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Evaluating De-Agriculturalization Patterns: Insights for Economic Sustainability and Policy Recommendations

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ABSTRACT

Objective: The research aims to analyze the transition from agriculture to non-agricultural activities in rural areas, focusing on the socioeconomic implications of this shift.

Research Gap: The study addresses the limited research on the de-agriculturization process in rural areas, particularly the socioeconomic outcomes for households that transition away from agricultural activities.

Design/Methodology/Approach: The study employs a mixed-method approach, combining quantitative data analysis with qualitative interviews to assess the impact of de-agriculturization on rural households. Using data from the World Bank on employment and output shares in agriculture and industry from 1991 to 2021, the study applies convergence criteria to determine the possibility of convergence in labour and output shares in the agricultural sector. Additionally, the study employs the Cobb-Douglas production function model to measure employment elasticities concerning agricultural output

The Main Findings: The research finds that de-agriculturization leads to both positive and negative socioeconomic outcomes, with some households experiencing improved income levels while others face challenges in adapting to non-agricultural employment. The findings contribute to the understanding of rural development by highlighting the complexities of economic transitions. Practically, the study suggests the need for targeted policies to support households in rural areas during the shift away from agriculture.

Originality/Value: The research is valuable as it provides a comprehensive analysis of the de-agriculturization process, a topic that has received limited attention in the context of rural socioeconomic development.

Critical and Policy implication: Therefore, the authors recommend that policymakers implement policies to support the agricultural sector, such as increasing investment in agricultural infrastructure, managing water resources, building dams, and promoting research and development to improve agricultural practices.

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1. Introduction

De-agriculturalization is a phenomenon characterised by a decline in the relative participation of a nation's populace in agricultural pursuits, accompanied by a concomitant rise in the number of individuals involved in alternative sectors, such as manufacturing and services. This phenomena may arise as a result of economic expansion and urban development, resulting in a transition of the workforce from agricultural activities to more efficient and lucrative non-agricultural sectors. The process of de-agriculturalization can provide both advantageous and disadvantageous consequences for a nation's economy, as it has the potential to foster enhanced

productivity and elevated revenues. However, it is important to note that this phenomenon can also lead to negative consequences such as unemployment and a downturn in associated sectors. Moreover, the process of de-agriculturalization carries significant social and environmental consequences, including alterations in land utilisation, shifts in population from rural to urban areas, and impacts on the availability and accessibility of food resources. Therefore, policymakers must possess an understanding of the potential ramifications of de-agriculturalization and implement suitable measures to alleviate any adverse effects.

According to (Matsuyama, 2008), de-agriculturalization refers to a reduction in the proportion of employment in the agricultural sector. This loss can be attributed to either labour push or labour pull factors. According to (Nurske, 1970), the labour push theory posits that breakthroughs in agricultural technology lead to the release of labour from the agricultural sector, resulting in a decrease in the share of employment in this sector. In contrast, (Lewis, 1954) referred to the labour pull theory, positing that an enhancement in industrial returns serves as a magnet for labour migration away from the agricultural sector.

The process of de-agriculturalization in Pakistan would incur significant costs, given the substantial progress made in the agricultural sector since the country's independence in 1947. The agricultural sector in Pakistan holds significant importance due to its contribution of around 20 percent to the national GDP, employment of around 42 percent of the labour force, and its substantial role in generating agricultural-related export earnings for the country. Pakistan is endowed with huge tracts of arable land and a highly efficient irrigation infrastructure. The significance of agriculture in any economy cannot be overstated, since it plays a crucial role in ensuring food security. Approximately 70% of the people in Pakistan are engaged in agricultural activities (The Economic Survey of Pakistan, 2018). The presence of de-agriculturalization in an economy is a matter of great concern in Pakistan, particularly due to the significant role it plays in generating foreign exchange revenues, driving growth in industrial and manufacturing sectors, and addressing unemployment challenges. This is especially important considering the substantial proportion of individuals who are directly or indirectly reliant on the agriculture sector. By implementing contemporary agricultural methods, the productivity of agriculture can be significantly enhanced, particularly concerning the cultivation of main crops such as cotton, wheat, and rice.

The current progress can be ascribed to key initiatives such as providing financial assistance to farmers, enhancing water accessibility, lowering tariffs for tube wells, improving credit disbursements, ensuring subsidised availability of fertilisers, and reducing customs duties on machinery imports for the dairy, and livestock, poultry, and cold chain industries.

