roads and incomplete regional roads lead to poor market access. Half of the Ethiopian population was found to spend less on food than is required for the consumption of the minimum level of calories (49.5%). Food and non-food prices have been on the rise since 2005. Between June 2007 and June 2008, the nominal price of maize shot up by an average of 202%, wheat by 83% and sorghum by 83%. Agricultural inputs are also more expensive, with the price of fertilizer doubling in a year. At the national level, the inflation rate steadily increased from a mere 3.4% in 2004 to 13.6 % in 2006 and rose further to 34.9 % by June 2008 (Ulimwengu et al., 2009). It was evidenced that the world oil price seems to play a major role in the food price hike in Ethiopia (AfDB, 2011). The government of Ethiopia has issued a 15% vat in food commodities for both domestic and international commodities. This increased the intensity of food insecurity.

Post-harvest loss and low nutritional literacy

Postharvest loss is collective food loss along the production chain, from harvest and handling, to storage and processing, to packing and transportation (Feed the future, 2013). In Africa, post-harvest losses of food grains are estimated at 25% of the total crop harvested. Certain crops such as fruits, vegetables and root crops are less hardy than grains, and post-harvest losses can be as high as 50% (Voices, 2006). In sub-Saharan Africa, the annual value of grain loss is estimated at $4 billion, enough to feed 48 million people for one year.

The magnitude of post-harvest loss in Ethiopia was tremendous ranging from 5 to 26% for different crops (Dereje, 2000; cited in Abebe and Bekele, 2006). This figure is quite large especially for Ethiopia where a great majority of people are food insecure. According to the African Postharvest Losses Information System (APHLIS) postharvest losses in 2012 for teff (the major food crop) were estimated at 12.3%, for sorghum at 11.6%, for wheat at 9.9% and for maize at 16.8%. Ethiopia's smallholders experience between 15 and 20 % post-harvest losses due to pest infestation and poor storage and handling (Pavlovic, 2013). U p to 50%, of the post-harvest loss in Ethiopia has been attributed to lack of adequate knowledge and implementation of sound grain storage management.

Many experts say that enough food exists to feed 10 billion people today. Unfortunately, it's not only inadequately distributed but also, to a large extent, wasted. "It is terrible that farmers put so much labor and water into growing crops, but then cannot sell them because they rot before getting to market. About 24% of all the calories produced for human consumption do not actually end up reaching human mouths (Knowledge@Wharton, 2015). This implies that globally 24% food energy is lost before being consumed by the needy people.

The food menu for majority of Ethiopians is cereal and bean based (Teff, Maize, beans). The general tendency to consume vegetables and fruits is low due to lack of stable supply of these food items throughout the year (poor shelf life) and affordability (expensive to buy). As a result, many of the essential vitamins and minerals are missing from daily consumptions of Ethiopians. The low

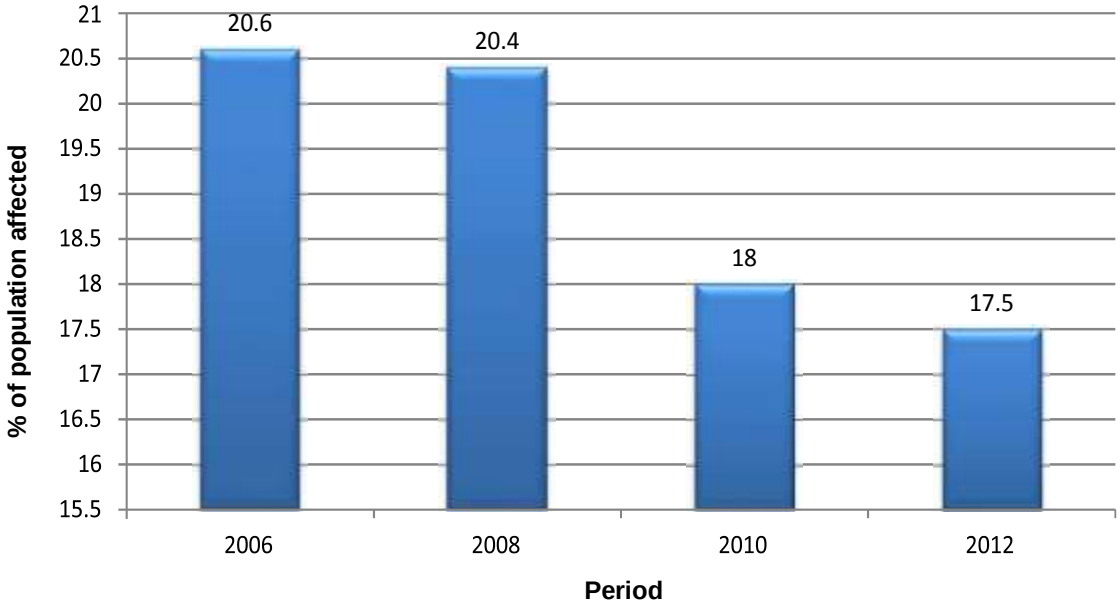

Figure 7. Ethiopian unemployment rate (CSA, 2014).

level of nutritional literacy leads people to eat just to fill the belly than balanced diet. It is likely to argue that in some rural areas people go hungry not necessarily due to lack of food, but due to lack of willingness to change their food habits. Typical examples can be consumption of Taro and Sweet potato in which most people consider these as crops of the poor and unwilling to use them. However, sweet potato is one of the essential crop to combat child malnutrition. Therefore, nutritional education is important to help people realize that there are several other alternatives to ensuring food security like consumption of inferior, very cheap, accessible but nutritionally useful foods.

Unemployment and low wage rates

The unemployment rate in Ethiopia and other countries is defined as the number of unemployed people as percentage of the active labor force.

Unemployment rate in Ethiopia was only slightly decreased to 17.40% in 2014 from 17.50% in 2012. Unemployment rate in Ethiopia averaged 20.26 % from 1999 until 2014, reaching an all-time high of 26.40 % in 1999 and a record low of 17.40% in 2014.

Unemployment rate in Ethiopia is reported by the Central Statistical Agency of Ethiopia (CSA, 2014). Ethiopia ranks 14th (45,650,000 people) in the world in terms of labor force rankings by 2013 estimation. During the same period the proportion of unemployed population was 17.5% (7,988,750). This figure is nearly equivalent to the number of chronically food insecure people in the country.

In terms of age composition, unemployment is essentially a youth phenomenon. Youth unemployment stood at 28.77% in urban areas, which is considerably higher than rural youth unemployment (4.08%). However, this masks the fact that in rural areas there is high level of underemployment, a phenomenon of not being fully employed or ineffectively employed (Martha, 2012).

Ethiopia accounts for the largest youth[3] population in Sub-Saharan Africa and the lack of employment opportunities for the youth is among the critical developing challenges facing the country. In rural areas (especially highland) youths are unemployed due to lack of factors of production mainly land. In urban areas it is due to the inability of the manufacturing and other service sectors to absorb the excess labor. Both the public and private sectors have a very limited labor absorbing capacity.

In Ethiopia, for example, agriculture's share of total employment was about 80%. Most of the poor in the country live in rural areas, so any growth in labor productivity has the potential to boost rural incomes, thus reducing poverty and food insecurity in the most vulnerable countries.

Generally, it is of paramount importance to reduce pressure on land by generating employment opportunities for rural youths. One possible option would be by enhancing Foreign Direct Investments and creating new employment opportunities so that the landless youths can generate adequate income to access foods. Figure 7 shows the trends of unemployment in Ethiopia has been declining. However, the rate at which unemployment

[3] Youth comprises persons aged 15-29, the rate of youth unemployment in urban areas is 23.7% in 2011.

declines is lower than that of population rates.

GOVERNMENT EFFORT TO COMBAT FOOD SECURITY

Political commitment

The current Ethiopian government is acknowledged for showing high political commitment for achieving food security through financial allocation to the sector. Much has been done to combat food insecurity. The government has favored liberalization of market in the 1990`s. However, a combination of many factors including weakly functioning agricultural markets, low purchasing power of the consumers, overall low level of technical knowledge of the producers, and a high illiteracy rate of the rural communities have hindered the much expected technical change and farm productivity (Berhanu, 2006).

To save life, for more than five decades, annual distributions of hundreds of thousands of metric tons of food aid have been channeled into safety net programs designed to alleviate the impact of food shortages in Ethiopia. Despite the massive size and duration of this effort, there remain many unanswered questions about its effectiveness and about its longer-term impact on the population it is designed to benefit (Clay et al., 1998).

The spending on poverty-targeted sectors (both recurrent and capital) steadily increased during this period rising from 42% of total expenditure in 2002/03 to over 64% and this has continued (FDRE, 2015). The government has also showed commitment in emergency responses. Ethiopia has been able to mitigate the impact of drought by deploying multi-year investments in safety nets and making significant advances in health and nutrition (CAI, 2012).

The Government of Ethiopia established the Agriculture Transformation Agency (ATA) by Federal Regulation in December 2010. The Ethiopian ATA seeks to promote transformation through enhanced support to existing structures of government, private-sector and other non-governmental partners to address structural bottlenecks in the system

Policy reform

In order to improve the food security situation of the country, successive national Food Security Strategies have been designed in 1996, 2002 and 2003/04. Following the recent famine of 2002/03, donors and the government have designed an ambitious national food security program called the New Collation for Food Security (FDRE, 2003).

Since 1992, the Government has been carrying out measures to reduce poverty in the context of a series of reform programmes in the political, economic and social spheres. In response to the reforms, the economy displayed marked levels of growth, reversing the previous two decades of poor economic performance (FDRE, 2003). The Federal Food Security Strategy rests on three pillars, which are: (1) Increase supply or availability of food; (2) Improve access/entitlement to food; (3) Strengthening emergency response capabilities.

Between 2005 and 2009, Government of Ethiopia and donors designed and engaged into a Food Security Programme (FSP), scaling up their level of intervention in the food security sector and incorporating and combining two main components: A large ‘Productive Safety Net Programme’ (PSNP) and a set of developmental interventions under the component "Other Food Security Programme" (OFSP).

The PSNP aimed to provide support to chronically food insecure families for several months either in the form of cash or food for up to five years, building their resilience and ability to withstand shocks. The families were then considered self-sufficient and would graduate from the program. This shift from the emergency system to a more predictable transfer system allowed, between 2005 and 2009, that more than seven million people have received PSNP transfers enabling them to meet consumption needs, reducing the risks they faced and providing them with alternative options to selling productive assets.

Over the last 10 years, Ethiopia has achieved an overall reduction in poverty levels as well as food insecurity. Nonetheless, poverty and food insecurity remain a big challenge. Over 30% of the population is below the food poverty line, unable to afford the minimum caloric intake for a healthy and active life. Chronic malnutrition is serious, with 44% of children under five years of age stunted and 10% affected by acute malnutrition (CSA, 2014). Nationally, 40% of households were food energy deficient, using the threshold of 2,550 kcal per adult equivalent per day.

Ethiopia has also made significant progress in reducing hunger, with a 39.24% reduction in the Global Hunger Index from 1990 to 2013. The percentage of the population below a minimum level of dietary energy consumption dropped dramatically from 74.8% in 1990 to 32% in 2015, although the total undernourished population remains high (31.6 million, down from 37.3 million in 1990) (Anderson et al., 2015).

The growth in agricultural output was largely attributed to improved productivity aided by favorable weather conditions and appropriate economic policies. The amount of land under cultivation increased steadily between 1996 and 2008, reaching 11.2 million hectares in 2009/10 (FDRE, 2015)

The following section presents the factors for the persistence of food insecurity in Ethiopia. With liberalization, the rolling back of the State has not yet

been replaced by an effective private sector. In addition, the focus of development aid from international donors has long been on the provision of emergency food aid; little aid is directed towards longer-term development (Ziegler, 2003). Food aid has saved lives, but it has not saved livelihoods.

PROSPECTS OF FOOD SECURITY IN ETHIOPIA: DOES THE NUMBER OF FOOD INSECURE INCREASE OR DECREASE?

There are two arguments concerning the prospect of food security in the world and Ethiopia. The first and optimistic view indicates that the number of food insecure and the problems of food insecurity has been declining and will decline. For instance, FAO (2013) put the evidence that since 1990 to 1992, the number of hungry people has fallen by over 200 million and built confidence hunger will be eradicated. This is encouraging for the future as it is showing that agriculture can be successful in Africa. Moreover, in terms of growth agriculture has performed relatively better (FAO, 2006).

