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Adoption of Improved Bread Wheat Varieties and Its Impact on Food Security: A Comprehensive Review

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ABSTRACT

The adoption of improved bread wheat varieties is a crucial strategy for enhancing food security and increasing household farm income in rural agricultural communities. This study examines the key determinants influencing farmers' decisions to adopt these varieties, including socio-economic, demographic, and institutional factors. The findings indicate that landholding size, livestock ownership, and off-farm activities significantly affect adoption rates, as they provide financial stability and risk mitigation. Institutional support, particularly through development agents, market access, remittances, and credit facilities, also plays a pivotal role in facilitating adoption. Additionally, demographic variables such as age, education, and gender influence decision-making, with younger, educated, and male-headed households more likely to adopt improved wheat varieties. The study further reveals that adoption leads to increased farm income, improved food security, and enhanced market participation. Policy implications highlight the need for strengthened extension services, improved infrastructure, and access to financial resources to encourage broader adoption. Future research should explore the long-term sustainability and resilience of improved wheat varieties in diverse agro-ecological contexts.

Key Words: Adoption, Agriculture, Food Security, Innovation

1. Introduction

Agricultural innovation and technology adoption are critical drivers of sustainable development, particularly in the context of global food security challenges. In recent years, there has been increasing attention towards understanding the dynamics of technology adoption among smallholder farmers in developing countries. Agriculture holds paramount importance in Africa's development, considering its vast arable land and the most of the population is engaged in this sector. Despite this, Africa faces challenges such as insufficient food production, low-value products, and stagnant productivity (AGRA, 2018). Agricultural productivity growth is pivotal for structural transformation, leading to economic diversification, increased income, and poverty reduction (FAO, 2017a). In Ethiopia over 85% of its GDP originates from agriculture, which experienced a 7.7% growth in 2017/2018. Crop production contributes significantly to GDP, with cereals and livestock playing crucial roles in the agricultural economy (Duguma et al., 2012).

Cereals like teff, wheat, maize, sorghum, and barley dominate cultivation, constituting a substantial portion of households' food budgets. Wheat, a globally significant cereal, contributes to Ethiopia's agricultural landscape, ranking fourth in area coverage and third in total production (CSA, 2017; MAFAP, 2014). Wheat consumption has steadily risen in the past two decades in Ethiopia due to population growth, changing food preferences, and urbanization. In 2013, African countries spent over $12 billion importing more than 40 million metric tons of wheat, revealing a growing food gap met largely by imports (FAO, 2017b). Despite a notable increase in wheat production, Ethiopia remains a net importer of wheat. Wheat production self-sufficiency stands at around 78%, with imports accounting for a significant portion of the market. The Ethiopian Grain Trade Enterprise controls commercial wheat imports, aiming to keep prices low for consumers. However, this subsidy indirectly affects local farmers by reducing the prices paid for their wheat, potentially discouraging domestic production (CSA, 2013).

Wheat production in the Somali Region dates to before 1970, but significant advancements occurred in 1999 with the introduction of improved bread wheat by regional agricultural bodies. The decision of agro-pastoral households to adopt new technologies is influenced by various factors, including socio-economic circumstances, resource endowments, and institutional support systems (DA contact). The agro-pastoral system, predominant in the Somali region,

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integrates crop and livestock production, with wheat playing a vital role in sustaining household livelihoods.

Approximately 87% of the region's population relies on pastoral and agro-pastoral products for sustenance and income (SoRPARI, 2015). Therefore, understanding the dynamics of wheat production and consumption in Ethiopia, particularly in the Somali region, is crucial for formulating strategies to enhance food security, increase local economies, and address challenges faced by agro-pastoral households. Adoption, as defined by various authors, encapsulates the process through which individuals embrace and integrate new ideas or practices into their lives. (Rogers and Shoemaker ,1971) conceptualized adoption as the decision to fully utilize novel ideas perceived as the best available courses of action. (Feder et al., 1985) extended this notion, characterizing final adoption as the sustained use of new technology by individual farmers when they attain full information and equilibrium. In Ethiopia, wheat holds the fourth position among all food crops in terms of production area and yield. Despite a significant increase in production by 55% from 2.2 million tons in 2005 to 3.4 million tons in 2012, the share of wheat in the total cereal area decreased by 6.2% over the same period. This decline is primarily due to a shift in cropping patterns towards other cereal crops like sorghum, maize, and millet (CSA, 2012). Ethiopia's wheat yield is lower compared to major producers in Africa, standing at an average of 2.11 tons per hectare in 2012. This is approximately 41% below Kenya and 77% below South African averages (FAOSTAT, 2012).

Bread wheat variety, developed by scientist Sanjaya Rajaram at the International Maize and Wheat Improvement Center (CIMMYT), gained popularity in Ethiopia after its release in 1995. However, over time, the variety became susceptible to wheat rust diseases, posing risks to farmers' yields and financial stability. Despite challenges, Kubsa remains one of many wheat varieties bred by Rajaram during his illustrious career, highlighting the importance of continuous research and innovation in agricultural development. Empirical studies investigating adoption decisions in agriculture reveal a multitude of influential factors guiding farmers' choices. These decisions are shaped by a combination of personal and demographic characteristics, socioeconomic status, institutional frameworks, and psychological attributes, as outlined by (Dixon et al., 2001). As a result of clarifying the determinants and dynamics shaping adoption patterns, these studies contribute to a deeper understanding of the factors driving agricultural innovation and its implications for rural livelihoods and food security with following conceptual clarity.

2. Materials and Methods

This study is conducted using qualitative datas from different aspects of human adaptation capacity while producing improved bread wheat varieties through analysis of requisite contents collected , accordingly inferences are drawn and conclusion is made.

