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Developmental Impact of New Wheat Varieties on Farmers' Income: A Comprehensive Review

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ABSTRACT
India is among the greatest producers and consumers of wheat worldwide, and agriculture plays a significant part in the country's economy and jobs. Wheat is the second- most significant food crop in India after rice. Punjab, Haryana, Uttar Pradesh and Rajasthan are the main wheat growing states of Northwest India. The most important input in the agricultural production cycle is seed. The Present study was undertaken with the objective to find out the Impact of Wheat Varieties on Farmers Perception Using Secondary data and the finding revealed that the Farmers using the new wheat variety increase in the wheat yield, growth rate found to be positive and demonstrated that adopters of improved wheat varieties had an average increase in wheat productivity in comparison to non-adopters. New varieties and production procedures employed resulted in an increase in farmers' income. Wheat improvement is such a remarkable success for the farmers.
Keywords: *Wheat seed varieties, Farmer Perception, Yield, Income, seed adoption.*

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INTRODUCTION

India is the second largest producer of wheat in the world, with production hovering around 68 to 75 million tons for the last two decades, about 12.5% of total production. Since 2000, India has struggled to match that record production figure and thus faces a critical challenge in maintaining food security in the face of its growing population [1]. Recorded highest wheat consumption of 109.88 metric tons in the year 2021-22 [2]. Clearly wheat and its products play an increasingly important role in managing India's food economy. Although India's population grew by around 650 million between 1965 and 2000, the severe wheat crises of the early 1960s gave way to wheat surpluses in late 1990s [3]. Wheat production of 6.5 million tons in 1950, was dwarfed by the 72 million tons produced in 2005, a tenfold increase [4]. This National production increase is reflected in increased yields per hectare that went from around 660 kg/ha in 1950 to 2,710 kg/ha in 2004 [5]. In terms of output, consumption and area grown, wheat is the second- most significant food crop in India after rice. Punjab, Haryana, Uttar Pradesh and Rajasthan are the main wheat growing states of Northwest India. About 78% of the Nation's wheat is produced in these states [6].

Mishraet.al [7] stated that Uttar Pradesh, Punjab, and Haryana are the three major wheat-producing states in India, accounting for nearly 70% of total wheat production. Better water systems in these states are likely to result in higher yield. In Haryana, 98% of the land area under wheat is irrigated, while in Punjab, 96% is. Wheat crops contribute significantly to national food security by providing more than half of the calories to those who rely on them. The small state of Haryana produced about 12 million metric tons out of the 109 metric tons of total Indian produce in the year 2021-22, contributed about 11% in the Indian production. The Haryana state wheat yield rate was 4.836 ton/ ha as compared to Indian wheat yield rate of 3.466 ton/ ha in the year 2021-22, shows that Haryana climate suits the wheat crop [2]. This paper focused on the development of new wheat varieties and adoption of different wheat varieties used by farmers also study was created to determine the level of farmers' understanding and the use of farm technologies.

Impact of Wheat Varieties on Farmers Perception

For emerging nations with limited resources, such as India, the foundation for boosting grain output is the availability of high-quality seeds of contemporary varieties [8]. The nation's wheat production and productivity have increased as a result of varietal development. Devi et. al [9] examined the sustainability and instability of Haryana's wheat production for the period 1980–81 to 2018–19 in the state of Haryana and found that an increasing trend pattern has been observed in the area, yield, and production of wheat crop in Haryana. In terms of area, production, and wheat yield, growth rate found to be positive and also revealed that Haryana ranked second in terms of sustainable wheat yield. Tesfaye et. al [10] discovered that 56% of improved wheat varieties were adopted in 2013 in Ethiopia. They also demonstrated that adopters of improved wheat varieties had an average increase in wheat productivity of 1 to 1.1 ton per ha in comparison to non-adopters. As a result Adopters had 35 to 50% higher income than non-adopters.Pavithra et al [11] mentioned that there has been a rise in the yield of wheat varieties between 2010 to 2015. Farmers lose out on productivity increases and genetic advancement when older varieties are cultivated and a small number of dominant types increase crop sensitivity to pests and diseases.Mazid et al. [12] mentioned that the new winter and spring wheat varieties developed and released by the Turkish national breeding program through international collaboration were adopted by various households of Turkey which showed a significant increase in their per-capita income when compared to the group of households using old varieties.

Byerlee & Harrington [13] studies that the impact of the new wheat varieties lends credence to a very different conclusion, namely that these new varieties have largely benefited the impoverished. The distribution of benefits to poor producers relative to larger producers is the only aspect of the benefits distribution from new wheat varieties that we summarise here [13]. Conceptual challenges in assessing these advantages are explored and empirical data from Mexico, India, and other nations where the new wheat varieties are extensively used. Dixon et al [14] revealed that adoption of improved wheat varieties showed a consistent rise in the yield over the previous four to five decades. The adoption of newer wheat varieties by millions of farmers, or their replacement with superior varieties, is what makes wheat improvement such a remarkable success. Chirwa [15] revealed that fertilizer and hybrid seed technologies adoption was positively associated with higher levels of education, larger plot sizes and higher non-farm incomes in Malawi but negatively associated with households headed by women and distance from input markets. Matuschke et al [16] demonstrate that farmers stand to gain a great deal from the proprietary technology in the hybrid wheat's acceptance and effects in India and also the adoption choice is not influenced by farm size or subsistence level; instead, credit and information availability are important factors. Furthermore, a willingness-to-pay analysis shows that lowering seed prices would increase adoption rates. The utilization of hybrid wheat has significant yield advantage and grain quality over open pollinated varieties. So the income is also significantly influence by the adaptation of hybrid wheat [17].

