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Trends in Major Cereal Crop Production and Utilization of Extension Packages by Smallholder Farmers in Ethiopia

Mohammed Ahmed[1*] and Truayinet Mekuriaw[2]
[1,2]Ethiopian Institute of Agricultural Research, Debre Zeit Agricultural Research Center, Debre Zeit, Ethiopia.
*Corresponding author email id: mosxe86@gmail.com

Abstract **– This article analyses the trends in the production and utilization of extension packages for major cereal crops, including maize, barley, wheat, tef, and sorghum, by smallholder farmers in Ethiopia between the 2003/04 and 2020/21 Meher cropping seasons. Data from the Central Statistical Agency of Ethiopia (CSA) published in the past two decades were utilized to analyze the growth rate of major cereal crops, the number of extension package users and the area covered by these packages for each crop. The study found a significant increase in the number of households engaged in the cultivation of major cereal crops, especially maize, wheat, and tef, in Amhara, Tigray, and Oromia regions, which experienced respective increases of 8.3%, 21.7%, and 25.4% over the past two decades. The study also shows a significant increase in the area coverage for major cereal crop production in Ethiopia during the same period, with maize, wheat, and tef being the main contributors to this growth. Moreover, the users of extension packages for cereals have increased from 23.9% in 2004 to 62.7% in 2021, this indicated that an increasing adoption of modern agricultural practices by smallholder farmers. The SNNP, Oromia, and Amhara regions showed the highest proportion of extension package users, while the Tigray region consistently had the lowest. Notably, maize (9.8%) and sorghum (9.1%) exhibited the highest compounded annual growth rate (CAGR), signifying their increasing popularity among farmers. However, the users of extension packages (-2.0) and the area coverage (-1.9) for barley in the Tigray region experienced a decline. Thus, further efforts should be made to promote the use of extension packages for barley in Tigray region.**

Keywords **– CSA, Cereal Crops, Extension Packages, Meher, Smallholder Farmers.**

I. INTRODUCTION

The agricultural sector plays a major role in Ethiopia's economy, accounting for approximately 80% of total employment, 40% of the country's gross domestic product (GDP), and 80% of exports [1] [2]. Crop production, particularly in cereal crops, is a crucial part of the Ethiopian economy and is responsible for providing food security and income to millions of people. Cereals, which are the primary staple crop, are the major crop in terms of both areas planted and production volume. It accounts for 81.2% of the total grain crop area, with tef, maize, sorghum, and wheat comprising 22.6%, 19.5%, 12.9%, and 14.6% of the grain crop area, respectively. Cereals contribute 88.4% of the grain production, with maize, tef, wheat, and sorghum accounting for 30.9%, 16.1%, 16.9%, and 13.2% of the grain production, respectively [3].

Smallholder farmers constitute the majority of the agricultural workforce in Ethiopia. For instance, more than 79 million people in Ethiopia rely on agriculture for their livelihoods [4]. These farmers rely on cereal crops such as maize, tef, sorghum, and wheat for their food security as well as for generating income. However, the productivity of these crops is low compared to their potential, both on farmers and research fields [5] [6]. For instance, in 2021, the gap between the yield of farmers (25.3, 30.5, 41.8, 26.9, 19.7 and 31.5 q/ha) and the potential yield of released varieties (31.2, 35.2, 61.1, 36.9, 32.9 and 37.2 q/ha) for barley, wheat, maize, sorghum, oats, and rice, respectively, was significant [7]. The main contributing factors for this yield gap could

be among other things, limited access to inputs such as seed, fertilizers and pesticides, inadequate extension services, low literacy levels, and poor infrastructure [8] [9]. It is widely recognized that reducing the yield gap is crucial for increasing food production and ensuring food security both at national and household levels [2][10].

Extension packages usually include a combination of improved technologies, management practices, and inputs that have been proven effective in increasing crop yields and reducing the yield gaps in agriculture [11] [12]. However, reducing the yield gap requires the adoption of modern technologies, improved management practices, and better access to resources, which can help small-scale farmers increase their productivity and food security [12].

To improve productivity and enhance the livelihoods of smallholder farmers in Ethiopia, several stakeholders have developed extension packages that focus on improving the production and utilization of major cereal crops. These packages aim to provide smallholder farmers with access to improved technology and agricultural practices such as the use of improved and high yielder varieties, better land preparation practices, effective pest and disease management, and improved post-harvest handling practices. Among the cereal crops that are included in the extension packages are varieties of maize, wheat, teff, barley, sorghum and millet [12].

Despite the efforts to develop and disseminate these extension packages, little research has been conducted to understand the trends in the production and utilization of these packages for major cereal crops such as tef (*Eragrostis tef)*, wheat (bread and durum wheat types), sorghum (*Sorghum bicolor*), maize (*Zea mays*), and barley (food and malt types), crops by smallholder farmers in the major producing regions of Ethiopia. This study sought to fill this gap by analyzing data from the Central Statistical Agency (CSA) of Ethiopia between the 2004-2021 for smallholder farms during the *Meher* season. The objective of the research is to provide valuable insights that could benefit policy-makers, researchers, and farmers in Ethiopia and beyond, seeking to enhance cereal crop production and uplift the livelihoods of smallholder farmers.

