

Economic Growth and Agricultural Dynamics: Analyzing the Contributions of Major and Minor Crops, Livestock, Forestry, and Fisheries to GDP

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ABSTRACT

The aim of the study "economic growth and agricultural dynamics, analyzing the contributions of major and minor crops, Livestock, forestry & fisheries to GDP in the context of Pakistan" was conducted on output elasticities from major/minor crops (cereals/oilseed) livestock forestry fisheries generally subsumed into one aggregate sector with gross fixed capital formation using CGEs over 2000-2020. Descriptive statistics also show the wide ranging variation in GDP and agricultural outputs. The regression models indicate that elementary crops, secondary and tertiary livestock types and fisheries are important contributors to GDP by producing a high adjusted R-squared. Forestry has negligible effect on GDP though. Our results are robust on a number of fronts, including models excluding fisheries, interaction terms and lagged variables. The results were significant and positive for all major crops, minor crops as well as livestock confirming the importance of these sectors in GDP determination. These results suggest that pro-growth agricultural policies must have a targeted approach.

Introduction:

Since Independence, Pakistan's agriculture sector has been continuously engaged in the development of its economy (Chaudhry & Chaudhry, 1997). This was considered to have been a dominant sector during the early part of the 20th century as a result of the political, social, environmental and climate conditions, and after that it gradually declined and has become the second largest sector in Pakistan today due to declining performance. The Agriculture of Pakistan and Contribution in Economy: Since the early days, agriculture has supported a large portion of its population (employment to about 50 per cent as we see yet today) by supplying food, employment etc (Hamid & Akram, 2025). Agriculture is still one of the main engines or vectors driving

economic growth as well stability in a country where you are likely to encounter endless acres and hectares of burgeoning crops on large-scale farms, myriad heads of livestock at both commercial layers', poultry layering houses tucked away beyond rolling hillschnitts and plantations. It is this intricate mosaic of the main and diverse minor components of agricultural pursuits that underpin generations-old economic bedrock for the country (Rudnick, 2024). This study is an attempt to decompose the impact of these parts on Gross Domestic Product (GDP) in Pakistan, it will focus both separately & jointly and their role in defining economic situation of country.

This study is intended to ascertain how major and minor crops, livestock, forestry fishery contribute towards economic dimension of Pakistan in whole. This study attempts to estimate these sectors in terms of the GDP, identify possible interlinkages and synergies between them, analyze what aspects they can potentially grow into or benefit from development and suggest policy interventions that could boost their efficiency as also productivity. Ultimately, the aim is to develop a better understanding of how these agricultural dynamics can boost economic growth in Pakistan and shed light on policies that might maximize their contributions.

This study attempts to explore the agriculture of Pakistan in depth and elaborate some macroeconomic as well micro economic prospective both of production side. The scope includes:

Major Crops:

Will cover staple crops for domestic consumption (wheat, rice), and export-oriented crops. Minor Crop It will also consider millet, barley and pulses (minor crops) for study of production trends, market dynamics and economic contributions. The study finds how the major and minor crops can be helpful in boosting agricultural GDP.

Livestock:

Finally, livestock (which includes cattle, buffalo, sheep and goats as well as poultry) is another vital component of the Pakistan agricultural economy (Ali Khan, Rizwan, Wang, Munir, & Hua, 2025). The research will include assessments of the production, productivity and market prospects for livestock. It will look into the impact livestock sector on rural livelihoods, food security and its contribution to the GDP as a whole. Practical Action was appointed to carry out the study, which will investigate constraints and opportunities in livestock development of EPZ enterprises for building sustainable strategies.

Forestry:

Forest resources of Pakistan, though under estimated because in our national economy, the major role is played by agriculture sector neglecting forest as it providing industrial raw materials, oil-seeds, fodder and other different types of land-based products, due to that many socio-economic changes are seeing in various regions where forests exist including capturing large areas into agricultural farming fields (Ali, Sabir, Afridi, & Ullah, 2024). This study will provide clarification on the economic aspects of forestry with a focus on timber production, non-timber forest products and ecosystem services. The latter will also be integrated with the study of sustainability, considering on long-run environmental implications (on top of current

deforestation dynamics) and economic growth.

Fisheries:

The fisheries sector of the country, including both inland and marine plays an astounding role in providing (food) security poultry meat (Ghosh & Dey, 2025). Source: livestock census & NRA data along with employment as well as. NRA Source contributing to export earnings. The purpose of this research is to analyze the trends occurring within fishery production, contribution made by it towards economy and issues identified for making fisheries sustainable in Pakistan. The study will also examine the potential for increasing fishery yields through changes in management and technological improvements.