Table 1: Agriculture Sector Growth, Major Crops Production (2003-2018)

Crop	2003–2004	2005–2006	2007–2008	2009–2010	2011–2012	2013–2014	2015–2016	2017-2018
Agri growth (%)	2.8	1.2	1.8	1.9	3.6	2.5	2.0	3.8
Wheat production (Tons)	19.5	21.3	20.9	23.3	23.5	26.0	25.6	25.5
Rice production (Tons)	4.8	5.5	5.6	6.9	6.2	6.8	6.8	7.4
Sugarcane (Tons)	53.4	44.7	63.9	49.4	58.4	67.5	65.5	82.1
Cotton production	10	13.0	11.7	12.9	13.6	12.8	9.9	11.9
Maize Production	1052	950	1087	1060	1168	5044	5700	6300

Source: Agriculture, Industry Drive Robust Growth in Pakistan. (Figures in MillionTon)

The agricultural sector has exhibited a largely steady growth pattern over the years, except for the 2017-18 period, during which there was a general improvement observed across all regions (refer to Table 1). The complete version was demonstrated through the growth in sugarcane production, while the contribution of wheat remained unchanged. The agricultural sector warrants support and should get increased focus throughout its various sub-sectors to serve as the foundational pillar of our economy. To facilitate the advancement of this sector, all government officials together must propose a comprehensive plan at the national level to restore the previous magnificence seen during the Green Revolution era.

Approximately 60% of the population resides in rural areas and derives their living directly or indirectly from agricultural activities. The agricultural industry also plays a crucial role in mitigating poverty in rural areas. The Green Revolution, characterised by advancements in irrigation technology, the utilisation of improved seeds, and

the application of fertilisers, significantly contributed to the augmentation of agricultural output, leading to a subsequent rise in GDP and a more equitable distribution of income among the populace.

Livestock constitutes a distinct sub-category within the broader domain of the agriculture sector. During the fiscal year 2017-18, it constituted around 58% of the total value added. However, on a smaller scale, Pakistan's total exports are only marginally influenced by this sector, accounting for a mere 5% contribution. This can be mostly attributed to the limitations imposed by European markets, which have imposed limits due to the current lack of quality standards in Pakistan. According to the Economic Survey of 2018, Pakistan experiences an annual population growth rate of approximately 2%, which consequently necessitates attention towards the matter of food availability. The agricultural industry has the potential to contribute significantly to the fulfilment of growing food demands. Furthermore, it has the potential to mitigate the need for food imports and bolster export profits through the cultivation and sale of diverse agricultural products. Table 2 displays the primary export of Pakistan with the greatest monetary worth. The percentage distribution of each export is indicated within brackets.

Table 2: Pakistan's major export in highest dollar value

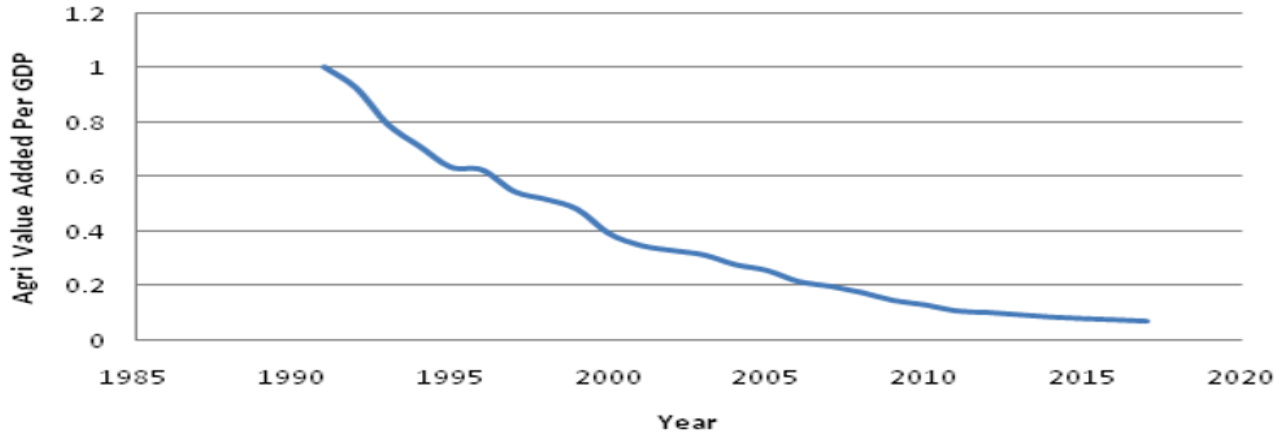
Miscellaneous textiles, and worn clothing: US$4 billion (18.1% of total exports)
Cotton: $3.5 billion (16%)
Knit or crochet clothing, and accessories: $2.5 billion (11.5%)
Clothing, accessories (not knit or crochet): $2.5 billion (11.3%)
Cereals: $1.8 billion (8%)
Sugar, sugar confectionery: $511.9 million (2.3%)