Ethiopia is now widely considered to be one of a pack of "African tigers", with ambitious plans to become a middle-income country by 2025. It has successfully reduced the share of its population living in extreme poverty, as defined by the World Bank, from 55 % in 2000 to 29.6% in 2011, with the average food supply improving by 117 kcals per day during the same period (Khalid and Dan, 2014). The share of chronically malnourished or stunted children dropped from 58% in 2000 to 44% in 2011 according to the 2011 Demographic and Health Survey. Thus, the number of chronically food insecure population is expected to drop in the future. Ethiopia's development efforts are also praised internationally for meeting some of the millennium development goals, particularly universal primary education and a reduction in infant mortality. FAO recognizes Ethiopia "for decreasing" prevalent undernourishment "from 74.8% in 1990 to 1992 to 35% in 2012 to 2014". Over the same period, the number of undernourished people has decreased from 37.2 to 32.9 million, thus reaching the MDG-1 target. Sustained political commitment at the highest level, with food security and nutrition as top priorities, is a prerequisite for hunger eradication (FAO, 2014).

The fact that global population growth is diminishing, suggesting that policy changes or improvements at the local level could dramatically increase agricultural yields. Food security optimists also believe that technology and research can create abundant food supplies in the future (APCSS, 1998).

On the other hand the contrasting and pessimistic view states the future of food security will worsen. The future of global and Ethiopian food security will face serious challenges as has been discussed including, population growth, soaring food prices, climate change etc. These factors will worsen the current situation of food security.

Some experts are warning that the number of malnourished could rise substantially as global demographic pressures clash with such limits as diminishing arable land and growing water scarcity asserts that as the pressures of diminishing arable land and decreasing water supplies become more acute, food prices will likely rise. Given these demographic constraints, food security pessimists argue that there are essentially two ways to increase food production: Increasing yield per hectare or expanding the amount of land to be cultivated (APCSS, 1998). Land allocation for investors (e,g. for commercial farms like floriculture, rice etc. as happened so far) may compromise food security unless farmers received a comparably sufficient amount of compensation to run new business and ensure families food security. Similarly, competition in land use like land use shifts from food production into export commodities may also challenge the goal of ensuring food security.

Sub-Saharan Africa is projected to face an increase in the number of food-insecure people and the food distribution gap over the next decade (Rosen and Shapour, 2012). If we put Ethiopia as part of below average sub-Saharan countries, it would lead to pessimism to conclude that the number of food insecure people will increase.

This paper does not deny that Ethiopia is experiencing food shortages in the future. However, it argues that progress in economic growth and poverty reduction will improve access to food by many. It has to be noted that economic growth by no means is not a sufficient condition for food security. "Economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition (FAO, 2012)

Conclusions

Almost all of the literatures reviewed indicate that Ethiopia is the top food insecure country from 1958 to 2003. The paper finds little literature on the strengths of the country with respect to food security during this period. However, the global and national efforts to combat the problem are promising. Thus, we can realistically expect food security to be improved for an increasing number of people if agricultural growth and employment generation sustained. However, the speed and extent it is improving is lower in comparison to those countries that combatted food security in a relatively short period of time. To improve the current situation of food security in Ethiopia, it is necessary to improve market functioning so that access to agricultural inputs and food will be improved through purchase of food at affordable price. Provision of incentives for increased production through strong support for farmers can make a

difference. The most important attention should be given in enhancing mechanization and use of improved inputs so as to improve efficiency of production. The government has been rewarding medals to model farmers every year. In addition to that, financial and input incentive for better performing farmers can bring significant change in boosting productivity per unit of land. Investment in science and technology; production and supply of seeds of High Yielding Varieties (HYVs) in order to augment production are necessary. Drought tolerant varieties can contribute towards higher food production in drought prone areas (over 60% land). In line, irrigation development can play indispensable role. Equally important is ensuring access to rural land for the unemployed youth, encouraging private companies to use labor intensive technologies; attracting domestic and foreign investors to labor-intensive technology industries (employ more youths). Reducing value added taxes on domestically produced foods will also play significant role in urban food security. Finally, this paper argues that the government should invest in food like it does in infrastructure so that the souring price will be stabilized; and food access by the poor will be ensured. Future research work should pay attention to present further evidences that compare similar countries with Ethiopia with respect to strategies to achieve food security as this paper does not address this issue.

CONFLICTS OF INTERESTS

The authors have not declared any conflict of interests.

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Determinants of the adoption of improved white haricot beans in East Shewa Zone, South-Eastern Ethiopia

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White haricot bean is a major source of food (protein) and income for the rural households of Ethiopia. Nationally, it is among the major pulse crops used for export. Despite its contribution, adoption of white haricot beans variety is very low. With this backdrop, this study analyzed the determinants of the decision to adopt and intensify the adoption of white haricot beans. A sample of 394 farm households were selected randomly proportional to their size in each sampled village. A double hurdle model is used to analyze the data. The findings reveal that the decision to adopt white haricot beans variety is influenced positively by frequency of extension visits, land size allocated to haricot beans, agricultural income, price perception, training obtained and perception on fertility enhancement benefit of the crop, and negatively by distant to market, ownership of haricot beans farm land (tenure) and nutritional perception of the crop. The intensity of adoption of white beans is affected negatively by the number of dependents in the household, ownership of haricot beans land (tenure) and positively by non-farm income and contact with non-governmental organisations (NGOs). The study recommends that appropriate measures should be taken to strengthen the extension services, provision of related trainings, improvement of existing infrastructures, family planning, more involvement of other NGOs (stakeholders) in the area, provision of the required inputs in time and quantity, and measures to reduce risks on output (loss) and market price in order to promote the adoption of white haricot beans in general.

Key words: White haricot beans, technology, decision to adopt, intensity of adoption, double hurdle model.

INTRODUCTION

Pulse crops are the most important source of food in the national diet of Ethiopia next to cereals. Nationally, pulses occupied 14% of the cultivated land yielding 2.86 million metric tons (11.4% of the total grain crop production) in 2013/14 *meher* season (CSA, 2014). Over the years 2006 to 2012, dry beans export value for Ethiopia increased from 20 to 100 million US dollar (FAOSTAT, 2015). Among pulses (dry beans), common (haricot) bean ranks third contributing about 9.5% of the total export value from agriculture in Ethiopia (FAOSTAT,

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2010). Despite its contribution, adoption of white haricot beans is very low.

Apart from climbing haricot beans that grow in western Ethiopian highlands and Metekel zone, haricot bean crop particularly grows (concentrated) in south-western (Wolayita and Sidama), rift valley (north-eastern) region, western lowland areas and eastern Hararghe zone of Ethiopia in sole and intercropped (widely) with maize and sorghum. Oromia region, especially east Shewa zone in the rift valley area is the major producer of white haricot beans, followed by Southern Nations, Nationalities and Peoples' Region (SNNPR) and Afar Region; the first two regions constituting nearly 85% of the total production (Setegn et al., 2010; Ferris and Kaganzi, 2008).

In Ethiopia, despite improvements over the past decade, about 46% of the population is undernourished, underscoring the importance of increasing domestic food productivity (WFP, 2013). The key constraints of agricultural productivity in Ethiopia include drought, a decline in soil fertility, poor linkage of input and output markets, low technology adoption rate (improved seeds, fertilizer, irrigation and modern agronomic practices), poor infrastructure (storage, processing, packaging and transportation) and market access, prevalence of pests and diseases, and low capacity and in-efficient governmental and private sector institutional services (Katungi et al., 2010; Dercon and Hill, 2009; Diao and Pratt, 2007; Odendo et al., 2004).

In relation to haricot beans, constraints on access to high yielding variety (due to higher seed price, poor quality, older and degenerated varieties), drought, poor soil fertility, poor linkage of input-output markets, and loss due to pests and diseases are the key causes of low productivity (Katungi et al., 2010; Fekadu, 2007).

A number of interventions have been identified and implemented to address some of the challenges that hamper haricot bean production in Ethiopia. The interventions included investment in the dissemination and promotion of existing technologies, improvement of infrastructures, strengthening market information, and informal seed systems, development and promotion of drought resistant varieties, and integrated soil and fertility management practices. For instance, in the rift valley region of Ethiopia, between 2004 to 2010, access to seeds on market demanded varieties has been increased from less than 20 to 60% across major beans growing areas by different actors (Katungi et al., 2010).

Although substantial amount of resources have been devoted to the development and provision of the required inputs over the past three decades, overall adoption rate of agricultural technologies has been lower for sub-Saharan countries, as compared to other parts of the world (World Development Report, 2008).

In Ethiopia, evidences indicate that the adoption rate of modern farm technologies including improved seeds is low. For example, at national level, the proportion of farm land area under different technologies such as fertilizer use, improved seeds, pesticides and irrigation in the *belg* season (2014) is 42, 5, 10 and 8%, respectively (CSA, 2014).

In light of this, this study was intended to analyze factors affecting the status and intensity of adoption of white haricot beans in the study area.

METHODOLOGY

Study area

The study area (east Shewa zone) is one of the administrative zones of Oromia Regional State. It is located in the south eastern part of Ethiopia. It extends between 7033'50''N-9008'56''N and 38024'10''E-400 05'34''E. It has a total area of 10,241 square kilometer and population of 1,208,825 with population density of 118 persons per km square. The average farm land holding size of the zone is about 1.5 ha per household which is relatively larger compared to the regional average of 1.0 ha per household (CSA, 2014). The zone covers about 8% of the cultivated area in Oromia region (CSA, 2014). Major crops grown in the area include cereals (*teff*, barley, wheat, maize and sorghum), pulses (soya bean, pea, green bean, horse bean and haricot (white and non white) beans, and vegetables and fruits (tomato, cabbage, potato, pepper, onion, carrot and papaya). The sizes (average) of crop land under cereals, pulses (including haricot beans), fruits and vegetables are provided in Annex 1.

Sample design and data source

Multi-stage sampling technique was used in selecting the units at different stages. The first stage involved a random sampling of three districts (27%) from 11haricot beans producing districts of east Shewa zone. The second stage involved a random sampling of three haricot bean producer farmer associations (villages) from each districts (a total of nine villages). Following the selection of villages, a random selection of adopters and non-adopters using Probability Proportional to Size (PPS) is made from each farmer association. Accordingly, the number of sample adopter and non-adopter farm households was 156 (one hundred fifty six) and 238 (two hundred thirty eight), respectively. Primary data of both qualitative and quantitative information were collected using a pretested questionnaire.

Model specification

According to Rogers (2003), "a technology is a design for instrumental action that reduces the uncertainty in cause-effect relationships involved in achieving a desired outcome". He goes on defining an innovation "as a thought, practice, or project that is perceived as new by an individual or other unit of adoption".

Further, innovation can be categorized into yield increasing, cost reducing, quality enhancing, risk reducing, environmental protection increasing, and shelf-life enhancing (Sunding and Zilberman, 2000). According to Feder et al. (1985), final adoption at the farmer's level is defined as the long-run degree of use of new technology given that the farmer has full information pertaining to the technology and its' potential uses. Technology adoption is a mental process through which an individual passes from first knowledge of an innovation to the decision to adopt or reject, and to confirm this decision (Ban and Hawkins, 1996).

Adoption refers to the decision to use a new technology, method, practice, etc. by a firm, a farmer or a consumer. Farm level

(household) adoption reflects a farmer's decision to incorporate a new technology into the production process. On the other hand, aggregate adoption is the process of spreading or diffusion of a new technology within a region or population. Therefore, a distinction exists between adoption at the individual farm level and aggregate adoption, within a targeted region or within a given geographical area (Feder et al., 1985)

The rate of adoption is defined as the proportion of farmers who have adopted a new technology. The extent of adoption is the percentage of farmers using a technology at a specific point in time (for example, the percentage of farmers using high yielding varieties). Based on Feder et al. (1985), definition of technology adoption (that is, for divisible technologies at farm household level), and the intensity of adoption of new high yielding variety is defined as the proportion (degree) of land allotted to the new technology (that is, from the total farm land size decided aprori) for this particular crop. The concept of adopters is meant for those farm households that produce any of or at least one of the export type high yielding white haricot beans varieties during the survey year, and at least two years before. The time limit is based on a study by Reilly and Schimmelpfennig (1999) that the adoption of a new variety of crop could take between 3 and 14 years. Intensity (degree) of adoption was measured in terms of the number of hectares covered by export type high yielding white haricot beans at farm household level.

Farmers adopt a given new technology if the utility (satisfaction) they derive in any form is higher than the local technology at hand. In modeling the satisfaction or utility derived from using the new varieties, the economic values or benefits associated with the high yielding variety over the traditional varieties needs to be considered. When confronted with a choice between two alternative practices, the i^{th} farmer compares the expected utility of the modern technology E_{mi} (W) to the expected utility of the traditional technology E_{ti} (W). Since the direct measurement of farmers' perceptions and risk attitudes on this particular technology are not available, inferences can be made for variables that influence the distribution and expected utility of the technology under long-run equilibrium (when the households have full information). These variables are used as a vector 'X's (attributes) of the choices made by farmer 'i', and ε_i is a random disturbance that arises from unobserved variation in preferences, attributes of the alternatives, and errors in optimization. Given the usual discrete choice analysis and limiting the amount of non-linearity in the likelihood function, E_{mi} (W) and E_{ti} (W) may be written as:

$$E_{mi}(W)=\alpha_{mi}X_{mi}+\varepsilon_{mi}$$
$$E_{ti}\ (W) = \alpha_{ti}X_{ti} +\varepsilon_{ti} \quad (1)$$

The difference in expected utility may be written as:

$$E_i\ (W) =E_{mi}\ (W) - E_{ti}\ (W) + \varepsilon_i = \alpha_i X_i +\varepsilon_i \quad (2)$$

Factors affecting the adoption of a farm technology has been widely analyzed using the Heckman (1979) and Tobin (1958) models. Heckman (1979) model is used with the assumption of selection bias in the process of adoption. Tobin (1958) model is the most widely used. The prime assumption for a Tobin (1958) specification is that farmers demanding modern technologies have unconstrained access to the technology. Studies show that underdeveloped input supply and marketing systems play on input choices and technology adoption in the case of smallholder agriculture (Asfawu et al., 2011; Shiferawu et al., 2008).

