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Assessment of Production and Utilization of Bread Wheat Farmer's Varieties (*Triticum aestivum* L.) in Agarfa and Goro CSBs of Bale Zone, Oromia Regional State, Ethiopia

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Abstract

The likelihood of wheat farmer's verities to be conserved on the farm (CSBs) increases when the markets for their derived products are expanded through improved consumer access to information on recipes, nutritive and cultural values. Therefore, local knowledge of farmer's verities diversity, when documented through interaction with farmers and linked to food traditions, local practices and social norms, is vital for on-farm conservation and increases their competitive advantage if farmers have other alternative options. The survey result indicated that the mean age of the respondents was 51.38 year, and the family size was 7.53 in number. The average land holding of the sample respondents was 2.92ha and the annual income from livestock was 1,879.29 ETB. Furthermore, from the total mean of agriculture income (91,227.48 ETB), Bread wheat production contributes about 80.21 % for the study respondents. The majority (95.56%) of the households perceived that production of Bread wheat crop is important in the study area. The major importance and utilization of producing Bread wheat crop for study households were as source of better income, better market price than other crops in total production, and their major livelihood source. The Probit model showed that producers perception of the importance of Bread wheat production were found to be statistically and significantly affected by age of households, education level, availability of labour for farm activities, access to credit facilities, average income from Bread wheat, and Bread wheat productivity trend through time. Hence, agricultural policy should give emphases at all operational level to exploit more benefit from this crop and production enhancement strategies, so as to bring foreseen change in the lives of producers.

Keywords: Bread wheat; perception; production; use; Probitmodel; Ethiopia.

1. Introduction

Wheat is among the most important crops in Ethiopia, ranking fourth in total cereals production 13.25% (1.63 million hectares) next to maize, sorghum and teff[1]. It is grown as a staple food in the highlands at altitudes ranging from 1500 to 3000 masl. Nearly all wheat in the country is produced under rain-fed conditions predominantly by small scale farmers. A few governments owned large-scale (state) farms and commercial farms also produce wheat [2]

Wheat farmer's verities are valuable sources to broaden the genetic base of cultivated wheat. The development of new varieties from farmer's verities populations is a viable strategy to improve farmer's verities yield and yield stability, especially under stress and future climate change conditions; also, these farmer's verities harbour genes and gene complexes

for quality traits, tolerance to biotic and abiotic stresses, and adaptation under a wide range of low-input and organic farming systems.

Community seed bank /**CSB**/members allocate resources for production of favourite or preferred farmer's verities, expecting benefits to accrue from their subsequent consumption or sale in local markets. Farmers continue to grow a wheat species or farmer's verities and maintain it if it meets their production and consumption needs. Therefore, direct use values, particularly the quality traits that farmers consider as valuable for consumption are indicators of private value. Socio-cultural values motivate farmers to retain some preferred farmer's verities on the farm, and they appreciate the special organoleptic qualities and multiple uses of these farmer's verities, despite the availability of improved wheat varieties in their locality.

The paper examines opportunities for supporting on-farm conservation of bread wheat in Bale zone of Oromiaregional state Ethiopia. In situ conservation relies upon the decisions of farmers who either adopt new varieties or retain farmer's veritiesfor various reasons [3]. In developing countries, however, many farmers retain farmer's veritiesto conserve local diversity in a process called de facto conservation [4]. Farmer's veritiesmay be retained simply because they fill local socio-economic, cultural and ecological niches that are not occupied by modern [5]

The objectives of this study were to examine factors affecting farmers' perception of the bread wheat production importance, and assess the current status of the crop on smallholder farming sector focusing on its general utilization purpose, and income potential for the farmers in two CSBs (Agarfa and Goro) of Bale zone ,of Oromia region in Ethiopia.

2. Materials and Methods

2.1 Description of the Study Area

Bale zone is one of the 18 administrative zones in Oromia national regional state which is located in south-eastern Ethiopia. It has borderlines with Arsi, Guji, West and East Hararge zones as well as Somali and Southern Nations and Nationalities and Peoples' Regional States.

