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ADVANCES AND CHALLENGES IN THE POULTRY INDUSTRY IN PAKISTAN

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1. INTRODUCTION

A balanced diet is essential for good health. The body's primary needs are nourishment and energy. Many, mainly phytogenous foods, do not contain all the nutrients that the human body needs. The human body needs lipids, protein, carbohydrates and vitamins as the most prominent nutrients. Protein from animal products, particularly meat, is essential for the body's growth, maintenance, and repair (FAO, 2020).

Chicken, turkey, duck, and other domesticated birds kept by human for producing goods like egg, meat, or feather are referred to as poultry. Over 90% of all poultry in the world is chicken, making it the most important poultry species worldwide (Huang et al., 2018). One ofthe largest and most active industries in Pakistan, poultry production has a considerable and rising trend contribution to the GDP of the nation (around 1.5 percent) (Peters et al., 2022).

After textiles, poultry is the second-largest sector of the national economy and has a rapid growth trend. Within the next several years, it is expected that this industry would create 1.5 million new employments (Manning et al., 2017). According to statistics from 2022, Pakistan's poultry industry now produces 1245 million kilograms of chicken meat and 11,250 million table eggs annually. With more than Rs.700 billion presently spent in the poultry industry, more expansion is anticipated.

Nowadays, a lack of animal protein consumption may be caused by a lack of consumer access to items that contain animal protein. This further shows that there is a far higher demand for chicken goods than what local producers can now meet. This helps to explain the thriving expansion of the poultry industry in Pakistan, as well as the anticipated huge increase in the demand for poultry products. This necessitates paying extremely careful attention to the sector's production and efficiency (Lawal et al., 2020).

There are several enterprises that raise chickens for meat production (broiler chicken), breeding stock (pullet), and egg production (lay hen). These activities provide financial and professional assistance to many individuals in many different civilizations; notablyin poorer nations, this sector is crucial for reducing poverty by generating income for

small farmers. Additionally, the chicken industry is essential for ensuring public health and food security (Khanal et al., 2022).

The biological value of egg is comparable to breast milk since it includes about forty different types of proteins, including strong antigenic, antihypertensive, and bactericidal ones. 18 distinct amino acids are also present in egg, 9 of which are essential for life (Rakonjac et al., 2014). Because of its high protein content and ability to assure that customers are getting enough micronutrients, meat has been a healthy element of a person's daily diet, especially in countries with developing economies. Poultry farming is the largest sector in this respect (Attia et al., 2022).

A comprehensive plan is needed to boost institutional and market-related issues, while also considering technology development and potential methods to raise production efficiency (Iannotti et al., 2014). However, lessons from research and development programs suggest that for economically underdeveloped countries like Pakistan, increasing efficiency should be prioritized as the major engine of productivity growth and a crucial factor in sustainable development. The poor population in emerging nations may also considerably benefit from an increase in efficiency (Miranda et al., 2015).

The requirement to raise agricultural output per input unit is one of the most urgent concerns in developing countries' agriculture. Understanding how well farmers use their few resources and the available technology is crucial for finding solutions to this problem. The output can be increased by applying the most efficient production adjustment factors (Liu et al., 2022). The output can be raised by innovation and the adoption of cutting-edge input and processing technologies if resources are utilized effectively within the current infrastructure. Therefore, there are a few techniques to boost output and productivity (Korres, 2016).

One strategy is to increase input or given a particular level of input, to enhance technologies. Making farmers more effective while using the same number of inputs and technology is another strategy to increase productivity. A farmer who is more technically proficient should yield more than one who is less productive. This benefits farmers' income, the battle against poverty, and the sustainability of agriculture (Phonpawi et al., 2022).

1.1. OBJECTIVES

In the present thesis, my main goals were:

- To review present status of poultry production in Pakistan.
- To find out socioeconomic factors of poultry farmers in Pakistan.
- To recommend better poultry production techniques that will ensure product and profit for farmers.

2. LITERATURE REVIEW

2.1 Poultry production in the world

Livestock has traditionally and historically been a key contribution to the global agricultural industry and rural phenomena at the level of rural households. However, there are commercial animal farming and breeding activities worldwide because of rising consumption relative to rising population. Worldwide, it is extremely clear that farming and breeding have been commercialized, particularly in the chicken sector. It may be said that the poultry industry has been referred to as an emerging business in the globe over the past three decades, given the rise of chicken meat consumption. In addition to other meat categories, the industry's future development prospects are also quite favorable.

In addition to supplying meat, the poultry sector benefits from and is tied to the delivery of eggs to customers. The world's egg output climbed from 37 thousand tons in 1990 to 82 thousand tons in 2018, which reflects both the global growth in egg consumption per capita and the global increase in demand (GCDL, 2020).

The cost of producing counter meats, like as beef and mutton, has an impact on the production of poultry meat. The consumption of chicken meat is also influenced by consumer pricing and population expansion. According to a study in the Czech Republic chicken meat production was impacted by variations in the cost of agricultural products. Poultry meat is seen as a necessary product in the Czech Republic, however there are replacements available, which affects the nation's demand patterns (Rumánková et al., 2012). The market structure in Turkey shows the poultry segment's ongoing oligopolistic conduct, which results in losses in consumer surplus. According to a historical breakdown of broiler chicken pricing in Turkey, the industry has far better profitability (Zertan etal., 2014).

2.1.1 World's Production of Poultry Meat

Around 38% of the world's meat production, or 130.4 million tons, was produced by poultry in 2020, according to the FAO (Figure 1.). The leading poultry-producing nations are China, Brazil, India, Russia, and the United States. Due to its low-fat level, poultry meat is a popular and adaptable source of protein among consumers. It is utilized in a variety of culinary products, such as sausages, nuggets, and ready-to-eat meals. The poultry sector also provides egg, which is widely consumed and used in many food products.