Source: International Monetary Fund, World Economic Outlook Database

Pakistan is recognised as the third largest global producer of milk. The anticipated annual milk production is approximately 50 billion litres. Although Pakistan has limitations in exporting milk, its dairy sector exhibits significant immaturity in terms of essential facilities such as infrastructure, processing capabilities, milk productivity, storage, and transportation provisions.

Within the agricultural sector, the livestock industry comprises the largest proportion of contributors, with key crops such as rice, cotton, wheat, and sugarcane following closely behind. The contributions made by lesser crops are placed in third position.

Figure 1: Trend in Agriculture Value Added per GDP

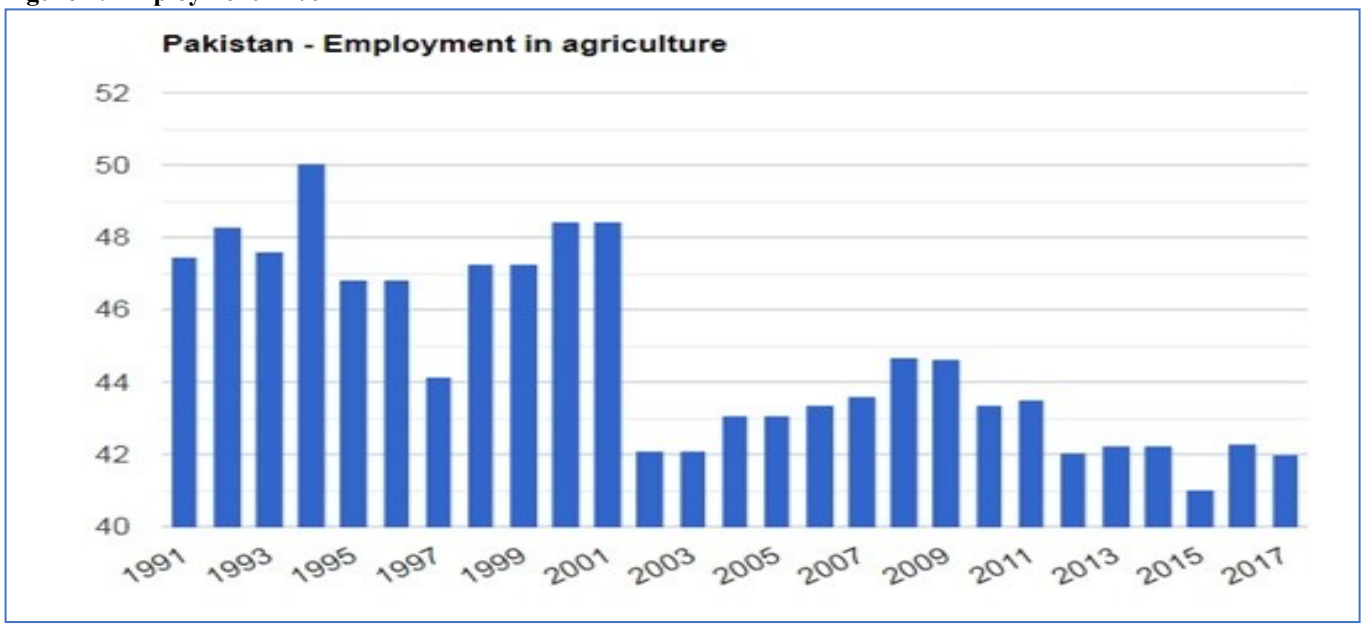


Source: WDI

Figure 1 above does not represent a favourable value added per GDP trend for the agriculture sector, which includes the cultivation of crops and livestock production. Such a trend is perhaps reflecting de-agriculturalization in Pakistan.

The importance of agriculture to Pakistan's economy is reflected by the fact that this sector is a key source of national employment.