Hassan et al [18] examined that the Factors influencing wheat production in Punjab's mixed cropping zone. To assess the effect of sowing time, seed rate, education, fertiliser application, irrigation, and other factors on wheat yield, a Cobb Douglas type production function was used. Sowing time, rotavator use, education, seed rate, weedicide cost, and nitrogenous fertiliser use were identified as factors that contributed to higher wheat yield. Iqbal et al [19] comparing the profit and wheat prices, quantities, and by-product prices are all positively correlated. Profit and total costs, on the other hand, are negatively correlated. Estimates have been made on the impact of farmers' certified seed, literacy, and flood-affected areas. The wheat yield per acre generated by the literate farmers was 99.9 kg more than that of the illiterate farmers. In comparison to farmers who did not use certified seed, certified seed users yielded 127.41 kg more per acre. Pandit et al [20] Studies that the effects of wheat variety selection the adoption of new wheat varieties and production technology, changes in wheat farmers' income and attitudes, etc. Adoption of production technologies, agricultural information sources, attitudes, and economic shifts all saw notable changes. New varieties cultivated and production procedures employed resulted in an increase in farmers' income. Saroj et al [21] Bihar, Gujarat, Haryana, Madhya Pradesh, Rajasthan, Punjab, and Uttar Pradesh are the seven states. When new wheat varieties are adopted, a farmer's decision is largely influenced by land size, education level, information sources, seed sources, outlets for selling the product, and variety features, according to an examination of these drivers. Adoption of new types, it turns out, has a major and favourable influence. Nazu et al [22] in the northwest of Bangladesh, a study evaluated the small farmers that use conservation technologies are more likely than their counterparts to adopt better management practices. The adoption of better wheat varieties, while the application of plant protection chemicals and the recommended seed rate was also adopted at lower rates. The degree of

adoption was impacted by the education, experience, labour force, land area under wheat production, organization membership, training, and market distance of wheat producers.

Patel et al [23],the study examined how different wheat varieties responded to sowing times in North Gujarat settings during the 2012–13 Rabi season. The treatment included four wheat varieties—GW 11, GW 173, GW 322 and GDW 1255 (d)—and three sowing times: November 15 (timely), December 1 (late), and December 15 (very late). Variety GW 322 showed significantly higher values for yield variables such as plant height, spike length, and number of grains per spike, while variety GW 1255 recorded significantly higher values for test weight and protein content. Grain and straw yields were considerably greater with the wheat variety GW 322.the rise in yields of grains and straw relative to GW 11, GW 173, and GDW 1255, in that order. Nalley et al [24] studies that the better varieties have been widely adopted, average wheat yields have increased steadily over the past four to five decades, and they have made significant contributions to both food security and the fight against poverty. Different geographic areas have different rates of improved variety development and acceptance, which affects how long it takes for a varietal to be widely used when it is released.

Abera et al [25] When research management procedures were followed, improved varieties did better. When compared to farmer practices, improved management practices showed higher grain yields. Better farmer management techniques resulted in a higher mean grain yield. An increase in yield was the outcome of better management techniques. Improved agronomic packages for wheat production resulted in maximum grain yield and increased net return. Verma et al [26] studies that by using a suitable variety and workable, scientific management techniques, wheat productivity per unit area could be boosted. Better practices resulted in a higher benefit-to-cost ratio. new variety and persuade the agricultural community of the potential benefits of enhanced wheat production management techniques. Akbar et al [27] studies that the overall performance of the variety indicated that the more recent ones outperformed the older ones. The most promising variety was the more recent, which displayed maximum emergence, moderate plant height, more productive tillers, high grains/spike, moderate grain weight, and better grain yield. Ahirwar *et al* [28] studies that the wheat cultivators stated that a number of production barriers prevented them from reaching their potential yield, including a lack of facilities for testing soil, ignorance of plant protection measures, ignorance of the recommended package of practices, a shortage of hired labour, irregular electricity supplies, a lack of capital, inadequate training, disease issues, a lack of high-yielding variety seed, and a lack of fertilisers during the operating period. Abera *et al* [25] examined that the Improved agronomic packages for wheat production resulted in maximum grain yield and increased net return. Wheat growers were able to significantly boost economic returns through the application of enhanced management strategies aimed at raising yield. In light of this, extension agents in the Eastern Wallagga Highlands should take this advice into account for wheat cultivation.

Elsir and Elamin[29] showed that the nation's resources were not used efficiently in the production of wheat, which prevented it from being competitive over the previous ten years. The government policy has increased the cost of production by driving up the price of tradable inputs. For the most part, Sudan's wheat growers have been burdened with debt as a result of the last ten years' lack of a rise in wheat prices relative to production expenses. Choudhary et al [30] study the when using raised beds instead of flat land with standard (20 cm) row spacing, the production of wheat was reduced by 12–17%. In raised beds, neither rice nor wheat produced additional tillering or leaf growth at the row margins to make up for the lost rows. The type of land preparation used for rice had no effect on the growth and production of the next wheat crop.

Nhemachena & Kirsten [31] reveals that the wheat varietal improved in South Africa. The nation's efforts to develop wheat varietals concentrated on agronomic traits, yield potential and stability, and adaptation to the production location. The most widely used varieties were chosen for additional research on cost attribution and the advantages of wheat varietal advancements. Farooq et al [32] study that the wheat yield performance. 50% of farmers, the primary obstacles preventing them from adopting enhanced wheat seed were the high cost of wheat seed, incomplete information, and unavailability of improved wheat seed. Sharma *et al* [33] the majority of respondents overall, according to the study, were medium adopters of advanced wheat cultivation technologies. It was also noted that the adoption of improved wheat farming technology was substantially correlated with knowledge, attitude, involvement in extension activities, social participation, education, size of land holding, and socioeconomic position. Dhandart *et al* [34] study that the in order to address these issues, a wide range of sustainable intensification technologies have been developed to reduce the irrigation and labour requirements, tillage intensity, and straw burning. Pakistan, Nepal, and Bangladesh are also confronted with challenges similar to those faced by Bangladesh in producing rice-wheat crops sustainably. These challenges include the depletion of the soil's nutrient pool, declining soil health, groundwater depletion, rising production costs,

labour scarcity. Degaltseva *et al* [35] reveal that the key theoretical aspects of the economic and environmental effectiveness of using chemical plant protection products and mineral fertilisers in agriculture have been developed by modern research. Considering the noteworthy accomplishments of researchers and practitioners in this area of agricultural development.