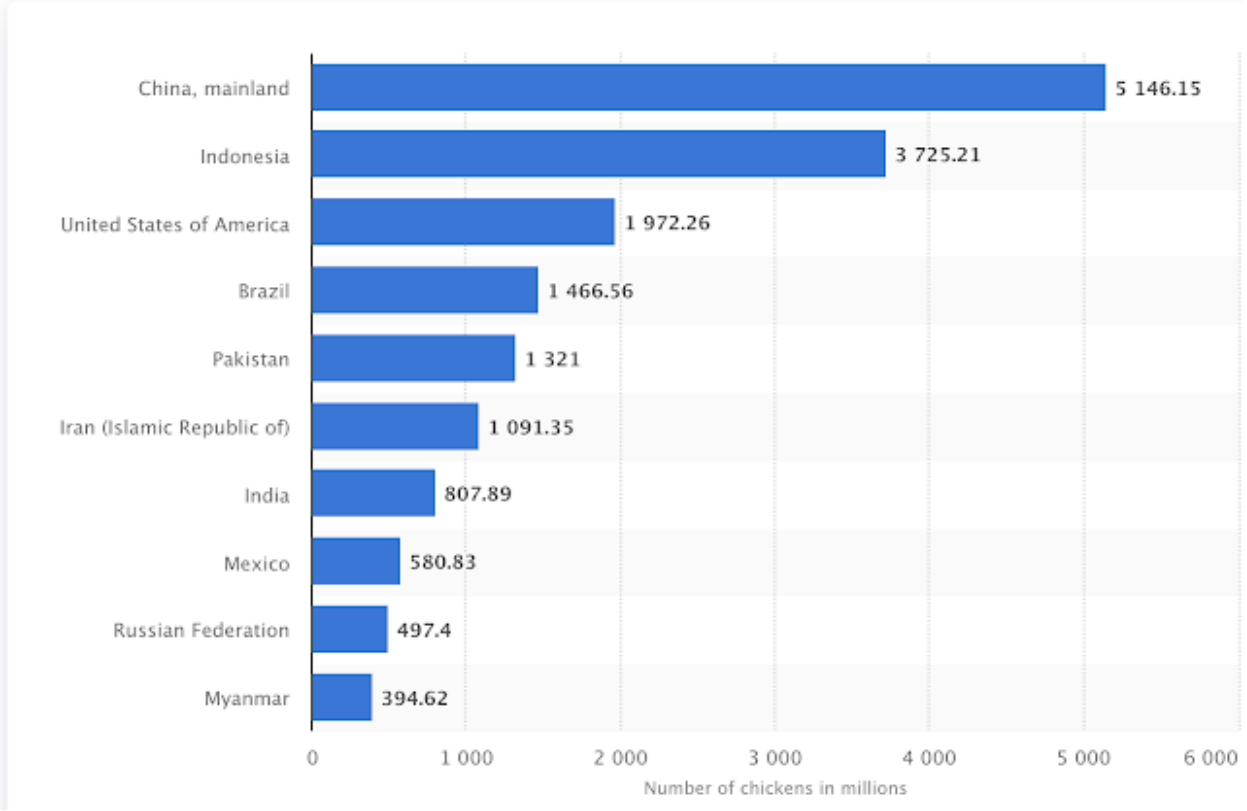

Figure 1. World poultry production (FAO)

2.1.2 Eggs Consumption in the World

In addition to being a common food consumed worldwide, egg is a good source of high-quality protein, vitamins, and minerals. China, the United States, India, Mexico, and Japan are the top egg-producing nations, according to the Food and Agricultural Organization of the United Nations (FAO), with global egg production which has reached 84.4 million metric tons in 2020. Although egg consumption varies by place and culture, it is typical for people to consume it for breakfast, as a snack, and as a component of many different meals. Eggs are a staple and are eaten in enormous numbers in various nations, including Japan and Korea. In the food sector, eggs are frequently utilized as an ingredient in goods including cakes, pasta, and mayonnaise.

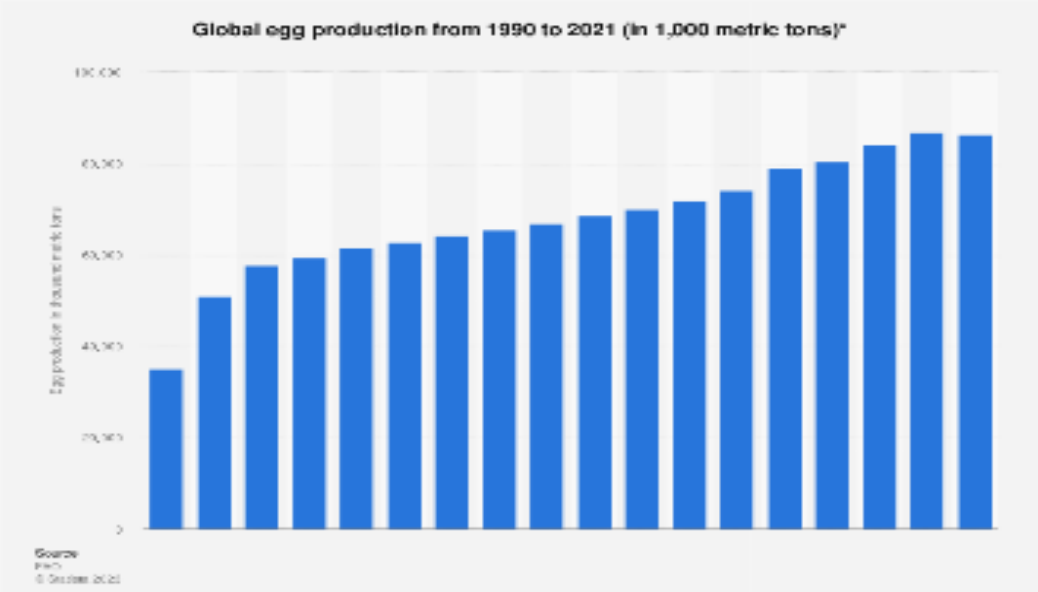

Figure 2. Global Egg Production from 1990 to 2021 (in 1000 metric tons)

Source: Statista US

2.2 Main Issues in poultry production in Pakistan

In Pakistan few officials are in charge of broiler marketing, and they pressure farmers to sell their produce atmanipulated prices. Because the expense of production rises more quickly after the prescribed growing period than the weight gain of the birds, farmers cannot bear the risk of retaining broilers after that time. During interviews with many stakeholders, it was discovered that the current marketing system's main issues were fast price volatility, under weighing, and excessive commission costs (Liaqat, 2018).

Numerous farmers said that middlemen violated corporate ethics and sought to maximize profits from business dealings. To trick the farmers, they employed a variety of strategies, including playing about with the weighing scales and undercounting and under weighing. The farmers proposed a tripartite market structure made up of farmers, intermediaries, and the government considering this. Commission agents, feed dealers, and butchers were typically the three middlemen that handled the bulk of the broiler business and who each received a commission fee inexchange for their services. Farmers utilized middlemen to dispose of their product quickly, but they complained that these intermediaries' commission costs were too costly. Sadly, no organization existed to monitor such egregious commission rates (Anwar, 2005).

Farmers mostly sold their goods in the main market, the town market, and the farm. The primary marketplaces were where around 70% of manufacturers marketed their products. Retailers and feed dealers served as middlemen at the town and agricultural levels. Farmers have voiced their strong disapproval of the present marketing system's practices (Maqbool, 2002). The current state of the marketing system is one of tradition and heterogeneity. Therefore, manufacturers were unable to establish direct connections with customers, and as a result, they are not receiving the desired rates while customers are paying exorbitant prices. One of the greatest obstacles to increasing the proportion of chicken to protein intake is this.