Figure 2: Employment in %



Source: WDI

In Figure 2, the trend of percentage employment in the agriculture sector is given. The sign of de-agriculturalization is quite visible as, since 1991, the employment proportion has declined in 2017. Apart from the areas mentioned above, the agriculture sector also supports industrial development via farm mechanization tools as they are utilized in agricultural activities.

As a backbone for the Pakistani economy, the role of textile industries cannot be neglected as these industries depend on raw agricultural output, thus contributing to economic growth. Finally, sugarcane production is also a significant contributor to economic growth, which is vastly produced and supplied to sugar manufacturing units to produce sugar and byproducts, raising employment levels.

1.1 Objective of the Study

This paper aims to analyze de-agriculturalization trends and their implications in Pakistan, where agriculture holds significant value in economic performance. The research specifically determined whether de-agriculturalization is occurring by analyzing employment and output shares in both the agricultural and manufacturing/industrial sectors. The purpose of this research is to examine the factors of structural changes, including shifts in labour preferences and sectoral productivity, along with their socio-economic ramifications. The study investigates the issues stemming from diminished agricultural participation by analyzing effects on other sectors and rural income-generating activities. This effort seeks to enhance policy-making by mitigating adverse effects and promoting beneficial growth patterns within the agricultural-industrial sector interface.

1.2 Problem Statement

The phenomenon known as de-agriculturalization, which is characterized by a falling contribution of agriculture to the economy of a nation, has substantial implications for the establishment of economic policy and for the maintenance of economic sustainability. In the context of Pakistan, there is an urgent requirement to assess the patterns of de-agriculturalization and the impact that these patterns have on the entire developmental process of the economy. To address this matter comprehensively, the purpose of this study is to ascertain whether or not de-agriculturalization and deindustrialization are prevalent in Pakistan. This will allow for the provision of insights into economic sustainability as well as policy recommendations.

1.3 Significance of the Study

This research is valuable as it systematically examines de-agriculturalization trends in Pakistan, a nation where agriculture remains significant due to its contribution to the gross domestic product and employment for numerous citizens. This study has significant consequences for comprehending the relative changes in employment and output shares within agriculture and other industries in Pakistan. The study has theoretical implications as it

enhances understanding of economic development and structural change, particularly in emerging economies. It expands upon the understanding of how the transition from agrarian societies restructures socioeconomic relations, culture, rural livelihoods, industrialization, and economic development. The research is beneficial for policymakers as it offers tangible, legally grounded ideas for effectively managing transition processes. It emphasizes the necessity to formulate targeted plans for many sectors, including the enhancement of infrastructure in the concerning livestock farming sector, the advancement of the industrial base, and the creation of social protection systems for disadvantaged populations. The analysis of challenges related to de-agriculturalization, including market issues that result in unemployment and decreased production rates in related sectors, demonstrates that the study highlights the importance of benefits that are equitable and sustainable for the economic development of vulnerable farming communities.

2. 2. Literature Review

2.1 De-Agriculturalization

Recently, the process of de-agriculturalization has gained significant attention from scholars, politicians, and practitioners. De-agriculturalization is the process in which agriculture's economic significance decreases in a country, while there is a corresponding increase in the importance of non-agricultural industries. This literature review consolidates recent research findings on de-agriculturalization tendencies, clarifying its consequences for economic sustainability and providing policy solutions to tackle related difficulties.

Sharma and Gupta (2024) analyzed the patterns of de-agriculturalization in India, emphasizing the intricate relationship between changes in the economic structure, migration from rural to urban areas, and developments in technology. Their research emphasized the necessity of specific policy measures to reduce the negative impacts of the decline in agriculture on rural lives and promote inclusive economic growth.

Zhang et al. (2023) expanded on this research by conducting a thorough examination of the de-agriculturalization patterns in East Asian economies. Their investigation unveiled notable disparities in the speed and path of de-agriculturalization among countries, influenced by factors such as industrialization, urbanization, and trade liberalization. The authors proposed a policy strategy that takes into account the unique circumstances of each country to encourage economic In addition, Wang and Li (2022) investigated the impact of technical innovation on the process of de-agriculturalization in China. The authors conducted a case study on agricultural mechanization to illustrate how technical progress has sped up the replacement of workers in the agricultural industry, while also generating prospects for other economic activity in rural regions. Their study highlighted the need to utilize innovation to improve agricultural productivity and competitiveness in response to the pressures of de-agriculturalization, Diversification and resilience.