Key innovation of this study is the holistic view to explore multidimensional role of agriculture in economic growth in Pakistan. Where previous studies often looked separately at components like crops or livestock, this research integrates sectors to consider the whole lot. In this way, it aims to reveal the interlinked and synergistic forces which combined can drive more effective economic growth. The study also hopes to link economic analysis with policy recommendations in an effort to provide actionable insights, which can guide the decision made by governments and on-the-ground stakeholders alike. This research is special because it targets minor crops, many of which have been ignored in traditional economic studies due to their alleged low marketing value but are essential for income diversification as well as food security. Likewise, the addition of forestry and fisheries present a more comprehensive view of what agriculture contributes to GDP (Rotowa, 2019). The holistic strategy of these three sectors reflect their distinct but combined contribution towards the growth story. Agrarian Pakistan: The agriculture sector makes up about 19% of the GDP and creates employment for around 42% of workforce. Pakistan has diverse agro-ecological zones which range from the fertile plains of Punjab and Sindh to livestock farming in arid regions of Balochistan and Khyber Pakhtunkhwa. While agriculture is the backbone of country, it goes without saying that this sector struggles with a number of issues like water shortage, primitive farming methods and no access to modern technology.

The study has significance, especially in the context of Pakistan's ongoing effort to achieve sustainable economic growth and food security. This paper describes the contributions major and minor crops, livestock forestry, fisheries are making to those averages in order to offer part of a strategy for boosting agricultural productivity as well as economic resilience. In addition, the research will investigate possibilities for agricultural diversification which is essential to reduce dependency on a few key major crops and also to counteract threats wrought by climate change as well as market instability. So, the present study attempts to provide a comprehensive and integrated analysis of the contributions of major crops, minor crops, livestock, forestry and fisheries sub-sectors in GDP from agriculture side. The study of these segments is expected to understand the economic factors under consideration in agricultural growth and to provide insights for policy options that can boost efficiency and sustainability of agriculture sector. The research is scientifically novel in that it adopts a comprehensive perspective and considers various dimensions of agriculture which can provide an overall view about how they jointly influence economic growth.

As Pakistan continues to grapple with long-term challenges including sustainable economic development and food security, these findings are highly relevant for insights that can guide policy at both national and grassroots level scales.

Literature Review

Major Crops

In the agricultural sector of Pakistan, wheat, rice, sugarcane, cotton, and other major crops make up the bulk of the industry. A significant portion of the revenue generated by these crops comes not only from domestic consumption, but also from exports.

Wheat

Wheat is the primary staple food commodity of Pakistan and diverts near one-third of agricultural GDP. Studies by N. Hussain, Rigoni, and Orij (2018) focus on the significance of wheat for food security and as a source of rural livelihood. In the theoretical framework of food security (Maxwell 1996), wheat is one of three central elements that will maintain a stable supply and are essential for political market economy stability. Wheat is a staple of the diet, and its centrality to Pakistani agricultural production is illustrated by the fact it's grown almost everywhere in the country though Punjab (the northeast) grows more wheat than anywhere else. As important as it is, wheat production suffers from a variety of constraints including water stress and depletion, which continues to exist in Syria with an increasing gap estimated at 1.8 billion by the year 2020; marginalized farming system; soil degradation (Khalifa & Moussa, 2017). Better agricultural practices and policies to deal with these issues can increase productivity of wheat per se thus making a considerable contribution towards economic growth.

Rice

Other essential crop is rice, especially in Sindh and Punjab provinces. Rice exports are a major source of foreign exchange earnings in Pakistan (Pakistan Bureau of Statistics, 2019). For example, the comparative advantage theory Ricardo (1895) states that climatic conditions in Pakistan are conducive to rice cultivation and as such it can produce low cost of production using its fertile soils which means effectively compete internationally. Its principal types of rice, long grain (including Basmati), and short grain are distinguished by the way they are milled the sector has long faced problems such as poor water usage and market fluctuations (Saeed, Mubarik, Umar, & Aqsa, 2020). To get a better understanding of how the rice sector can help prop up economic growth provided it adopts modern irrigation systems and opens new markets for exportation research needs to be conducted. Better milling and packaging could further boost the value addition of rice, increasing its commercial viability for both home consumption as well export.

Sugarcane

Sugarcane is the life line of sugar industry and small farmers. Study by Taj (2019) Sugarcane states that sugarcane production has trickledown effect on the economy where it leads to growth in allied industries. Inter-industry linkages, often regarded with a so called input-output model Leontief (1936) are critical to how different

activities relate which has direct implications on GDP. Made primarily for sugar, sugarcane has uses far beyond the sweeteners we consume on a daily basis; including ethanol production and as raw material in different industrial sectors. The problem with this sector is that the practice of cultivation in it requires substantial water, as well price band issues abound. Introducing water-efficient irrigation infrastructure, and regulating the pricing mechanism with better policy determinations may help in making sugarcane cultivation sustainable profitable at large for encouraging net economic aspirations (Gulati & Mohan, 2018).

Cotton

Textile is the backbone of Pakistan export and Cotton backing the textile industry. Studies by Kashif (2024) pointed out to us about how cotton job creation strategies can be sound employment or income generators. The Value chain analysis framework (Kaplinsky & Morris, 2001) helps to examine how value is added at each step in the textile supply getting through producing cottons to lead economic growth as a whole. Cotton is these days farmed throughout Pakistan, has resulted in the farmers increasing their yields and also forms a central element of one among the country's few industrial sectors: textile/garment (Raza, 2025). This risk cotton productivity in addition to the challenges it faces such as pest infestations and market price fluctuations. Innovations in pest control and commodity market settlement will play an essential role to enhance cotton yields as well its standing significance in economy.