At the store level, commission agents and wholesalers have a crucial role in setting prices. Lack of direct connections between producers and consumers, which deny producers the possibility to understand customers' behavior, and a lack of investment in infrastructure development are the causes of non-remunerative prices for producers. By giving the bird producers credit, they will

be able to communicate directly with the shops and may eliminate the need for commission brokers. Additionally, government should work to create legislation that would let manufacturers to sell their goods directly to consumers (Islam, 2003).

2.3 Impacts of COVID-19 on Poultry Production

Contrary to other pandemics like SARA-CoV and Ebola, the COVID-19 pandemic had a significant indirect influence on the food supply chain through interruptions of the downstream phases like transportation and logistics (Hafez et al., 2021). This pandemic had an impact on all aspects of food security, including availability, access, usage, stability, and sustainability (Hashem et al., 2020).

In general, COVID-19 had a substantial impact on the animal production sectors in several nations, including China, the US, the UK, Germany, Spain, Italy, France, and India (Weersink et al., 2020). It also had an impact on the supply and demand of food. In Canada, for instance, supply chain interruptions, a lack of human resources, the dysfunction of livestock markets, pricevolatility, and modifications in consumer buying habits resulted in dramatic reduction in the poultry industry (Uddin et al., 2021; Abu Hatab et al., 2021).

Poultry are therefore immune to SARS-CoV-2 because there is no proof that the virus may be spread from them to people through their consumption of poultry products (Rahman et al., 2020). However, there is a detrimental effect on the poultry sector worldwide. Given that 400 million birds were killed globally in 2006 owing to the avian influenza pandemic, it is thought that the losses might be higher (Hussain et al., 2020). The indirect consequences of COVID-19's movement restrictions on essential supplies including feed, chicks, medication, vaccinations, andpoultry products are to blame for the industry's bad effects. Additionally, the marketing of chicken products was hampered by the stringent limitations that were in place during thisepidemic. Farmers suffered significant financial losses since they were unable to sell their eggs at nearby markets or restaurants because of the market closures (Surni et al., 2020). The detrimental effects of COVID-19 on poultry were shown to be substantially greater in underdeveloped nations than in industrialized nations since the production of poultry helps to combat hunger and poverty (Hafez & Attia, 2020).

2.4 Movement of Chicken and Chicken Products

Due to fierce production competition and cost variances from across the world, chicken and its products' prices and international mobility would be influenced. The likelihood of illnesses spreading into regions that are meant to be free of poultry diseases may increase because of this phenomenon (Jackwood, 2020). Poultry diseases will continue to be the primary issue for the future of the poultry industry internationally. Any illness outbreak has the potential to spread like wildfire and have a serious detrimental effect on the global trade in chicken products (Alsultan et al., 2019).

Increased feed costs and raw material prices, as well as their availability, will have a substantial influence on the sector's growth and consumers' purchasing power (Mulder, 2011). The economics of chicken production and the strategic planning are also predicted to suffer from climate change and limited water supplies (Abd et al., 2014).

2.5 Poultry products

Losses totaling Rs.876 million have already been incurred by the Artel group by 1997. The Artel group decided to bail out in the late 1990s and sold the KFC franchise to Cupola, Ava Water to Nestle, and "Value Chicken" to K&N's Poultry Farms because of this disaster, and the political situation of the nation. Since 1964, K&N's Farms has been in the chicken business and opted to purchase the venture. They started out with a similar business strategy to Value Chicken but also concentrated on increasing sales to grocery shops by installing refrigerators. Additionally, the product line was enlarged. Among the producers of frozen foods in Pakistan, K&N's Foods handles its own product distribution and has the largest company- owned cold-chain distribution infrastructure. Additionally, it operates 65 outlets that serve 18 Pakistani towns and cities and provide ready-to-cook and completely cooked chicken items.

Consumers will be able to purchase freezers and quick meals as the number of dual-income households rises. Although the market for frozen goods has expanded, it is still a small sector. At a production rate of 1.75 kg per chicken, Pakistan now produces 950 million chickens. 1,662,000 tons of chicken flesh are the result. The market is approximately Rs 199,440 million if sold at Rs 120 per kilogram. Less than 1% of this is frozen. In 2007, Pakistan was one of the top 10 poultry

producers in the world, generating more than 800 million birds annually from over 8 million broiler parent stock.

2.6 Emergence and Re-Emergence of Poultry Diseases

Animal diseases can develop more quickly and/or be brought on by a variety of factors. These factors have an impact on how poultry farming is structured and developed, heighten production costs and worldwide competition, and increase the transportation of chicken and poultry products throughout the world (Mulder, 2011). Increased mobility might raise the likelihood of diseases spreading to regions that are now disease-free. Numerous infections, acting independently (mono-causal), in combination with other microorganisms (multi-causal), or as a result of non-infectious causes, can result in poultry disorders (Maasjost et al., 2015).

Non-infectious elements that affect chicken health include the weather, sanitary conditions, housing design and stock density, water and feed hygiene, and the expertise and training of poultry producers (Nguyen et al., 2016). Producers of poultry should provide adequate nutrition, suitable environment, good husbandry, and disease prevention strategies to provide the desired production output (El-Adawy et al., 2012). To minimize disease transmission, maintain optimal immunity, health, and performance in poultry, standard rearing practices must be followed in husbandry. Stress-related factors have the potential to weaken poultry's immune systems, increase their susceptibility to diseases, and reduce the effectiveness of vaccinations (Schlottau et al., 2022).

Infectious diseases in poultry are caused by a variety of infectious pathogens, including bacteria, viruses, parasites, and fungi. These infections can spread across farms by horizontal and/or vertical transmission (Attia et al., 2017).

The most prevalent poultry illnesses worldwide include infectious bronchitis, avian flu, Gumboro, Newcastle disease, E. coli, coccidiosis and mycoplasma (Attia et al., 2020).

Virulence, type, and pathogenicity of the infectious agent(s), meteorological conditions, and environmental factors (ventilation, high stocking density, litter condition, poor management, and high levels of toxic gases like carbon dioxide and ammonia) and secondary infections all have a significant impact on the severity of clinical signs, duration of disease, and rate of mortality and

morbidity (Sigrist et al., 2012).