Knowledge/adoption / awareness of Farmers (Wheat variety)

Singh et al. [36] study that the majority of farmers were in the 31 to 45 years age group, according to the study, which also showed that most of them had fair to good knowledge of newer technologies for producing wheat. However, more than half of the small farmers expressed a favourable and very favourable attitude towards wheat produced using enhanced technology. Abda [37] examine the demonstrated that the adoption decision of improved wheat varieties was significantly influenced by the sex of the household head, the size of the land and livestock holdings, the availability of credit, the availability of market information, the frequency of extension contacts, the household head's educational level, membership in cooperatives, and the perception of yield capacity. Kumar *et.al* [38] study that the adoption level of medium for wheat seed production technology. When it came to the adoption of practises, field preparation, suggested varieties, seed standards, and field standards were highly adopted, whereas spacing and sowing time were less frequently used. the study also found a positive and significant correlation between the adoption level and independent variables such as age, education, socioeconomic status, land ownership, extension contact, exposure to mass media, change proneness, risk orientation, scientific orientation, and experience producing seeds.

Sharma, [39] investigate how campaigns and promotional activities affect consumers' purchasing decisions. The study's findings indicated that a farmer's personal experience testing seeds on his own property has a significant influence on his decision to buy.Ullah et.al [40] study that the using a logit model, the results demonstrate a strong correlation between farmers' awareness of improved wheat varieties and their adoption of the technology, with access to credit having a positive impact on farmers' awareness. The elements that encouraged farmers to use the technology, while household size and educational attainment had the opposite effect. Kelemu [41] analysing the variables that affect the likelihood that farmers who grow wheat will have access to information about better varieties. A logistic regression model was used, and a number of institutional and socioeconomic factors, including age, education level, family size, total livestock owned. According to the study, a very high percentage of farmers lack knowledge about improved wheat varieties.

Sharma & Jain [42] evaluate the effects of frontline demonstration on wheat farmers' knowledge, adoption, and barriers in the districts of Indore, Ujjain, Dewas, Dhar, and Jhabua (MP). The majority of farmers (86.67%) who responded to the results stated that the price of MSP was lower and they ranked 1 in seriousness. The next significant effect is an 85.00% increase in input costs for farmers ranked second. 80.00% of the respondents (ranked third) said that crucial viewpoints could not be obtained quickly. Ndondi et al [43] While many new wheat varieties were resistant to the majority of common wheat illnesses, the majority of older wheat types were prone to yellow rust, stem rust, and leaf rust. To verify their advantages over older wheat varieties, the most popular new wheat varieties will undergo additional evaluation on the farm. Kalsa [44] examines the prevalent beliefs and methods among farmers regarding the usage of certified seeds, seed replacement, and seed storage, as well as wheat variety. The farmers' knowledge of certified wheat seed is good, but their attitudes, which determined how often farmers bought certified seed, need to be adequately addressed by supporting the certified seed supply chain with disease-resistant varieties that have the lowest yield penalty.

Mishra et al [45] study to determine the technological gap and boost adoption rate by analysing respondents' knowledge, attitude, and adoption level as well as their socioeconomic profile. In the Uttar Pradesh district the majority of wheat growers adopted the SHUATS W-6 variety with a medium degree of knowledge, attitude, and acceptance. Also, prompt seed, fertiliser, and marketing facility availability as well as a decrease in the price of essential inputs were advised. Subedi et al [46] examine the acceptance of better wheat cultivars in Nepal's western and eastern Terai, revealed that the main issue affecting wheat output was a lack of high-quality, improved seeds. This was followed by a lack of agricultural machinery, inadequate fertiliser availability, a labour deficit, and inadequate irrigation. Nazli and Smale [47] studied the speed at which variety changes varies according to farm size as well. For larger farms, adoption is greatly influenced by media and extension sources compared to knowledge obtained through social interactions; however, this is not the case for marginal farmers. Higher yields propel adoption for the most marginalised, subsistence-oriented group. On smaller wheat farms, where households both sell and consume their wheat, traits associated to consumer quality accelerate adoption. Battese et al [48] discover that the education has no statistically significant effect on human capital, yet older farmers tend to be more technically inefficient than younger farmers. Wheat producers are more productive when they

have access to extension guidance. The efficiency of wheat production is adversely correlated with the time to varietal change, later adopters were not less efficient than earlier adopters. Lastly, compared to other farmers, those whose land experienced extreme toxicity or salinity are less productive and efficient. Glenna et al [49] study that the three wheat variants have recently been developed: (a) a wheat variety that was genetically altered to withstand the herbicide glyphosate; (b) wheat varieties with traits chosen to cater to particular markets; and (c) new research and development of perennial wheat types. Different personal traits and attitudes were linked to farmers' interest in these three groups of wheat types. Fatima & Khan [50] study that the wheat variety's parameter estimate is considerable and negative. Additionally, the seed rate variable's parameter is statistically significant and negative. The majority of farmers usually use crop seeds to save money, however doing so comes at the expense of production potential that could have been achieved by using more recent seed varieties. Before adopting any kind of seed, the ecological circumstances of the place must also be taken into consideration; otherwise, subpar results will be obtained.