II. METHODOLOGY

This study analyses the trends in production and use of extension packages by smallholder farmers for major cereal crops (Barley, Maize, Sorghum, Tef and Wheat) between 2003/04 and 2020/21 Meher cropping seasons of Ethiopia. The study uses longitudinal data from the annual agricultural sample surveys and farm management practices of CSA, which is responsible for the generation, administration and dissemination of statistical data related to the socioeconomic condition of the country. In addition, a thorough review of the existing literature published in peer-reviewed journals, proceedings, and technical reports related to the subject matter was also used. The study analyzes the data on the trends in the number of holders, the area coverage in hectares, the production and productivity of cereal crops, the extension package users and the area covered by extension package by farmers.

Each datum set was graphed to generate a time plot to visualize the datum and investigate if there is any pattern that exists over time. In addition, the Durbin-Watson Statistic was used as a criterion to detect serial autocorrelation. These preliminary analyses revealed the presence of first- and second-order serial auto correlation (regardless of the significance level) and a non-linear relationship between time and all the variables mentioned above.

Consequently, the compounded annual growth rate (CAGR) of production of cereal crops and extension pac-

-kage utilization was estimated by transforming the exponential trend model ($Y_i = i^{xi}$) to a semi-logarithm trend function, which is $Log_{10}Y_i = b_0 + b_1X_i$; where Y_i = the production under a particular crop or the number households who use extension packages on a particular crop, or the area covered by extension packages under a particular crop in year X_i; b_0 is the mean values of production under a particular crop, or the mean area covered by a particular crop, or the mean number of households who use extension packages, or the mean values of areas covered by a particular crop in the 2003/04 crop season; b1 the parameter that measures the CAGR per annum. A trend is detected when the b1 is significantly different from zero [13]. Since the exponential trend model was used, b1 was converted to CAGR (%) as (10^{b1}-1) x 100. As indicated before, because of the presence of variable levels of first and second-order serial autocorrelation, each datum set was analyzed using Proc Autoreg of SAS. Furthermore, the proportion of extension package holders and area covered with the extension packages in any one year was calculated as the proportion of extension package users.

$$\text{The proportion of extension package holders} = \frac{\text{Total number of hhs who grow a particular crop}}{\text{Total hhs who use extension packages}} * 100$$

$$\text{The proportion of extension package area coverage} = \frac{\text{Total area covered by the extension packages}}{\text{Total cropped area for that particular crop}} * 100$$

III. Results and Discussions

3.1. *Overview of Cereal Crop Production in Ethiopia*

Cereal crops are the main source of food and income for the majority of Ethiopian farmers. It accounted for about 75% of the total cultivated area and 69% of the total agricultural production in 2019/2020 [3]. The major cereal crops grown in Ethiopia are tef, wheat, maize, barley, sorghum, and millet [5] [14] [15]. These crops are produced in different agro-ecological zones, ranging from highlands to lowlands, and under various farming systems, such as rain fed, irrigated or mixed. Cereal crop production in Ethiopia faces several challenges, such as climate change and variability, pests and diseases outbreak, soil degradation, and market fluctuations and these leads to low crop productivity in Ethiopia [14]. To address these challenges, the government and other stakeholders have implemented various interventions, such as delivery of improved seeds, fertilizer rate recommendations, extension services and market linkages.

3.2. *Trends of Cereal Crop Growers in Ethiopia*

Nationally, among the major cereal crops, maize recorded the highest number of households that grew the crop, followed by wheat, tef, sorghum and barley. For instance, in 2004, maize was grown by 6.3 million households, while in 2020/21, it was grown by 10.2 million households, representing an increase of 61.7%. The number of tef growers also increased from 4.6 million in 2004 to 6.9 million in 2021, showing a growth rate of 50.4%. Similarly, the number of wheat growers increased from 3.4 million in 2004 to 4.6 million in 2021 with an increase of 35.6%. The number of sorghum growers increased from 3.7million in 2004 to 4.3 in 2021, an increase of 18.8%. The number of barley growers also increased from 3.5 million in 2004 to 3.8 million in 2021, an increase of 8.2% (Table 1).

The number of growers for major cereal crops increased in all of the main crop producer regions of Ethiopia over the past two decades. The largest increases were seen in Oromia, where the number of growers for sorghum, tef, maize and wheat increased by 3.5 million, 1.2 million, 0.5 million and 0.4 million respectively.

This is followed by Amhara region with the number of growers for maize, tef, wheat, and sorghum increased by 1.3 million, 0.9 million, 0.8 million and 0.3 million respectively. On the other hand, the smallest increases were observed in Tigray, where the number of growers for maize, sorghum, tef and wheat increased by 0.5 million, 0.3 million, 0.2 million and 0.1 million respectively. This is followed by SNNP region with 0.8 million, 0.6 million, 0.5 million, and 0.3 million growers for sorghum, maize, tef, and barley respectively (Table 1). These results show that Oromia and Amhara regions have experienced the highest growth in the number of growers for major cereal crops, while Tigray and SNNP regions have had the lowest growth.