In situations where the input supply systems are undeveloped, farmers often face input access constraints. Tobin (1958) model does not distinguish households with a constrained positive demand for new technology from those with unconstrained positive demand and hence, assumes that a non adopter household is a rational decision maker. As a result, the Tobin (1958) model yields inconsistent parameter estimates in the situations of access constraints to get inputs (Croppenstedt et al., 2003).

The double hurdle model originally proposed by Cragg (1971) in addition to its assumption that the two decision tiers are not necessarily affected by the same set of factors, is a remedy to the problem of corner solution arising in the Tobit model, and has been extensively in use in several studies (Mignouna et al., 2011; Yu and Ninpratt, 2014; Martínez-Espiñeira, 2006; Moffat, 2003; Newman et al., 2001; Burton et al., 1996).

The first hurdle is to decide to be a potential adopter, while the second hurdle is how much (intensity) to adopt. The advantage with this approach is that it allows us to understand the characteristics of a class of households that adopted the technology, households wanting to adopt but reporting no positive use (due to access constraint) and households that have never adopted the technology (Yu and Nin-Pratt, 2014; Mignouna et al., 2011). However, it has not widely been used in the area of adoption of agricultural technologies with some exceptions (Yu and Nin-Pratt, 2014; Sosina et al., 2014*;* Asfawu et al., 2011*;* Berhanu and Siwnton, 2003).

This study used a double hurdle model assuming that factors that affect farmers' choice of adoption are not necessarily the same to the factors that affect the intensity of adoption. The adoption of export type white haricot beans variety is constrained by access to input (shortage and quality of the white High yielding variety, HYV) by the farm households (Katungi et al., 2010). The farm households need to cross two hurdles to adopt the white haricot beans high yielding variety.

A double hurdle model consists of two separate stochastic processes that determine the decision to adopt, and the intensity (degree) of use of a technology. The first hurdle is an adoption decision equation with a probit model. The model has an adoption (D) decision with an equation:

$$\begin{bmatrix} D_i = 1\ if\ D_i^{*} > 0\ and\ 0\ if\ D_i^{*} \le 0 \\ D_i^{*} = \alpha z'_i + U_i \end{bmatrix} \quad (3)$$

D_i^* being a latent variable that takes the value 1 if a farmer adopts the improved haricot beans technology and zero otherwise, z is a vector of household characteristics and α is a vector of parameters. The level of adoption (y_i) has an equation of the following:

$$\begin{bmatrix} y_i = y\ if\ > 0\ and\ D_i^{*} > 0 \\ y_i = 0, otherwise \\ y_i^{*} = \beta x_i^{'} + V_i \end{bmatrix} \quad (4)$$

Where, y_i is the observed level (proportion) of white high yielding haricot beans variety, x is a vector of individual household characteristics and β is a vector of parameters. If the independence model works, the error terms U_i and V_i are distributed as follows:

$$U_i \sim N(0,1)\ and\ V_i \sim N(0, \sigma^2) \quad (5)$$

If both decisions are made jointly (the dependent double hurdle), the error term can be defined as:

$$(U_i\ V_i\ ) \sim \text{BVN}\ (0, D)\ \text{Where, D} = \begin{bmatrix} 1 & \rho\delta \\ \rho\delta & \delta^2 \end{bmatrix} \quad (6)$$

The model is termed as a dependent model if there is a relationship between the decision to adopt and the intensity of adoption. This relationship can be expressed as follows:

$$\rho = \frac{\text{cov}(U_i \ V_i)}{\sqrt{\text{var}(U_i) \ var(V_i)}} \quad (7)$$

If $\rho = 0$ and there is dominance (the zeros are only associated to non-participation, not standard corner solutions) then the model decomposes into a probit for participation and standard ordinary least square (OLS) for intensity of adoption. Based on Craggs (1971) proposal, the following equation integrates the probit model to determine the probability of $y > 0$ and the truncated normal model for given positive values of y.

$$f(w,y)|x_1,x_2) = \{1 - \phi(x_1\gamma)\}^{1(w=0)} [\phi(x_1\gamma)2\pi^{-\frac{1}{2}}\sigma^{-1} \exp\{-y - x_2\beta)^2 / 2\sigma^2\}/\phi(\tfrac{x_2\beta}{\sigma}]^{1(w=1)} \quad (8)$$

Where w is a binary indicator equal to 1 if y is positive and 0, otherwise. In Cragg (1971) model, the probability of y >0 and the value of y, given y>0, are determined by different mechanisms (the vector γ and β, respectively). Furthermore, there are no restrictions on the elements of x_1 and x_2, implying that each decision may even be determined by a different vector of explanatory variables altogether. Also, the Tobin (1958) model is nested within Cragg (1971) alternative because if $x_1 = x_2$ and $\gamma = \frac{\beta}{\sigma}$, the models become identical (Wooldridge, 2002). Fitting Cragg (1971) alternative requires the additional assumption of conditional independence for the latent variable's distribution, or:

$$D(y^*|\text{w, x}) = D(y^*|\text{ x}) \quad (9)$$

The same probabilities and expected values from Tobin (1958) model can be obtained by using the updated functional form. The probabilities regarding whether y is positive are:

$$P(y_i{=}0|x_{1i}) = 1 - \Phi(x_{1i}\gamma) \quad (10)$$

$$P(y_i{>}0|x_{1i}) = \Phi(x_{1i}\gamma) \quad (11)$$

The expected value of y, conditional on y > 0 is:

$$E(y_i|y_i > 0, x_{2i}) = x_{2i}\beta + \sigma \times \lambda(x_{2i}\beta/\sigma) \quad (12)$$

where; $\lambda(C)$ is the inverse mills ratio (IMR)

$$\lambda(C) = \emptyset(c)/\phi(c) \quad (13)$$

where $\emptyset$ is the standard normal probability distribution function.

The "unconditional "expected value of y is:

$$E(y_i|x_{1i}, x_{2i}) = \phi(x_{1i}\gamma \{x_{2i}\beta + \sigma \times \lambda(x_{2i}\beta/\sigma)\} \quad (14)$$

For a given observation, the partial effect of an independent variable, x_j, around the probability that y > 0 is:

$$\frac{\partial P(y>0|x_1)}{\partial x_j} = \gamma_j \emptyset(x_1\gamma) \quad (15)$$

where γ_j is the element of γ reperesenting the coefficient on x_j. Equations 10, 11 and 12 are the same as the probabilities and partial effect from a probit regression of w on x_1. The partial effect of an independent x_j on the expected value of y, given $y > 0$, is:

$$\frac{\partial E(y_i|y_i>0, x_{2i})}{\partial x_j} = \beta_j[1 - \lambda(x_2\beta/\sigma)\{x_2\beta/\sigma + \lambda(x_2\beta/\sigma)\}] \quad (16)$$

Where β_j is the element of β representing the coefficient on x_j. Equations 12 and 16 are the same as the expected values, and partial effect from a truncated normal regression of y on x_2, with emphasis that the effect is conditional on y being positive. The partial effect of an independent x_j on the 'unconditional" expected value of y depends on whether x_j is an element of x_1, x_2, or both. First, if x_j is an element of both vectors, the partial effect is:

$$\frac{\partial E(y|x_1,x_2)}{\partial x_j} = \gamma_j \emptyset(x_1\gamma) \times \{x_2\beta + \lambda(x_2\beta/\sigma)\} + \phi(x_1\gamma) \times \beta_j[1 - \lambda(x_2\beta/\sigma)\{x_2\beta/\sigma)\}] \text{ if } x_j \in x_1, x_2 \quad (17)$$

If x_j is only determining the probability of $y > 0$, then $\beta_j = 0$, and the second term on the right-hand side of Equation 14 is canceled. On the other hand, if x_j is only determining the value of y, given that $y > 0$, then $\gamma_j = 0$; and the first right-hand side in Equation 17 is canceled. In either of the cases, the marginal effect is a function of parameters and explanatory variables in both tiers of the regression. After estimation of the double hurdle model, multivariate Tobin (1958) model is adopted to test the independence of the decision to adopt and intensity of adoption. The test statistic confirms the independence of the two tiers at 1% level of significance (Annex 2).

RESULTS AND DISCUSSION

Demographic characteristics of the farm households

91% of the sampled households in the study area are male headed, while the remaining 9% are female headed. Of the total 394 sample farmers, 156 are (one hundred fifty six) white haricot bean variety adopter farmers, of which 94 and 6% are male and female headed farm households, respectively. Within the remaining 234 (two hundred thirty eight) non adopters of white haricot bean variety, male and female headed farm households constitute 89 and 11%, respectively. There is a significant (5% level of significance) difference between the two groups of adopters and non adopters in terms of sex of the households (Table 1). Average age of the farm households in the study area is 40 years with minimum age of 21 and maximum of 75 years. The average age of the adopter farm households is about 40 years, whereas, that of the non adopters is 41 years. The result depicts that the farm households are in active working age category on average. The t-test statistics showed that there is no significant difference in terms of ages between adopters and non adopter farm households. The farm households have six family members on average. The average household size is slightly greater than the zonal (East Shewa) average of 5.04, regional average of 5.36 and national average of 5.04 (CSA, 2014). As revealed

by the t-test, the average family size did not show variation among the groups of adopters and non adopter

Table 1. Descriptive statistics of the variables by adoption status of the households.

Variable	Unit	Mean		P- value t/Chi-square test
		Adopters (n=156)	Non-adopters (n=238)	
Dependent variables				
Adoption decision (adopstat)	Dummy (if adopted white haricot bean=1;otherwise=0)	0.40	0.6	-
Intensity of adoption (proporn)	Proportion (%) of land (that is, from total land under all haricot beans) allotted to white haricot beans	96	4	-
Explanatory variables				
Demographic characteristics				
Gender of the household head (sex)	Dummy (1=male; 0=female)	-	-	0.04**
Male	-	0.94	0.89	-
Female	-	0.06	0.11	-
Age of household head (age)	Years lived by the household head	39.7	41	0.21
Household size (Hsize)	Number	6.1	6.1	0.93
Working members of the household (Activelabor)	Number of household members with age>15 and age <65	2.9	3.1	0.4
Dependent members of the household (dependents)	Number of household members with age<15 and age >65	3.0	2.9	0.7
Economic characteristics				
Land holding size (Landhold)	Hectare	2.8	2.2	0.002***
Land under haricot beans (Hbfsizeha)	Hectare	0.82	0.46	0.00***
Livestock ownership (TLU)	TLU	8.7	7.2	0.01***
Household income from farming (Lnhhfincom)	Natural log of income from farming activities as a whole in ETB	61928	39092	0.00***
Household nonfarm income (Lnnfisize)	Natural log of income from nonfarm activities as a whole in ETB	2299	1636	0.2
Amount of credit used (Creditsize)	Amount of credit borrowed/utilized in ETB	1258.3	834	0.03**
Ownership of haricot bean farmland (tenure)	Dummy (owned=1; rented/leased-in=0)	-	-	0.00***
Owned	-	86.45	94.9	-
Leased in/share basis	-	13.5	5.1	-
Crop diversification (Diversifn)	Herfindal index	0.4	0.3	0.00***
Number of plots in different location (Fragmentation)	Number of plots owned	2.8	2.9	0.00***
Institutional characteristics				
Extension visits made (Extnuse)	Number of visits during crop season	2.4	1.7	0.00***
Distance to market (Dmkt)	Km	5.3	6.1	0.00***
Distance to development agents office (Distdaof)	Km	2.5	3.1	0.03**
Education of the household head (Educyr)	Years of schooling	4.2	3.8	0.2

Table 1. Contd.