Acceptability of new Wheat Variety

Gandhi &Koshy [51] farmers are choosing cultivars based more on the needs of the market, placing equal weight on quality and acceptance as yield. In exchange for commissions and profits, the typical market middleman offers very few unique, value-adding, or developmental services. There are wide regional variations in the demand for wheat among consumers. Retailers maintain a variety of wheat and wheat products because they are becoming more aware of customer demand and quality. Mishra et al [52] farmers are choosing cultivars based more on the needs of the market, placing equal weight on quality and acceptance as yield. In exchange for commissions and profits, the typical market middleman offers very few unique, value-adding, or developmental services. There are wide regional variations in the demand for wheat among consumers. Retailers maintain a variety of wheat and wheat products because they are becoming more aware of customer demand and quality. Sendhil et al [53] wheat in Asia's diet and food chain is demonstrated by the notable expansion of the crop's cultivated area and the notable increase in its production over the last several decades. Asia is thought to be the main region with the most potential to increase wheat crop yield and production. The amount consumed has increased. Rasheed & Venkatesh [54] studies that the Plant variety protection (PVP) in India: a particular focus on wheat. A market concentration analysis of private seed businesses involved in PVP was conducted, and the impact of PVP on wheat variety seed demand was assessed. Trends in PVP from 2009 to 2019 were examined with regard to crop groups, crops, and PVP participants.

Begna et al [55] study that the improved wheat seeds were used by 80% of respondents, although only 33.7% of them were frequent users. The factors that decreased its regular utilization were high cost, limited availability, and delayed delivery of high-quality, enhanced wheat seeds. Due to mismatches in variety preference, financial availability, rainfall trend changes, and supply shortages, farmers' demands for improved wheat seeds changed over time. Kumar et al [56] calculate the wheat's marketing expenses, margins, and price spread, and examine changes in wheat arrivals and prices. The proportion of marketable and marketed excess rose as holding sizes increased. Small farmers sold more food than there was a marketable excess, either as a result of distressed sales or because they were unable to estimate what was needed on the farm. The majority of farmers sold their harvest between April and July, when it was at its peak. Due to a shortage of storage facilities and the farmers' precarious financial situation, they did not store stock throughout the lean time.

Chauhan et al [57] examined the productivity increases made over the previous few decades are no longer sustainable with traditional cultivars and conventional agronomic techniques. Food demand is rising in tandem with population growth and consumer spending power. The issue is further compounded by the loss of soil quality, the emergence of new weeds, and the arising problems of climate change. However, some of them have not been fully adopted by the farmers because they are costly, require a lot of knowledge, or don't work with the current system, which has led to additional unanticipated issues. Bishaw & Alemu [58] examine the discrepancy in the quantity of wheat seed provided by the formal sector and the value of the attainment indices of the varieties, which led to a mismatch in supply and demand and significant carryover seed. The formal sector must think about expanding the variety of bread wheat varieties it offers and strengthening its ability to deliver seeds in order to effectively adapt to new issues and farmers' desires. Habte et al [59] study that the amount of surplus wheat that is sold increases substantially in direct proportion to landholding, fertilizer use, extension services, and the cost of producing wheat. Crop rotation and information asymmetry have a negative correlation. The amount of a commodity that players supply to the markets is influenced by their strategic interactions. It could be wise to concentrate efforts on enhancing extension services, lessening knowledge asymmetry, and promoting the use of wheat technology to increase the supply of wheat.

Kumar & Puran [60] study that the farmers of governmental agencies simply received the seeds, the wheat seed farmers of private agencies received all inputs, production technologies, and extension services. The public agency's medium and big seed wheat farmers saw net gains that exceeded the comparable gains of farmers. Compared to the equivalent groups of grain producers, the private agency's small, medium, and big wheat seed growers had higher net gains.

Climate Change and its impact on wheat

Joshi et al [61] in rainfed conditions and places where previous local inspections were in operation, new cultivars were reported to have a greater yield advantage. new high-yielding varieties provided an extra 0.3–0.5 tonnes of grain per ha, enough to feed two to three people annually, and offered smallholder farmers hope for food security. Innovative farmers in rainfed regions developed wheat kinds indicated for irrigated regions to identify high-yielding wheat varieties with reliable performance, according to research as well. Reidsma *et.al* [62] examined that because farmers adjust by modifying crop rotations and inputs, effects on crop yields cannot be directly translated into effects on farmers' income. Second, the effects of climate variability over time, for which more varied patterns are seen throughout Europe, differ from those of climate variability over space, with lower yields in warmer climates generally and farmers' incomes reflecting this difference. Thirdly, the real effects of climate variability and change rely heavily on farm features (such as size, intensity, and land use), which affect adaptation and management.

Singh and Leua, [63] study that the main problem face by agriculture sector is climate change which adversely affects the farmer's income. Therefore, to double the farmers income and reduce the effect of climate change various advanced technologies were used like improve varieties, advanced irrigation system, drought tolerant varieties, new farm management techniques, biofertilizers and pesticides, mixed farming and mulching etc. Kumar &Sidana [64] studies that the goal of the current study was to assess how climate resilient technologies affected Punjabi agriculture's ability to produce wheat and rice. The most significant adaptations to climate variability, according to the results, are the laser leveller and the improved irrigation structure, which accounted for 30 and 27 percent of all adoptions, respectively. Fahad et.al [65] studies the primary causes of climate variability were changes in crop yields, crop diseases, water scarcity, and loss of soil fertility. Additional findings included a lack of labour, an unstable land tenure system, market access issues, poverty, a lack of government support, difficulty accessing assets, a lack of water sources, a lack of credit sources, and a lack of knowledge. Newport et al [66] discovered that attitudes about climate change had no effect on wheat-sowing dates, nor did farmers implement measures to adjust to rising temperatures. The type of irrigation and agricultural decisions made during the monsoon season before the winter wheat growing season were the most significant elements influencing wheat-sowing-date decisions. also discovered that delayed wheat sowing was linked to the use of canal irrigation as opposed to groundwater irrigation, the planting of rice during the monsoon season, the transplanting of rice, and the transplantation of rice later in the monsoon season.