Table 1. Number of growers for major cereal crops in the main crop producer regions of Ethiopia (2003/04-2020/21; smallholder farms *Meher* season).

National/ Region	Number of Growers for Major Cereal Crops (,000)									
	Barley		Maize		Sorghum		Tef		Wheat	
	2004	2021	2004	2021	2004	2021	2004	2021	2004	2021
Ethiopia	3,474	3,738	6,300	10,189	3,636	4,323	4,563	6,867	3,380	4,579
Tigray	345	420	365	836	245	559	390	634	271	387
Amhara	1,290	1,397	1,715	2,978	936	1,192	1,804	2,703	1,115	1,907
Oromia	1,203	1,509	2,321	2,843	1,688	5,205	1,656	2,861	1,422	1,833
SNNP	502	789	563	1,140	573	1,372	676	1,225	524	762

Source: Authors own computation from the CSA data, 2003/04-2020/21.

3.3. *Trends of Cereal Crops Area Coverage in Ethiopia*

The results from the study show a significant increase in area coverage for cereal crop production in Ethiopia across the four regions between 2004 and 2021. For instance, maize production increased by 101% from 1,254 hectares in 2004 to 2,526 hectares in 2021. Similarly, tef production area expanded by 109% from 1,398 hectares to 2,928 hectares. Barley has registered an 18% increase, sorghum grew by 27%, and wheat has recorded a 36% expansion during the same period.

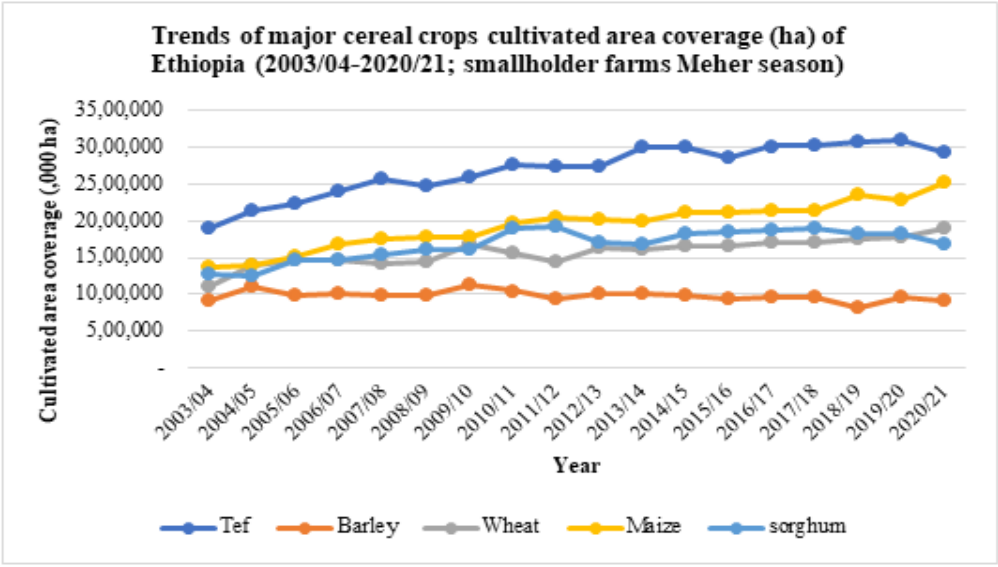

Fig. 1. Trends of major cereal crops cultivated area coverage (ha) of Ethiopia (2003/04-2020/21; smallholder farms Meher season).

The study shows that the Amhara and Oromia regions experienced the most substantial growth in area coverage for cereal crop production. Amhara has registered 176% increase in tef production area, 63% increase in wheat, 44% increase in maize, and 21% increase in barley area coverage. Similarly, Oromia witnessed remarkable growth in maize, tef, and wheat production with increases of 163%, 82%, and 30%, respectively. Tigray had the highest increase in sorghum with a growth rate of 70%, while SNNP witnessed a 241% increase in maize and a 233% increase in sorghum area coverage over the study period.

The trends in the cultivation of major cereal crops in Ethiopia indicate that maize, tef, and wheat are the most significant crops in terms of cultivation area, followed by sorghum and barley. The result shows that the cultivation of maize, tef, and wheat has increased significantly, with the Oromia and Amhara regions being the main contributors to this growth. Meanwhile, the cultivated area of barley, wheat, and sorghum has shown steady growth, while the cultivation of sorghum has decreased.

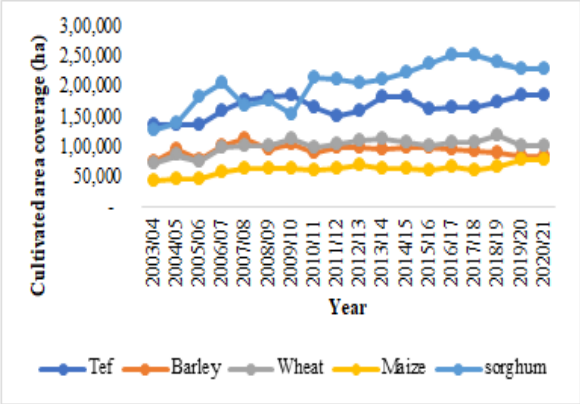

Fig. 4. Trends of cultivated area coverage (ha) for Tigray region (2003/04-2020/21; smallholder farms Meher season).

