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Contribution of Improved Wheat Technology Adoption to Farm Household Income in Ethiopia: Review

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Abstract: Many African Countries including Ethiopia are producing wheat for both consumption and sale. Wheat is a strategic commodity which generates farm income and improves food security. The aim of this systematic review was to generate comprehensive information about the extent of improved wheat technology adoption contribution to farm household income in Ethiopia. Data searching was done using Google scholar and Science Direct web search engines. Studies conducted starting from 2012 to date were included to address the objective of review. studies related to impact of agricultural technology adoption in Ethiopia were critically identified for this review. Studies conducted before 2012, duplicated articles, abstract only, book chapters that have no full information were excluded. Despite many studies have been conducted on improved wheat technology adoption and its impact, no summarized information on this particular topic. Improved wheat technology adoption has a positive and significant effect on wheat productivity and farm household income, thereby increasing their likelihood of decreasing poverty levels. Improved wheat technology adoption contributes significantly from 9% to 55% increase to farm household income in Ethiopia. Households adopting improved wheat technologies are more likely to have higher income compared to non-adopters. This suggests that promotion of improved wheat technology can enhance farm household income in Ethiopia.

Keywords: Adoption, Contribution, Ethiopia, Improved Wheat, Technology

1. Introduction

Wheat (Triticumaestivum L.) is one of the globally produced and marketed cereal crops which covers 15% of the total sowing areas of cereal crops in the world. It is an important industrial and food grain which ranks second among the most important cereal crops in the world after rice and traded internationally [3, 13]. In sub-Saharan African countries, wheat is also a strategic commodity which generates farm income and improves food security status [2, 19, 20]. Many African countries are producing wheat for both consumption and sale, but the level of production and sale is varied between countries. Ethiopia is one of the largest wheat producers in terms of total wheat area cultivated and total production. Besides, low input usage and shortage of agroecology specific technologies are hampering crop productivity and this continued to cause food insecurity among millions of people in the country. Population of Ethiopia has been increasing rapidly over the past four decades, from 35 million in the 1980s to 99.4 million in 2015 and passed 100 million in 2017 [11]. Crop production makes up 72% of the total agricultural GDP, while the livestock sector ejects about 20% and other areas contribute 8.6%. Cereals (such as wheat, maize, Teff, sorghum, and millet), comprise the major share of crop production as principal staples [12, 6].

In Ethiopia wheat is a major staple crop and consumed heavily in different forms [9]. In the Country, wheat is one of the most important food security crops and is cultivated on a total area of 2.1 million (1.7 million ha rain fed and 0.4 million ha irrigated) hectares annually with a total production of 6.7 million tons of grain at an average productivity of 3.0 and 4.0 t/ha under rain-fed and irrigated conditions, respectively during 2021/22 [10]. Wheat has several foods uses which can be prepared in modern or culturally processed technique. Injera is one of the traditional foods that can be prepared by using wheat. Besides, pasta and macaroni can also be prepared in industrial processed way [21]. At the

same time, wheat straw is commonly used as a roof tacking material and as a feed for animals [5]. A number of studies have been conducted on adoption impact of improved variety and technology package to productivity, food security, yield, farm household welfare, [24, 11, 4, 17, 18]. But a limited number of studies have been conducted on impact of improved wheat variety adoption for farm house hold income [28, 25, 1, 22, 16]. From the available information, the reviewers understood that improved wheat technology adoption has numerous effects on farm household livelihood in Ethiopia. Even though different researches have been conducted on improved technology adoption impact on several aspects of farm households including farm income, the extent of income change has not been summarized in one document and made easily accessible for information users. In addition, there is scanty empirical evidence on the impact and performance of agricultural technologies developed, disseminated and/or scaled-up by Agricultural Research Centers and Agricultural Universities and their roles in improving food security and livelihood outcomes for farm households. Therefore, the current reviewer aimed to prepare comprehensive information on contribution of improved wheat technology adoption to farm household income in Ethiopia based on the existing information and knowledge for policy makers, researchers, and other users those who are in need of the information.

2. Methodology

Data searching was done using Google scholar and Science direct Web search engines. The key terms used include improved technology adoption, technology adoption and its impact, farm household income, improved wheat technology adoption in Ethiopia and contribution of technology adoption. Relevant articles which could address the review questions were collected starting from the late December 2022 through to 20 April 2023. Articles which address the objective of this review were identified based on inclusion and exclusion criteria. That is, studies related to impact of agricultural technology adoption in Ethiopia were critically identified for this review. Manuscripts written in English language, studies done in different regions of Ethiopia, published Journal articles, studies conducted on agricultural technology adoption and impact evaluation, cross-sectional studies and studies which were conducted within the time period of 2013-2023 years were included in this review. Studies conducted before 2012, duplicated articles, abstract only, book chapters that have no full information were excluded.