Zero tillage

Laxmi & Mishra [67] one such technique is zero tillage (ZT), which can preserve resources while raising food production to satisfy future demand. Tripathi et al [68] examined the economics of wheat production in Haryana using conventional and zero-tillage methods. Additionally, the contribution of technology and inputs to the higher productivity resulting from zero-tillage (ZT) was evaluated. The ZT method yielded a higher net income than the conventional method, primarily because the production cost was lower. According to the study, ZT technology has the ability to help farmers earn more money and conserve finite resources. Kumar &Sidana [64] compared to non-adopters, the adoption of Zero Till wheat among various climate-resilient wheat cultivation technologies resulted in a 5% net return savings. To determine the technical farming efficiencies of wheat and paddy cultivation among adopters and non-adopters, data envelopment analysis was used. Compared to non-adopters, those who use climate resilient technologies are far more efficient. The main barriers to the adoption of climate resilient technologies were low-capacity building, credit availability, and a lack of technological understanding.

DISCUSSION

Laxmi & Mishra [67] Impact wheat variety on Farmers Income Intense rice-wheat farming has reduced land productivity and depleted resources while meeting the needs of the expanding population for food. Adoption of enhanced resource conservation methods is therefore necessary. These technologies appear to have potential for significant increases in output and revenue. Hailu et al [69] finding that the regression analysis also showed that adopting agricultural technology has a positive and significant impact on farm income, making adopters financially better off than non-adopters. Ahmed et al [70] study that productivity, cash income, labour, land use, and seed supply had all changed favourably in the production patterns. In some varieties, the productivity of the improved seeds was higher than that of the

local ones; in others, it was lower. This study produced some recommendations for raising small farmers' standard of living in the Bara locality as well as for increasing crop productivity and production. Wake and Habteyesus [71] to analyze the impact of the adoption of high yielding wheat varieties on smallholder farmer's revenue. The results showed about 9% increase in farmer's income by using high yielding wheat varieties as compared to those who were using local varieties for cultivation.

Singh et.al [72] The Indian government made the announcement in 2016 to double the farmers' income (DFI) by 2022 by putting more emphasis on income security than on agricultural productivity and food security. Farm household income comes from a variety of sources, including wages, crop production, raising livestock, and non-farm activities (such as well as trade, transportation, communication, and personal services in rural areas). Sendhil et al [73] analyse the pattern in wheat growers' income from 2006–07 to 2013–14, and then propose a plan to double farmers' income (DFI) by 2022. An environment for DFI will be made possible by the convergence of science, technology, institutions, and policy, with a focus on potential drivers such as improved genotypes that increase productivity. Roy et al [74] found that, in terms of both technical (or productivity) and economic efficiency, the best cultivars were HD 2967 wheat and PB 1121 paddy. Net return and benefit-cost ratio (BCR) between improved and local varieties differ significantly, as estimated by the t-test. According to the study, the lower Shivalik hills of Uttarakhand have seen a notable increase in productivity, farm income, and standard of living due to the benefits of improved varieties of major crops. Miah et al [75] study that because of seed was more expensive, had a larger storage capacity, and was stored in a plastic or metal drum, the farmers who kept their wheat seed in these containers had the largest net revenue/income. Significant changes have been brought about in the research fields by the wheat storage programme. Wheat area, productivity, and the collective financial gain of wheat growers all showed significant increases.