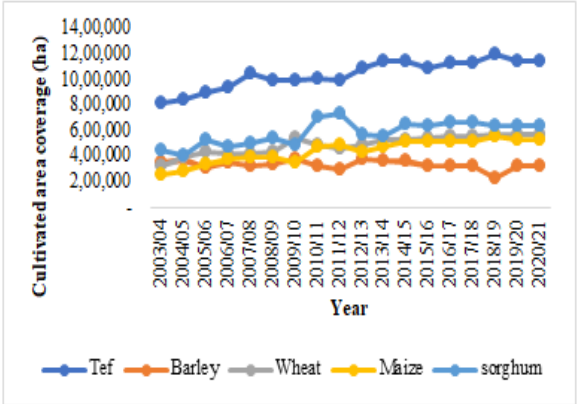

Fig. 5. Trends of cultivated area coverage (ha) for Amhara region (2003/04-2020/21; smallholder farms Meher season).

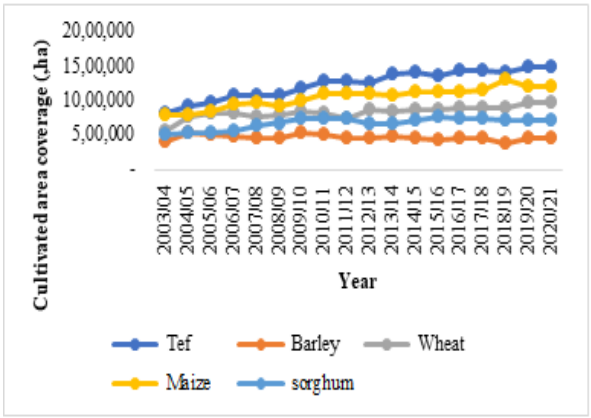

Fig. 2. Trends of cultivated area coverage (ha) for Oromia region (2003/04-2020/21; smallholder farms Meher season).

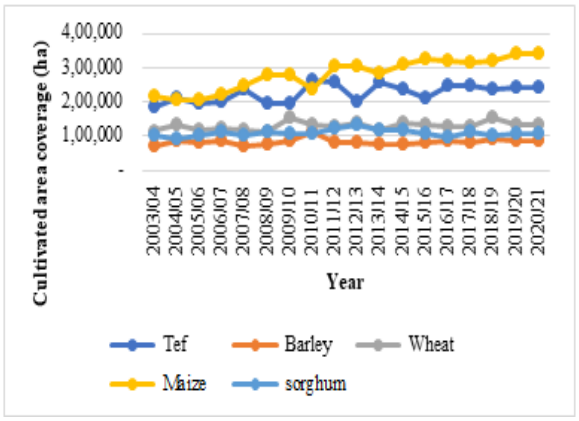

Fig. 3. Trends of cultivated area coverage (ha) for SNNP region (2003/04-2020/21; smallholder farms Meher season)

Source: Authors own computation from the CSA data, 2003/04-2020/21.

3.4. *Trends of Cereal Crop production in Ethiopia*

The results showed a significant increase in the production of major cereal crops in Ethiopia between 2004 and 2021, both at the national level and across four regions. Nationally, the largest increase was observed in maize, with the production rising from 25.4 million to 105.6 million quintals, indicating an increment of 315%.

This is followed by wheat, where the volume of production increasing from 16.2 million to 57.8 million quintals, representing a 258% increase in production. In addition, sorghum production climbed from 17.4 million to 55.1 million quintals, indicating a 216% change in production. Similarly, tef production demonstrated growth from 16.8 to 55.1 million quintals, signifying a 228% change. Finally, barley production increased from 10.8 to 23.4 million quintals of production, indicating a notable 117% increase in production. Overall, the study demonstrated a clear and noteworthy increase in the production of all the major cereal crops over the period under investigation.