It has 18 districts out of which nine are located in highland agro-ecology whereas the remaining nine are located in mid and lowland respectively. The zone is found in Southeast of Oromia Regional State that extends from 5^o 22'S – 8^o 08'N latitude and 38^o 41'W – 40^o 44'E longitudes. Bale zone has four agro-ecological zones namely extreme highlands 0.04%, highland 14.93%, midland 21.5%, and lowland 63.53%. The altitude ranges from below 1000 in the lowlands to 4377m above sea level in the highlands. Total area of Bale zone is about 63,555 km2 which is 16.2% of Oromia region. About 10.6% of the land is arable land used for crop production, 24.6% grazing land, 41.8% forest, and others 25% [6]. Most of the districts in Bale highlands are known for their bimodal rainfall patterns and are therefore highly suitable for agriculture. They have two distinct seasons i.e. Belg (from March to July) and Meher (from August to January). About 274,785 hectares of land in Bale zone is cultivated during Belg season while 371,628 hectares is cultivated during Meher season. .

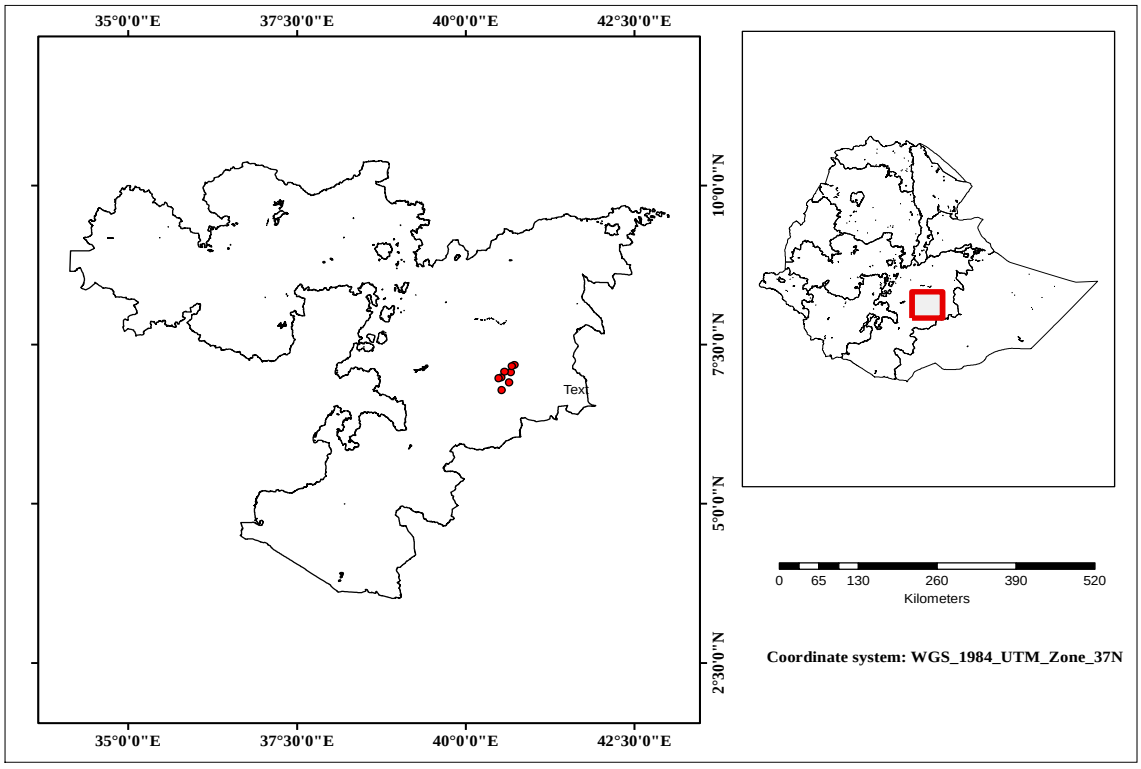

Figure1. Map of the study area

The area receives an average annual rainfall of 400-2500mm and min and max temp 3.5^{0} c and 35^{0} c and altitude ranges from 300 to 4377masl. Based on the figure from [6] report Bale zone has an estimated total population of 1,741,197 out of which 881,559 are male and 859,638 are female. More than 95% of the rural population is dependent on agriculture and 88% lives in rural areas. Forests and shrubs covered about 34.4% of the zone, while about 4.8% of the zone was degraded and others. Major crops grown in the zone are wheat, barley, maize, teff, sorghum, faba beans, field pea, and linseeds. Enset, coffee and chat are also grown in the zone.