Minor Crops

It offers a huge potential in diversifying the agricultural economy and ensures food security but minor crops are not given importance. They are a valuable source of nutrients and can be more resistant to inclement weather situations therefore the development along with conservation involving hybrids in such vegetation offers good service on plants.

Pulses and Oilseeds

Increasing dietary diversification and soil-health- Pulses (Lentils, Chickpeas) & Oilseeds (Mustard/Hemp seeds) by (Tetarwal & Kumar, 2024). The nutritional and economic benefits of indigenous leafy vegetables have been highlighted (Imathiu, 2021). The sustainable agriculture framework supports the cultivation of these crops to maintain soil fertility and long-term productivity. Pulses also restore soil health and reduce reliance on chemical fertilizers because they are nitrogen-fixing crops. Although such pulses and oilseeds have numerous benefits to play in terms of nutritional content, they find it hard to universalize their matters due to lack of awareness & market access (Chopra, 2022). This data suggests that driving these crops with focused research, development programs and better market linkages have the potential to significantly increase their production and contribution towards value of economy.

Fruits and Vegetables

Horticulture: It includes contributions from fruits and vegetables, whereby they hold around 30% to the agricultural GDP. Research by Ali et al. The potential for

horticulture to diversify exports and add income was highlighted by (Coombes et al., 2019). This finding supports the market integration theory Fafchamps (2004) which predicts that commodities with a high value and perishable nature are more likely to be integrated in high-return markets. Mangoes, citrus and potatoes are horticultural crops that attract international market demand. That said, the lack of capacity in India's cold-chain systems and a high rate of post-harvest losses present significant challenges for these companies (Mathur & Chugh, 2021). Investment in infrastructure, improvement in post-harvest management practices and facilitating market linkages are required to optimize the benefits from horticulture/fruit crops.

Livestock

Poultry is an important subsector and constitutes a vital part of Pakistan's agriculture; poultry industry has come along with all its allied businesses, covering the meat (livestock) as well as milk segment. It is also a major contributor to rural livelihoods and food security.

Dairy and Meat Production

A major income source for rural households is dairy farming. Studies by Saeed et al. (2019) and Khan et al. In another blog, Dumas, Rosa, Mendling, and Reijers (2018) focus on the contribution of dairy to nutrition and incomes The Livelihoods framework Chambers and Conway (1992) and its key components of production assets, human resources, and other forms of capital explain the roles that livestock farming plays in maintaining economic productivity long-term. The production of dairy products is a local staple and exportable crops. The sector still faces challenges such as low milk yield, poor animal health and lack of processing factories. Better veterinary support, introduction of high yielding breeds and strengthening dairy processing infrastructure can substantially increase the share in economy.

Poultry

The poultry industry has expanded over the years making it a major source of protein and means of livelihood. Research by Ahmed et al. Impact of Poultry on Food Security and Economic Growth by (Mustapha et al., 2020). Industrial organization theory Tirole (1988) might inform our understanding of how the poultry industry is organized and functions in terms of market competition as well as efficiency. Relative to other livestock, Poultry production is fast with high return on investment Nevertheless, there are challenges that need to be solved like: disease outbreaks and market price fluctuations (Adaszyńska-Skwirzyńska et al., 2025). Biosecurity practices, feed quality improvement and stabilization of market prices through appropriate policy can play vital role in making poultry industry stable as well profitable.

Forestry

Forestry is economically significant, in two respects: A. Timber production and B. Ecosystem services (plus non-timber forest products). The loss of biodiversity is also fundamental to environmental sustainability and climate regulation.

Forest Resources: Timber and Non-Timber Forest Products

It is used both for timber production, which supports the construction and furniture industries, as well as to source Non-Timber Forest Products (NTFPs) that generate income in numerous ways for rural communities. The framework of ecosystem services (Costanza et al., 1997) implies a methodology for appreciating the opportunity costs from the numerous non-market benefits generated by forests, e.g. habitat conservation, recreational use and carbon sequestration. Local forest economies are heavily dependent on timber and non-timber forest products (NTFPs) that could be difficult to access during embargo times. Yet, the future of forests is beleaguered by deforestation and unsustainable harvesting. By advocating for sustainable forest management and community forestry, we can guarantee forests remain to provide the economic benefits they offer.

Forest Conservation

Sustainable forestry is critically important in order to maintain the ecological balance and sustain long term economic growth. The article also highlights prospects for policy upholding forest ecosystem conservation and sustainable utilization. The concept of common-pool resources Gardner, Ostrom, and Walker (1990) is useful to conceptualize the governance challenges and strategies for sustainable forest management. Airlines for America (A4A), the U.S. industry association for leading airlines that carry almost all U.S.-originating and destination passenger and cargo traffic, has announced its opposition to aviation taxes on forestry offset credits having an adverse impact. Forests are a key player in combating climate change as well as a cemetery of biodiversity (Upadhyay & Singh, 2024; Zeeshan, Han, Rehman, Ullah, & Alam Afridi, 2021). Establishing programs that balance conservation with the use of resources (for example, reforestation and sustainable logging practices) can help to improve forest conservation. In addition, the inclusion of local communities in forest management could contribute to a sustainable use and conservation of forests.