Martinez et al. (2022) examined the de-agriculturalization patterns in Latin America within a distinct geographical framework, with a specific emphasis on the consequences for both food security and rural development. Their study highlighted the susceptibility of smallholder farmers to market volatility and environmental hazards, which are worsened by the de-agriculturalization processes. The authors advocated for governmental interventions to foster sustainable agriculture, bolster rural entrepreneurship, and improve the accessibility of markets and resources for marginalized farming communities.

Using the pre and post-hydrocarbon development and observing employment shares in manufacturing and agriculture sectors, Matallah & Proops (2006) found that the development of oil & gas and hydrocarbon sectors in Algeria had resulted in industrialization. Thus de-agriculturalization in the economy has taken place.

Developing a model that explained the impact on employment share in the agriculture sector of agrarian constraints' vector and productivity in agriculture activities and tested for the data of various countries around the globe for the yearly period of 1963-2005, Ungor (2013) found that the decline in the employment share of agriculture sector is caused by the declining growth of productivity in agriculture sector such that de-agriculturalization is not just associated with an increasing percentage of industrialization in an economy.

Hosein's (2007) Study compared (the only country in the Caribbean region with oil reserves) Trinidad and Tobago's oil boom of the 1970s and early 2000 and found the positive signs of industrialization in agricultural

subsectors - like sugar manufacturing - as output per worker rose. This structural transformation is considered phenomenal by the author as the sectors like tourism, manufacturing, and mining were considered the impetus for the economic growth in the Caribbean region, hinting at a de-agriculturalization in the region but at the cost of food security issues.

Zaman et al. (2012) analyzed the causal link between energy utilization and agricultural-based technological factors in the Pakistani rural sector by applying Granger causality tests on energy demand and agricultural technical-based factors such as fertilizers from 1975 to 2010, inferred that a bi-directional relationship across energy demand and agricultural technological based factors in Pakistan. They highlighted that among the key variables that cause demotion of the agricultural sector in the Pakistani economy, the usually included factors are water deficiency, electricity load shedding for the farmers, inactive land reforms, high costs of fertilizers, underutilization of arable land, conventional practices of farming, unavailability of crop insurance, and lack of upgraded agrarian sector related technologies. Authors thus suggested that the above-highlighted issues are fundamental to improving agricultural performance, avoiding de-agriculturalization, and increasing its share in the economy.

Fry (2011), in a case study on rural Mexico, analyzed how an increase in mining activities negatively affects rural agricultural arable lands and residents' livelihoods. Arable land's changes were compared on Global Positioning System (GPS) field maps, and around 70 interviews were conducted with the region's residents. It is found that from 1995 to 2006, mines' surface area increased by four times. The author reported factors such as higher prices, demand for homes, and falling returns from the agriculture sector. The author believes that diminished agricultural scope could force farmers to migrate to urban areas to get employment.

Huang et al. (2010) identified key changes in the agriculture economy in China to avoid any possibility of a decline in the rate of agricultural contributions to national income. Chinese policies are found to be directed toward achieving sustainable development in agriculture.

Lee et al. (2010) investigated the causes of the growth phase in Vietnam after the Doi Moi reform of 1986 and further attempted to find why a decline in agricultural employment was occurring. It is found that the Vietnamese economy has significantly grown since 1986 but has increased reliance on factors like technological capabilities that are more parental towards enhancing the industrialization process and thus the industrial sector's contribution to GDP.

Imrohoroglu et al (2014) examined the growth patterns in Turkey; found that the main cause behind its relative stagnation was its low agricultural productivity growth due to policies that discriminated against the rural side of the economy and; deserve to understand why low productivity in the Turkish agricultural sector is prevailing. The authors conducted an experiment in which it was indicated that if Turkish policies were pro-Spanish agricultural policies then de-agriculturalization would have been even faster from the present scenario. The authors further extended their Study by providing some evidence that import substitution policies and highly overvalued foreign exchange rates are hampering the agriculture sector in Turkey.

Liu (2012) quantitatively analyzed unbalanced urban agglomeration near the Yangtze River from 2002 to 2012 on industry and de-agriculturalization. It was found that there are three elements on the rise near the Yangtze River, including the behaviour of residents' willingness to promote urban development; the emergence of a high degree of urbanization has increased an unbalanced growth in the area, and the degree of arable land used for agriculturalization has greatly reduced.