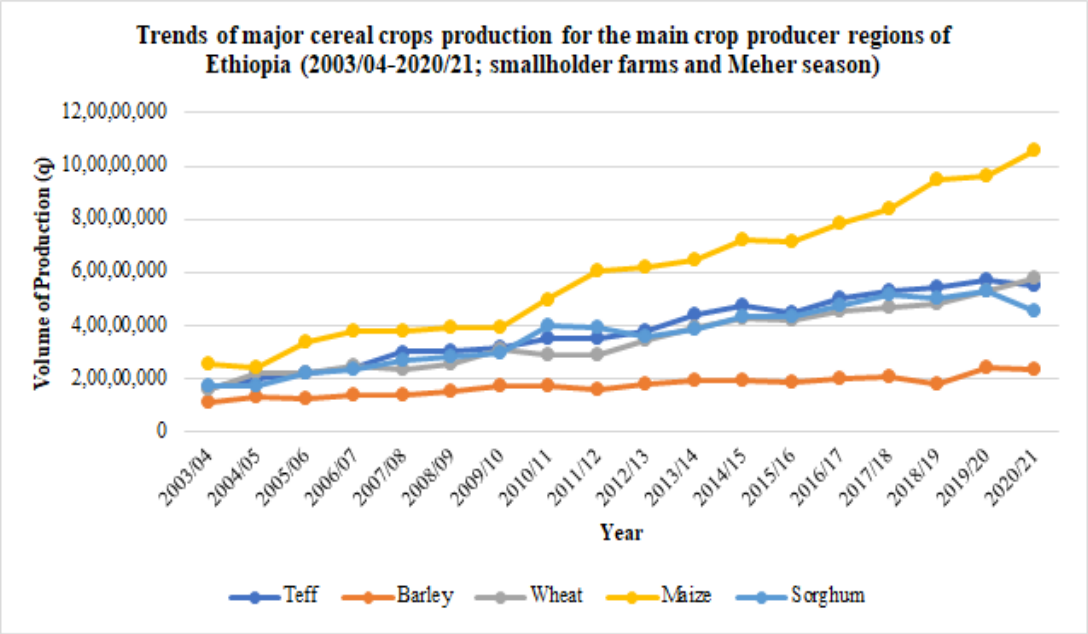

Fig. 6. Trends of major cereal crops production for the main crop producer regions of Ethiopia (2003/04-2020/21; smallholder farms and Meher season).

Source: Authors own computation from the CSA data, 2003/04-2020/21.

The results further indicate that there has been a significant increase in the production of cereal crops across all regions. Although the percentage increase varies for each crop and region, the overall trend is positive. The largest increase in production was seen in Amhara and Oromia regions, with the production of maize, wheat, tef and sorghum increasing the most. In Amhara, maize, wheat, tef and sorghum production has increased by 447%, 338% and 187% and 163% respectively. In terms of barley production, SNNP registered the highest increase, with a 141% growth, followed by Oromia with 124% Amhara and Tigray also experienced growth, with 99% and 96% respectively.

Maize production witnessed the highest growth in Amhara, with a 480% increase, followed by Oromia with 447%. Tigray and SNNP also showed growth, with 286% and 141% respectively. Sorghum production showed the highest increase in Tigray, with a 261% growth, followed by Amhara with 163%. Oromia and Tigray also showed growth, with 143% and 75% respectively. Tef production demonstrated strong growth across all regions, with the highest increase seen in Oromia at 282%, followed by Amhara with 187%. Tigray and SNNP also displayed notable growth, with 198% and 213% respectively. Finally, for wheat production, Oromia had the highest growth, with a 260% increase, followed by Amhara with 338%. SNNP and Tigray also experienced growth, with 149% and 158% respectively. The increase in production can be attributed to diverse factors, inclu-

-ding the expansion of cultivated lands, increased accessibility of seeds, improved agricultural practices, etc.