REFERENCES

1. Joshi. A.K., Mishra, B., Chatrath, R., Ferrara, G. O.& Singh, R. P. (2007). Wheat improvement in India: present status, emerging challenges and future prospects. Euphytica: Netherlands Journal of Plant Breeding.,157(3):431-446.
2. Keerley S. 2023, https://www.statista.com/statistics/1310589/india-wheat consumption-volume 15th Decemebr, 2023 @11.00a.m.
3. Evenson, R.E., Pray, C.E &Rosegrant, M.V. (1999). Agricultural research and productivity growth in India. IFPRI, Washington, DC.. USA.
4. Directorate of Wheat Research (2006). Project Director's Report: 2005–2006. B Mishra, Project Director, Directorate of Wheat Research, Karnal 132001, p 29.
5. FAO (2004). Statistical database.www.fao.org. Verified 4 January, 2007.
6. Fertiliser Association of India (2004). Fertiliser statistics 2002-2003. New Delhi: Fertiliser Association.
7. Mishra, P.,Sahu, P.K.,Dhekale, B.S., Vishwajith, K.P.(2015). Modeling and forecasting of wheat in India and their yield Sustainability, J. Econ. Dev., 11 (3):637–647.
8. Waddington, S., Lantican, M. & Tripp, R. (2012). Varietal Replacement and Evolving Seed Systems for Wheat and Maize in South Asia – A Scoping Study, A study report prepared for the CIMMYT Socio-Economics Programme, CIMMYT, Mexico, Draft April.
9. Devi, M., Kumar, J., Malik, D.P. &Mishra, P.(2021). Forecasting of wheat production in Haryana using hybrid time series model, Journal of Agriculture and Food Research.,5:100175.
10. Tesfaye, S.,Bedada, B. &Mesay, Y. (2016). Impact of Improved Wheat Technology Adoption On Productivity And Income in Ethiopia. African Crop Science Journal.,24(s1):127 – 135.
11. Pavithraa, S.,Mittal, S.,Bhatc, S.A.,Birthala, P.S.,Shahd, S.A.&Hariharane, V.K. (2017). Spatial and Temporal Diversity in Adoption of Modern Wheat Varieties in India. Agricultural Economics Research Review., 30(1):57-72.
12. Mazid, A.,Keser, M., Koffi, N. A., Morgounov,A., Bagci, A., Peker, K., Akin, M., Kucukcongar, M.,Kan, M., Semerci, A.,Karabak, S.,Altika, A.&Yakyubay, S. (2014). Measuring The Impact of Agriculture Research: The Case Of New Wheat Varities In Turkey. Exp Agric.1-18.
13. Byerlee, D.& Harrington, L.(1982).New Wheat Varieties and Small Farmers. CIMMYT, Mexico.
14. Dixon, J., Nalley, L., Kosina, P., La Rovere, R., Hellin, J. & Aquino, P. (2006). Adoption and economic impact of improved wheat varieties in the developing world. Journal of Agricultural Science., 144(6): 489-502.
15. Ephraim, C.(2005). Adoption of fertiliser and hybrid seeds by smallholder maize farmers in southern Malawi, Development Southern Africa., 22(1):1-12.
16. Matuschke, I.&Qaim,M. (2006).Adoption and Impact of Hybrid Wheat in India. World Development., 35(8):1422–1435.
17. Kumar, N., Godara, A.K., Malik, A. K., Kumar, R., Dhayal, B.L.&Jitarwal. O.P. (2021). Adoption level of wheat seed production technologies in north-west zone and south-west zone of Haryana. The Pharma Innovation Journal., 10(4S): 98-101.
18. Hassan, I.,Chattha, M. B., Chattha, T.H.& Ali, M.A. (2010). Factors Affecting Wheat Yield: A Case Study of Mixed Cropping Zone of Punjab. Factors affecting wheat yield in Punjab J. Agric. Res., 48(3): 403-408.

19. Muhammad, I., Muhammad, F., Zaman, Q., Muhammad, U., Sundus&Rahman, A.U.(2014). Effect of Various Factors on Wheat Production.Sarhad J. Agric., 30(1): 135-143.
20. Pandit, D.B.,Baksh, M. E.,SufIan, M. A.,Harun-Ur-Rashid, M.& Islam, M. M.(2007). Impacts of Participatory Variety Selection in Wheat on Agro-Economic Changes of Wheat Farmers in Bangladesh. Bangladesh J. Agril. Res. 32(3): 335-347.
21. Saroj, S., Kumar, A.& Joshi, P. K.(2022).Adoption of new wheat crop varieties in India: Status, determinants, and impacts, The Journal of Developing Areas. 56(3):247-270.
22. Nazu, S. B., Khan, M.A., Saha, S.M., Hossain, M.E. & Rashid, M. H. (2021). Adoption of improved wheat management practices: An empirical investigation on conservation and traditional technology in Bangladesh. Journal of Agriculture and Food Research. 4:100143.
23. Patel, M.D.,Dabhi, M.S., Patel, A.K., Desai, H.A.& Ram, C.(2018).Response of Wheat Varieties (*Triticum aestivum* L. and Triticum durum Desf.) to Sowing Time. Int.J.Curr.Microbiol.App.Sci.,7(10): 1555-1561
24. Nalley, L. L.,Kosina, P.,Rovere, R.,Hellin, J. & Aquino, P.(2006).Adoption and economic impact of improved wheat varieties in the developing world. The Journal of Agriculture Science.,144(06):489 - 502.
25. Abera T, Tsadik G W, Feyissa D, Yusuf H,Keneni G, (2005). Evaluation of Improved Wheat Varieties under Different Management Practices in Eastern Wallaga Highlands, Ethiopia. Pakistan Journal of Biological Sciences, 2005. 8: 849-854. DOI: 10.3923/pjbs.2005.849.854
26. Verma, A.K., Jeengar, K.L., Ram, J.&Naager, K.C.(2016). Popularization of high yielding varieties of wheat (*Triticum aestivum* L.) in Jhalawar district of Rajasthan state through Frontline Demonstrations. Journal of Wheat Research, 8(1):39-44.
27. Akbar, H., Ali, A., Shafi, M., Ahmad, B., Bakht, J. &Saeed. H. (2000). Comparative study of agronomic traits of old and new wheat varieties. Sarhad Journal Agriculture 16(1): 1-5.
28. Ahirwar, R.F.,Verma, A. K.& Shekhawat, L.S.(2015). Cost and income structure of wheat cultivation in Vindhyan Plateau of Madhya Pradesh. Economic Affairs. 60(1): 83-88.
29. Elsir, A. &Elamin, M.(2004). Analysis of Marketing and Pricing Policies on Technology, Input Use and Production of Wheat in the Sudan.In: Proceedings of 12th Regional Wheat Workshop for Eastern, Central, and Southern Africa. Nakuru, Kenya, 181-194.
30. Choudhury, B.U., Bouman, B.A.M. & Singh, A.K. (2007). Yield and water productivity of rice–wheat on raised beds at New Delhi, India. Field Crops Res., 100:229–239.
31. Nhemachena, C. R. &Kirsten, J.(2017).A historical assessment of sources and uses of wheat varietal innovations in South Africa. South African Journal of Science.,113(3/4):1-8.
32. Farooq, A., Ishaq, M.,Yaqoob, S.& Sadozai, K.N.(2007).Varietal Adoption Effect on Wheat Crop Producation in Irrigated Areas of NWFP.Sarhad J. Agric., 23(3): 807-814.
33. Sharma, R., Sharma, S.K. &Bhati, D.S.(2016). Factors affecting adoption of improved technology of wheat cultivation. Journal of progressive Agriculture., 7(1):33-37.
34. Dhanda, S., Yadav, A., Yadav, D.B.&Chauhan, B.S. (2022). Emerging Issues and Potential Opportunities in the Rice–Wheat Cropping System of North-Western India. Frontier in Plant Science., 13:832683.
35. Degaltseva ZV, Govdya VV, Velichko KA,(2021). Management of expenses for fertilizers and chemical plant protection products in the accounting and control system of agrarian formations .Journal of Water and Land Development., 2021; 49(IV–VI): 229–234.https://doi.org/10.24425/jwld.2021.137116.
36. Singh, P.,Choudhary, M.&Lakhera, J.P. (2014). Knowledge and Attitude Farmers Towards Improved Wheat Production Technology. Indian Res. J. Ext. Edu., 14 (2): 54-59.
37. Abda, N.(2022). Adoption of Improved Wheat Varieties by Wheat Producers in the Bale Zone of Ethiopia. International Journal of Agricultural Extension and Rural Development Studies., 9(2):1-19.
38. Kumar, N., Godara, A.K., Malik, A.K., Kumar, R.,Dhayal, B.&Jitarwal, O.P. (2021). Adoption level of wheat seed production technologies in north-west zone and south-west zone of Haryana., The Pharma Innovation Journal, SP-10(4): 98-101.
39. Sharma, V.R. &Jhamb, D. (2020). Impact of promotional activities and campaigns on buying decision of agricultural seeds. Custos E Agronegocio.,17(1):22-35.
40. Ullah, A.,Saqib, S.E. &Kächele, H. (2022). Determinants of Farmers' Awareness and Adoption of Extension Recommended Wheat Varieties in the Rainfed Areas of Pakistan.Sustainability.,14(6):3194
41. Kelemu, K.(2017). Determinants of Farmers Access to Information about Improved Wheat Varieties: Case of farmers in major wheat growing regions of Ethiopia. International Journal of Research in Agricultural Sciences., 4(1):43-50.
42. Sharma, V.K. & Jain, R. (2023). To study the constraints in adoption of recommended technology of wheat cultivation in Malwa Region of Madhya Pradesh. The Pharma Innovation Journal. 12(10S): 1442-1443.
43. Ndondi, R. V.,Kuwite, C .A.&Shekibula, R.(2004). On-Farm Evaluation and Comparison of New and Old Wheat Varieties.In: Proceedings of 12th Regional Wheat Workshop for Eastern, Central, and Southern Africa. Nakuru, Kenya, 125-133.
44. Kalsa, K.K.(2019). Farmers' attitudes and practices towards variety and certified seed use, seed replacement and seed storage in wheat growing areas of Ethiopia. African Journal of Science Technology Innovation and Development., 2021; 11:107-120. DOI:10.1080/20421338.2018.1550932