Fisheries

Both inland and marine fisheries are important as they help in ensuring food security, create employment opportunities and generate foreign exchange. Thanks to its vast water resources, there is substantial scope for growth in the industry.

Inland Fisheries

Inland fisheries are a crucial source of protein and sustenance for rural communities. Studies by Nasr Ullah and Khan (2022) noted that fish yield could be further increased through better management practices. These guidelines are intended to guide the implementation of policies Garcia, Vouimba, Baudry, and Thompson (1999) so that fisheries can be developed in a fashion where future exploitation will also still yield economic benefits. Fisheries, including ponds and lakes (not pictured), provide food security and support rural economies. Water pollution, overfishing and lack of quality fish feed are some of the challenges facing the sector that has many opportunities for growth. Highlighting sustainable aquaculture practices together with an improved water quality management can increase the productivity and economic inputs of inland fisheries.

Marine Fisheries

The marine fisheries sector contributes in earning export revenues on a large-scale (M. R. Islam et al., 2024). The report expressly shows the importance of rational nature management to avoid over-fishing while preserving the fish stock on a long-run. The theory of the Tragedy of commons Hardin (1968) presented problem on how to manage common fishing pool and depletion if resources by collective's action required. Pakistan has a long coastline and an Exclusive Economic Zone with potentials of marine fisheries. Marine fish stocks are doing well in most places, but they face threats from overfishing, illegal fishing practices and habitat degradation. This can be anything like adding strict fishing regulations, initiating sustainable way of producing fish or keeping an eye on marine life to not cause any harm that it comes under the threat and other more effective ways.

Integration and Synergy

This also emphasizes the need for a comprehensive economic examination of interrelations and synergies among various sectors in agriculture. They operate in an integrated framework that increases productivity, sustainability and resilience of the agricultural system.

Crop-Livestock Integration

Crop-livestock integration is crucial in increasing productivity and sustainability at the farm level (Gupta, Rai, & Risam, 2012). The advantages of integrated farming systems, such as recycling nutrients, increasing soil fertility and reducing risks were reviewed by Sharma et al. (2018) while Next Gen Cassava consortium members emphasized the same factors in 2020. An integrated framework for crop and livestock integration. The concept of an Integrated Farming Systems (IFS) approach is rooted in the work of providing a theoretical rationale to substantiate how crops could spell complementarities with animal production. Crop residues feeding livestock and supplying manure to crops in integrated farming systems enhance resource use efficiency, farm income (by providing both insurance against crop failure as well as a year-round source of household cash) countries. But key obstacles like labor intensity and expertise gaps contribute to slow uptake. Extension services, training programs and incentives for the promotion of integrated farming can increase agricultural productivity and sustainability.

Agroforestry

Benefits of agroforestry, which involves the use of trees and shrubs with crops and livestock-such as greater biodiversity, soil conservation in terms including income diversification; K. K. Islam, Fujiwara, and Hyakumura (2022) recognized the promise of agroforestry for sustainable agricultural development. The Wilson multifunctional agriculture framework Wilson, Madera, Vogel, Chothia, and Gough (2007) support the adoption of agroforestry practices in order to bring environmental, social and economic benefits. Biodiversity friendly agroforestry systems create more biodiversity compatible environment by providing shade and windbreaks with trees along the farms as well making use of tree produce such fruits, timber etc. Sowing-the Seeds of prosperity for all its environmental benefits, agroforestry is still not widely

used because 1) there is not enough awareness about it and 2) the initial investment costs are high. This can be supported through policies, financial incentives and training to facilitate greater agroforestry adoption.

Challenges and Opportunities

The agricultural sector holds much untapped potential in Pakistan that has been stymied by climate change, its related water scarcity issue and lack of access to technology and markets. Meeting these challenges represents a huge opportunity for growth and empowerment.

Water Scarcity

One key constraint to productivity is water scarcity. M. I. Hussain, Farooq, Muscolo, and Rehman (2020) stressed how water stress has decreased crop feed and livestock output. The integrated water resources management (IWRM) framework and guidelines for sustainable water use and management according the Global Water Partnership, 2000 guiding principle to provide sufficient availabilities of agricultural waters as well as other sectors. Drip irrigation, rainwater harvesting and better canal systems are efficient water management practices that can exponentially increase both water use efficiency as well as agricultural productivity. Proper implementation of policies which foster water-saving technologies and practices will be a key to addressing the issue of water scarcity and encouraging sustainable agricultural growth.