2.2 Deindustrialization

Rasiah and Nazeer (2016) questioned the earlDeindustrialization Pakistan faced and attempted to explore the causes. Since the fluctuating trends in manufacturing growth remain linked with import substitution strategies policies and a relatively depreciated local currency, the lack of a consistent industrial policy to target technological catch-up mattered most.

Hamid and Khan (2015) believed that Deindustrialization is a normal phenomenon for the developed world, such that several developing nations have a high employment share in the manufacturing sector thus coining the term "premature deindustrialization" for developed economies specifically. The authors focus on growth patterns in the manufacturing sector and the possibility of premature Deindustrialization in Pakistan. They found that Pakistan's industrial base has stagnated and suggested that Pakistan need to adopt proactive industrial strategies to overcome shortcomings in the manufacturing sector.

Brady & Denniston (2006) examined manufacturing employment and economic globalization in prosperous democratic economies. They found that globalization has different effects across various capitalistic regions and other effects under historical events of a global nature. This academic outcome is matched with Kollmeyer & Pichler (2013), who relate Deindustrialization and high unemployment rates across many developed countries from 1975 onwards and noted that the manufacturing sector is a significant factor of low employment in the OECD bloc for 34 years. From a different perspective, Rowthorn & Coutts (2004) refers to Deindustrialization as a decline in manufacturing employment. Examining the experience of Britain and America, the authors found rapid Deindustrialization in these two economies and concluded that balance of payments issues and non-manufacturing GDP contributions like inroads towards the agriculture sector made declining performance in the manufacturing sector.

Inchausti-Sintes (2015) reported a decline of around 25 million jobs in industrialized European countries. Thus Inchausti-Sintes found that a process of such a degree of Deindustrialization has a significant adverse effect on the growth potentials of manufacturing sector-related employment and investments. This rapid fall in industrial employment is referred to as the Dutch Disease1.

Tregenna (2008) developed a new decomposition inquiry approach to analyze changing employment patterns in the manufacturing sector. It separates the share of employment manufacturing into two components; one is linked with a share of manufacturing in GDP, and the other is connected with the growth of value-added by the labour in the manufacturing sector. The authors found that in most countries, declining manufacturing employment is due to falling labour intensity in the manufacturing sector and is not the manufacturing sector's role.

Sabitino (2016) analyzed that due to the Italian GDP's fall in the 2000s (which is a decline of more than 7 percent), industrial performance was also in decline, hinting that the Italian economic growth prospects would be alarming. The crisis of the industrial sector in the last two decades was reported to be caused by three factors; the overall Italian production failed to adapt to the innovative global changes mainly because of the inability to transform into new structural standards, having a structural disadvantage over other economies. Finally, the stagnant domestic demand caused a significant economic growth contraction.

Yahya, Mehboob & Lopez (2018) observed that Pakistan experienced a rise in the share of services GDP while the manufacturing sector share has remained constant. In their Study, the authors traced Deindustrialization's effects on GDP growth using annual data from 1972 to 2017 and applied the ARDL modelling technique. They conclude that Pakistan has become a service sector-based economy, indicating signs of Deindustrialization, and advised that progress in the services sector must not accompany unsustainable manufacturing.

Bernard, Smeets, and Warzynski (2017) use employer-employee data to examine the possibility of Deindustrialization from 1994 to 2007 in Denmark. Authors claim that one of the key reasons is that firms are opting to switch from manufacturing to the services sector. Still, they also found that employment at manufacturing businesses exaggerates the losses incurred in manufacturing units.

Ike et al. (2016) pointed out that for any economy, the transmission mechanism is usually reflected by crowding out phases via direct and indirect Deindustrialization and may improve agriculture sector performance. Authors analyzed the connection between oil dependence and the GDP growth in the Nigerian economy with ARDL regression modelling and found that oil dependence had a significant inverse link with GDP growth but in the short run only, thus suggesting the existence of the Dutch disease in the Nigerian economy.

[1] The Dutch Disease is the possible causal relationship between the increase in the economic growth of a particular sector and a fall / decline in sectors like manufacturing or agriculture sectors.

Rising de-agriculturalization in an economy is one of the key concerns in Pakistan when a large percentage of people are directly or indirectly attached to the agriculture sector. The eclectic literature summarized above suggests the industrial and agriculture sectors' influential role in economic growth. Still, the two sectors should not be opponents of each other in designing a sustainable policy framework. Thus, this study intends to explore the determinants of de-agriculturalization in Pakistan.