45. Mishra, G.,Mazhar, S. H. &Jahanara, J.(2021).Adoption Behaviour of Farmers Towards Wheat Varity SHUATS W-6, in Holagarh Block of Prayagraj District, Uttar Pradesh. International Journal of Advances in Agricultural Science and Technology., 8(9):61-69.
46. Subedi, S.,Ghimire, Y.N.,Adhikari, S.P.,Devkota, D., Poude, H.K.&Sapkota, B.K.(2019). Adoption of improved wheat varieties in eastern and western Terai of Nepal. Journal of Agriculture and Natural Resources, 2019; 2(1): 85-94.https://doi.org/10.3126/janr.v2i1.26047
47. Nazli H, Smale, M, (2016). Dynamics of variety change on wheat farms in Pakistan: A duration analysis. Food Policy, Elsevier. 2016; 59(C):24-33.DOI: 10.1016/j.foodpol.2015.12.009
48. Battese, G.E., Nazli, H. &n Smale, M. (2014). Productivity and Efficiency of Farmers Growing Four Popular Wheat Varieties in Punjab, Pakistan. Washington, DC: Harvest Plus and International Food Policy Research Institute.
49. Glenna L L, Jussaume R A, Dawson, J C, (2011). How farmers matter in shaping agricultural technologies: Social and structural characteristics of wheat growers and wheat varieties. Agriculture and Human Values. 2011;28(2): 213-224. https://doi.org/10.1007/s10460-010-9275-9
50. Fatima H, Khan M A. (2015). Influence of wheat varieties on technical efficiency and production of wheat crop in Pakistan (In selected area of Punjab). Sarhad Journal of Agriculture, 2015; 31(2): 114-122. http://dx.doi.org/10.17582/journal.sja/2015/31.2.114.122
51. Gandhi, V.P., &Koshy, A.(2006). Wheat Marketing and its Efficiency in India.India Institute of management Ahmedabad india. Research and Publication,p 1-34.
52. Mishra, C.N., Sharma, A., Kamble, U., Singh, S.K., Singh, G.P. (2022). Accelerating Varietal Replacement in Wheat Through Strengthening of Seed Systems. In: Kashyap, P.L., et al. New Horizons in Wheat and Barley Research . Springer, Singapore. p 63-79 https://doi.org/10.1007/978-981-16-4449-8_4
53. Sendhil, R. et al. (2022). Wheat in Asia: Trends, Challenges and Research Priorities. In: Kashyap, P.L., et al. New Horizons in Wheat and Barley Research . Springer, Singapore. p 33-61 https://doi.org/10.1007/978-981-16-4449-8_3
54. Rasheed, S.&Venkatesh, P(2022). Status of Wheat Variety Protection in India: Implications and Future Directions. New Horizons in Wheat and Barley Research, Springer. p 81-92.
55. Begna, B., Kalsa, K.K., Solomn, T., Esatu, A., Atilaw, A., Gemechu, A., Tilahun, D., Usman, S. &Zeberga, A. (2015). Characterization of the seed demand dynamism in wheat growing areas of Ethiopia .Journal of Biology, Agriculture and Healthcare., 5(15):32-37.
56. Kumar, A., Patel, V. M., Patel, R. R. &Bindage, A. (2014). Marketing costs margins and price spread of wheat in Banaskantha district of Gujarat State. Indian Journal of Agricultural Marketing., 28(2):1-14.
57. Chauhan BS, Mahajan G, Sardana V, Timsina J, Jat M L. (2012). Productivity and sustainability of the rice-wheat cropping system in the Indo-Gangetic plains of the Indian subcontinent: Problems, opportunities, and strategies. Advances in Agronomy. Edited by Donald L. Sparks. San Diego United States: Academic Press.315-369. https://doi.org/10.1016/B978-0-12-394278-4.00006-4
58. Bishawa, Z. &Alemub, D.(2017). Farmers' perceptions on improved bread wheat varieties and formal seed supply in Ethiopia. International Journal of Plant Production., 11(1): 117-130.
59. Habte Z, Legesse B,, Haji J, Jaleta M,(2020). Determinants of Supply in the wheat value chain of ethiopia. Eastern Africa Social Science Research Review., 2020; 36(1): 37-61 https://doi.org/10.1353/eas.2020.0002
60. Kumar, S., &Puran, C.(2004). Prevailing practices and dimensions of contract wheat seed farming in Haryana state. Agriculture Economics Research Review., 17(2): 149-161.
61. Joshi K D, Rehman A U, Ullah G, Nazir M F, Zahara M, Akhtar J, Imtiaz M, (2017). Acceptance and competitiveness of new improved wheat varieties by smallholder farmers. Journal of Crop Improvement, 2017;31(4): 608–627. https://doi.org/10.1080/15427528.2017.1325808
62. Reidsma P, Ewert F, Oude Lansink A G J M, Leemans R, (2010). Adaptation to climate change and climate variability in European agriculture: The importance of farm level responses. European Journal of Agronomy, 2010; 32(1): 91-102. https://doi.org/10.1016/j.eja.2009.06.003
63. Singh, N., &Leua, A.K. (2017). Adoption and Climate Change; Challenges for doubling the farmers income. Indian journal of Economics and development. 13(2):437- 442.
64. Kumar, S. & Sidana, B. K. (2017). Enhancing Farmers' Income through Climate Resilient Technologies. Indian Journal of Economics and Development, 13(4): 609-618.
65. Shah F, & Jianling W, (2018). Farmers' risk perception, vulnerability, and adaptation to climate change in rural Pakistan. Land Use Policy, Elsevier, 2018; 79(C): 301-309. DOI: 10.1016/j.landusepol.2018.08.018
66. Newport D, Lobell B, Singh B, Srivastava A K, Rao P, Umash aanker M, Malik R K, Mcdonald A, and Jain M,(2020).Factors Constraining Timely Sowing of Wheat as an Adaptation to Climate Change in Eastern India. Weather, Climate, and Society, 12(3): 515-518. DOI:10.1175/WCAS-D-19-0122.1
67. Laxmi, V. & Mishra, V, (2007). Factors Affecting the Adoption of Resource Conservation Technology: Case of Zero Tillage in Rice-Wheat Farming Systems, Indian Journal of Agricultural Economics, Indian Society of Agricultural Economics, 62(1):1-13.
68. Tripathi, R.S., Raju, R. & Thimmappa, K.(2013). Impact of Zero Tillage on Economics of Wheat Production in Haryana, Agriculture Economics Research Review.,26(1):101-108.
69. Hailu, B.K., Abrha, B.K. & Weldegiorgis, K.A. (2014). Adoption and Impact of Agriculture Technology on Farm Income. Evidence from Southern Tigray, Northern Ethiopia, International Journal of Foodand Agricultural Economics., 2(4): 91-106.