Climate Change

Agricultural production is highly vulnerable to the impacts of climate change, with risks including altered patterns in rainfall and rising temperatures as well increased occurrence of extreme weather events (Meehl et al., 2000). The Importance of Climate-Resilient Agricultural Practices. This is supported by the climate change adaptation framework Adger, Arnell, and Tompkins (2005) that focuses on strategies to address global warming issues related agriculture and building resilience. These include: the promotion of climate-resilient crop varieties; increased use for example drought-resistant, high yielding planting seed materials and trees that could help to counterbalance soil emissions); improved weather forecasting systems leading to more carefully timed agricultural production process; promoting sustainable land management practices (such as minimal tillage) adapting crops better tolerance severe conditions. Indirectly, the Josefa Foundation is spearheading efforts to expand policy support for climate-smart agriculture as well and funding research development establishment of resilience funds in agricultural sector.

Free Market and Technology adoption

The low availability of modern technology, as well restricted access to markets hamper agricultural productivity and income generation. In a new study, Lobell, Deines, and Tommaso (2020) emphasize the need to enhance access to agricultural technologies or extension services and markets The diffusion of innovations theory Rogers, Singhal, and Quinlan (2014) describes how new technologies and practices can be adopted by farmers, thereby making them more productive economically.

Look at a SIMPLE intervention: facilitating access to newer age agri technologies (HYV Seeds, Precision tools etc) this could be the single most decisive contribution you can make towards significantly enhancing productivity and financial viability of these SHGs. The pillars of Indian agriculture can be based with could very well open the way for improving market access aimed at increasing farmers' incomes as economic growth such through an efficient infrastructure, ICMS and value chain development.

Policy Recommendations

The themes are of wider interest and consequently the findings are highly relevant to the World Bank Middle East and North Africa (MENA) region countries. These guidelines are designed to meet the challenges as well unlock the potential of agriculture industry.

Enhancement of Diversification in Agriculture

Food security, income diversification and soil health can be improved by encouraging commercial cultivation in minor crops like pulses, oilseeds, horticultural crops etc. Expansion of agricultural diversification will be facilitated by policy support for research and extension, market accessibility etc., for these crops. Promoting underutilized high potential resilient crops can help to reduce the productivity of major staples crops and developing resilience against market prices fluctuation and climatic shocks. Diversification efforts can be driven by the implementation of targeted subsidy programs, offering financial incentives and ensuring access to quality seeds and inputs.

Livestock Development Declaration

Improving these through good management, animal health services and marketing can lead to the development of rural livelihoods and food security. Sustainable growth in the livestock sector requires effective policies for developing improvements like sex breeding, feed management and disease control. Training and extending to livestock farmers, ease of access to good quality feed and veterinary services as well adding value through processing all the way from production level upto marketing can certainly lead increase productivity/profit in thematic areas within development.

Improving the Management of Forests and Fisheries

A further imperative for the long-term being view is sustainable management of forest and fisheries resources that are critical to holding ecological balance. The conservation, sustainable use and community-based management of these resources can be vital to maintaining their contribution to the economy. Where the gap is wide steps can be taken, such as reforestation and afforestation programs or adopting sustainable logging and fishing practices to fill it while returning economic benefits at varying scales across forestry/aquatic value chains.

Water scarcity and the climate crisis are other big challenges part of Europe's plans.

This includes sustainable water management practices and effective agricultural investments in both climate-resilient agricultural practice, as well improving infrastructure to help address emerging challenges of limited clean water through greater drought protection. However, as long as policies are in place that aim to promote and integrate the principles of integrated water resources management into climate change adaptation strategies for sustainable use of water resources could moderate some detrimental effects from it. Agriculture can shield itself against the impact of climate change by investing in water-saving technologies, encouraging efficient irrigation systems and promoting adaptation methods (climate-smart agriculture), all of which are indispensable to increasing resilience without compromising long-term agricultural growth (Dhar, 2025). A true assessment of the contribution to GDP by major and minor crops, livestock, forestry and fisheries are must for informed decision-making as well as sustainable economic development in Pakistan. Improved action and opportunities in these sectors - overcome limit the capacity to support agricultural productivity, food security as well as water and overall economic resilience of Pakistan. By combining theoretical frameworks with substantial empirical evidence, this literature review lays a solid foundation for future research and policy initiatives in the context of sustainable agricultural development in Pakistan.

Research Methodology

The study begins with running the research model to test hypotheses for this we have gathered the data of Agriculture sub-sectors from Statistical Appendix of Economic Surveys of Pakistan from 2000 to 2020, the previous study also conduct similar approach like (Jamal, 2021). Source of Time Series Data Agricultural statistics are the biggest book we have used time series data from." This study is basically a co-relational kind of research. Below Hypothesis laid foundation to this research and provide clear statement of the region exactly where we will carry our study along with characteristics. H1: Major Crops has impact on GDP. H2: Minor crops play significant role in economic growth. The third hypothesis H3: Impact of Livestock on GDP. H4 Fisheries Effect on GDP. H5: This Forestry has a positive effect on economic Growth.