Agarfa and Goros CSBs were established in Agarfa and Goro districts since 1997 after a technical cooperation agreement was signed with UNDP/GEF in 1994. The crop conserved in this two CSBs include *Triticum aestivum ,Hordeum vulgare, Triticum durum, Triticum dicoccum, Pisum sativum- Pisuma bisinicum* , Pisumsp, Lepidium, Fenugreek, Faba bean, Linseed, Coriander, Black cumin, Cicersp .Those CSBs had 245 members (Goro 99 male 44 female, Agarfa 71 male and 31 female)

2.2 Sampling Techniques and Sample Size

In this study, a multistage sampling technique was used. In the first stage, from Oromia regional state, Bale Zone was selected purposely based on the production potential of the Bread wheat crop. In the second stage, from Bale Zone, two CSBs (Agarfa and Goro) were selected based on production potential of Bread wheat. In the third stage, 80CSB members were selected randomly from the each of the CSBs.. Finally, a total of 160 households (member of CSBs) were randomly selected for the analysis of this study.

2.3 Types and Method of Data Collection

Both primary and secondary data were used for this study. The primary data was collected from sample respondents through face to face interview by structured questionnaire, focus group discussion and field observation. The questionnaires included were the socio-economic characteristics, institutional factors, biophysical factors and other related issues with the production, marketing and utilization of bread wheat. Secondary data was collected from agricultural office, kebele administration office, books, and journals. Finally, office documents were also consulted to supplement the whole of the perception on the importance of producing Bread wheat, perceived it as important or not, we applied a discrete choice Probit model for binary choice (yes, no) responses to the importance Bread wheat production perception question.

Probit model is a statistical probability model with two categories in the dependent variable [8]. Probit analysis is based on the cumulative normal probability distribution. The binary dependent variable y takes on the values of zero and one [9]. The Probit analysis provides statistically significant findings of which demographics increase or decrease the probability of consumption.

In the binary Probit model, perceived it as important to produce was taken as 1, while not perceived it as important as 0. It is assumed that the i^{th} household obtains maximum utility; it has perceived it as important to produce rather than not to produce the crop. The probability pi of choosing any alternative over not choosing, where φ represents the cumulative distribution of a standard normal random variable [10]:

$$Pi = prob[Yi = 1|X] = \int (2\pi/ \exp(-'\beta \infty)dt \ldots\ldots(1)$$
$$= \Phi(Xi\ \beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The relationship between a specific variable (xi) and the outcome of the probability is interpreted by means of the marginal effect, which accounts for the partial change in the probability. The marginal effect associated with continuous explanatory variables Xk on the probability P (Yi = 1 | X), holding the other variables constant, can be derived as follows [10]:

$$= \emptyset Xi\ '\ \beta \quad (3)$$

The marginal effect on dummy variables should be estimated differently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal effect when evaluating the influence of a dummy variable. Such an effect can be derived from the following [10]:

$$\Delta = \Phi(, = 0) - \Phi(, = 0) \quad (4)$$

The marginal effects provide insights into how the explanatory variables shift the probability of frequency of Bread wheat production. Using the econometric software Stata 13, marginal effects were calculated for each variable while holding other variables constant at their sample mean values.

3. Results and Discussion

3.1 Socio-Economic Characteristics of Study Farmers

The variables used to describe demographic characteristics of sample farmers were religion, educational level, sex, marital status, age and family size. The results presented in Table 1 depicts that 58.75% and 41.25% of the respondents were Muslim and Orthodox respectively. The results of the study also indicated that 88.13% of the respondents were male household heads. While the remaining 11.87% were female household heads. The result also reveal that 91.87% of them were married, 5% widowed and 3.13% were divorced.