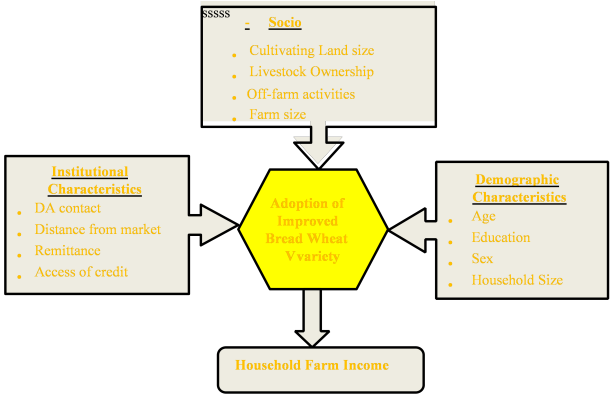

Figure 1: Conceptual framework

3. Results and Discussion

Adoption of Improved Bread Wheat Variety and Its Determinants

The adoption of improved bread wheat varieties is vital for enhancing food security and increasing household farm income. This study assesses the key factors that influence farmers' decisions to adopt these improved wheat varieties, focusing on socio-economic, demographic, and institutional characteristics.

3.1. Socio-economic Characteristics

Socio-economic factors play a crucial role in the adoption of improved wheat varieties. The size of a farmer's landholding directly influences their capacity to experiment with new technologies (Deressa et al., 2009). Farmers with larger plots of land are more likely to dedicate a portion of their farms to improved varieties, as they face a reduced risk of total crop failure. Additionally, owning livestock contributes to financial stability, enabling farmers to invest in high-quality seeds (Asfaw et al., 2012). Engaging in off-farm activities can further supplement household income, making it easier to purchase the necessary inputs for modern agriculture. Larger farms also offer better opportunities for mechanization, which can enhance the efficiency of adopting improved varieties.

3.2. Demographic Characteristics

Demographic characteristics such as age, education, sex, and household size significantly influence decision-making in agricultural innovation. Younger farmers tend to be more open to adopting improved technologies compared to older farmers, who may resist change due to risk aversion (Feder, 1985). Education plays a crucial role by enhancing farmers' understanding of new farming techniques, making literate farmers more likely to embrace improved wheat varieties. Gender disparities also affect technology adoption; male-headed households generally adopt new technologies at a higher rate due to better access to resources (Doss, 2018).

The size of the household can have both positive and negative effects on adoption, depending on factors such as labor availability and financial constraints.

3.3. Institutional Characteristics

Institutional factors such as contact with Development Agents (DAs), market access, remittances, and credit availability play a crucial role in the adoption process of agricultural practices. Regular interactions with extension agents help disseminate knowledge and provide farmers with exposure to innovative farming techniques (Abdulai and Huffman, 2014). However, distance from markets can negatively impact adoption rates, as farmers struggle to access quality seeds and to sell their produce at competitive prices. Additionally, remittances from family members abroad often provide extra financial support that enables investment in high-yield seed varieties. Access to credit facilities also helps farmers overcome liquidity constraints, facilitating investment in improved wheat farming practices.

3.4. Impact on Household Farm Income

The adoption of improved bread wheat varieties has a significant impact on household farm income. Higher yield potential results in a greater marketable surplus, which contributes to better financial stability for farming households (Feleke and Zegeye, 2006). Farmers who choose high-yielding varieties often experience improved food security, reducing their reliance on external food sources. Furthermore, surplus production increases participation in local and regional markets, which enhances rural livelihoods.

3.5. Policy Implications

To improve adoption rates and maximize economic benefits, policymakers should concentrate on enhancing extension services, increasing market access, and facilitating credit opportunities. Investing in rural infrastructure, such as roads and storage facilities, can lower transaction costs and encourage the wider adoption of improved wheat varieties. Additionally, targeted training programs should be established to educate farmers about the economic advantages of adopting better seed varieties. The adoption of improved bread wheat varieties is affected by various socio-economic, demographic, and institutional factors. Overcoming the barriers to this adoption can greatly enhance farm productivity and increase household incomes, thereby contributing to food security. Future research should focus on the long-term sustainability and resilience associated with the adoption of modern agricultural technologies.

4. Conclusion and Recommendations

Adopting improved bread wheat varieties is instrumental in transforming rural agricultural livelihoods by enhancing productivity, ensuring food security, and increasing household farm income. The study establishes that socio-economic factors such as landholding size, livestock ownership, and off-farm activities significantly influence adoption rates, providing both financial security and risk mitigation. Institutional support mechanisms, including extension services, market access, and credit facilities, play a critical role in promoting adoption by reducing financial and informational barriers. Moreover, demographic characteristics such as age, education level, and gender disparities further determine the likelihood of technology uptake, emphasizing the need for targeted intervention strategies. To maximize adoption and its associated benefits, policymakers must prioritize strengthening extension services, improving rural infrastructure, and facilitating access to financial credit. Investment in roads, storage facilities, and training programs will enhance market access and reduce transaction costs, fostering a conducive environment for technology dissemination. Furthermore, addressing gender disparities and enhancing women's access to agricultural resources can lead to more inclusive and sustainable adoption outcomes.

Overall, the findings underscore the importance of a holistic approach that integrates economic, institutional, and demographic factors in promoting agricultural technology adoption. Future research should focus on assessing the long-term sustainability, resilience, and climate adaptability of improved wheat varieties to ensure continued benefits for smallholder farmers. Implementing targeted policy interventions will be essential for sustaining agricultural productivity and ensuring food security in rural communities.

Conflict of Interest

Authors declare that there is no conflict of interest involved in publishing this research paper.

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