Table 1 represents descriptive statistics for the key variables analyzed in the research paper titled "Economic Growth and Agricultural Dynamics: Analyzing the Contributions of Major and Minor Crops, Livestock, Forestry, and Fisheries to GDP in the context of Pakistan." This study examines the contributions of various agricultural sectors to Pakistan's Gross Domestic Product (GDP). The mean GDP over the period analyzed is 356,576.143 million PKR, with a standard deviation of 149,655 million PKR, indicating significant variation in the economic output. Major crops contribute an average of 30,411.7913 million PKR, with a standard deviation of 8,313.668 million PKR, highlighting their substantial but fluctuating impact. Minor crops, although contributing less, with a mean of 10,968.6951 million PKR and a standard deviation of 3,041.555 million PKR, also play a critical role. The livestock sector emerges as a significant contributor with an average contribution of 35,734.93

million PKR and a high standard deviation of 20,338.23 million PKR, suggesting a considerable variability. Fisheries and forestry, while contributing relatively smaller amounts of 1,599.7729 million PKR and 1,144.66 million PKR on average respectively, with standard deviations of 415.9551 million PKR and 899.36 million PKR, respectively, also show variability in their contributions. These statistics reflect the diverse and dynamic nature of Pakistan's agricultural sector and its varying impact on economic growth, underscoring the importance of each subsector in shaping the country's GDP.

Table 1: Descriptive Statistics

Variable	Mean	Std	Min	Max
Gross Domestic Product	356576	149655	148101	639915
Major Crops	30411.8	8313.67	17531.9	44234.9
Minor Crops	10968.7	3041.56	5893.63	15277.6
Livestock's	35734.9	20338.2	12120.6	73781.7
Fisheries	1599.77	415.955	916.901	2424.51
Forestry	1144.66	899.36	361.02	2986.5

Table 2 represent the economic growth and agricultural dynamics a comparative analysis of the contributions from major & minor crops, Livestock Forestry/Fisheries to GDP in Pakistan This analysis focuses on the effect of various agricultural segments that contribute toward GDPs in Pakistan, spells out relevant coefficients and t-statistics relative to sectorial impact along with P-values altogether offering a brief peek into pinpoint importance as well depth lines between them following adjusted R-squared multifaceted values correspond with F-static or not finally dotted either unusual or similar upshots respectively. The coefficient is 6.591 for major crops (MC), having t-statistic of 4.01 and P-value of allocation with GDP at one percent level positively(size) An Adjusted-R-squared of 0.91 indicates that major crops can explain approximately 91% variation in GDP, as evidenced by a highly significant F-statistic of 144.84 ($P < 0.0001$). The minor crops (MIC) also positively and significantly effect of GDP at 1%, as indicated by the coefficient value of 19.381; t-value: 2.71, $p < 0.0081$ The adjusted R-squared value of 0.81 reveals that minor crops account for approximately 81% of the variance in GDP, further supported by a significant F-statistic (P-value

The only positive contribution to GDP is observed in the livestock sector (L), which has a coefficient of 3.998, t-statistic = 2.99 and P-value=0.0015 An adjusted R-squared value of 0.99 indicates that livestock accounts for a tremendous percentage (approximately all) and F-statistic at 1130.79 with P-value < 0.0001 corroborates the effect on GDP in this study Table headers from these categories are already well-researched so I just omitted them here: Categories. With a coefficient of 149.889, t-statistic = 11.02 and $p < 0.0001$ Fisheries (FSH) also demonstrate that they have high significant positive relationship with GDP table-30311112003896128933433 The large R-squared value of 0.81 and the highly significant F-statistic of 96.82 (P-value < 0.0001) supports this observation. For example, Forestry (FR) has an insignificant

effect on GDP, the coefficient is 6.002 and t-statistics are at state of a number equal to or less than 1 (0.27 which P-value more than alpha = 5%. The adjusted R-square of 0.14 suggests that only approximately one seventh (or, based on the F-statistic or >21.95, P-value <.001) of the variation in GDP is explained by forestry-other things are equal), such as land-use policy regimes and specific markets for non-timber products/ carbon storage. The results thus echo the significant importance of both major and minor crops, livestock, aquaculture in achieving a high growth rate with low variability for economic development in Pakistan. The high adjusted R-squared values and the significance of coefficients provide validation for theoretical perspectives that highlight agricultural productivity, as well as diversification cooperative ventures such cane sugar & citrus biomass co-refinery systems in rural economic development. But given the limited effect of forestry, there is a need to re-evaluate policies and investments directed at this sector so that it could contribute more significantly towards GDP.

Table 2: Summary of the Findings

Variables	co-efficient	t-Statistic	P-value	Adj R ²	F-Stat	P-value
Constant	1,917,471.16	0.610	2	0.60		
Major crops	6.591*	4.010	04	0.00	144.84	(<.0001)
Constant	1,698,832.63	0.390	79	0.71		
Minor crops	19.381*	2.710	81	0.00	79.9	(<.0001)
Constant	2,220,062.35	0.590	01	0.53		
livestock sector	3.998*	2.990	15	0.00	1130.7	(<.0001)
Constant	2,560,570.54	8.720	001	<.0		
Fishery	149.889*	11.020	001	<.0	96.8	(<.0001)
Constant	4,473,724.75	3.130	39	0.03		
Forestry	6.002	0.270	21	0.80	21.9	(<.0001)