Table 1: Demographic and socioeconomic characteristics of respondents

Variables		Frequency N=160	Percent N=160
Religion	Muslim	94	58.75
	Orthodox	66	41.25
Sex	Male	141	88’13
	Femal	19	11.87
Education level	Illiterate	17	10.63
	Read and write	9	5.62
	Primary (1-4)	62	38.75
	Junior (5-8)	50	31.25
	Secondary (9-10)	18	11.25
	Preparatory (11-12)	4	2.5
Marital status	Married	147	91.87
	Widowed	8	5
	Divorced	5	3.13
	Total	160	
Age	Mean	51.38 (40.33)	
Family size	Mean	7.53 (3.08)	

Source: Own computation

Age is one of the important characteristics of the community. It reflects on the productivity of the population as it has a bearing on the overall health situation within the community. In developing countries, aged members are more prone to diseases and thus are less productive. It has a bearing on the employment pattern, spatial mobility and quality of work done. Age plays a significant role in any kind of business, particularly in agriculture, because the use of child labour on the farms is quite high. Accordingly, the maximum and minimum age of the respondent was 43 and 76 years respectively with mean age of 51.38 years

Educational level of the household head can influence how he or she views the new technologies and new ways of doing business. It can affect technology adoption decision. Education can also contribute to decision-making processes that alter the paths people take in life. Educational level of the sample household heads in the study area ranges from illiteracy to tertiary levels. The proportion of household heads that were illiterate was 10.63%those who can read and write were 5.62%, those who were at primary, junior, secondary and preparatory educational levels were 38.75%, 31.25%, 11.25% and 2.5% respectively.

The livelihood of rural farm households mainly relies on agriculture which requires more labour for various activities like land preparation, planting, weeding, cultivation, harvesting, threshing, animal keeping, fetching water and fire wood collection and so on. The family size with age composition is important to carry out different agricultural activities. The average family size in the study area was 7.53 with standard deviation of 3.08.

3.2 Land Characteristics of Bread wheat Producers

Land related characteristics are important features for the farmers as a whole.. These characteristics of land include soil fertility status and productivity of land; that is important factors influencing agricultural production in general and bread wheat production in particular. The majority (81.88%) of the respondents responded that their land soil fertility status was medium, followed by very fertile status. Only few respondents (5.63%) said that their land categorized as low fertile. Therefore, this result implies that, in study area, there is a good opportunity to increase the bread wheat crop production activities. Also, most (75%) of the respondents revealed that the productivity of land was declining through time and about 10.63% said that their land productivity was increasing through time. Moreover, 9.37% of respondents were responded that their land productivity might increase or decrease depending on their farm work activity, rainfall availability and input usage. Only few (5%) respondents said that there was no change in productivity of land over the time (Table 2).

Table 2. Land characteristics of the sample producers of the bread wheat

Variable		Frequency	Percentage
Soil fertility status	Low fertile	9	5.63
	Medium	131	81.88
	Very fertile	20	12.49
	Total	160	
Productivity of land	Declining	120	75
	No change	8	5
	Increasing	17	10.63
	Increase or decrease	15	9.37
	Total		

3.3 Access to Extension and Credit for Producers of Bread wheat

Extension service in agriculture is indispensable and it provides assistance for farmers in improvement of production and productivity, it also enables flow of information and transfer of knowledge and scientific findings to practice. Access to agricultural information services makes farmers to be aware of and get better understanding and ultimately leads to decision to take risk for improved agricultural practices. It helps in disseminating new innovations and ideas that emerges from research findings and improves better understanding of technologies that benefit farmer's production and productivity. In addition, access to agricultural extension services helps to facilitate dissemination and adoption of improved technologies and ensure the local availability of these technologies for the majority of smallholders.

The result in Table 3 below indicated that 45% of respondent farmers have access to agricultural extension services only very few (6.88%) respondents not received seeds in terms of credit. Additionally, factors like access to market and distance from the market are crucial for farmers to sell and buy agricultural products and inputs. The result revealed that most of (87.5%) respondents had access to market. The majority (50.%) of sampled respondents revealed that the average distance from the market to their home was 10 to 30 minutes and which followed (31.88) by 31 to 60 minutes. Most (71.25%) of the respondents also perceived that the distance of market from their residence was near and about 27.5% perceived the distance as far (Table 3).