Education of the family members (Educfam)	number of literates	3.7	3.7	0.91
Membership of cooperative/associations (asso)	Dummy (member =1; not member=0)	-	-	0.02**
Member of cooperative	-	75.6	63.4	-
Not a member of cooperatives	-	24.4	36.5	-
Farmer attributes				
Haricot beans farming experience (Hbexp)	-	13.1	12.3	0.42
General farming experience of the household head (Fexp)	-	21.5	21.7	0.83
Training attended by household head (training)	Dummy (attended=1; did not attend=0)	-	-	0.00***
Attended training	-	76.3	32.7	-
Did not attend training	-	23.7	67.3	-
Perception of the nutritional importance of haricot beans (nutrperc)	Dummy (perceived positively=1; did not perceive)	-	-	0.07***
Perceived as nutritious	-	56.7	67.2	
Did not perceive as nutritious	-	43.3	32.8	
Perception on yield of haricot beans (Yldperc)	Dummy (perceived positively=1; did not perceive)			0.00***
Perceived to give better yield	-	86	54.6	
Did not perceive better yield	-	14	45.4	
Perception on price of haricot beans (priceperc)	Dummy (perceived positively=1; did not perceive)	-	-	0.00***
Perceived better price	-	81	50	
Did not perceive better price	-	19	50	
Perception on soil fertility importance of haricot beans (fertperc)	Dummy (perceived positively=1; did not perceive)	-	-	0.00***
Perceived to enhance	-	93	64	-
Did not perceive to enhance	-	7	36	-

*, ** and *** indicate 10, 5 and 1% level of significance, respectively.
Source: Computed from own survey (2015).

farm households.

Economic characteristics of the farm households

The average land holding size of the farm households in the study area is 2.4 hectare with average of 2.79 ha for adopters, and 2.21 hectare for non adopter groups. The group test statistic shows that there is a significant (1% level of significance) difference in terms of land holding size between the two groups (Table 1).

Similarly, the average farm size under haricot beans is 0.60 hectare with the average of 0.82 hectares for adopters, and 0.46 hectares for non adopter groups. Similarly, the test statistic between adopters and non adopters reveal a significant (1% level of significance) difference among the groups in terms of land allotted to haricot beans cultivation.

The farm households have earned an average gross income of 50,510 (fifty thousand five hundred ten) birr from farming (that is, from crop sector, livestock, horticulture and other sectors such as forestry and beekeeping) during the year under study. Adopter farm households and non adopter farmers have earned about 61,927.00 (sixty one thousand nine hundred twenty seven) and 39,092 (thirty nine thousand ninety two) birr from farming in the same year respectively. Similarly, gross farm income of adopters is significantly (1% level of significance) higher than that of the non adopter farmers.

The gross non farm income of the farmers is about 1,967.00 (one thousand nine hundred sixty seven) birr on average. Similarly, the adopter farm households has earned better nonfarm income of 2,299 (two thousand two hundred ninety nine) birr as compared to the non adopter farm household's nonfarm income of 1,636.00 (one thousand six hundred thirty six) birr during the year, but not significant.

Existing land tenure (that is, possession for haricot beans farm) system in the area could be categorized as owned, leased-in and share cropping system. About 91% of the crop farms were owned, while the remaining 9% were either leased in and/or cultivated on sharecropping basis. There is a significant difference among the group of adopters and non adopters in terms of proportion of land tenure (ownership) system.

The average number of plots in different locations (fragmentation) for the farm households was three. There is a significant (1% level of significance) difference in mean fragmentation among the adopter and non adopter farm households (Table 1).

Major haricot beans varieties (types) widely cultivated in the study area include Awash-I, Awash Melkasa-II, red haricot beans, stripe color and black haricot beans. The frequency distribution of farmers by haricot bean types cultivated is given in Annex 4. Of the total farm households interviewed, about 30% of the famers cultivated Awash-I, 7% Awash-II, 57% red haricot beans, and 2% stripe (mixed) color haricot beans. When compared by adoption status, 30, 7 , 2 and 1% of the adopter farmers cultivated Awash-I variety, Awash Melkasa-II, mixture of Awash-I and Awash Melkasa-II, and Awash-I and red haricot beans respectively; while 58, 2 and 1% of the non adopter farmers cultivated the red haricot beans, mixed color; and red and awash-I varieties, respectively.

Institutional and infrastructural characteristics

The farm household heads had 4 years of education on average with a minimum of zero and maximum of 13 years of schooling. The group of white haricot beans variety adopter farm households has about 4.2 years of education (with minimum of zero and maximum of 13 years) whereas; it is 3.78 years of schooling for the non adopter farm households with minimum of zero and maximum of 15 years (Table 1).

There is no significant difference in years of education between adopter and non adopter farm households. Similarly, in terms of the number of literates in their family, the farm households have about 4 literate family members on average with minimum of zero, and maximum of 16 members. The number of literate family members is nearly similar for adopter and non adopter farm households (that is, equal to 4) on average. The test statistic revealed that there is no significant difference in terms of number of literate family members between adopter and non adopter farm households.

The average extension visits (frequency) by the development agents to the farm household was 2 during the production year. The record is significantly (1% level of significance) higher for adopter farm households as compared to the non adopter farm households (Table 1). The average distance of the farm households from the market is 5.7 kilometers (km) with a minimum distance of 0.25km, and maximum of 18 kilometers. The average distance from the market is about 5.3 and 6.1km for adopter and non adopter farm households respectively.

Similarly, the distance of the farm households' residence from the development agents' office is about 2.8 km on average with minimum distance of 0.01 km, and maximum of 16 km. It is 2.5 and 3.1 km for adopter and non adopter farm households respectively. Both distances from the market (at 1% level of significance) and distance from the development agent's office (5% level of significance) of the farm households are significantly shorter for adopter farm households compared to the non adopter farm households.

About 50% of the farm households have attended training on haricot beans production and related subjects on average; where the adopter farm households has the largest share (77%) compared to 33% for non adopter farm households. There is a significant (at 1% level of significance) difference among the two groups in terms of proportion of training attended.

68% of farm household heads were members of cooperative association; while the remaining 32% were non members. There is a significant (at 5% level of significance) difference in terms of proportion of membership in agricultural cooperatives among the group of adopters and non adopters.

Farm households' attributes

The overall experience of the farm households in farming is about 22 years in general; while the average years of experience in haricot beans farming in particular was 13 years. The average number of years on haricot beans farming is higher for the adopter (13 years) than non adopter (12 years) farm households (Table 1). There is no significant difference between the two groups of

adopters and non adopters of white haricot beans in terms of farming experience.

The farm households also expressed their perception on the different attributes of haricot beans crop in relation to its nutritional importance, yield, market price (profit) and land fertility enhancement capacity of the crop (Table 1). About 62% of the farm households perceived that haricot beans is nutritious; the percentage being significantly (at 1% level of significance) higher for the non adopter (67%) farm households compared to the adopter (57%) farmers.

Similarly, about 66% of the farm households perceived better yield from the crop; the perception being significantly (at 1% level of significance) higher for the adopters (86%) compared to the non adopter (55%) farm households. In relation to the market price (profit) of the crop, about 61% of the farm households perceived better price (profit); with a higher percentage of (81%) by the adopter farmers compared to the non adopters (50%).

Haricot beans belong to the leguminous crop category; well known for their nitrogen fixing capacity that in turn improves the soil fertility. As depicted in Table 1, of the total farmers interviewed, 74% of the farm households perceive that haricot beans have the capacity to enhance the fertility status of the land; the proportion being significantly (at 1% level of significance) higher for the adopter (93%) compared to the non adopter (64%) farm households.

Econometric

We have adopted Cragg (1971) tobit alternative model with the assumption of the independence of the two decision tiers (that is, the correlation between the decision to adopt and intensity of adoption is zero). The overall Wald chi^2-test of the Cragg (1971) model is significant at 1% level of significance (Annex 2). The result of the multivariate model (Table 2) reveals that the two decisions are significantly independent at 1% level of significance (Cappellari and Jenkins, 2006; Roodman, 2009). The Average Partial Effect (APE) for the significant variable is depicted in Annex 3.

Determinants of decision to adopt white haricot beans

Significant variables associated with the decision to adopt white haricot beans variety adoption are frequency of extension (extnuse) positively, distant to market (dmkt) in kilometers negatively, haricot beans farm size (hbfsizeha) in hectares positively, haricot beans farm land possession (tenure) system negatively, agricultural income of the household heads (lnhhfincom) positively, nutritional perception (nutrperc) negatively, price perception (priceperc) positively, training (training) positively and fertility enhancement perception (fertperc) positively of the farmers.

Frequency of extension service had a significant (positive) effect on the likelihood of adoption of white haricot beans. Provision of up-to-date information on production and marketing of white haricot beans variety, technical support and confidence building are usually done by the extension workers located at the village level. Previous studies by Tsegaye and Bekele (2012) and Mignouna et al. (2011) also showed similar (positive) association of extension service with the status of adoption of high yielding varieties.

Distance of the farm household residence from the market is significantly (negatively) related to the status of adoption of white haricot beans variety at 1 and 5% level of significance, respectively. Distance from the market of the farm households is expected to directly affect the transaction cost on input purchase and output marketing. The higher the distance from the market, the higher the transaction cost and lower the likelihood of adoption and intensity of white haricot beans variety. Results of similar previous studies (Ogada et al., 2014; Tsegaye and Bekele, 2012) also supported existence of inverse relationships between distance of the farmers from market and the likelihood of adoption of new crop variety.

Farm size (that is, land allotted for haricot beans as a whole) is significantly (highly and positively) related to the status of adoption of white haricot beans. The result revealed that the higher the farm size of the farm households (size of the land decided for the crop in general), the higher the likelihood of adoption of white haricot beans. This indicates that farmers who have previously devoted larger size of land for haricot beans cultivation in general are likely to adopt white haricot beans variety than farmers who cultivated traditional haricot beans on small pieces of land (even if they currently own larger size of land). A study by Katengeza et al. *(*2012) on adoption of improved maize variety also reveal that farm size is positively related to the decision to adopt.

Land tenure (possession) system is significantly (negatively) related to status of adoption of white haricot beans. Land possession (tenure) system refers to whether the land under white haricot beans is owned or not (rented-in or shared in). The study revealed that farmers who rented in or shared in land were likely to adopt white haricot beans variety. That is, a positive correlation was observed between rented in and/or crop-share land and status of adoption of white haricot beans. The fact that land ownership is negatively related to the decision to adopt might be attributed to differences in information on production and marketing of white haricot beans variety among the farmers.

Some farmers, irrespective of the size of their land, might have better access to information, better educated and had better information processing capacity to take the advantage of existing market opportunities on white

Table 2. Double hurdle model maximum likelihood estimate on determinants of adoption.

Variable	Coef.	Std. Err.	Z	P>z
Adoption decision				
Age	0.00	0.01	0.01	0.99
Gender	-0.42	0.29	-1.43	0.15
Hsize	-0.01	0.06	-0.23	0.82
Asso	0.04	0.19	0.20	0.84
Extnuse	0.10	0.05	2.00	0.04**
Educfam	0.01	0.05	0.29	0.77
Dmkt	-0.12	0.03	-3.62	0.00***
Crediuse	0.05	0.19	0.26	0.79
Landhold	-0.03	0.09	-0.41	0.69
Hbfsizeha	0.64	0.36	1.78	0.07*
Tenure	-0.71	0.31	-2.32	0.02**
Fragm	0.04	0.06	0.64	0.52
Tlu	-0.02	0.02	-0.89	0.38
Lnnfisize	0.00	0.03	0.12	0.90
Hbexp	-0.01	0.01	-0.68	0.50
Lnhhfincom	0.69	0.20	3.43	0.00***
Comass	0.05	0.29	0.18	0.86
Nutrperc	-0.62	0.18	-3.40	0.00***
Priceperc	0.84	0.20	4.11	0.00***
Ngocont	0.07	0.21	0.35	0.72
Training	0.91	0.20	4.61	0.00***
Distdaof	0.04	0.03	1.20	0.23
Yldperc	0.36	0.24	1.51	0.13
Fertperc	1.04	0.24	4.35	0.00***
diversifn2	2.41	0.89	2.70	0.01***
_cons	-9.14	2.23	-4.10	0.00
Intensity of adoption				
Age	0.01	0.06	0.15	0.88
Gender	-0.50	0.86	-0.59	0.56
Activelabor	-0.83	1.06	-0.79	0.43
Dependents	-0.47	0.26	-1.82	0.07*
Extnuse	-0.13	0.26	-0.50	0.62
Educfam	0.89	0.69	1.29	0.20
Dmkt	-0.05	0.18	-0.26	0.80
Crediuse	1.26	0.94	1.34	0.18
landhold2	-0.25	0.43	-0.58	0.56
Hbfsizeha	-0.03	1.15	-0.03	0.98
Tenure	-1.82	0.77	-2.36	0.01**
Tlu	0.08	0.17	0.46	0.64
Lnhhfincom	-0.52	1.01	-0.52	0.61
Lnnfisize	0.22	0.11	1.88	0.06*
Hbexp	-0.05	0.08	-0.69	0.49
Nutrperc	-0.37	0.86	-0.43	0.67
Priceperc	0.11	1.27	0.09	0.93
Ngocont	2.13	1.02	2.09	0.04**
Yldperc	0.14	1.28	0.11	0.91
Fertperc	-1.20	0.95	-1.27	0.20

Table 2. Contd.

diversifn2	0.10	3.15	0.03	0.98
_cons	107.23	10.57	10.15	0.00
Sigma	-	-	-	-
_cons	6.64	1.36	4.87	0.00

Number of obs = 394; Wald Chi^2 (25) = 167.71; Logpseudo likelihood = -670.31 Prob > chi2 = 0.00; *, ** and *** indicate 1,5 and 10% level of significance respectively.
Source: Computed from own survey (2015).

haricot beans. In addition, inverse relationship on the decision to adopt among land owners and those who obtained land through rent and crop share basis might also be attributed to the risk averse behavior of the land owners comparatively. Despite their resource position, farmers' decision on production is dependent on the prevailing risks such as output, price and etc.