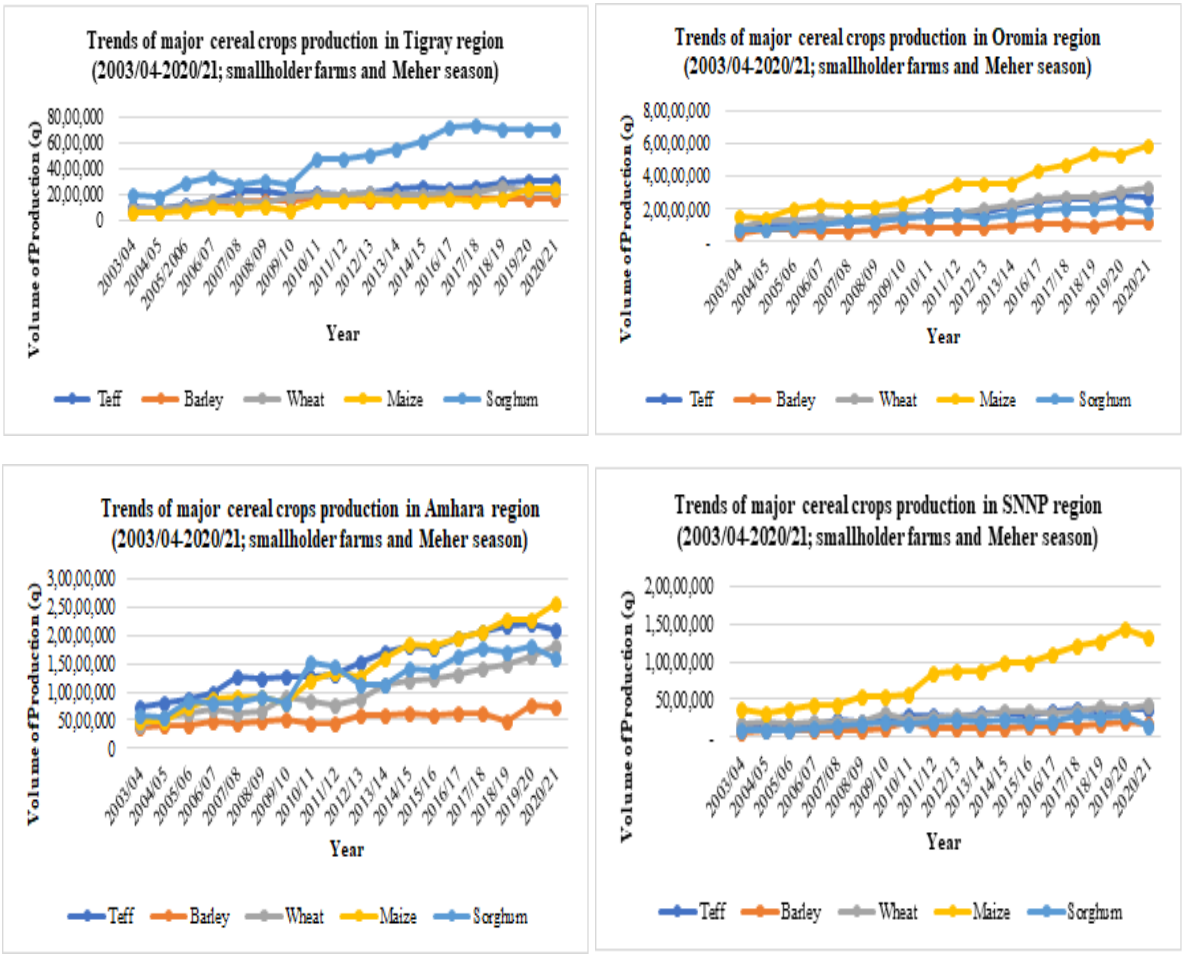

Fig. 7. Trends of major cereal crops production (2003/04-2020/21; smallholder farms and Meher season).

Source: Authors own computation from the CSA data, 2003/04-2020/21.

The results of the compounded annual growth rate (%) of cereal crop production at the national level showed an overall growth of 7.1%. Maize had the highest CAGR of 8.3%, while barley had the lowest CAGR at 3.8% (Table 4). Furthermore, the growth rates of cereal crop production varied across different regions of Ethiopia. The SNNP region had the highest CAGR (7.7%) for all cereals, followed by Amhara (7.3%) and Tigray (6.3%). The Oromia region had the lowest CAGR at 5.8%.

Maize exhibited the highest growth rates, ranging from 6.4% to 9.8%, across all four regions. The Amhara region achieved the highest CAGR of 9.8% for maize, while the Tigray region had the lowest CAGR at 6.4%. Wheat showed growth rates ranging from 5.3% to 7.5%, while Tef had rates ranging from 5.3% to 7.8%. The SNNP region had the highest CAGR for Tef and wheat production, whereas the Amhara region had the highest CAGR for maize and wheat production. Similarly, the Tigray region had the highest CAGR for sorghum and maize production while the Oromia region had the highest CAGR for Tef and maize. Conversely, the SNNP region had the lowest CAGR for barley production, with a negative growth rate of -3.8%. This decline may be attributed to factors such as climate change, soil degradation, or changes in farming practices. Overall, the results show that cereal crop production in Ethiopia has been growing steadily over the years, except for barely in the SNNP region.

Table 4. Compounded annual growth rate (%) of major cereal crops production and area coverage for the main crop producer regions of Ethiopia (2003/04-2020/21; smallholder farms and *Meher* season).

Crop	CAGR (%) of production and area coverage of cereal crops									
	Ethiopia		Tigray		Amhara		Oromia		SNNP	
	Production	Area	Production	Area	Production	Area	Production	Area	Production	Area
Cereals	7.1	8.9	6.3	4.5	7.3	10.5	5.9	8.1	7.7	10.7
Tef	7.1	9.0	5.3	2.7	6.5	9.3	6.9	10.0	7.8	14.6
Barely	3.8	5.0	3.8	-0.7	3.3	9.8	4.0	3.0	-3.8	14.2
Wheat	6.6	6.7	5.3	2.1	7.5	10.3	6.6	4.6	5.4	11.5
Maize	8.3	10.5	6.4	4.2	9.8	9.0	6.7	12.0	8.8	8.5
Sorghum	6.8	10.4	7.5	7.5	6.6	13.8	5.5	8.2	8.3	8.4

Source: Authors own computation from the CSA data, 2003/04-2020/21.

3.5. *Trends of Extension Package users for Major Cereal Crops*

Extension packages have been used as important tools to increase agricultural productivity and improve farmers' livelihoods, particularly for smallholder farmers in developing countries. Extension packages are bundles of agricultural practices and technologies, such as improved seed varieties, inorganic fertilizer use, pest and disease management, and irrigation systems that are promoted and delivered to farmers through extension services [16].

Nationally, the use of extension packages by smallholder farmers has been increasing over the years. Accordingly, the CAGR of extension package users by smallholder farmers for cereals from 2004 to 2021 was 9.2% while the area covered by extension package was 8.9%.

The result further shows that Tigray had the highest CAGR of households using extension packages for cereals at 14.0%, followed by SNNP at 10.9%, Oromia at 9.3% and Amhara at 8.9%. In terms of area coverage by extension packages, Tigray also had the highest CAGR for cereals at 12.5%, followed by SNNP at 10.7%, Amhara at 10.5%, and Oromia at 8.1%. This indicates that there has been progress in the adoption of extension packages by smallholder farmers in Ethiopia, particularly in Tigray and SNNP regions.