3. Data & Methodology

Using the World Bank's data source2, we have obtained Pakistan's annual data of employment share in agriculture & industrial sectors, and output share in agriculture & industrial sectors of Pakistan from 1991 to 2021, and GDP at constant 2010 US$. All the data series are also transformed into natural log series for further estimations.

For employment data, we considered the United Nations definition that the labor force comprises people at least 15 years old who offer their labour hours for the production process for goods and services in a given time and are employed by either service agricultural or industrial sectors.

3.1 Estimation Methodology

We estimated the model (3.1) to find the possibility of convergence in shares of labour and output in the agricultural sector.

$$S_{eat} = \alpha_1 + \beta_1 t_{jat} + \mu_{1t} \quad (1)$$

$$S_{emt} = \alpha_2 + \beta_2 t_{jmt} + \mu_{2t} \quad (2)$$

$$S_{qat} = \alpha_3 + \beta_3 t_{jmt} + \mu_{3t} \quad (3)$$

$$S_{qmt} = \alpha_4 + \beta_4 t_{jmt} + \mu_{4t} \quad (4)$$

Where S is the share, e is employment, q is output, a is the agriculture sector, m is the manufacturing sector, α is the intercept, β is the slope of how much S will change over time t_3, and μ is the residual term. Among subscripts, e represents employment, q represents agriculture (a) and manufacturing (m) output, and t is the time period.

Convergence criteria refer to a situation if β in equation 3.1-3.4 is found to be negative. This means the employment or output shares in question are declining, reflecting that de-agriculturalization / deindustrialization is taking place in the economy through employment and output criteria. We will also test the possibility of de-agriculturalization via the returns to scales approach. To get the returns to scale parameters, we estimate a model, a variant of the Cob Douglas production function, given in the following form.

$$Y_t = A(Ea)^{\alpha}(Em)^{\beta}\mu_{5t} \quad (5)$$

$$\ln Y_t = A + \alpha \ln(Ea) + \beta \ln(Em) + \mu_{5t} \quad (6)$$

In equation 3.5, Y is GDP, Ea is employment share in the agriculture sector, and Em is employment share in the industrial/manufacturing industry.

The parameter α is the elasticity of employment share in the agriculture sector on GDP growth, β is the elasticity of employment share in the manufacturing sector on GDP growth, and μ is the residual term. The log transformation of (3.5) will give (3.6), which will be tested using OLS regression.

4. Results

Table 3 explains the results of beta convergence applied to Employment share in the Agriculture Sector, Employment share in the Manufacturing Sector, Output share in the Agriculture Sector, and Output share in the Manufacturing Sector. The results show that beta convergence was achieved in employment share in agriculture, suggesting a possibility of de-agriculturalization in Pakistan.

The finding further strengthens this that a significant and diverging beta in the manufacturing sector suggests an expansionary employment share in the manufacturing sector, offering employees the choice to leave agricultural opportunities.

The possibility of de-agriculturalization in Pakistan is validated again by the prevalence of a significant beta convergence of output share in the agriculture sector. However, it is not supported by output share in the manufacturing sector as an un-diverging beta in the manufacturing industry prevailed.

Table 3: Regression Results on Convergence Criterion

Sector	Coefficient	Std. Error	t-Statistic	Prob.
Employment Share in Agriculture	48.18	0.52	91.12	0.0000
	-0.21	0.03	-6.29	0.0000
Employment Share in Manufacturing	18.71	0.38	48.29	0.0000
	0.05	0.02	2.05	0.0507
Output Share in Agriculture	25.74	0.51	49.72	0.0000
	-0.08	0.03	-2.41	0.0238
Output Share in Manufacturing	25.52	0.53	48.08	0.0000
	-0.21	0.03	-5.83	0.0000

Source: Author Estimation

Not accounting for the role of the service sector, table 4 provides regression results for equation 3.6. Employment share in the agriculture sector and employment share in the manufacturing industry were significant variables that affected the combined output of the agriculture and manufacturing sectors.

Table 4: Returns to Scale Criteria

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EMP_A)	0.863277	0.147606	5.848516	0.0000
LOG(EMP_M)	-0.459648	0.170437	-2.696883	0.0123
R-squared	0.671027	F-statistic		24.47716
Adjusted R-squared	0.643613	Prob(F-statistic)		0.000002

Source: Author Estimation

Table 5: Wald Test of Coefficient Restrictions.