Agricultural income of the households has a positive significant effect on the status of adoption of white haricot beans. In this study, agricultural income refers to all income derived from the agricultural sector (that is, crop, livestock and horticulture, etc...) excluding income derived from haricot beans and other non-farm incomes. The results show that farmers with higher agricultural income (that is, wealthier farmers) are more likely to adopt white haricot beans variety. Agricultural income helps them to cover the required expenditures (on seed, fertilizer, chemicals, for hiring labor and/or oxen, etc.) of the new technology under consideration. Previous study by Letaa et al. (2009) also show the occurrence of a significant positive correlation between agricultural wealth and adoption of common beans in Tanzania.

The nutritional perception of white haricot beans (compared to the non white haricot beans) is significantly (highly and negatively) related to status of adoption. As observed from the survey, farmers in the area prefer the traditional (nonwhite haricot beans) for food while production of white haricot beans is mainly for income generation.

On the other hand, price perception of white haricot beans are significantly (highly and positively) related to status of adoption of white haricot beans variety. The result reveals that farmers with positive perception of yield and market price of the crop were likely to adopt white haricot beans variety. Previous studies by Rahmeto (2007) and Otiento (2011) also confirmed the existence of positive relationship between market price perception of improved haricot beans and the likelihood of adoption.

Similarly, fertility enhancement perception of the farm households on the crop is significantly (highly and positively) related to status of adoption of white haricot beans. Farmers with positive perception of fertility enhancement capacity of white haricot beans are likely to adopt the new variety. Past study by Letaa *et* al. (2009) in Tanzania also show that there is a positive correlation between farmers fertility enhancement perception and adoption of improved common beans variety.

Training had a positive significant (highly) relation with the status of adoption of white haricot beans variety. Trainings on production (time of planting, weeding, application of chemicals, harvesting, threshing and storage), and marketing (grading and standardization, transporting) are provided to the farm households in Farmers Training Centers (FTC) by the extension workers, cooperative unions, and NGOs working on the subject. Farmers with better training status have better information and confidence and hence, are likely to adopt white haricot beans variety. Past similar studies by Awotide et al. (2012), Alemitu (2011) and Rahmeto (2007) also showed the positive association of training with the status of adoption of improved crop varieties.

In the first tier (decision to adopt), a unit increase in number of hectare of land allotted to haricot beans cultivation in general and income of the household from the farm sector (in ETB), increases the probability of adoption by 0.14 and 0.15 respectively; while a unit increase in distance of the households' residence from the nearest market (in km), decreases the likelihood of adoption by 0.03 (Annex 3).

The possibility that all individuals in the sample obtained extension service, perceived better price, perceived fertility enhancing benefit of haricot beans and obtained training increases the likelihood of adoption of white haricot beans by 0.02, 0.18, 0.23 and 0.19, respectively; while the possibility of owning land under haricot beans cultivation (tenure) and not perceiving the nutritional importance of white haricot beans, decreases the probability of adoption by 0.15 and 0.13, respectively (Annex 3).

Determinants of intensity of adoption of white haricot beans

In the second tier, the number of dependents in the households (dependents), tenure system (tenure), non farm income (lnnfisize) and contact with NGOs (ngocont) had a significant effect on the intensity of adoption of

haricot beans.

The number of the economically dependent family members (dependents) had a significant negative association with the intensity of adoption of white beans. The dependent portion of the family (children and aged members) requires special treatment (care) of the active family members incurring resources (time and money) of the farm households. Such shift of existing meager resources has a detrimental effect on acceptance and expansion of new farm technologies. The decision to adopt might not require more resource since one can begin cultivation on a very small farm size. However, when it comes to the second tier (intensity), the number of dependents had a significant negative association as expected.

Haricot beans farm land possession (tenure system), is negatively related to the intensity of adoption. Some of the farm households that owned the land and who decided to adopt white haricot beans cultivation on a portion of their land, might be relatively risk averse compared to those who cultivated based on rented-in and/or crop share basis. Such behavior halts them from allotting more land under the crop in fear of anticipated output loss, and market price reduction. Alternatively, households with rented-in and/or leased-in land might be risk takers, have better capacity to process and use information for decision making.

Nonfarm income had a significant (positive) effect on intensity of adoption of white haricot beans since extra income source gives them a better opportunity to purchase the required inputs for the technology and to rent in/ share crop more land. Results of previous studies (Awotidie et al., 2011; Diiro and Sam, 2014; Beshir et al., 2012) also confirm the existence of a positive relationship between nonfarm income and the intensity of adoption of improved varieties. Farm households can decide to adopt with available cash from farming and other sources initially. However, the influence becomes significant to put more land under cultivation on its effect on the purchase of the required inputs such as seeds, fertilizer and other chemicals. Moreover, income from the nonfarm sector could also serve to rent in more land from others thereby increasing the level of adoption.

Similarly, contact with other NGOs is significantly (positively) related to intensity of adoption of white haricot beans technology. The result reveals that farmers, who had contact with NGOs working on similar subject in the area, are likely to put more land under white haricot beans technology. Alemitu (2011) and Rahmeto (2007) in southern nation also found that contact with NGOs in this regard had a significant positive influence on the status of technology adoption. As part of capacity building programs, these farmers might have information/net-working/, obtained related trainings, awareness workshops, access to inputs (such as seeds and other chemicals) and other supports on production and marketing of haricot beans crop. Such supports might motivate the farm households to put more land under cultivation of the crop. As compared to its effect on decision to adopt, the significance of contact with NGOs on intensity of adoption might be related to confidence building on production and marketing of the crop, and support or capacity building through provision of key inputs such as seeds, fertilizer and other chemicals

Finally, crop diversification (measured in herfindhal index) has a highly significant positive relationship with the status of adoption of white haricot beans. Diversification might be linked to the risk-averse behavior of the farm households in terms of stabilizing the stream of their incomes over time in relation to the changing climate (output risk) and market prices of crops. Risk-averse behavior might not force the farm households to diversify more crops. The higher the crop diversification index, the lower the number of crops (common or traditional) grown by the households. Alternatively, the households might decide to adopt a new crop variety (that is, white haricot bean) in which they might have positive perception of the essential attributes (better confidence) of the crop. However, the variable does not have significant effect (that is, negligible) on the intensity of adoption, since their risk-averse behavior does not necessarily push the farm households to put more land under single crop.

In the first tier (decision to adopt), a unit increase in number of hectare of land allotted to haricot beans cultivation in general and income of the household from the farm sector (in ETB), increases the probability of adoption by 0.14 and 0.15 respectively; while a unit increase in distance of the households' residence from the nearest market (in km), decreases the likelihood of adoption by 0.03.

The possibility that all individuals in the sample obtained extension service, perceived better price, perceived fertility enhancing benefit of haricot beans and obtained training increases the likelihood of adoption of white haricot beans by 0.02, 0.18, 0.23 and 0.19, respectively; while the possibility of owning land under haricot beans cultivation (tenure) and not perceiving the nutritional importance of white haricot beans, decreases the probability of adoption by 0.15 and 0.13, respectively.

CONCLUSION AND RECOMMENDATIONS

Different factors (farm and farmer specific characteristics, farm household socio economic characteristics, infrastructural services, institutional factors, policy related factors and location variables) are associated to the adoption (that is, decision to adopt and intensity of adoption separately) of white haricot beans variety.

Frequency of extension contact, agricultural income of the farm household (other than from haricot beans), and trainings obtained, farm size under haricot beans and diversification positively have contributed to the decision

to adopt white haricot bean varieties.

Moreover, a positive perception of the farmers on price and fertility enhancement capacity of the crop compared to other crops played a significant role on the decision to adopt the crop. However, in environmentally (climate) fragile (risky) areas like this, farmers' positive perception of the output price do not sensitize them to intensify the cultivation of haricot beans. This might be due to the presence of a number of agricultural risks and uncertainty in the area. In theory, the optimal level of new technology use increases with higher output price if the elasticity of risk response to modern input is lower compared to the elasticity of the average yield response to modern input use.

The nutritional perception of white beans (compared to other non white beans), distance to market, and number of dependents in the family had negative repercussion on the adoption of the crop. Other sources of income (non farm income) also plays a positive role on the intensity of adoption. Contacts of the farmers with other nongovernmental organizations in this respect has a significant contribution on adoption and intensity of the crop in the area. This might call for drawing a lesson from the involved nongovernmental organizations for future use. Existing land possession (tenure) system has a negative association with the adoption and intensity of white haricot beans variety. Significant number of adopters of the crop possess land through rent and/ or crop share basis, the later being insignificant in number. This might be attributed to differences in information on the existing market, difference in capacity (financial, age, etc), risk behavior and/or other factors that exist among the land owners and the adopters.

Since the dissemination of the HYV (Awash 1 in1998 and Awash Melka in 2007) of white haricot beans in the area, the adoption of export type white haricot beans varieties has increased overtime. Awash 1 and Awash Melka are the dominant export type or canning white beans observed in the study area. The proportion of land under white beans has increased by 58% on average from the first year of adoption to the survey year (2014/2015), indicating a positive change in the intensity of adoption.

The following variables are found to be crucial among others, in influencing the adoption of white haricot beans. Agricultural and non agricultural income; relevant training (on production and marketing) provided, variables related to risk-averse behavior of farm households (such as tenure, crop diversification and perception on price); perception of farmers on the positive attributes of the crop (nutritional importance and soil fertility improvement contribution of the crop), the number of dependent family members (that is, on time and cost), existence of NGOs on capacity building in relation to the subject, and provision of extension service are the major ones. Moreover, constraints on the use of certified seeds as related to time and quantity of supply are major problems influencing the adoption of white haricot beans.

Based on the results of the study, the following measures are recommended to enhance the adoption of white beans variety in the study area. Given the high contribution of extension service on decision to adopt the crop, it is essential to further strengthen existing extension works in this respect. These can be done through increasing the frequency of extension visits (that is, via increasing the number of extension workers) and improvement of the quality of the extension services provided by the extension workers.

Quality improvement could be achieved via measures on the relevance of existing disciplines, provision of consecutive training to the extension workers, provision of required incentives, provision of other (material) capacity building to the development agents, and strengthening the monitoring and evaluation system of extension services. The perception of the farm households on the nutritional, fertility enhancement importance of the crop could also be improved through better extension services and relevant trainings.

In addition, enhancement of the involvement of NGOs working on similar issues and improvement of infrastructure (access to market as related to road and market centers or yards), provision of information on production and marketing are the appropriate measures to enhance the decision and intensity of adoption of white bean variety.

Moreover, measures to halt the negative consequence of the number of dependents in the farm households through appropriate family planning are important. The proportion of dependents (that is, for age less than 14) is nearly half of the population nationally, while the proportion of age greater than 65 is about 4%. The number of dependents in the first category could substantially be reduced through better family planning in the rural areas as first hand option. Problems related to the risk aversive behavior of the farm households could be reduced by suitable measures on price stabilization and measures related to output loss due to climate factors, crop diseases and pests in the mid and long-term. Other sorts of measures such as crop insurance are also crucial to minimize the risks on the farm households in the short and medium term. Depending on the economic progress and hard realities of the farm sector, subsidies on price of crops are also some of the long run solutions proposed to enhance the adoption of white haricot beans in the country.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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ANNEX

Annex 1. Land size (ha) under crops of the households (adopters=156; non adopters=238).

Crop		Mean	Std. Dev.	Min	Max
Cereals	Adopters	2.	1.9	0.25	10.45
	Non adopters	2.2	1.6	0.2	10.25
	Total	2.4	1.7	0.25	10.45
Teff	Adopters	0.74	1.13	0.00	8.00
	Non adopters	0.50	0.56	0.00	3.90
Barley	Adopters	0.09	0.20	0.00	1.70
	Non adopters	0.14	0.27	0.00	1.40
Wheat	Adopters	0.50	0.65	0.00	3.50
	Non adopters	0.45	0.7	0.00	5.20
Maize	Adopters	1.29	0.83	0.00	5.00
	Non adopters	1.1	0.8	0.00	5
Sorghum	Adopters	0.10	0.29	0.00	3.00
	Non adopters	0.11	0.35	0.00	4.30
Pulses	Adopters	0.8	0.7	0.25	5.00
	Non adopters	0.5	0.35	0.13	2.25
	Total	0.6	0.5	0.13	5
Soya bean	Adopters	0.01	0.08	0.00	1.00
	Non Adopters	0.00	0.03	0.00	0.40
Pea	Adopters	0.00	0.02	0.00	0.25
	Non adopters	0.00	0.02	0.00	0.25
Horse bean	Adopters	0.00	0.03	0.00	0.25
	Non adopters	0.00	0.00	0.00	0.00
Green Bean	Adopters	0.00	0.02	0.00	0.25
	Non Adopters	0.00	0.01	0.00	0.20
Traditional haricot bean	Adopters	0.03	0.12	0.00	1.00
	Non adopters	0.74	0.70	0.00	5.00
White haricot bean	Adopters	0.79	0.67	0.00	5.00
	Non adopters	0.02	0.15	0.00	2.10
Vegetables	Adopters	0.04	0.2	0.00	1.75
	Non adopters	0.01	0.05	0.00	0.38
	Total	0.02	0.12	0.00	1.75
Tomato	Adopters	0.02	0.12	0.00	1.00
	Non adopters	0.00	0.03	0.00	0.25

Annex 1. Contd.

