

EDUCATION, INSTITUTIONS, AND LAND TENURE: A REVIEW OF SOCIO-ECONOMIC DRIVERS OF WHEAT PRODUCTIVITY"

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Abstract

Wheat (*Triticum aestivum* L.) is vital to global food security, yet actual yields in developing countries remain well below research-station potential. While agronomic and climatic drivers of this gap are well studied, growing empirical evidence shows that socio-economic factors education, age, experience, household size, farm size and fragmentation, tenure security, credit and extension access, market access, gender, and off-farm income are equally decisive, particularly among smallholder farmers. This review synthesizes empirical findings on socio-economic determinants of wheat productivity and technical efficiency across Ethiopia, Pakistan, India, Nigeria, Sudan, Afghanistan, Kazakhstan and China, using studies based on stochastic frontier analysis (SFA), data envelopment analysis (DEA), Cobb-Douglas, and Tobit/Beta regression models. Findings show consistent evidence that education, extension contact, credit access, and experience raise technical efficiency, while land fragmentation, insecure tenure, and poor market access constrain productivity; farm-size and tenure effects, however, remain context-dependent. The review highlights key gaps treating farms as a homogeneous group, reliance on cross-sectional data limiting causal inference, and a narrow focus on technical efficiency over land productivity and calls for future longitudinal, climate-interactive studies comparing wheat productivity and socioeconomic factors across landholding size and tenancy status.

INTRODUCTION

Wheat is the staple food crop of Pakistan and a cornerstone of the country's food security policy, given that domestic demand now exceeds 20 million tons annually. However, actual wheat yields on Pakistani farms remain well short of the yield potential demonstrated at research stations. Pakistan faces a 60% yield gap between its

potential wheat output at research facilities and its actual wheat yield on farms (Shahzad et al., 2022). At the provincial level, this gap is even more pronounced in some regions, the yield gap of wheat is highest in Khyber Pakhtunkhwa at 4,734 kg/ha, followed by Baluchistan at 4,424 kg/ha, Punjab at 4,000 kg/ha, and Sindh at 3,529 kg/ha,

with most provinces exceeding the national average yield gap (Khan & Idrees, 2024). Pakistan's national average wheat yield remains modest compared internationally Sindh province, despite outperforming the national average by roughly 32%, still only reaches about 3,747 kg per hectare while progressive, well-resourced growers under irrigated conditions can achieve substantially higher output, since progressive wheat growers in irrigated areas obtain grain yields of 5–7 tons per hectare, compared to a national average of around 1.2 t/ha under rainfed conditions and 3.0 t/ha under irrigated conditions (Palal et al., 2025).

There exists a large amount of agronomic evidence linking these disparities to soil fertility, climate variability, water availability, and input use, particularly in Pakistan's predominantly rainfed and semi-arid wheat belts. Yet an equally influential empirical literature shows that socio-economic factors relating to human capital such as farmer education, age, and experience factor endowments such as farm size and land tenurial arrangements, labor and capital availability, and access to institutions such as credit, extension services, and markets are equally important in predicting wheat productivity and technical efficiency among Pakistani farmers (Ali et al., 2020; Khan et al., 2021; Ali et al., 2022; Khan et al., 2024). Grasping these socio-economic determinants is critical for Pakistan's policymakers to design interventions capable of converting agronomic and varietal potential into realized on-farm yield gains, particularly given that a large share of the country's wheat is produced by smallholder and tenant farmers operating under resource, credit, and land-access constraints (Khan et al., 2021; Ali et al., 2022).

This review presents a synthesis of recent empirical findings (2018–2026) concerning the impact of socio-economic variables on wheat productivity from the perspectives of studies conducted in Ethiopia, Pakistan, India, Nigeria, Sudan, Afghanistan, Kazakhstan and China. This review aims at (i) classifying the socio-economic determinants of productivity found in the empirical literature, (ii) comparing the findings according to the different approaches and regions, and (iii) identifying points of disagreement.

2. METHODOLOGY OF THIS REVIEW

This is an empirical narrative review. Empirical peer-reviewed journal articles, working papers, and institutional reports published predominantly between 2018 and 2026 have been identified through targeted literature search, focusing on productivity/technical efficiency and socio-economic determinants. Preference was accorded to studies utilizing quantitative econometric methodologies such as stochastic frontier analysis (SFA), data envelopment analysis (DEA), Cobb-Douglas and trans-log production function, Tobit and Beta regression, propensity score matching (PSM), logit/probit adoption models due to their ability to isolate the marginal effects of socio-economic variables on wheat yield. The review is categorized into socio-economic themes: (a) Human capital (Education, Age, Experience, Gender); (b) Household composition and labor; (c) Farm size, land fragmentation and tenure; (d) Credit, Extension, Information access (e) Market access and commercialization; and (f) Interplay with climate and institutions.