Tef has the highest CAGR of 9.9% in households using extension packages, indicating increased adoption of modern agricultural practices. Maize, being the most widely grown cereal crop in Ethiopia, has the highest CAGR of 10.5% in area coverage, suggesting that more farmers are expanding their croplands to grow maize. It also has a significant CAGR of 9.8% in households using extension packages, indicating the adoption of new technologies to improve maize yields and quality. On the other hand, barley has the lowest CAGR for both extension package growers (6.6%) and area coverage (5.0%), potentially indicating a need for more support.

The CAGR values for area coverage of specific cereal crops by region vary, ranging from 2.0% to 21.3%. Tef, maize, wheat, and sorghum show positive CAGR values in extension package users and area coverage across all regions. Sorghum has the highest CAGR in Tigray and Amhara at 21.3% and 21.2%, respectively. However, in the case of barley, the CAGR values for extension package users and area coverage are negative in Tigray region, indicating a decline in the use of extension packages and reduction in cultivation area. Above all,

the CAGR of most crops in households who use extension packages and area coverage is positive, signifying that more smallholder farmers are adopting modern agricultural practices and expanding their croplands, which could contribute positively to the agricultural output of Ethiopia.

Table 5. Compounded annual growth rate (%) of extension package users and area coverage for major cereal crops in the main crop producer regions of Ethiopia (2003/04-2020/21; smallholder farms *Meher* season).

Crop	CAGR (%) of extension packages users and area coverage for major cereal crops									
	Ethiopia		Tigray		Amhara		Oromia		SNNP	
	Users	Area	Users	Area	Users	Area	Users	Area	Users	Area
Cereals	9.2	8.9	14.0	12.5	8.9	10.5	9.3	8.1	10.9	10.7
Tef	9.9	9.0	8.7	7.4	10.6	9.3	10.7	10.0	15.8	14.6
Barely	6.6	5.0	-2.0	-1.9	8.6	9.8	4.5	3.0	18.1	14.2
Wheat	7.9	6.7	4.0	5.6	10.3	10.3	5.2	4.6	12.9	11.5
Maize	9.8	10.5	10.5	11.6	9.0	9.0	11.4	12.0	8.8	8.5
Sorghum	9.1	10.4	21.3	21.2	9.6	13.8	8.7	8.2	11.7	8.4

Source: Authors own computation from the CSA data, 2003/04-2020/21.

Nationally, the proportions of extension package users for major cereal crops have significantly increased from 23.9% in 2004 to 62.7% in 2021. The highest proportion of extension package was observed in wheat (65.5%) followed by maize (60.3%) and tef (55.0%) and the lowest increase for sorghum (25.2%). The results of this study showed a notable increase in the proportion of extension package users for various cereal crops in Ethiopia over the years, indicating a positive trend in terms of farmers' engagement with extension services for cereal crops.

When examining regional trends, it is evident that certain regions have experienced a higher proportion of extension packages compared to others. For instance, the Tigray region consistently shows a higher proportion of extension package users across all cereal crops, both in 2004 and 2021. However, it is also clear that the proportion of extension package users for barley and sorghum has declined. Despite this, the Amhara region has shown impressive improvements in extension coverage for cereals, with the proportion of extension package users increasing from 30.0% in 2004 to 74.7% in 2021.

Tef, as an essential crop in Ethiopia, particularly in the highlands, has also experienced a notable increase in the proportion of extension package users across all regions. The Amhara region has consistently had the highest proportion of extension package users for tef, with the proportion of extension package users increasing from 21.8% in 2004 to 74.4% in 2021, followed by Tigray and Oromia regions. Whereas, the Southern Nations, Nationalities, and Peoples' (SNNP) region has had the lowest proportion of extension package users increasing from 5.1% in 2004 to 40.5% in 2021.

Similar to tef, the SNNP region has consistently had the highest proportion of extension package users for barley, while the Tigray region has had the lowest. However, the Amhara region has also exhibited noteworthy improvements in extension coverage for barley, with the proportion increasing from 24.7% in 2004 to 78.1% in 2021. For wheat, the SNNP region consistently has the highest proportion of extension package users, while the

Tigray region had the lowest. Furthermore, both Amhara and Oromia regions have experienced significant improvements in extension coverage for wheat, with the proportion of extension package users increasing from 24.7% and 20.2% in 2004 to 78.1% and 45.6% in 2021 respectively.

The Amhara region has consistently had the highest proportion of maize extension package users, while the Tigray region has had the lowest. Additionally, the Oromia and SNNP regions have also experienced remarkable improvements in extension coverage for maize, with the proportion of extension package users increasing from 16.6% and 22.0% in 2004 to 62.3% and 53.2% in 2021 respectively.

Sorghum is an important crop in Ethiopia, particularly in lowland areas. The result illustrates a significant increase in the proportion of extension package users across all regions, from the national average of 7.4% in 2004 to 25.2% in 2021. The Tigray region has consistently had the highest proportion of sorghum extension package users, while the Oromia region has consistently had the lowest proportion.