Cabbage	**Adopters**	**0.02**	**0.13**	**0.00**	**1.50**
	Non adopters	0.00	0.04	0.00	0.60
Potato	Adopters	0.00	0.01	0.00	0.13
	Non adopters	0.00	0.00	0.00	0.00
Pepper	Adopters	0.01	0.05	0.00	0.50
	Non adopters	0.02	0.15	0.00	1.40
Onion	Adopters	0.00	0.02	0.00	0.25
	Non adopters	0.02	0.22	0.00	3.40
Carrot	Adopters	0.00	0.02	0.00	0.25
	Non adopters	0.00	0.00	0.00	0.00
Fruit (Papaya)	Adopters	0.00	0.01	0.00	0.13
	Non adopters	0.00	0.00	0.00	0.00
	Total	0.00	0.00	0.00	0.13
All crops	Adopters	3.5	2.2	0.5	12.58
	Non adopters	2.7	1.7	0.38	10.75
	Total	3.0	1.9	0.38	12.58

Source: Computed from own survey (2014).

Annex 2. Multivariate Tobit model output on the determinants of adoption of white haricot beans.

Variable	Coef.	Std. Err.	Z	P>z	(95% Conf.	Interval)
Adoption decision (Adopstat)						
Age	0.00	0.01	-0.38	0.71	-0.02	0.01
Gender	-0.01	0.18	-0.07	0.94	-0.37	0.35
Hsize	0.00	0.01	-0.35	0.73	-0.03	0.02
Asso	0.03	0.04	0.67	0.50	-0.05	0.10
Extnuse	0.06	0.03	2.07	0.04	0.00	0.12
Educfam	-0.02	0.03	-0.55	0.59	-0.07	0.04
Dmkt	-0.05	0.02	-2.85	0.00	-0.08	-0.02
Credituse	0.03	0.11	0.26	0.79	-0.19	0.25
landhold2	-0.01	0.05	-0.28	0.78	-0.12	0.09
Hbfsizeha	0.05	0.16	0.34	0.73	-0.26	0.37
Tenure	-0.31	0.17	-1.79	0.07	-0.65	0.03
Fragm	0.00	0.01	-0.38	0.70	-0.03	0.02
Tlu	0.00	0.01	-0.10	0.92	-0.02	0.02
Lnnfisize	0.00	0.01	-0.32	0.75	-0.03	0.02
Hbexp	0.00	0.01	0.45	0.65	-0.01	0.02
Lnhhfincom	0.44	0.12	3.79	0.00	0.21	0.66
Comass	0.07	0.07	0.99	0.32	-0.07	0.20
Nutrperc	-0.41	0.11	-3.64	0.00	-0.63	-0.19
Priceperc	0.60	0.14	4.40	0.00	0.33	0.86
Ngocont	0.20	0.11	1.78	0.08	-0.02	0.43
Training	0.11	0.04	2.89	0.00	0.04	0.19
Distdaof	-0.02	0.01	-2.11	0.04	-0.03	0.00

Annex 2. Contd.

Yldperc	0.32	0.15	2.09	0.04	0.02	0.62
Fertperc	0.78	0.16	4.99	0.00	0.48	1.09
diversifn2	1.66	0.49	3.39	0.00	0.70	2.62
_cons	-5.89	1.28	-4.61	0.00	-8.40	-3.39
Intensity of adoption (landpr0p)						
Age	-0.25	0.69	-0.37	0.72	-1.61	1.10
Gender	-17.82	18.72	-0.95	0.34	-54.51	18.87
Activelabor	-0.72	1.49	-0.49	0.63	-3.64	2.19
Dependents	-1.42	0.97	-1.46	0.14	-3.31	0.48
Extnuse	7.22	3.17	2.28	0.02	1.01	13.43
Educfam	1.52	2.96	0.51	0.61	-4.29	7.33
Dmkt	-6.14	1.78	-3.46	0.00	-9.62	-2.66
Credituse	6.44	11.34	0.57	0.57	-15.79	28.66
landhold2	-1.44	5.44	-0.27	0.79	-12.11	9.22
Hbfsizeha	1.87	16.34	0.11	0.91	-30.16	33.91
Tenure	-26.97	17.88	-1.51	0.13	-62.02	8.07
Tlu	0.33	1.19	0.28	0.78	-2.00	2.65
Lnhhfincom	48.40	11.80	4.10	0.00	25.26	71.53
Lnnfisize	-0.15	1.47	-0.10	0.92	-3.03	2.73
Hbexp	-0.43	0.74	-0.59	0.56	-1.88	1.01
Nutrperc	-37.92	11.55	-3.28	0.00	-60.55	-15.30
Priceperc	62.72	13.92	4.51	0.00	35.43	90.01
Ngocont	21.85	11.66	1.87	0.06	-1.00	44.69
Yldperc	35.72	15.62	2.29	0.02	5.11	66.33
Fertperc	74.20	15.91	4.66	0.00	43.01	105.38
diversifn2	204.48	50.63	4.04	0.00	105.25	303.70
_cons	-636.55	131.06	-4.86	0.00	-893.43	-379.68
/lnsigma1	-0.24	0.07	-3.44	0.00	-0.37	-0.10
/lnsigma2	4.39	0.07	62.92	0.00	4.26	4.53
/atrho12	2.03	0.08	24.35	0.00	1.87	2.19
sigma1	0.79	0.05	14.44	0.00	0.69	0.90
sigma2	80.79	5.64	14.33	0.00	70.46	92.63
rho12	0.97	0.01	173.46	0.00	0.95	0.98

Likelihood ratio test of rho12 = 0: chi2(1) = 521.175 Prob > chi2 = 0.0000.

Annex 3. Mean marginal effects of the probability, conditional and unconditional after double hurdle model for significant variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Overall probability pw1(Pry>0|x_{1i})	394	0.39	0.33	0	1
Overall expectation eyyx2(Pry>0|x_{1i})	394	98.48	2.15	90.59	104.77
Overall Un exp eyx1x2(Pry>0| x_{1i} ,x2i)	394	38.95	33.06	0	101.39
Prextnuse(Pry>0|x_{1i})	394	0.02	0.01	0	0.04
Expextnuse(Pry>0|x2i)	394	0.13	0	0.13	0.13
UncondExpextnuse (Pry>0| x_{1i} ,x2i)	394	2.12	1.45	0.13	4.08
Prdmkt(Pry>0|x_{1i})	394	0.03	0.02	0.05	0
Expdmkt(Pry>0|x2i)	394	0.05	0	0.05	0.05
UncondExpdmkt(Pry>0| x_{1i} ,x2i)	394	2.59	1.74	4.93	0

Annex 3. Contd.

Prhbfsizeha(Pry>0|x_{1i})	394	0.14	0.09	0	0.25
Exphbfsizeha(Pry>0|x2i)	394	0.03	0	0.03	0.03
UncondExphbfsizha(Pry>0| x_{1i} ,x2i)	394	13.61	9.17	0.03	26.01
Prtenure(Pry>0|x_{1i})	394	0.15	0.1	0.28	0
Exptenure(Pry>0|x2i)	394	1.82	0	1.82	1.82
UncondExptenure(Pry>0| x_{1i} ,x2i)	394	15.86	10.41	29.84	0
Prlnhhfincom(Pry>0|x_{1i})	394	0.15	0.1	0	0.27
Explnhhfincom(Pry>0|x2i)	394	0.52	0	0.52	0.52
UncondExplnhhfincom(Pry>0| x_{1i} ,x2i)	394	14.57	9.89	0.52	27.97
PrnutrPerc(Pry>0|x_{1i})	394	0.13	0.09	0.25	0
Expnutrperc(Pry>0|x2i)	394	0.37	0	0.37	0.37
UncondExpnutrperc(Pry>0| x_{1i} ,x2i)	394	13.37	8.94	25.44	0
PrPricePerc(Pry>0|x_{1i})	394	0.18	0.12	0	0.33
Exppriceperc(Pry>0|x2i)	394	0.11	0	0.11	0.11
UncondExppriceperc(Pry>0| x_{1i} ,x2i)	394	18.01	12.11	0	34.39
Prtraining(Pry>0|x_{1i})	394	0.2	0.13	0	0.36
Exptraining(Pry>0|x2i)	0	0	0	0	0
UncondExptraining(Pry>0| x_{1i} ,x2i)	0	0	0	0	0
PrfertPerc(Pry>0|x_{1i})	394	0.23	0.15	0	0.41
Expfertperc(Pry>0|x2i)	394	1.2	0	1.2	1.2
UncondExpfertperc(Pry>0| x_{1i} ,x2i)	394	21.82	14.89	1.2	42.01
Prdiversifn2(Pry>0|x_{1i})	394	0.52	0.35	0	0.96
Expdiversi~2(Pry>0|x2i)	394	0.1	0	0.1	0.1
UncondExpdiversifn2(Pry>0| x_{1i} ,x2i)	394	51.64	34.76	0.01	98.65
PrdePendents(Pry>0|x_{1i})	0	0	0	0	0
Expdependens(Pry>0|x2i)	394	0.47	0	0.47	0.47
UncondExpdependents(Pry>0| x_{1i} ,x2i)	394	0.47	0	0.47	0.47
Prlnnfisize(Pry>0|x_{1i})	394	0	0	0	0
Explnnfisize(Pry>0|x2i)	394	0.22	0	0.22	0.22
UncondExplnnfisize(Pry>0| x_{1i} ,x2i)	394	0.15	0.1	0	0.27
Prngocont(Pry>0|x_{1i})	394	0.02	0.01	0	0.03
Expngocont(Pry>0|x2i)	394	2.13	0	2.13	2.13
UncondExpngocont(Pry>0| x_{1i} ,x2i)	394	2.42	1.46	0	4.24

Source: Computed from own survey, 2014.

Annex 4. List of haricot beans varieties cultivated in the area.

Names of haricot bean varieties		Frequency	Percentage (%)
	Adopters	117	75.00
Awash-I	Non adopters	0	0
	Total	117	30
	Adopters	27	17.31
Awash Melka-II	Non adopters	0	0
	Total	27	7
	Adopters	0	0
Mexica-142	Non adopters	0	0
	Total	0	0

Annex 4. Contd.

	Adopters	3	1.92
Red haricot beans	Non adopters	226	94.96
	Total	229	58
	Adopters	0	0
Mixed (stripe color) haricot beans	Non adopters	9	3.78
	Total	9	2
	Adopters	0	0
Black haricot beans	Non adopters	1	0.42
	Total	1	0
	Adopters	6	3.85
1 and 2	Non adopters	0	0
	Total	6	2
	Adopters	3	1.92
1 and 4	Non adopters	0	0
	Total	3	1
	Adopters	0	0
4 and 5	Non adopters	2	0.84
	Total	2	0
Total		394	100

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Who engages in urban and peri-urban agriculture in the condensed urban slums of Bangladesh?

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Urban and peri-urban agriculture (UPA) have been considered solutions for improving poor living conditions in undeveloped urban and peri-urban areas of developing countries. Therefore, this paper aims to identify the factors affecting UPA decision-making, with special attention to land constraints among poor urban slum dwellers in Bangladesh. A logit regression model was applied using secondary individual household data obtained from the International Food Policy Research Institute (IFPRI), and the predicted probabilities of engaging in UPA for each significant independent variable were estimated. In moderately populated Jessore, households that had more family members without children under five, had some savings, lived in their own house or lived there without paying rent, and had any water logging around the house 1 to 60 days per year were more likely to engage in UPA than other households. On the other hand, in densely populated Tongi, households that lived in their own house or lived there without paying rent, lived there for longer periods, had any water logging around the house less than four months per year, or could rely on neighbors through a difficult period were more likely to engage in UPA than other households. This finding suggests that constraint factors associated with engaging in UPA differ in various urban settings. Therefore, nonprofit/community organizations or local governments are required to plan carefully when promoting UPA, which is one of the coping strategies of poor urban dwellers wishing to enhance their resilience against food insecurity.