Human Capital Factors

a) Education

Education of farmers ranks as the one of the most persistent socio-economic variables determining wheat productivity and efficiency. In northwestern Ethiopia, education has been reported to have a significant negative relationship with technical inefficiency in wheat production along with farming experience and price information (Endalew et al., 2023). Likewise, in West Shewa zone of Oromia, Ethiopia, education level, frequency of contact with agricultural extension agents and credit use had been negative correlates of technical inefficiency with mean technical efficiency of selected farmers being 0.82 (Girma et al., 2024). In Goba, Lemu, Siyadebr, and Basona districts of Ethiopia, education level together with income, extension contact, and land area have been established as significant variables in determination of wheat productivity and rate of fertilizer usage (Mohammed et al., 2024). A similar trend of education as one of the factors contributing to higher levels of productivity exists among efficiency studies in South Asia, where

education and experience of farmers were revealed to be important and significant positive determinants of technical efficiency of wheat and cereals production in India, Pakistan, Ethiopia, and Sri Lanka (Ali et al., 2020; Ali et al., 2022).

b) Age, Experience, and Gender

Farming experience is associated with improved efficiency due to learning by doing. Human capital attributes including age, gender, education, and farming experience have been cited in Kunduz province, Afghanistan as some of the main determinants influencing farmers' ability to use available resources efficiently (Dogeje et al., 2024). In Nigeria, experience in wheat farming together with extension visits, gender, literacy level, and family size have been observed to negatively affect the productivity of wheat among 866 respondents who are wheat farmers in various wheat producing states (Jibrin et al., 2025). Gender stands out as a recurring and complex variable. In India, the interaction between gender and socio-household factors determines not only the efficiency but also variety and trait preference in wheat production where mechanization lowers the need for female labour in traditional activities like transplanting and weeding affecting the income and decision-making abilities of women in wheat growing families (Gartaula et al., 2024). In contrast, in Jigawa state, Nigeria, gender discrimination restricting women's access to productive resources is considered as one of the induced constraints that prevent wheat farmers from achieving efficiency in output maximization, minimization of costs and maximizing profits (Sadiq et al., 2024).

2.2 Household Composition and Labor Endowment

The size of the household and dependency ratios have implications for the labour that is used for the cultivation of wheat. In northwestern Ethiopia, an increase in dependency ratios was linked with inefficiency, together with a higher distance from the local wheat market and extension office (Endalew et al., 2023). Family size and labour availability from one's own farms were found to positively influence technical efficiency

in smallholder wheat farmers (Ali et al., 2022; Geta et al., 2020). Off-farm and non-farm incomes were seen as less straightforward since the time spent in those activities was positively influencing technical inefficiency in West Shewa, Ethiopia (Girma et al., 2024).

Farm Size, Land Fragmentation, and Tenure Security

a) Farm Size

The effect of farm size on the level of wheat productivity is another controversial topic discussed in the literature. The results of some researches on technical efficiency in Pakistan's rainfed Punjab state that farm size, fragmentation of land, and traction power have negative effects on the technical efficiency level, meaning that smaller and managed better plots can have higher efficiency scores in comparison with large farms in spite of the fact that large farms in Pakistan in general tend to show higher levels of output, which means 3.5 t/ha for farms over 10 acres and 2.1 t/ha for small farms, due to better access to mechanization, finance, and markets, rather than to the effect of scale (Fallahinejad et al., 2022; Khan, 2021; Ali et al., 2020; Gollin 2019).

b) Land Tenure Security

Security of land tenure affects farmers' incentives for investments and adoption of yield-improving sustainable land management practices. A study conducted by Khan et al., (2024) using a mixed methods approach on a sample of 350 farm households from rural areas of Pakistan suggested that formal registration of land tenure would have a significant effect on investment decision-making, adoption of sustainable land management, and ultimately, crop yield/production. But again, not all literature agrees to this, there are some pieces of literature that suggest that secure land tenure could lead to less agricultural productivity when it limits the land and labor mobility or it leads to investments in land tenure signaling assets rather than yield improving ones also, in many African countries formal land titling does not increase productivity because customary land tenure provides sufficient security or complementary

financial and input market constraints do not allow this benefit (Challa et al., 2026).

2.4 Access to Credit, Extension Services, and Agricultural Information

Institutional variables are amongst the most consistently influential socio-economic determinants of technical efficiency of wheat across the studied literature. An analysis of Ethiopian literature on wheat efficiency reveals that institutional and information variables such as training, access to credit, extension services, and cooperative membership are consistently important in driving technical efficiency by addressing liquidity limitations and enhancing the access to technical advice and inputs (Gebrehiwot, 2017). The use of credit has been found to reduce technical inefficiencies amongst wheat producers in West Shewa, Ethiopia (Girma et al., 2024). Access to credit along with education and extension services is negatively correlated with land fragmentation and positively with productivity in Punjab, Pakistan (Ali et al., 2022). Agricultural information access has proven to be one area with a remarkably high estimated impact: in cross-sectional data collected from 403 households growing wheat in the East Gojjam Zone, Amhara Region, Ethiopia, those who had adequate access and utilized agricultural information were able to experience wheat yield increases of 19.675% per hectare compared to their counterparts without information access, a factor that is enhanced by mobility of farmers, extension services quality, availability of inputs, market access, and exposure to electronic information (Shitaye et al., 2025). Extension office distance was observed to lead to technical inefficiency in several studies conducted in Ethiopia (Endalew et al., 2023).