Table 3. Access to different institutional services for the sample farmers

Variable		Frequency	Percentage
Contact by Extension agents	Yes	72	45
	No	88	55
	total	160	100
Access to Credit	Yes	11	93.12
	No	149	6.88
	total	160	
Market access	Yes	140	87.5
	No	20	12.5
	total	160	
Average distance of market from residence	<10min	14	8.75
	10-30min	80	50
	31-60min	51	31.88
	>60min	15	9.37
	Total	160	100
Perceive the distance of market from your residence	Near	114	71.25
	Far	44	27.5
	Very Far	2	1.25
	Total		100

Source: Own survey, 2018

3.4 Bread wheat Producer's Farm Input Usage and its Source

Cooperatives and unions are major suppliers of fertilizer for producers in the study area. Government (National Input Supply Enterprise) supplies to the unions with DAP and Urea fertilizers and then the unions can either sell to primary cooperatives, state farm, university, national and international research institutions. Fertilizer application is one of the most important agricultural practices that are used by wheat growers in the study area. Moreover, proper application of the recommended fertilizer rate is important to obtain the required production and marketable supply. However, farmers in the study area apply varying fertilizer rate, which is below the blanket recommendation rate given by Sinana Agricultural Research Centre. The recommendation rate given by Sinana Agricultural Research Centre is to apply 100kg of DAP and 50kg of UREA per hectare The survey result indicated that 73.13 % the sample respondents used UREA and DAP fertilizer on their wheat field.

Seed distribution remains largely informal and farmer-to-farmer exchanges account for as much as 90% of the seed trade. Community seed banks and Regional Seed Enterprises are the only public sector organizations involved in seed production, processing, and distribution. Research institutions provide foundation seed and breeding lines for improved varieties to the seed enterprises and CSBs provide farmer varieties .The result in Table 4 below indicated that 90.87% of respondent farmers have used Bread wheat farmers varieties while the remaining used improved seeds and 73.13% of the respondent have used fertilizer.

Table 4. Respondents' farm input use

Variable		Frequency	Percentage
Fertilizer use	Yes	117	73.13
	No	43	26.87
	total	160	100
Local seed	Yes	51	90.87
	No	109	9.13
	total	100	100

3.5 Sample Households Income from Bread wheat and Others Sources

In the study area, sample respondents engaged in different activities to generate their income. These activities include farm crop production, livestock rearing and livestock products sale, engagement in non-farm and off-farm activities. The major crop includes wheat, teff, barley, garlic; and livestock includes cow, oxen, sheep and donkey. The major non-farm income sources are remittance, petty trade, and hand craft. Similarly, the off-farm activity includes daily labor work, renting assets and firewood sale.

Table 5. Sources and mean annual income for sample households at 2018 in ETB

Variables	Obs	Mean	Std. Dev.	Min	Max
Total crop income	160	89,348.19	40,063.71	6,650.00	202,800.00
Income from Bread wheat	160	71,666.67 (80.21 %)*	25,316.20	0	198,000.00
Livestock and its products	160	1,879.29	3,911.06	0	16,000.00
Total agriculture income	160	91,227.48	39,961.41	6,500.00	213,000.00
Off-farm income	160	747.78	4,714.16	0	60,000.00
Non-farm income		1,442.22	6,602.52	0	60,000.00

Source: Own survey, 2018

* Income share of bread wheat from the total income of crops produced by the respondents

The result in Table 5indicated that the mean annual income from crop was 89,348.19 ETB, livestock and its product sale was 1,879.29ETB. Hence, the total agriculture mean was 91,227.48 ETB. Moreover, the mean annual income of the same year from non-farm and off-farm activities earned was 1,442.22 ETB and 747.78 ETB, respectively (Table 5). The Table also revealed that the mean income from Bread wheat production and sale was 71,666.67or 80.21 %% of the total mean income of all crop production activities. It implies that this crop alone contributes high proportion of all crop income and the producers fetch higher income. Therefore, it is a good opportunity for marginal farmers to cultivate and earn more income from this crop. Thus, this confirms that in both of the study CSBs there is potential for Bread wheat production. Hence, this paves the way for the inclusion of this crop in agricultural policy to exploit more benefit, sustainable use and production enhancement strategies. Besides, the result indicates that the higher mean annual income earned from crop and followed by livestock and its products sales. The size of mean income from non-farm activities was found next to livestock and its products. Thus, these imply that, in the study area, the major livelihood and/or income source for households was crop production activities.