Key words: Urban and peri-urban agriculture, urban slum, Bangladesh.

INTRODUCTION

In the 15 years of the Millennium Development Goals (MDGs), the proportion of undernourished people in developing and transitional areas has been almost halved (UN, 2015), but eradication of pervasive food poverty is still one of the most difficult challenges the world is facing. The majority of the poverty-stricken population in developing countries, who are most likely to suffer from perpetual nutritional deprivation, are still cut off from access to sufficient basic food to meet their daily needs. Vulnerability to food insecurity inhibits the poor from

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engaging in stable income-generating activities, investing in human and physical capital, and thereby breaking the vicious circle of poverty. Therefore, mitigating their vulnerability has always been high on the agenda of poverty reduction programs.

The question is what remedies can reduce this vulnerability from the viewpoint of food poverty reduction in situations where urbanization has grown rapidly in developing countries. Seemingly old-fashioned but low-cost urban and peri-urban agriculture (UPA) offers an answer here. UPA is roughly defined as growing food crops (such as vegetables, root and tuber crops, staple grains, and fruits) and raising domestic animals (such as poultry, cattle, swine, and goats) within and around urban areas. Various empirical studies claim that UPA has been considered a solution for improving poor living conditions in undeveloped urban and peri-urban areas of developing countries, on the grounds of its effects on improving household food and nutrition intakes (Amrullah et al., 2017; Bhatta et al., 2008; Bukusuba et al., 2007; Dossa et al., 2011; Gallaher et al., 2013a; Lynch et al., 2013; Smart et al., 2015; Zezza and Tasciotti, 2010) and the physique of a child (Maxwell, 1995; Maxwell et al., 1998), increasing or diversifying household income (Amrullah et al., 2017; Ashebir et al., 2007; Maxwell, 1995; Smart et al., 2015; Zezza and Tasciotti, 2010), providing remunerative economic activities for women (Mudimu, 1996; Maxwell, 1995), empowering women through economic independence (Gororo and Kashangura, 2016; Masvaure, 2015; Simiyu and Foeken, 2014), and accumulating social capital (Gallaher et al., 2013a).

However, determinants or deterrents of urban and peri-urban agriculture in developing countries have rarely been examined in detail, with the few exceptions pointing out that the more members there are in a family (Dossa et al., 2011; Maxwell, 1995) and the longer their length of stay at their current residential address (Maxwell, 1995), the more likely a family is to engage in urban agriculture in cities in Africa. Additionally, previous studies regarding UPA have paid considerable attention to African countries only where severe food poverty has been pervasive, and UPA in Asian countries has rarely been discussed. However, it is well known that food poverty remains widespread and continues to be a challenging problem in South Asian countries, particularly in Bangladesh, which has a large poverty-stricken urban population. Hence, it is valuable to obtain insights into the factors affecting UPA engagement in the urban slums of Bangladesh, not only to bring us closer to understanding urban food production in the country, but also to map out strategies for mitigating vulnerabilities to food insecurity among poverty-stricken slum dwellers in Bangladesh and other South Asian countries, such as India, Pakistan, and Nepal. Therefore, this study identifies the factors affecting UPA decision-making, with special attention to land constraints among poor urban dwellers in Bangladesh. To accomplish this objective, a logit regression model was applied using secondary individual household data obtained from the International Food Policy Research Institute (IFPRI).

MATERIALS AND METHODS

Data and study areas

Slum household data were obtained from the Supporting Household Activities for Health, Assets, and Revenue (SHAHAR)[1] Project Baseline Survey, conducted by the International Food Policy Research Institute (IFPRI) and CARE-Bangladesh in the municipal areas of Tongi and Jessore during August and September 2000. Although the data set was not collected recently and most probably does not reflect the current situation of UPA in rapidly growing urban slums due to a massive inflow of job-seeking migrants from rural and suburban areas, it still seems that clarifying the factors affecting decision-making around UPA provides policy makers and practitioners with useful information on a situation where a reliable large sample microdata set including UPA practices in urban slums in Bangladesh is not available.

The SHAHAR Project was designed by utilizing an integrated Household Livelihood Security (HLS) framework, aimed to improve livelihood security for vulnerable urban households through infrastructure improvements, nutritional education, vocational and skills training, community mobilization, and institutional strengthening.

Jessore is mainly a peri-urban city located approximately 200 km southwest of Dhaka, the capital of Bangladesh. The Jessore district adjoins India on the west. Thus, the city is an important transit route to that neighboring country. According to the IFPRI's (2003) City Profiles, 40% of men and 33% of women in Jessore are undernourished; approximately one-fourth of women suffer from being underweight, and 34% of men and 48% of women over seven years old are illiterate. Tongi is located approximately 25 km north of Dhaka and is a center of the textile and rice-milling industries. Similarly to Jessore, 41% of men and 49% of women in Tongi are undernourished; approximately two-thirds of women suffer from being underweight due mainly to extreme poverty, and 44% of men and 56% of women over seven years old are illiterate.

CARE-Bangladesh (2001) estimated that there are 63 slums with a total population of 11,228 households (51,832 persons) in Jessore and 21 slums with 13,664 households (56,689 individuals) in Tongi. The IFPRI and CARE-Bangladesh randomly chose households from Jessore and Tongi, and a total of 1,120 households consisting of 5,265 individuals were interviewed: 563 households consisting of 2,581 persons from nine slums in Jessore and 557 households consisting of 2,684 individuals from six slums in Tongi. The IFPRI and CARE-Bangladesh prepared a list of questions covering a wide range of topics, such as household composition, employment earnings, transfers and other income, assets, savings, loans, hygiene, food consumption and security, health conditions, utilization of health care facilities, social networks, community participation, and anthropometry, on the basis of which trained staff interviewed household members. Of the 1,120 households interviewed by the IFPRI and CARE-Bangladesh, 1,058 were selected because they provided all the information necessary to carry out a quantitative analysis.

Approach

CARE-Bangladesh and IFPRI (2001) first asked the following question regarding UPA: "Does the household have access to any

[1] For detailed information on the SHAHAR project, see CARE-Bangladesh (2001).

[2] In concrete terms, these spaces were open land on housing sites, rooftops, balconies, and areas where people could raise small livestock and/or cultivate

urban land[2] including a homestead that can be used to grow crops or raise animals?" If the answer was "Yes," they were further asked, "Does the household grow any fruits or vegetables on this land?" and "Does the household raise any animals on this land?" When households answered "Yes" to one or both questions, they were treated as "households engaged in UPA." The others were regarded as "households not engaged in UPA." Because the answers to these questions were either "Yes" or "No," a dichotomous logit model was applied, with *engagement in UPA* set as a bivariate dependent variable (Yes = 1, No = 0).

After confirming no multicollinearity among the independent variables, the independent variables was established as follows: The *highest number of years of schooling in the household* (years); the *age of the household head* (years); a dummy for the *gender of the household head* (male = 1, female = 0); the *number of household members* (individuals); a dummy for *infant* (a household with any children under five years old = 1, otherwise = 0); a dummy for *saving* (a household with at least one member having savings = 1, otherwise = 0); a dummy for a *stable occupation* (a household with at least one member employed as a salaried worker in the government and/or private sectors, working as a medical doctor, engineer, teacher, or medium/large trader whose annual revenue is above BDT 5,001 = 1, otherwise = 0); a dummy for *residence type* (rental [reference category], own, or live there without paying rent); the *length of residence* in Jessore or Tongi (in years); a cross-term of the dummy for *residence type* and the *length of residence*; a dummy for *the number of days of water-logging* per year (0 [reference category], 1-60, 61-120 and 121 days or more); a dummy for a *network of relatives* (households who can rely on any relatives through a difficult period = 1, otherwise = 0); and a dummy for a *network of neighbors* (households who can rely on any neighbors through a difficult period = 1, otherwise = 0). By using the logit regression model, the factors that affect households' engagement in UPA and the predicted probabilities of each significant independent variable were estimated.

For more detail, the well-known mathematical formula of the logit model was used to estimate parameters as follows:

$$P_r(Y = 1|X) = \frac{exp(X'\beta)}{1 + exp(X'\beta)}$$

$$\log\left(\frac{P_r}{1 - P_r}\right) = X'\beta$$

Where Y is a binary response variable (that is, *engagement in UPA* in this paper), X a vector of independent variables, and β a vector of unknown parameters to be estimated by the maximum likelihood logit model. The estimated values of β only show the direction of the effect of each independent variable on the probability of slum dwellers engaging in UPA and do not make much economic sense. To evaluate the extent to which each independent variable affects the probability of dwellers engaging in UPA, the predicted probability of a specific independent variable X_k was estimated, holding all other independent variables $\tilde{X}$ at observed values. In more detail, the formulas for calculating the predicted probability of each independent variable are as follows:

$P_r(Y = 1|\tilde{X}, X_k = 1)$ and $P_r(Y = 1|\tilde{X}, X_k = 0)$ if X_k is a dummy variable[3].

$P_r(Y = 1|\tilde{X}, X_k = \mu)$ and $P_r(Y = 1|\tilde{X}, X_k = \mu \pm \sigma)$ if X_k is a continuous variable.

RESULTS AND DISCUSSION

Before presenting the model estimation results, UPA engagement will be briefly explained. According to Table 1, 44.8% of households in Jessore and 14.4% in Tongi are engaged in UPA. In Jessore, which is moderately populated and where land for UPA can be acquired with comparative ease, 91.8% of households engage in UPA, and 41.1% of all households, including both UPA-engaged and non-engaged households, have livestock. The share of households planting vegetables or fruits to UPA-engaged households is 35.8%, indicating that raising livestock is more pervasively practiced than vegetable/fruit farming. More than 90% of households, or 202 of 243 households, having livestock raise poultry, followed by goats (18.4%, or 41 households), and cows (17.0% or 38 households). Conversely, the location of Tongi, which is densely populated in comparison with Jessore, prevents households from acquiring reasonably sized land or space suitable for raising livestock. Therefore, many households grow vegetables or other plants in vacant land or space. In Tongi, 59.5% of households engaged in UPA, or only 8.5% of all households have livestock. The share of households planting vegetables or fruits to UPA-engaged households is 71.6%, indicating vegetable/fruit farming is more pervasively practiced than raising livestock. As in the case of Jessore, poultry farming is the most widely practiced, with 93.2% of households, or 41 of 44 households, raising livestock. However, only five and three households raise goats and cows, respectively. The difference in land availability between Jessore and Tongi may affect these UPA characteristics. Dossa et al. (2011) revealed a negative relationship between population density and the prevalence of UPA in African urban cities. In an urban city with a high population density, such as Tongi, the nutritional and/or economic benefits of engaging in UPA appear to be confined to a small proportion of urban dwellers.

The estimated results from the logit model are shown in Table 2. The null hypothesis that coefficients of all independent variables are equal to zero is rejected at the 1% level in both estimated results (test statistics are approximately distributed, as the chi-square distribution with 17 degrees of freedom is 138.702 for Jessore and 65.669 for Tongi). The percentages correctly predicted by the logit model are 71.8% for Jessore and 85.4% for Tongi. Additionally, the Hosmer-Lemeshow test shows there is no evidence for rejecting the null hypothesis (test statistics are approximately distributed, as chi-square distribution with eight degrees of freedom is 2.283 for Jessore and 6.110 for Tongi), suggesting that the fitted model is correct. Therefore, the estimation results of the logit model are reliable.

[2] In concrete terms, these spaces were open land on housing sites, rooftops, balconies, and areas where people could raise small livestock and/or cultivate vegetables or fruits.

[3] Note that the difference between $P_r(Y = 1|\tilde{X}, X_k = 1)$ and $P_r(Y = 1|\tilde{X}, X_k = 0)$ is equal to the average marginal effect.

Table 1. Urban and peri-urban agriculture (UPA) in Jessore and Tongi

	Jessore		Tongi	
Urban and peri-urban agriculture				
Yes	243	44.8	74	14.4
No	300	55.2	441	85.6
Total	543	100.0	515	100.0
Rearing livestock				
Yes	223	91.8	44	59.5
No	20	8.2	30	40.5
Planting vegetables/fruits				
Yes	87	35.8	53	71.6
No	156	64.2	21	28.4
Total	243	100.0	74	100.0

Source: Authors' calculation.