70. Ahmed, E.E.B., Maryoud, M.E., Elkhidir, E.E. & Mahmoud, T.E.(2013). Impact of improved seeds on small farmers productivity, income and livelihood of bara locality in north kordofan state, Sudan. Russian Journal of Agriculture and Socio-Economic Science, 20(8): 3-10.
71. Wake, R.D. &Habteyesus, D.G. (2019). Impact Of High Yielding Wheat Varirties Adioption On Farm Income Of Smallholder Farmers In Ethiopia. Int. J. Agr. Ext., 7(1):45-59.
72. Singh, G. P.,Sendhil R., Kumar, A., Singh, S.& Tripathi, S. C.(2018). Doubling farmers' income by 2022: pathway and strategies for wheat producers, Indian Farming, 68(01): 24–26.
73. Sendhil, R., Kumar, A., Singh, S., Chatrath, R.& Singh, G. P. (2017). Framework for Doubling the Income of Wheat Producers' by 2022: Trends, Pathway and Drivers. Indian Journal of Economics and Development, 13(2a):1-8.
74. Roy P, Hansra B S, Burman R R, Roy T N, Bhattacharyya S, Kumar P, (2021). Impact of improved varieties on farmers income: Insight from lower Shivalik hills. The Indian Journal of Agricultural Sciences, 2021; 91(11): 1612–1616. https://doi.org/10.56093/ijas.v91i11.118542
75. Miah, M.A.M.,Islam, Q. M. S.,Baksh, M. E., Ross, F. J.&Tiwari, T. P. (2018). Impacts of wheat seed storage at poor household level in Bangladesh. Bangladesh J. Agril. Res., 43(2): 345-360.