2.7 Development projects and incentives

2.7.1. National Programs for the Control and Preservation of Avian Influenza

The Ministry of Food, Livestock, and Agriculture has announced a project called National Programs for the Control and Preservation of Avian Influenza, with an estimated cost of Rs. 1180.142 million. The initiative was carried out over a three-year period throughout all of Pakistan (Memon et al., 2015). The project goals included enhancing and expanding federal and provincial district-level avian influenza surveillance, reporting, and diagnostic efforts. Disease control was strengthened, and outbreak containment increased consumer compensation to farmers, and stakeholder awareness of AI, vaccine development, and improved veterinary services.

2.7.2. Credit

The ADB of Pakistan distributed 517826 million rupees for all agricultural uses between 1960 and 2008, of which 4701.945 million rupees went to the poultry industry. Small farmers in Pakistan rely on non-institutional sources and have limited access to institutional loans, according to earlier writers; official credit lenders prefer larger enterprises (Malik, 2003). Khandker & Faruqee (2000) have demonstrated that, even though small farmers recover loans at a rate that is significantly higher, the major institutional lender, the Agricultural Development Bank of Pakistan ADBP, heavily favors lending to bigger farms.

2.7.3. Sada Bahar Scheme/Revolving Finance Scheme

To offer timely input operational capital for poultry among other agricultural enterprises, the Bank launched the Sada Bahar Scheme. The input requirements for the full year are assessed at the time of the initial application. The sum in question is regarded as a revolving limit. It is not essential to conduct a new inquiry for a repeat loan (Hadi et al., 2018). The Managers have the jurisdiction to approve such a loan within the scope of their loan-approval authority and to renew it even if it has already received approval from a higher authority. A total of Rs.33473.514 million was paid out between July 2007 and March 2008, including Rs.8187.698 million that was paid out for one-

window operations (Omar, 2014).

2.7.4. Livestock Development Policy and Poultry

As part of the Development Strategy the government has just begun to pay some attention to livestock and within that poultry development policy. The government's role is to provide an environment that is conducive to the development of the private sector's in agriculture. As a result, the Livestock and Poultry Development Board, which is driven by the private sector, has been founded. This is providing a base for investments in poultry industry (Belova et al., 2012). The federal government has significantly increased public sector investment in the livestock industry in addition to provincial government initiatives. It has also launched projects worth Rs.7.1 billion to strengthen livestock services for improving disease prevention, meat production, and management practices.

2.7.5. Reduce Input Costs in Poultry Production The government has waived all customs duties on the importation of incubators, brooders, cooling systems, evaporation pads, grain storage silos for poultry. Poultry vaccinations, coccidiostats, growth promoter premixes, vitamin premixes, feed additives, copper sulphate, and zinc sulphate used in chicken feed have all been zero-rated in an effort to lower input costs in the production of poultry. Butter cream, processed milk, uncooked poultry meat, cheese-flavored milk, yoghurt, and are all free from sales tax. Additionally, there is no customs charge on poultry, vaccinations, feed additives, or coccidiostats used in the production of poultry feed (Alders et al., 2018).

2.8 Poultry production in Pakistan

According to Barbacaru (2013), poultry farming is a crucial subset of the livestock industry with both high profitability and disease risk. There are three types of poultry farming in Pakistan: industry-intensive, household-intensive, and household-extensive. Over the past three decades, Pakistan's industry-intensive sector has changed. Since 1971, Pakistan's poultry sector has

experienced phenomenal expansion, in line with worldwide trends. The current turnover of around 750 billion PKR (Pak Rupees) reflects this expansion and meets the criteria for industry designation (Liaquat, 2018). According to an overview of the poultry industry Pakistan's cumulative investment in the poultry sector was 1.17 trillion PKR, supporting 1.5 million jobs (Hussain et al., 2015).

In terms of economic output, the industry also consumes agricultural goods and by-products worth roughly 190 billion Pakistani rupees. In Pakistan 40 and 45 percent of meat consumption belongs to poultry. The poultry industry also generates 17.5 billion table eggs annually in addition to 1.44 billion kg of meat each year (An Overview of Poultry Industry, 2020). However,compared to other meat sources, the chicken business has a significant opportunity to grow its market share in the nation. (Hussain et al., 2015).

Ali et al. (2014) Pakistani open-shed broiler farmers' cost effectiveness has been investigated. According to the results of the maximum likelihood estimation, cost efficiency ranged from 0.425 to 0.972, with a mean efficiency of 0.741, meaning that on average, farmers saved 74 percent of their costs.

Imtiaz (2012) did a research to examine the poultry farming businesses in Pakistan's District Peshawar. According to the survey, 79 percent of one-day-old chicks are supplied through commission agents, while the remaining 21 percent are bought at wholesale markets. One day old chicks were purchased on credit in 74 percent of the cases, with 63 percent coming through commission agents and the remaining 11 percent via wholesale markets. Bano et al. (2011) performed a cost and return analysis as well as a descriptive study of the socioeconomic traits of the sample chicken producers in Rawalpindi. The findings revealed a capital turnover of 1.32 and a rate of return on fixed costs of 424 percent and variable costs of 135%.

Noonari & Memon, (2020) was conducted by taking into account the significance of poultry farming output in Balochistan, Pakistan. The findings revealed that 45.00 percent of respondents raised poultry on a modest scale (2000 birds), 34.35 percent of respondents were raising between 2000 and 4000 birds, and 21.77 percent of respondents were housing up to 4000 birds at their farms.

There are several literature data on poultry production economics in different regions of the world.

Taru et al. (2010) for instance conducted an investigation of the business aspects of Cameron's

broiler production. The analysis' findings indicate that the production operations of the broiler producers were inefficient. Islam (1998) reported that for small, medium, and big scale chicken farms, respectively, the repeated expenditure on day old chicks was Rs.87765, Rs.28764, and Rs.158986.

Adeola (2005) studied the elements impacting Nigerian poultry growers. The study found that strengthening poultry production requires national support in the areas of finances and input. According to a study done in Peshawar by Mussawar and Durrani (2002), commercial egg production was found to be increased and made more profitable by maintaining efficient use of resources, good housing, maintaining highly productive stock, maintaining standard hygienic practices, right size of the operation, proper planning, and minimizing production costs.

According to an Indian study (Afzal & Khan, 2017) a survey was carried out in Lower Dir in 2015 to undertake a research on the economics of broiler poultry farms. Small poultry farms typically cost Rs.3, 10,098 per flock, but medium and big farms, respectively, cost Rs.4, 99,987 and Rs.7, 34,766. Feed was predicted to be the most expensive item, followed by chicks. Small farms had an average gross margin of 38,556 rupees, while medium and large farms had margins of 62,844 and 89,261 rupees, respectively. Despite high mortality rates in big farms, the large scale poultry farms reported the largest net benefits.