Table 5. The proportion (%) of extension package users for major cereal crops in the main crop producer regions of Ethiopia (2003/04-2020/21; smallholder farms *Meher* season).

Crops	Proportion (%) of extension package users for major cereal crops									
	Ethiopia		Tigray		Amhara		Oromia		SNNP	
	2004	2021	2004	2021	2004	2021	2004	2021	2004	2021
Cereals	23.9	62.7	46.6	55.2	30.0	74.7	20.8	54.3	10.5	45.7
Tef	17.1	55.0	50.0	51.6	21.8	74.4	9.5	32.9	5.1	40.5
Barley	15.0	43.3	47.1	36.9	11.9	50.5	14.3	28.8	4.1	38.4
Wheat	22.5	65.5	50.7	47.7	24.7	78.1	20.2	45.6	11.1	56.6
Maize	20.5	60.3	42.5	36.4	26.3	62.3	16.6	57.1	22.0	53.2
Sorghum	7.4	25.2	29.7	45.7	10.3	33.6	3.8	11.3	2.5	13.4

Source: Authors own computation from the CSA data, 2003/04-2020/21.

3.6. *Trends of Extension Package Area Coverage for Major Cereal Crops*

The findings of this study indicates that the proportion of area covered by extension packages for the major cereal crops has increased significantly nationally and across regions between 2004 and 2021. In 2004, only 18.2% of cereals area in the country was covered by extension packages, which increased to 51.9% in 2021. The highest increase in extension packages area coverage was observed in maize (24.9% to 68.1 %) followed by wheat (29.5% to 61.7%), tef 17.2% to 49.7%) and barley (16.7% to 43.3%). While the smallest increase was observed in sorghum with the proportion of extension package area coverage increased from 6.5% in 2004 to 23.6% in 2021.

The proportion of area coverage has shown remarkable improvement in all regions. For example, in the Amhara region, the proportion of area covered by extension packages for cereals increased from 19.5% in 2004 to 67.4% in 2021. Similarly, in the Tigray region, the proportion of area covered by extension packages for cereals increased from 33.7% in 2004 to 49.7% in 2021.

The result also shows variations in the proportion of area covered by extension packages across different regi-

-ons and crops. For example, in 2021, the proportion of area covered by extension packages for tef was highest in the Amhara region at 74.7%, while it was the lowest in the SNNP region at 40.5%. Similarly, the proportion of area covered by extension packages for sorghum was the highest in the Tigray region at 45.2% and followed by the Amhara region at 37.1% and SNNP at 13.4%.

Overall, the result suggests that the use of extension packages has increased significantly over the past two decades in Ethiopia. However, there are still variations in the proportion of area covered by extension packages across different regions and crops, indicating a need for further efforts to promote the use of extension packages in certain areas and for certain crops.

Table 6. The proportion (%) of area covered by extension package for major cereal crops in the main crop producer regions of Ethiopia (2003/04-2020/21; smallholder farms Meher season).

Crops	Proportion (%) of area coved by extension package for major cereal crops									
	Ethiopia		Tigray		Amhara		Oromia		SNNP	
	2004	2021	2004	2021	2004	2021	2004	2021	2004	2021
Cereals	18.2	51.9	33.7	49.7	19.5	67.4	17.4	43.8	10.5	45.7
Tef	17.2	49.7	46.3	51.7	22.8	74.7	10.6	32.1	5.1	40.5
Barley	16.7	43.3	38.4	38.2	9.4	51.0	20.1	39.2	4.1	38.4
Wheat	29.5	61.7	40.5	48.2	27.1	79.2	33.4	52.7	11.1	56.6
Maize	24.9	68.1	45.8	52.2	41.6	79.8	19.9	70.3	22.0	53.2
Sorghum	6.5	23.6	23.4	45.2	6.8	37.1	3.1	8.4	2.5	13.4

Source: Authors own computation from the CSA data, 2003/04-2020/21.

IV. Conclusions and Recommendations

In conclusion, smallholder farmers in Ethiopia have made significant progress in the production of major cereal crops over the past two decades, largely due to the increased access to improved agricultural practices and the expansion of cultivated land. Cereal crop production in Ethiopia has been growing steadily for all crops except barley in SNNP region. Hence, it is essential to identify the factors leading to the decline of barley production in the Tigray region and to implement strategies to improve barley production the region. In addition, smallholder farmers in Ethiopia have demonstrated an increasing trend in the use of extension packages and area coverage for most cereal crops. This suggests that farmers are realizing the benefits of modern agricultural practices and are willing to invest in them. Thus, it is important to continue to invest in initiatives that support the growth of these crops, such as providing access to improved seed varieties, better soil management, and access to markets. However, the proportion of extension package users and area covered by extension packages for barley has declined in Tigray region. Thus, further efforts should be made to promote the use of extension packages for barley in Tigray region.

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AUTHOR'S PROFILE

First Author
Mohammed Ahmed, Ethiopian Institute of Agricultural Research, Debre Zeit Agricultural Research Center, Debre Zeit, Ethiopia.

Second Author
Truayinet Mekuriaw, Ethiopian Institute of Agricultural Research, Debre Zeit Agricultural Research Center, Debre Zeit, Ethiopia.