3.6 Bread Wheat production

Wheat is one of the major few crops which national food security depends on in Ethiopia. South East Oromia is particularly known for its extensive wheat production and sometimes called “wheat belt of Ethiopia". Wheat is dominant cereal crop that grows in Bale zone, so that all of the respondents (100%) in Agarfa and GoroCSBs were wheat growers and allocates large proportion of the average land holding for the crop compared to other crops. Zonal wheat production accounts for more than 16% of wheat production in Ethiopia (CSA, 2012/2013).

The result of study indicates that on average respondents allocated 2.92ha for bread wheat which is 74.70% of their total average landholding. On average, a farmer household produced 67.5qt and 7.8qt of wheat in Bona and Ganna season respectively. The average productivities of the crop were 27.4qt/ha and 24.8qt/ha in Bona and Ganna seasons respectively.

Table6. Farm land allocated and Productivity of Bread wheat

Variables (N=160)	Mean	Std. Deviation
Area allocated for wheat in 2017/18 in hectare	2.92	1.99
Productivity of wheat per hectare in Bona season (quintal)	27.36	1.33
Productivity of wheat per hectare in Ganna season (quintal)	24.83	14.14

Source: Own computation, 2018

Table 7.Probit model result of factor affecting the perception producers on the importance of producing Bread wheat

Variables	Coefficients	SD	Z-value	Marginaleffect (dy/dx)
Age	.0966	.0202	4.32***	.0168
Education	.1308	.0559	2.34*	.0228
Total family size	.0116	.04957	0.23	.0020
Land holding	.0492	16130	0.31	.0085
Labour availability	.6600	.35984	1.63*	.1150
Extension services	-.2242	14924	-1.50	-.0391
Aces to credit	1.1145	.6352	1.79*	.1943
Market distance	.2747	.1987	1.38	0479
TLU	-.0637	.0598	-1.06	-.0111
Bread wheat income	.0054	.00001	3.33***	.00062
Productivity trend	1663	.07107	2.34**	.0289
Market demand	-.0979	16292	-0.60	.0170
Land productivity	-.06769	.055019	-1.23	-.0118
Constant	-7.6762	1.9282	-3.88***	
Number of obs = 160 Log likelihood = -58.5191				
LR chi2(13) = 93.73 Pseudo R2 = 0.4447				
Prob> chi2 =0.0000				

Source: Own computation, 2018

***, ** and * means statistically significant at 1%, 5% and 10% level

4. Conclusion

Food sovereignty is the basis for forging a free, sovereign society that has the right and the capability to produce its own food and other agro-ecosystem services. Bread Wheat genetic resources contributed to diversify traditional and modern farming systems, and increased their productivity under a wide range of growing conditions. The more diverse the farming systems, the more they are resilient in the face of adverse conditions, thus enhancing food security of local communities.

Bread Wheat Farmer's Varieties, as an underutilized but valuable genetic resource in contemporary agriculture, are gaining increasing importance. However, a major part of their diversity is conserved, but not fully utilized. A wheat Farmer's Variety is composed of genetically heterogeneous populations comprising breeding lines and hybrid segregates which have evolved over many generations in a multitude of environments and local farming systems. Genetic erosion of wheat Farmer's Varieties due to replacement with improved varieties could devastate future sustainability of cropping in centres of origin and centres of diversity by reducing the diversity available for future farmer-mediated crop evolution, as well as reducing diversity available for future breeding efforts in the wheat-growing parts of Bale zone, Oromia Riginal state of Ethiopia.

The survey result indicated that the mean age of the respondents was 51.38 year, and the family size was 7.53 in number. The average land holding allocated for Bread wheat production of the sample respondents was 2.92ha and the annualincome from livestock was 1,879.29ETB. Furthermore, from the total mean of agriculture income (91,227.48 ETB), Bread wheat production contributes about 80.21% for the study respondents. The majority (95.56%) of the households perceived that production ofBread wheat crop is important in the study area. The major importance and utilization of producing Bread wheat crop for study households were as source of better income, better market price than other crops in total production, and their major livelihood source.

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