Aujla & Sadiq, (2018) outlined how Pakistan's poultry industry is a significant and thriving part of the country's agricultural system. Since real prices have declined and output of chicken meat has increased rapidly during the past several years, the impact of poultry meat prices on supply is deemed to be minor. However, recent growth in cage-free broiler farming has boosted the nation's output of chicken meat. According to the requirements of the linear and polynomial price lag models. In contrast to the past growth rate of 9.1 percent per year between 1980–1981 and 2011–2012, it is hoped that poultry meat production will increase at a rate of about 8.0 percent per year by the year 2030.

Jamali et al. (2011) analysed the issues the Pakistani poultry sector is having. Using straightforward random approaches, information was gathered from 1000 respondents. The parent stock layer was found to be growing at a pace of 120% annually, with growth reaching almost 200% in several years, including 2004, 2006, 2009, and 2010. In contrast, broiler parent stock had a constant growth rate of 135 percent. It was further disclosed that the government should be in

charge of overseeing the development of effective human resources through the coordination of numerous agencies. There aren't enough poultry training facilities in Pakistan, which prevents increasing the production efficiency.

According to Chaudhry et al. (2016), who studied the pricing processes in commercial broiler value chains, the industry was in danger of failing because of the sharp price fluctuations. Jalil et al. (2017) looked at the value chains of meat among Pakistani smallholders and found that expensive transportation was the reason of high meat prices. It is vital to do in-depth study on the broiler and layer value chains in order to grasp and concentrate on the disease and value chain management intervention points that can promote economic resilience and food safety within the poultry production chains.

Khawaja et al. (2012) the hatchery of the Poultry Research Institute in Rawalpindi donated a total of 2001 day-old, unsexed chicks from the Rhode Island Red (RIR) and Desi, Fayoumi breeds. For 72 weeks, the birds were maintained on the deep litter system. RIR had the highest average day-old weight, Desi had a median weight, and Fayoumi had the lowest average day-old weight, according to the findings. The composition of the breast and thigh meat in three breeds was found to be similar ($p>0.05$). The breeds Desi (29%), RIR (41%), and Fayoumi (36%), all produced the most eggs. However, no differences between the Fayoumi and Desi breeds were found to be statistically significant ($p>0.05$). The largest egg bulk and weight belonged to RIR.

Khan et al. (2022) studied sample included 105 layer chicken farms (egg production using a battery cage technique) and 105 broiler chicken farms (environmental control shed system, meat production). TE levels were estimated together with factors affecting efficiency using a Cobb-Douglas stochastic frontier production analysis method using the inefficiency effect model. According to the findings, vaccination was shown to be unimportant, however flock size, labor, feed, and water use are all positively associated to egg production. The study finds that by using the current resources and technology more effectively, egg output may be increased by 11%, and meat production can be increased by 8%. Policy interventions should concentrate more on the pronounced impacts of factors like education, farmer experience, financial availability, and extension services to increase the productivity of poultry producers.

Hafez & Attia, (2020) observed that the poultry industry's capacity to expand in the future is constrained by several factors, including chicken immunity, health, and productivity. The

introduction and reemergence of illnesses, product kinds, safety concerns, and product quality issues will all continue to be important obstacles to the sector's existing position and its strategic future.

2.9. History of poultry industry in Pakistan

Native chickens, which produce an average of 0.769 kg of meat at four months of age and lay 30 eggs per year, were Pakistan's primary supply of eggs and meat before 1963 (Sahota & Bhatti, 2003). These birds were bred in backyards for specific household requirements. The Department of Poultry Husbandry at the University of Agriculture, Faisalabad introduced Lyallpur Sliver Black (LSB), an improved breed of chicken, in 1965–1966. In a two-way cross breeding effort, the local Desi breed was crossed with three foreign breeds White Leghorn, White Cornish, and New Hampshire—to create this breed, which can produce up to 150 eggs annually and can withstand the severe weather conditions of rural locations (Siddiqui et al., 1979). The first commercial hatchery in Pakistan was created in Shaver Poultry Breeding Farms of Canada in the middle of the 1960s (Sindh Province) and Karachi by Pakistan International Airlines (PIA). Inthe Punjab province's Rahim Yar Khan Area, Lever Brothers Pvt. Ltd. opened the first industrial chicken feed plant at the same time (Memon, 2012).

2.9.1. Introductory period (1965-1970)

Government support was significant for early poultry enterprises at this period, especially those that included financial risk. All national taxes were exempt from chicken production. It was allowed for poultry farmers to import machinery and breeding stock with improved genetics duty-free. Pakistan had a shortage of food protein, large profit margins, the accessibility of technology, and official supports and those were the main reasons affecting the sector's early development. The Directorate of Poultry Production was established to provide services to Karachi's steadily growing community of chicken growers.

2.9.2. Institutional development phase (1971-1980)

With the help of the government's pro-poultry policies and healthy revenues, Pakistan's poultry industry has started to grow into a successful business. The government was inspired by the industry's success to enhance the institutions that support it. The Federal Poultry Board was established in 1979 in order to forge an effective connection between business and the government. With aids from UNDP/FAO poultry research institutions were set up in 1978 in Karachi and Rawalpindi to offer services to poultry producers. In Pakistan's poultry industry's history, this time is regarded as a boom period. Numerous business individuals were drawn to this industry by the special incentives provided by the Sindh government, including the provision of state land for poultry farming under ten-year leases and the nationalization of other industries by the federal government (Memon, 2012).

However, because chicken goods were prohibited from being exported at this time, the poultry business suffered from fewer marketing prospects. The situation became severe because disease issues, expensive, low-quality feed, and limited quantity of feed components. The Pakistan Poultry Association, meanwhile, was founded in 1979 to encourage campaigning to improve the standing of the sector and farmers. The total poultry meat production, total number of eggs, and total number of birds all increased in the poultry business between 1971 and 1980 by 177%, 271%, and 297%, respectively (GOP, 2013).

2.9.3. The depression and adjustment phase (1981-1990)

The poultry sector had a distinctive regional migration in the period of 1981-1990. The Sindh province's poultry sector had a notable decline in size and volume towards the beginning of the 1980s. Additionally, a variety of issues were confronted by poultry farms spread throughout several clusters. Long-term solutions were needed to address disease outbreaks and decreasing output brought on by climate stress. Progressive farmers made the decision to move their fields to Pakistan's slightly cooler and more bio secure northern regions in light of all these limitations. (GOP, 2013).

2.9.4. Severe disease outbreaks and re-emergence the industry (1991-2000)

Many calamities in the sector, notably from sickness, made up this time period. When HPS (Hydro Pericardium Syndrome) first arose in 1990, broiler breeder chickens and flocks of broiler suffered severe losses. Gumboro first arose in 1991 and had a negative impact on flocks of parents, layers, and broilers. While the industry was striving to recover from the prior Gumboro outbreaks and HPS, a second epidemic of avian influenza in Abbotabad and Murree in 1995 affected the parent flocks and caused up to 80% mortality (Anjum et al., 1994).