Test Equation: C(1) + C(2) = 1

Test Statistic	Value	Df	Probability
F-statistic	7.476339	(1, 24)	0.0116
Chi-square	7.476339	1	0.0063

Source: Author Estimation

Wald test rejects the hypothesis of constant returns to scale and supports that the sum of two beta coefficients is found to be 0.41 (less than unit), implying decreasing returns to rise in the agriculture sector via employment factor, thus suggesting a possibility of de-agriculturalization in Pakistan. [Table 5].

The results presented in this study corroborate with the developments presented in the literature regarding de-agriculturalization processes in developing and emerging countries. For example, Zhang et al. (2023) found that East Asian developing economies followed similar patterns of change, featuring not only industrial growth and urbanization as having a strong role in depressing the agricultural sector's employment and output shares. In similar vein, Martinez et al (2022) identified in Latin America that de-agrarianisation is correlated to transition to other non-agriculture sectors; a transition which as been shown to have both beneficial and adverse socio-economic effects, on the rural folks. Wang and Li (2022) showed that this process intensified with development and changes in agricultural mechanization technology indicating a trend of a declining number and proportion of people engaged in agriculture in China and increased dependence on industrial development. Together, these studies confirm the findings of this research including changes in labour and output preferences from agriculture to

manufactures and industries in Pakistan. The similarity of the results obtained within different contexts underscores the generality of structural economic changes in emerging economies.

5. Conclusion

As our results suggest, there are signs of a decline in agricultural share in total employment and GDP. The employment preferences are moving away from the farming sector, and the de-agriculturalization phenomenon is occurring. We tested de-agriculturalization through the beta convergence approach and found people associated with the farming sector prefer to leave. We found a similar conclusion about the possibility of de-agriculturalization in Pakistan using returns to scale analysis. The sum of the elasticities is less than one, which is also verified by the Wald coefficient restriction test. Being the second largest sector and accounting for around 22 percent of national income, this sector is the biggest employer in Pakistan; it absorbs roughly 45 percent of total labour, and the importance of the agriculture sector cannot be ignored.

De-agriculturalization is just not associated with the agriculture sector only. Still, it is a very vital factor that can cause Deindustrialization in agricultural-related goods and services providing industries, e.g., firms manufacturing tractors, fertilizers, biotechnology developers, pesticides/herbicides for unwanted green growth can face recessions or shutdowns at the cost of those alternatives in which they may meet through quality and pricing competitions. Concerning Table 6 provided below, it is notable that the trends in per capita freshwater availability are declining and hence becoming an alarming issue that could further cause a setback to the agriculture sector in Pakistan as its availability for the agriculture sector is becoming scarce over time. A decline in such a vital resource is thus an important cause of de-agriculturalization.

Table 6: Trends in Per Capita Renewable Freshwater Resource[3]

1977	1982	1987	1992	1997	2002	2007	2012	2017 [p]
775	659	559	483	426	380	343	309	286

Source: WDI (In cubic meters)

World Bank's data on renewable freshwater resources per capita (cubic meters) in Pakistan is showing a declining trend and thus would back the severity of the issue undertaken in this Study.

5.1 Policy Recommendations.

Hence, the challenge of de-agriculturalization and the inability to achieve sustainable economic development warrant the design and formulation of friendly agriculture sector policies. These policies should aim at greatly boosting the financing of basic facilities necessary for the expansion of agricultural value chains; including facilities required in making and improving irrigation systems, storage, packing and transport facilities among others with the view of improving production and minimizing wastage. First, there is the urgent need to help maintain and cultivate R&D culture amongst the agricultural sector. This can be done through creation of institutions specialized in research, offering grants for companies to undertake innovation and supporting the development of improved agricultural technologies through cooperation between government and private industries.

Pakistan should learn from those developing countries which have enjoyed successful results in adopting precision scale farming and scientific practices in farming as well. The application of new geo-spatial sensors for multi-hazard risk mapping can be very useful for knowing the weather conditions and producing a forecast that farmers can respond to and reduce vulnerability due to climate change. They are useful not only in terms of developing the higher stability of the agricultural sector but also in creating new conditions for its sustainable growth through efficient resource management and demographic security of a population.

[3] Renewable freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country. Renewable internal freshwater resources per capita are calculated using the World Bank's population estimates.

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Individual author contribution

Nasir Munir: conceptualization, Introduction, Literature Review
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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on request.

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