Table 2. Estimated result of the logit model

	Jessore					Tongi				
	Coeff.	**t-statics**		**Mean**	**SD**	**Coeff.**	**t-statics**		**Mean**	**SD**
Highest number of years of schooling in the household	-0.011	-0.393		6.105	4.132	0.077	1.725		4.429	3.610
Age of the household members	-0.017	-1.651		41.273	11.821	0.010	0.785		39.693	12.490
Gender of the household head	-0.117	-0.395		0.864		0.048	0.116		0.852	
Number of household members	0.175	2.874	**	4.783	1.939	0.047	0.635		4.619	2.045
Dummy for infant	-0.516	-2.297	*	0.488		0.128	0.416		0.499	
Dummy for saving	0.755	3.584	**	0.606		0.397	1.191		0.631	
Dummy for a stable occupation	0.431	1.915		0.378		0.113	0.384		0.464	
Dummy for residence type										
Own	1.291	3.541	**	0.505		2.836	3.709	**	0.536	
Live there without paying rent	2.301	3.399	**	0.074		3.936	4.014	**	0.070	
Length of residence	0.006	0.544		23.357	18.271	0.089	2.142	*	16.734	13.367
Residence type x length of residence										
Own	0.013	0.943				-0.093	-2.129	*		
Live there without paying rent	-0.026	-1.055				-0.138	-2.552	*		
Number of days of water-logging										
1-60 days	0.455	2.119	*	0.378		0.665	2.237	*	0.299	
61-120 days	-0.091	-0.229		0.070		1.064	2.254	*	0.072	
121days or more	0.457	0.735		0.024		0.310	0.259		0.017	
Dummy for a network of relatives	0.087	0.369		0.696		-0.097	-0.309		0.627	
Dummy for a network of neighbors	-0.022	-0.091		0.755		0.651	2.100	*	0.598	
Constant	-1.976	-3.413	**			-6.233	-6.215	**		
Log likelihood		-304.031					-179.142			
LR chi²(17)		138.702					65.669			
Hosmer-Lemeshow chi²(8)		2.283					6.110			
Correctly classified		0.718					0.854			
Pseudo R^2		0.186					0.155			
Sample size		543					515			

** and * indicate significant at 1 and 5%, respectively.
Source: Authors' calculation.

The results in Jessore were first focused on. As shown in Table 2, some independent variables are statistically significant at the 1 or 5% levels as follows: The *number of household members*, *infant* dummy, *saving* dummy, *residence type* dummy (own or live there without paying rent), and *number of days of water-logging* per year dummy (1-60 days). Only the coefficient of the *infant* dummy is significantly negative, the other four variables being significantly positive. The following independent variables are not significant at the 5% level: The *highest number of years of schooling in the household*, *age of the household head*, *gender of the household head* dummy, *stable occupation* dummy, *length of residence*, cross-term of the dummy for *residence type* and the *length of residence*, *number of days of water-logging* per year dummy (61-120 and 121 days or more), *network of relatives* dummy, and *network of neighbors* dummy.

The results for Tongi also show that some independent variables are statistically significant at the 1 and 5% levels. The following coefficients are significant: The *residence type* dummy (own or live there without paying), *length of residence*, cross-term of the dummy for *residence type* and the *length of residence*, *number of days of water-logging* per year dummy (1-60 and 61-120 days), and *network of neighbors* dummy. The following independent variables are not significant at the 5% level: The *highest number of years of schooling in the household*, *age of the household head*, *gender of the household head* dummy, *number of household members*, *infant* dummy, *saving* dummy, *stable occupation* dummy, *number of days of water-logging* per year dummy (121 days or more), and *network of relatives* dummy.

Table 3 shows the predicted probabilities of engaging in UPA for significant variables, holding all other variables in the model at their means. In Jessore, the predicted probability of engaging in UPA is 33.8% for a household with the number of family members equal to the mean minus the standard deviation ($\mu - \sigma$), 41.7% at the mean (μ), and 50.1% at the mean plus the standard deviation ($\mu + \sigma$). As pointed out by Dossa et al. (2011) and Maxwell (1995) when examining the case of urban cities in Africa, the more members there are in a family, the more likely a family is to engage in urban agriculture in Jessore. The predicted probability for a household with more than one child under five years old to engage in UPA is 35.5%, which is 12.4% lower than that for a household without any children under five, indicating that having a young child under five is a deterrent for engaging in UPA in Jessore. Considering that the *number of household members* and the *infant* dummy are not significant in more condensed Tongi, where land is a scarce resource, not land but labor availability for UPA is an important factor affecting the probability of engaging in UPA in Jessore, which is moderately populated and where land for UPA can be acquired with comparative ease. As explained previously, Jessore is located in a peri-urban area, approximately 200 km from Dhaka.

Moreover, land availability is not strictly limited compared to Tongi. As such, it is not difficult to find land to cultivate. Consequently, the number of family members who can engage in UPA is important for those living in Jessore.

In Jessore, the predicted probability of a household with at least one member having savings to engage in UPA is 49.1%t, which is 17.9% larger than the probability (31.2%) of a household without savings. As pointed out by Dossa et al. (2011) in examining the relationship between participation rates in UPA and a household economic status in urban cities of Tanzania, Zimbabwe, Nigeria, and Cameroon, this result indicates that raising livestock is more common among households in the medium and upper income strata. Compared to vegetable or fruit farming, raising livestock, which is more pervasively practiced in Jessore than vegetable/fruit farming has more capital-intensive risks, and a larger loss could be suffered if all or part of the domestic animals are lost due to disease, theft, predation, or floods. Therefore, a household with savings can afford to take the risk of losing its livestock in order to obtain a significant source of animal protein and nutrition.

The dummy for *residence type* is significant in both Jessore and Tongi. A household living in its own house or not paying rent is predicted to have a 58.1 or 60.8% probability to engage in UPA, respectively, in Jessore and a 18.2 or 24.1% probability, respectively, in Tongi. These estimations indicate that the household is 36.1 and 38.8%, respectively, more likely to engage in UPA compared to a household living in a rented house in Jessore and 12.4 and 18.3%, respectively in Tongi suggesting that households owning the house they live in or living there without paying rent can more easily secure suitable land or space for UPA in or around the house.

In densely populated Tongi, the predicted probability of engaging in UPA is 10.2% for a household living there for the length equal to the mean minus the standard deviation divided by two ($\mu - \sigma/2$)[4], 12.1% at the mean (μ), and 14.4% at the mean plus the standard deviation divided by two ($\mu + \sigma/2$). This result is consistent with Maxwell (1995), who pointed out that in the case of Kampala, the capital of Uganda, the longer the length of stay at the current residential address is, the more likely a family engages in urban agriculture. However, the *length of residence* is not significant in moderately populated Jessore, suggesting that whether a household with a longer-term residence is more likely to engage in UPA depends on the extent of competing land use among urban dwellers. It also should be noted that the cross-term of the dummy for *residence type* and the *length of residence* is significant in Tongi. Although the predicted

[4] As for the *length of residence*, since many data points lie far from the mean value, the standard deviation is large enough that the estimated probability at the mean plus/minus the standard deviation is likely to provide a low precision. Therefore, the points at the mean plus/minus the standard deviation divided by two was used.

Table 3. Predicted probability of engaging in UPA

	Jessore		Tongi	
	Probability	**Difference**	**Probability**	**Difference**
Number of household members				
Mean minus s.d. (2.843)	0.338		n.s.	
Mean (4.783)	0.417	0.079	n.s.	
Mean plus s.d. (6.722)	0.501	0.163	n.s.	
Dummy for infant				
No	0.479		n.s.	
Yes	0.355	-0.124	n.s.	
Dummy for saving				
no	0.312		n.s.	
yes	0.491	0.179	n.s.	
Dummy for residence type				
Rent a house (reference)	0.220		0.058	
Own	0.581	0.361	0.182	0.124
Live there without paying	0.608	0.388	0.241	0.183
Length of residence				
Mean minus s.d./2 (10.050)	n.s.		0.102	
Mean (16.734)	n.s.		0.121	0.020
Mean plus s.d./2 (23.418)	n.s.		0.144	0.043
Residence type x length of residence				
Rent a house				
x length of residence (10.050)	n.s.		0.033	
x length of residence (16.734)	n.s.		0.058	0.025
x length of residence (23.418)	n.s.		0.101	0.068
Own				
x length of residence (10.050)	n.s.		0.186	
x length of residence (16.734)	n.s.		0.182	-0.004
x length of residence (23.418)	n.s.		0.178	-0.008
Live there without paying				
x length of residence (10.050)	n.s.		0.305	
x length of residence (16.734)	n.s.		0.241	-0.064
x length of residence (23.418)	n.s.		0.187	-0.118
Number of days of water-logging				
0 day (reference)	0.375		0.094	
1-60 days	0.486	0.111	0.169	0.075
61-120 days	n.s.		0.232	0.138
dummy for a network of neighbors				
No	n.s.		0.085	
Yes	n.s.		0.152	0.067

Source: Authors' calculation.

probability to engage in UPA for a household renting its house tends to increase with the length of residence, that for a household living there without paying rent has a downward tendency to some extent. It seems that this antinomic relation is because the household living there without paying is more likely to face eviction with an increasing length of residence, due probably to a lack of legal land entitlement or valid lease agreement.

In Jessore, a household which has water-logging around its house for 1 to 60 days per year has a 48.6% probability of engaging in UPA, that is, 11.1% more than that for a household which does not experience water-logging through the year. In Tongi, a household which has water-logging around its house for 1-60 or 61-120 days per year has a 16.9 and 23.2% probability, respectively, of engaging in UPA, that is 7.5 and 13.8% larger, respectively, than that for a household which does not experience water-logging through the year. Land where water-logging sometimes occurs in the rainy season is generally unsuitable for residence. However, this situation may change significantly between the rainy and dry seasons in regions with 1 to 120 days of water-logging. Although water appears around homes in the rainy season, the land is suitable for cultivation or livestock farming in the dry season, when the water has withdrawn.

In Tongi, a household that can rely on neighbors through a difficult period is expected to engage in UPA at a 15.2% probability and is 6.7% more likely to do so compare to a household who cannot rely on anyone. Tongi is located near Dhaka and is densely populated. Therefore, people have difficulty obtaining land that is suitable for UPA. To avoid trouble with neighbors over land utilization, it is important for residents to maintain good relations.

CONCLUSION AND POLICY IMPLICATIONS

This study identifies the factors affecting UPA decision-making, with special attention to land constraints among poor urban dwellers in Bangladesh. To accomplish this objective, a dichotomous logit regression model was applied using secondary slum household data obtained from the SHAHAR Project Baseline Survey, conducted by the IFPRI and CARE-Bangladesh in Tongi and Jessore.

The results show that in moderately populated Jessore, households that have more family members without children under five, have some savings, live in their own house or live there without paying rent, and have any water-logging around the house 1 to 60 days per year are more likely to engage in UPA than other households. On the other hand, in densely populated Tongi, households that live in their own house or live there without paying rent, live there for longer periods, have any water-logging around the house less than four months per year, and can rely on neighbors through a difficult period are more likely to engage in UPA than other households.

In Jessore, where households are often able to acquire land for planting food crops or raising livestock, the number of family members available for engaging in UPA is an important factor in UPA engagement. In Tongi, where it is difficult to obtain land, good relationships with neighbors help households avoid some of the problems of land utilization. This finding suggests that constraint factors associated with engagement in UPA differ in various urban settings.

Although it is difficult to raise domestic animals or plant vegetables or fruits on a large scale in highly competitive situations for vacant land suitable for UPA (which is decreasing along with rapid urbanization in developing and transitioning countries), the Food and Agriculture Organization[5] insists that urban agriculture on just one square meter can provide 20 kg of food per year. In densely populated urban cities in Africa and Asia, many poor dwellers, particularly women, grow vegetables in pots and/or sacks that can be put in front of the house or a narrow vacant space, such as a roadside, rooftop, or balcony. UPA is one of the coping strategies for poor urban dwellers to enhance their resilience to food insecurity. Therefore, it is suggested that more people should understand the merit of UPA and start running recommended and systematic UPA programs[6]. For example, female group farming or livestock rearing, which is reported to result in strengthening social networks among participants at the community level and then lessening the risk of tension over who utilizes a vacant space or land suitable for UPA (Gallaher et al., 2013a), should be promoted in situations where a massive inflow of people from rural to urban areas is expected to continue, as in many developing countries like Bangladesh.

However, UPA has many benefits but is not free from faults. For example, some researchers worried about the accumulation of heavy metals by using contaminated irrigation water and soil (Antwi-Agyei et al., 2016; Gallaher, 2013b; Nyantakyi-Frimpong et al., 2016) and livestock excrements. Pest issues and diseases, which lead to a production failure and lower return, are also pointed out as detrimental factors in preventing urban dwellers from engaging in UPA (Amrullah et al., 2017). Although UPA engagement can be expected to have many positive effects, it also has negative effects or effects that do not match expectations. Thus, it is important for us to promote UPA engagement with great care. A majority of urban slum dwellers do not have enough knowledge of either the health risks of consuming vegetables contaminated by hazardous viruses or toxic materials, such as heavy metals, or growing vegetables and/or rearing livestock properly. Therefore, technical support and basic training programs should be provided by agricultural extension or NPO officers to attain more efficient and safe food production in densely populated urban cities.

CONFLICTS OF INTERESTS

The authors have not declared any conflict of interests.

[5] http://www.fao.org/urban-agriculture/en/ (last accessed on February 21, 2017).

[6]The findings are based on a case study of two slums in Bangladesh using cross-sectional household data. Therefore, it should be noted that the results may not be applicable or generalizable to urban cities in other Asian countries.

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