3. Adoption and Impacts Improved Technology

Most empirical studies have shown that improved agricultural technology adoption have contributed significantly to increased production and farm-level efficiencies, improved incomes, reduce poverty and overall wellbeing of the farm households (Table 1). Appreciating the importance of impact evaluation, Alawia *etal*, brought forward that it helps policy makers understand the effect of one intervention can guide concurrent and future impact evaluation of related interventions [1]. These authors investigated the impacts of wheat production packages on farmers' productivity and income using propensity score matching method and found that improved technology beneficiaries realized wheat yield 62% higher than non-beneficiaries. The researchers also discussed the household income of the adopters and non-adopters have difference of 3311.47$. Similarly, Tesfaye et al., studied impact of improved wheat variety on productivity in Oromia Regional State, Ethiopia using propensity score matching and concluded that improved wheat variety adopters enjoy higher and significantly positive productivity than non-adopters. [24]. From the findings of these authors, it is possible to understand that improved wheat variety adoption has huge potential to increase productivity of adopters and in return increases farm household income, productivities of adopters and non-adopters are 1.88 ton and 1.2 ton respectively.

Musa investigated impact of improved seed and inorganic fertilizer on Maize yield and welfare in Eastern Ethiopia using multinomial endogenous switching regression model and found that adopters of improved maize seed and inorganic fertilizer have significantly higher yields by 331 kilogram per hectare [18]. The author found that the combined technology adoption is more important than mere improved variety adoption. This finding enhances full package technology dissemination and adoption so as to improve yield and welfare.

Table 1. *Summary of Literature on Impacts improved Technology Adoption.*

Outcome variable	Research Technology	Findings/Results	References
Yield and farm income	Wheat-Chickpea double cropping	Positive and significant on yield and income	[11]
Farm income	High yielding Wheat variety	Positive, 9% increase in income	[22]
Productivity	Improved Wheat variety	Significantly higher, 34-38% yield increment	[24]
Yield and productivity welfare	Improved Maize seed and Inorganic fertilizer	Significantly improves welfare and productivity	[18]
Farm household welfare	Improved Rice variety	Increases productivity by 0.564% per hectare	[4]
Farm household income	Improved Tef Technology	Significant income difference, 7943 ETB	[15]
Food security	Improved Wheat varieties	Significantly positive effect	[16]
Productivity and income	Improved Wheat Technology	Improve productivity and raise household income	[25]
Household income	Improved Agricultural Technology	Significant income gain, annual average of 23031.28 ETB	[28]
Multidimensional poverty	Climate -Smart Agricultural Technology	Multidimensional poverty declines between 2.0 and 3.0%.	[27]

Outcome variable	Research Technology	Findings/Results	References
Household food consumption and dietary diversity	Agricultural technologies	Household food consumption and dietary diversity increased, higher score for adopters	[7]
Welfare	Improved Chickpea	Contribute to household income and poverty reduction	[29]
Productivity	Improved Wheat Technology Package	51 to 55% higher in productivity	[8]
Wheat productivity	Agricultural Technology	Significantly increased productivity	[30]
Farm income	Agricultural Technologies	Income increased to 4717.575 ETB	[17]
Honey production efficiency	Beehives Technology	19.5% average estimation of honey production	[23]
Productivity and income of household	Improved Wheat Technology	10460.63 ETB average income increased	[26]
Productivity	Improved Wheat variety	Desired positive and significant impact not gained across Agroecology	[14]

Source: Studies done in Ethiopia across different regions.

Wordofa *et al*., conducted study on improved agricultural technology adoption and its impact on household income in Eastern Ethiopia using propensity score matching estimation and found that households using improved agricultural technologies obtained, on average, 23,031.28 ETB higher annual farm income compared to those households not using improved agricultural technologies [28]. Almost all the reviewed studies indicated that improved technology adoption have positive and significant effect on farmers' livelihood and welfare although the location and duration of studies are different along with the results found. Improved technology adoption in general and improved wheat technology adoption in particular contributes to farm household in multiple ways, like productivity gains, poverty reduction, income increment, production efficiency improvement, yield improvement, food consumption and dietary diversity. The research conducted by Fitsum revealed that adoption of improved wheat varieties that were released and disseminated so far doesn't have the desired positive and significant impact on productivity growth in all of the different wheat producing agroecological zones of Ethiopia [14].

Improved wheat technology adoption impact on income ranges from 9% to 55% [22, 24, 8]. The studies done by Tilaye and Yunkura, Tesfaye *etal*, Zegeye *etal*., Asaye *etal*., Tarekegn and Ayele and Hailu and Tolossa, focus on the impact of improved technology adoption on productivity, food security, welfare, multi-dimensional poverty reduction and household income using propensity score matching and multinomial endogenous switching regression method [26, 25, 30, 23, 16]. The results of these studies showed that improved agricultural technology adoption has positive and significant effect on farm income by which adopters are better off than non-adopters.

4. Conclusion and Recommendation

The review was undertaken to provide summarized information on the contribution of improved agricultural technology adoption to farm household income in Ethiopia. Agricultural technology adoption can contribute to improving productivity and raising income of farm household in general. In particular, improved wheat technology adoption has a positive and significant effect on wheat productivity and farm household income, thereby increasing their likelihood of decreasing poverty levels. The impact evaluation of improved agricultural technology adoption includes all types of technologies starting from improved seed, inorganic fertilizer, and other management practices at all. Adoption of combination of technology appears to be the most important beyond the mere adoption of single improved variety to affect production and productivity of farm households even though, it varies from region to region and time to time. Regular and timely impact assessment is needed to widely scale up technology to appropriate beneficiaries.

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