The rise of these illnesses created new opportunities for the sector, leading to the introduction of preventative measures including immunization and biosecurity. New businesses were established to import vaccinations and medications. Controlling these issues required the assistance of the Faisalabad University of Agriculture, poultry research facilities, and veterinary research facilities (PPA, 2013). On the other side, poor planning resulted in an overabundance of parent stock in 1996, which sharply reduced the cost of day-old chicks.

The situation worsened in 1997, when the federal government decided to forbid providing lunch at wedding receptions, where chicken was served. As a result, the local market's demand for poultry goods fell by around 40%. 1998 saw an increase in chick prices and breeding and hatchery businesses' financial stability, but owing to the resurgence of influenza-like infections in 1999, the sector once more suffered (PPA, 2013). Despite the significant losses realized by the industry during this time, it continued to expand and displayed a superb growth rate in terms of the overall number of birds produced, the overall production of poultry meat, and eggs, with growth values of 99, 125, and 67% (GOP, 2013), respectively.

2.9.5. Poultry Farming in recent time

In the late 1990s, the poultry sector began to stabilize as a result of increased profit margins on chicken products. New investors joined the market and embraced contemporary technology like ecologically friendly housing. During this era, new investors made substantial investments in the business, and poultry farming began transitioning from open-sided homes to brand-new, cutting-edge barns. In order to provide qualified professionals and further assistance for this rapidly

expanding business in Pakistan, the University of Veterinary and Animal Science was established in Lahore in 2002. The graduates in veterinary medicine and poultry science turned out to be valuable resources for the sector.

The development of avian influenza in Southeast Asia (Naeem and Siddique, 2006) and its suspected spread into Pakistan slowed this expansion, which had been great up until 2004 and had significant profit margins. The issue got worse after Middle Eastern nations imposed a restriction on the import of chicken products. Despite its ups and downs, the Pakistani sector managed to increase the number of birds by 127%, the amount of meat produced by 126%, and the number of eggs by 71% between 2000 and 2010 (GOP, 2013) (Figure 3-5).

The availability of a solid foundation for this business in Pakistan is the cause of this amazing growth. Currently, the chicken industry's eggs and meat are the least expensive forms of animal protein in Pakistan (PPA, 2013a).

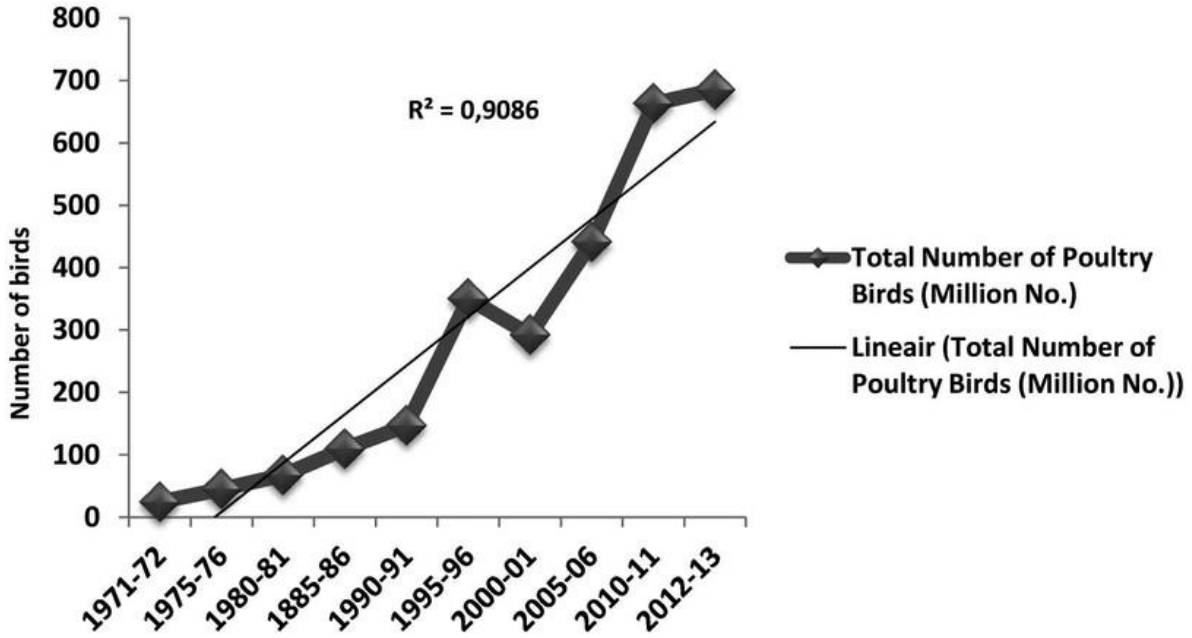

Figure 3. Overall growth in terms of total number of poultry birds (million no.)Source: Federal Bureau of Statistics, Government of Pakistan

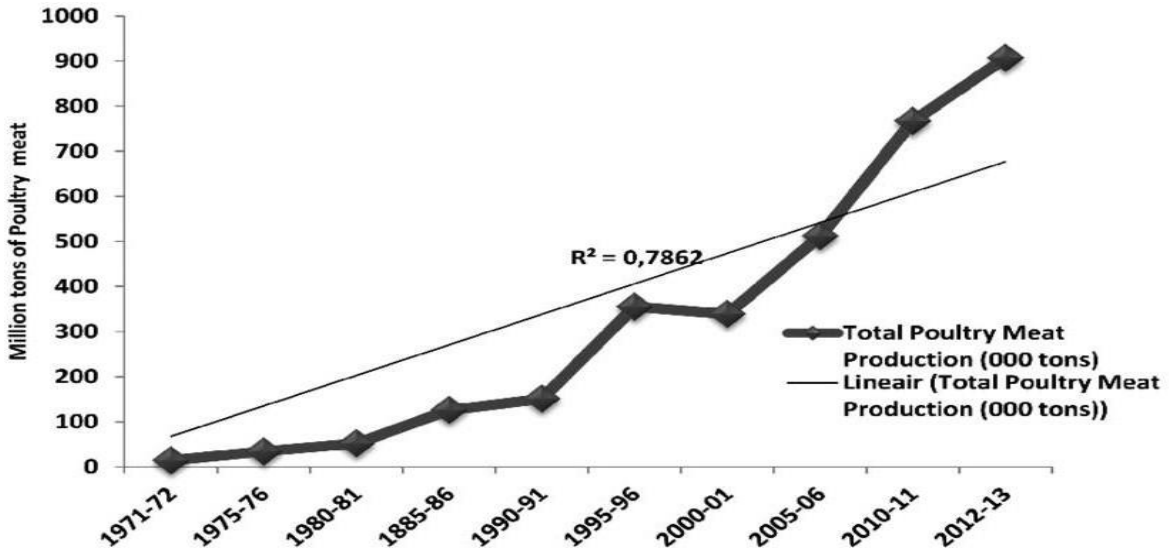

Figure 4. Overall growth in terms of total Poultry Meat Production (million tons)Source: Federal Bureau of Statistics, Government of Pakistan.