Table 3 shows the robustness checks of this study attempt to test the consistency and reliability between major crops, minor crops, livestock, forestry and fisheries with respect to their contributions into GDP in case of Pakistan. Given the complex pathways within which socioeconomic factors linked with health operate, particularly in low- and middle-income countries such as Pakistan where environmental change

has been increasingly affecting agricultural output that directly or indirectly influence market prices of staple foods due to increasing risks posed by adverse climate events yet at the same time governance related shocks driven by changing policies necessitates a comprehensive exploration. Model 1: We repeated all the tests of Model A also for a model that includes sarcastic tweets, but excludes fisheries (to look at robustness without this sector). Difference in Portfolio Composition Fisheries these 'coefficient associated with fisheries. The significant coefficients of major crops and minor crop and livestock sector are important role to Macro economy even if without fisheries. This model underscores the considerable share of agriculture in GDP which suggests a persistent requirement for assistance to these sectors. In model 2, the interaction of major and minor crops is incorporated to decide whether virtual effects as a group deviate significantly from singular crop results. Significance of the interaction term indicates that two together enhance one another on economy in particular Thus, implying the need for crop diversification and integrated agricultural policies; pertinent reasons found ever before. Model 3 instead features lagged variables to test whether past values of agricultural contributions can predict the current GDP. The high estimation of the coefficients corresponding to lagged variables, reflects a long-run effect on GDP growth in Mexico for historical performance characteristics transmitted from agriculture showing that the impacts are permanent and not transitory-emphasizing how it is necessary for agricultural planning and investment should therefore consider implications over time. The results of these robustness checks reaffirm that the presence effect among major crops, minor `crops and livestock are extremely influential for GDP in Pakistan but the effect is found with a relatively low intensity by forestry contributions. In the current circumstances of economic downturn, this suggests that there is scope for policy support to improve productivity and resilience in agriculture -- especially against a background of climatic shocks or market fluctuations.

Table 3: Robustness Tests

Variables	Co-efficient	t-Statistic	P-value	Adj R ²	F-Stat	P-value
Model 1: Excluding Fisheries						
Constant	2,360,342.65	0.580	0.563	0.900	139.760	(<.0001)
Major crops	5.891*	3.870	0.001			
Minor crops	17.512*	2.630	0.009			
Livestock sector	3.708*	2.870	0.002			
Forestry	5.502	0.250	0.790	0.130	20.840	(<.0001)
Model 2: Including Interaction Terms						
Constant	2,450,572.75	0.610	0.545			
Major crops	4.698*	3.720	0.001			
Minor crops	15.398*	2.520	0.011			
livestock sector	3.501*	2.780	0.002			

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Fishery	135.998*	10.020	<.0001			
Forestry	4.912	0.230	0.776	0.120	19.230	<.0001)
Model 3: Lagged Variables (One-Year Lag)						
Constant	2,380,234.45	0.570	0.570	0.900	142.340	<.0001
Major crops (t-1)	5.512*	3.800	0.001			
Minor crops (t-1)	8.002*	2.690	0.008			
livestock sector (t-1)	3.802*	2.880	0.002			
Fishery	139.998*	10.120	<.0001	0.810	95.630	<.0001
Forestry	5.102	0.260	0.785	0.130	21.030	<.0001

Discussion

This study was aimed at providing a thorough overview of the role that various agricultural sectors equally play in contributing to Pakistan's GDP during 2000 and through successive years till now up to 2020. Descriptive statistics indicate that GDP varied considerably, with the variations seen in output of major crops, minor crops and livestock as well as fisheries and forestry (Saini, Singh, Paul, Thakur, & Singh, 2024). Regression analysis result shows, major crop, minor crops livestock and fisheries have a significant effect on GDP. The high adjusted R-squared values for major crops and minor crops show their key role in the economy, are significantly favorable impactful. A strong positive contribution is also reflecting from the livestock sector underscoring its significance in Pakistan agriculture. Fisheries exhibit a strong positive correlation with GDP, which is supported by their importance in the economy. In contrast, forestry does not have a significant effect whereas it seems that the added value of this sector may be very limited and needs policies to unlock its development. These results were robust to a number of additional tests, including various alternative specifications and OLS regressions related to those in table 2. Even if fisheries were omitted from the analysis, their main crops and minor crops as well as livestock would still be contributing a lot to economic growth. The results showed that major and minor crops have significant pairwise interactions, suggesting a coherent advantage of combined policy packages (Table 1). In addition, with the help of lagged variables this paper also finds evidences which favor on long-run behavior in contributions to GDP by sectors and therefore indicates that agricultural performance has a more powerful impact on economic growth over time.

It was concluded that these results have substantial importance, which are highly apt in the current state of Pakistan where agriculture has a significant role to contribute towards economy. Their small percentages of GDP but large contributions by the major crop subsector, minor crops subsector, livestock and fisheries indicate that higher productivity across these sectors could have important economic implications. This is not surprising as the section on forestry did relatively little to changes in employment patterns which points towards a requirement for more specific interventions and investments to evolve this sector.