2.5 Market Access and Commercialization

Market integration influences not only the motivation of the farmers to enhance wheat production but also their actual efficiency and productivity. It was established that the increase in the distance of farmers from the local market resulted in higher technical inefficiencies in northwestern Ethiopia (Endalew et al., 2023).

Concerning a similar study of wheat commercialization in Debre Elias Woreda, Ethiopia, it was found out that such aspects as educational status, number of oxen, land size for growing wheat, experience in farming, extension services, and market distance are the major determinants of the intensity of smallholder wheat commercialization. Moreover, only a quarter of farmers was identified to be fully commercialized (Endalew et al., 2020). In their turn, smallholder wheat farmers in Kenya produce significantly less yield than large farms. Besides, the former have high production costs per unit and low gross margins as a result of high input cost, low prices, lack of bargaining powers, and low access to machinery services that are essentially socio-economic and institutional rather than agricultural (Mwangi et al., 2021).

2.6 Socioeconomic Factors, Climate Adaptation, and Technology Adoption

Socio-economic variables play a role in determining the ability of farmers to adapt to climate variability and to adopt new technologies for wheat cultivation. Socio-economic and biophysical determinants of crop productivity are therefore linked since farmers' ability to adopt new techniques and technologies in the face of climatic variability depends on the socioeconomic status of the household. In Pakistan's rainfed region, there were interactions between socio-economic characteristics of farmers and climate variability in influencing both the mean yields and the variability in yields. Lack of access to markets for inputs was associated with lower mean yields and higher yield variability due to temperature anomalies (Khan et al., 2024). In the irrigated, arid, heat-prone environments of Sudan, a binary logistic model applied to 300 farmers across three states found that socioeconomic and production factors jointly shaped farmers' adoption of improved and recommended wheat technologies, reinforcing the finding that technology uptake and hence realized productivity gains from improved varieties is conditioned on the socioeconomic profile of the adopting household (Ibrahim et al., 2024).

3. SYNTHESIS ACROSS METHODOLOGIES AND REGIONS

3.1 Consistency of human capital and institutional-access effects.

In spite of the variations in context, models used (SFA, DEA, Tobit, beta regression, PSM), and crop-specific factors, education, extension services contact, credit facilities, and farming experience are invariably associated with increased wheat productivity/efficiency. This cross-country similarity in Ethiopia, Pakistan, Nigeria, Afghanistan, India, and Kazakhstan points to the existence of structural, not contextual, linkages.

3.2 Ambiguity in farm-size and land-tenure effects

Unlike human capital variables, farm size and land tenure show context-dependent and sometimes opposing effects, reflecting the difference between allocative efficiency at the plot level and absolute productivity driven by unequal access to complementary inputs such as mechanization, irrigation, credit that tends to favour larger holdings.

4. CONCLUSION

The current literature review clearly indicates that social and economic factors play an essential role, rather than being marginal, in accounting for the variations in wheat productivity and efficiency levels in different parts of the world. The human capital indicators, especially the combination of education, experience, and extension visits along with the availability of finance, information, and market facilities, are significant factors that differentiate between efficient and inefficient wheat producers. The structural aspects of the farms, especially land fragmentation, bear the cost of productivity reduction, while the impact of farm size and tenure security varies according to the environment.

5. Limitations and Directions for Future Research

Though, most of the reviewed literature considers the farmers as one homogeneous group through the aggregation of small scale and large-scale farms, which may conceal the variations in the

determinants of technical efficiency for the two groups. This makes it difficult to determine whether there is any difference in the effects of socio-economic, institutional and production factors on technical efficiency among small- and large-scale farms. Additionally, the concentration on technical efficiency may fail to capture the variations in land productivity in relation to landholding size and resource endowment. Moreover, use of cross-sectional data through household surveys makes it difficult to establish causality in the direction of relationship between education and efficiency and whether wealthy and efficient farmers invest more in education. Most samples are small and the studies cover small geographical areas such as one district or zone. Therefore, future research should consider analyzing the two farm groups independently according to the landholding size and whether they are tenants or not.

Author's Contribution

Muhammad Sher (Research Scholar): Wrote the first draft of the manuscript.

Dr. Sajad Ali (Supervisor): Reviewed and refined the first draft.

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