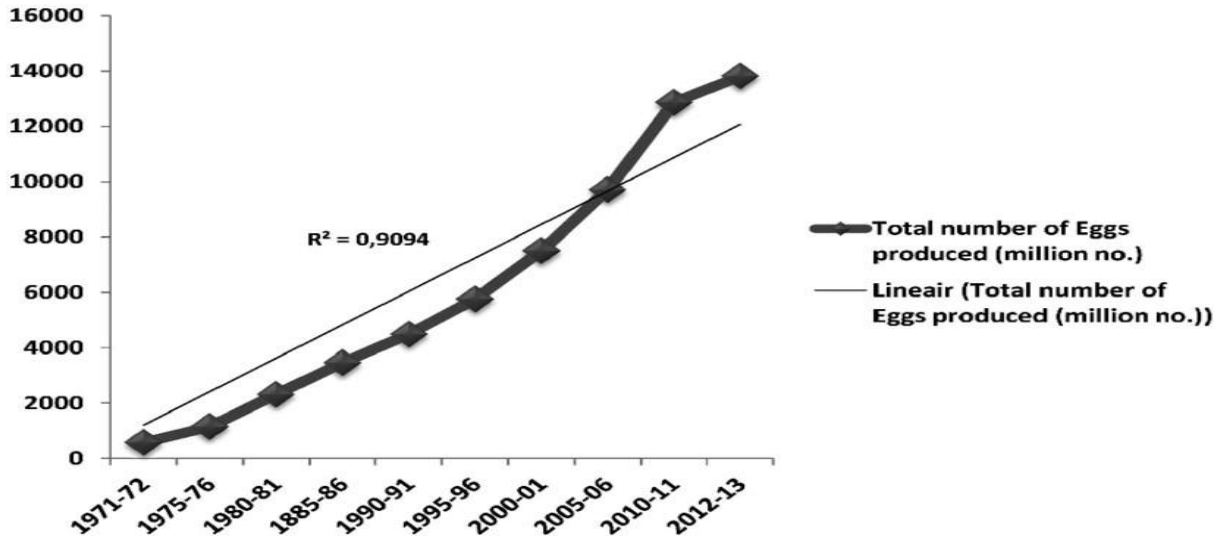

Figure 5. Overall growth in terms of total number of Eggs produced (million no.)

2.10. Poultry production system in Pakistan

2.10.1. The traditional rural system (Domestic poultry system)

Almost all rural families and 20% of urban households employ the conventional rural method, which involves keeping flocks of 5–10 birds with a cock (Pictures 1, 2). These scavenging birds are kept inside the home at night and feed on crop waste and kitchen scraps. Lyallpur Silver Black, Rhode Island Red, Desi, Fayoumi, Aseel, and hybrids are popular breeds. Old chickens and cockerels are ultimately be consumed or sold. Raising poultry has always been a woman's job; it not only yields egg and meat for the household, but also for guests (Adebisi et al., 2020).

Picture 1.
Traditional rural system

Picture 2.
Traditional rural system

2.10.2. Commercial poultry production

With an initial investment of 23 billion rupees to supply the Karachi market, commercial poultry production began in 1963. A layer flock typically has 2500 birds, whereas a broiler flock typically has 2200 birds (Pictures 3, 4). In hotter climates, homes made of concrete and brick are frequently cooled in the summer (Sinowo & Tolorunju, 2019). Broilers and layers are both raised on a thick rice husk or sawdust litter. Battery cages are used by 10% of farmers for their hens. Between four and six batches of broilers are raised annually on farms. Purchased and raised for five to seven weeks, day-old chicks are sold at 1.25-to-1.5-kilogram live weight. At 20 weeks, layers begin

producing eggs, and they are often maintained for 45 weeks. Most farmers use commercial poultry feed, although others utilize home-mixed feed (Ullah et al., 2019).

Picture 3
Commercial broiler production

Picture 4
Commercial layer production

2.11. Organizations associated with poultry industry in Pakistan.

2.11.1. Poultry Sector Organizations

Poultry/Broiler Farming, Poultry Associations in Pakistan from 1990 forward, the poultry sector had significant growth despite a few hiccups. However, it is important to note that the Punjab area benefited considerably from this period's growth balance. Asia feed group, Islamabad group, and SB group are the next largest players in the poultry sector after the well-known Hi-Tech group, National group, and Olympia group. Hi Tech Group recently separated into two organizations, Shehzor, and Hi Tech although the Rawalpindi location of Hi-Tech Feed Mill continues to hold the title of being Pakistan's biggest feed mill. The list below includes the names and locations of poultry breeding farms and hatcheries:

- Arbor Acres Pakistan Ltd (Lahore)
- Poultry Breeders(Lahore)
- Murgha Valley Poultry Breeding House(Rawalpindi)
- Karachi Farmers(Karachi)
- Marakash Poultry Breeders (Karachi)
- Al-Madina Breeders(Karachi)
- Olympic Chicks (Lahore)
- Sadiq Brothers(Islamabad)
- Islamabad Poultry and Breeding(Islamabad)

- Sieghal Poultry Farms(Karachi)
- Best Birds (Lyallpur)
- K $ N's Poultry Breeding Farms(Karachi)
- Golden Breeders(Karachi)
- M.A. Farms (Karachi)
- Star bro (Karachi)
- Hi-tech(Lahore)
- Big Bird(Lahore)

There are some government poultry farms as well, with large, intensive flocks.

- Government Poultry Farm, Bahawalpur
- Government Poultry Farm, D.G.Khan
- Government Poultry Farm, Multan
- Government Poultry Farm, Bahawalnagar
- Government Poultry Farm, Attock
- Government Poultry Farm, Dina
- Government Poultry Farm, Gujrat
- Government Poultry Farm, Sargodha

2.12. Recent development of poultry industry in Pakistan

The production of chicken meat and eggs has long been known for its positive rise in the livestock industry's overall results, and it has now reached a point where the influence on the nation's economy is plain to see. The business of raising poultry is one of the most promising sources of supplementary income. Additionally, raising chickens provides a variety of benefits. It generates much-needed protein food, and provides many people with a source of money and work in addition to having high returns (Barbacaru, 2013).