Conclusion:

The results of this analysis show that major crops, minor food and non-food crops, livestock & fisheries have significant contribution in Pakistan GDP while forestry as a whole is on the lower side. The significance of developing and enforcing effective policies that enhance the productivity in these major agricultural sectors is further underscored by our results. And that allows for real progress in Pakistan economically. The major and minor crop contributions are huge, indicating the importance of policies that promote diversification in cropping patterns or Integrated Agricultural Practices (Rajendran et al., 2017). Policies must target the optimum crop complementarities to increase overall output. This also underscores the vital need for adopting holistic livestock management programs that enhance animal health, productivity and sustainable practices. An essential requisite for this sector is investing in agriculture technology to provide a shot in the arm to productivity levels across all its. Farm yields and livestock productivity change if advanced technologies like precision farming, better irrigation methods or more modern practices for pest management are used. Government must make it possible for farmers to enjoy access to these technologies, particularly among smallholders who have the most gain from its adoption. Infrastructure deficit must also be priority addressed. Better transportation, storage infrastructure and market linkages can help in reducing these losses and assure farmers a fair price of their produce. It will generate employment opportunities as well, check on urban migration and foster a balanced regional development through the expansion of rural infrastructure. The importance of sustainable farming practices towards the long-term resilience of the agricultural sector. Promoting practices like rotational farming, organic agriculture and use of renewable energy in manufacturing can mitigate the adverse effects of climate change to a large extent while ensuring long term productivity (Zou, Liu, Chen, Wang, & Feng, 2024). However, training and education programs for growers in these management practices helps facilitate adoption. The relatively low GDP contribution of forestry means that specific policies and investments directed at the development of this sub-sector is necessary. Forestry and forestry policy can also bring economic benefits through sustainable forest management practices, afforestation programs and the development of value-added products. While planting agroforestry (integrating trees and shrubs into agricultural landscapes) plays a critical role in improved biodiversity, better soil fertility among farmers and increased income stream etc. Research questions for the future could ask about how much agricultural productivity is at risk from climate change, and what can be done to grow our forestry industry. Improved understanding of the effects of changing weather patterns, extreme events and temperature variability on crop yields as well as livestock health will allow for the development of adaptive strategies to ameliorate these impacts. Opportunities for new growth will be valuable in identifying the best strategies to increase and maximize the economic contributions of forestry through sustainable management practices. The exhaustiveness of these strategies would essentially help in formulating well thought-out policies to make agriculture competitive and aid sustainable economic growth of Pakistan. Strengthening the Agriculture Sector and Driving Economic Development in Pakistan by meeting the challenges and harnessing opportunities identified in this study, policy makers can go a long way towards improving both resilience as well

productivity of agricultural sector which will further contribute to economic development.

Recommendations:

Similarly, there are a number of policy recommendations that need to be carried out in order to optimize the agricultural role in GDP. The very first one is higher investment in agriculture technology. New and improved technologies will contribute to increased crop yields, reduce losses from pests/diseases (biosecurity) resulting in the more efficient use of water and other inputs. A guaranteed way to spread benefits is that the government facilitates access of such technologies and machinery to small/medium scale farmers. Infrastructure is another significant aspect that needs to be enhanced. Transport links, cold storage and selling at market can cut losses after harvest and help ensure that farmers receive a decent price for their produce. Therefore, strengthening rural infrastructure will also create employment opportunities and reduce urban migration leading to balanced regional development. Agricultural integrity depends upon sustainable farming practices. This means promoting crop rotation, organic farming and the production of renewable energy sources. Farmers should be educated and trained in sustainable practices as a solution to the unfavorable effects of climate change on agriculture, making it more resilient. Equally important is policy integration. The dramatic interaction effects of a major crop with minor crops provide evidence that using integrated agricultural policies can enhance the synergy value in such situations. Well-designed agricultural policies that take into consideration the linkages between different crops and livestock will boost overall productivity, as well as economic contributions.

Future Directions of the Study

Questions remain for future research. Future studies can help establish how our results apply to other populations or these patients over longer duration. Most importantly is the study of the effect climate change has had on crop yields (agricultural productivity). Knowledge of how variability (e.g., changing weather patterns, temperature extremes) affects yields or livestock health is needed to improve our ability to manage for the additional stress incurred from such impacts. The forestry sector is another promising area for future research. Forestry. Despite the minimal contribution of this sector to GDP (upwards of 1% each year), focusing on boosting economic factors by stimulating sustainable forestry management practices and promoting afforestation programs as well as producing higher value-added products could boost new growth. Agroforestry, an approach that incorporates trees and shrubs onto agricultural land can also help. Agroforestry systems can be used to improve biodiversity by increasing soil fertility while also providing additional sources of income for farmers, promoting economic resilience. Third, further exploring the role of fisheries and small regions can lead to higher impacts on GDP. Improving productivity and making the sector sustainable would be possible only if we know the difficulties by the fisheries and cater to them with a lot more precise approach. These future investigations would provide an important lesson for policymakers to formulating strategies which support agricultural sector as well as entire economy of Pakistan.

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