The business of raising poultry is tremendously lucrative, but requires increasing amounts of cash. Within 8 to 9 weeks for broilers and 20 to 22 weeks for layers, the money from the poultry industry starts to materialize. A young male or female fowl kept for meat production under 10 weeks of age is referred to as abroiler (Overland et al., 2022). These breeds are typically raised and sold as fast-growing meat animals. According to feed and management, broiler mature in 8 weeks weighing close to 2-2.5 kg, and the typical age for marketing is when the broiler consumes around 4 kg of feed over the course of 6 to 8 weeks. The majority of breeders raise broilers so that they will be prepared for sale during holidays when demand for profit is strong (Alam & Khan, 2000)

- Factors that inhibit the distribution and transportation of poultry throughout the nation, Demand for poultry meat is quite price sensitive among low- and middle-income consumers.
- Low- and middle-income customers are quite price-sensitive when it comes to their desire for poultry meat. Slowing consumption and production growth may also be a goal of domestic chicken market protection measures.
- There is a low demand for frozen goods, a poor and expensive transportation infrastructure, and a lack of cold chain, or frozen storage, facilities. These factors discourage the transport and distribution of poultry within the nation and may have an equal or greater impact on trade restrictions than tariffs.
- By increasing manufacturing and marketing effectiveness and bringing down consumer costs, vertical integration can encourage sector growth.
- Competitive poultry and egg production depends on competitive feed pricing. Slowing the rise of poultry is also likely to result from policies that defend local feed producers.

2.11.1. Poultry sector data in the 2017-2021 period (million birds)

Data on the production of poultry birds from 2017 to 2021 was gathered and statistically examined (Pakistan Poultry Association). As shown in Table 1, the findings indicated a significant improvement as egg production more than doubled between 2017 and 2021. Based on the production pattern over the evaluated five years period, regression models were used to forecast future levels of poultry bird production at commercial farms. In Table 2 the overall performance of poultry industry is summarized according to the different species and their products.

Table 1. *Poultry Birds production for 2017-2021 period (million birds) at the commercial poultry farms*

Years	**Number of poultry birds at farms (million birds)**
2017-18	1,132
2018-29	1,321
2019-20	1,443
2020-21	1,578

Table 2. Domestic poultry production for 2017-2021 period (million birds/eggs/kg)

Type	**Units**	**2018-19**	**2019-20**	**2020-21**
Domestic Poultry	Million Nos.	88.49	89.84	91.22
Cocks	Million Nos.	12.18	12.51	12.85
Hens	Million Nos.	43.15	43.93	44.72
Chicken	Million Nos.	33.16	33.40	33.65
Eggs	Million Nos.	4,315	4,393	4,472
Meat	Million kg.	122.28	124.72	127.22
Duck, Drake & Duckling	Million Nos.	0.40	0.38	0.37
Eggs	Million Nos.	17.93	17.18	16.47
Meat	Million kg.	0.54	0.52	0.50

Success of chicken industry is based on the performance of breeder stocks in the country. In Table 3 breeder flock development is summarized for the examined five years long period of 2017-2021 (Pakistan Poultry Association).

Table 3. *Breeding Stock production for 2017-2021 period (million birds) at the commercial poultry farms*

Years	**Number of Breeding stock at farms (Million birds)**
2017-18	12.89
2018-29	13.01
2019-20	13.66
2020-21	14.34

2.11.2. Egg production for 2017-2021 period (million birds) at the commercial poultry farms in Pakistan

Data on egg production from 2017 to 2022 was gathered and statistically examined (Pakistan Poultry Association). The output of eggs more than doubled between 2017 and 2021, as indicated in Table 4, and this resulted in a noticeable rise. Regression models were used to forecast future egg production at commercial layer farms based on the pattern in egg production over the previous five years. The table displays the annual growth in eggs produced on average. Regression analysis shows that the independent variable explained 83.41% of the variation in egg output (years). The computed coefficients revealed that the independent variable (years) had a considerable influence on egg output. The table also displays the approximate number of eggs produced (Table 5).

Table 4. *Egg production for 2017-2021 period (million birds) at the commercial poultry farms*

Years	**Number of eggs at farms (million birds)**
2017-18	13,856
2018-19	14,719
2019-20	15,723
2020-21	16,797

Table 5. *Regression model to predict the egg production in Pakistan*

Predictor	**Co-efficient**	**S.E**	**T**	**P-VALUE**
Constant	1992.3	147.6	13.50	0.00001
X	83.41	22.73	3.67	0.0004

2.11.3. Broiler production for 2017-2021 period (million birds) at the commercial poultry farms in Pakistan

Table 6 shows the broiler produced from 2017 to 2022 to fullfil the demand for chicken meat (Pakistan Poultry Association). Similar trends in the production of broilers and layers over the past few years have been seen according to data. All segments of the poultry industry have had continuous growth and increasing production, which is evidence of rising demand. Regression models were applied based on the population during the previous five years to forecast the output of broilers at commercial poultry farms.

Table 7 displays the boiler production regression model's coefficient for various time periods. The fact that the coefficient of production of the boilers has a p-value of 0.0001, which is less than 0.05, further demonstrates its significance. The number 33.146 displays the annual rise in boiler production that is on average. R value demonstrates that the independent variable's influence was responsible for 33.146% of the variance in broiler output (years). The calculated coefficients show

the independent variable (years) has a considerable influence on broiler output. The kind and size of the change in broiler production in the research region may be predicted using the model.

Table 6. *Broiler production for 2017-2021 period (million birds) at the commercial poultry farms*

Years	**Number of Broiler at farms (million birds)**
2017-18	1022.87
2018-29	1,163.42
2019-20	1,279.76
2020-21	1,407.73

Table 7. *Regression model to predict the Broiler production in Pakistan*

Predictor	**Co-efficient**	**S.E**	**T**	**P-VALUE**
Constant	79.56	38.31	2.08	0.065
X	33.164	5.90	5.62	0.0001

2.11.4. Chicken meat production for 2017-2021 period (million birds) at the commercial poultry

Production of chicken meat at the commercially established poultry farms in the research region increased significantly from 111772 metric tons in 2017 to 1,681.64 metric tons in 2022, a rise of 12785.98 percent (Pakistan Poultry Association). Based on the trend in chicken meat output during the previous five years, regression models were used to anticipate the production of chicken over the following ten years at commercial poultry farms (Table 8). Table 9 displays the regression model's coefficient for the production of chicken meat over various time periods. The fact that the co- efficient of chicken meat production has a p-value of 0.0001, which is less than 0.05, further demonstrates its significance.

Number 23353 displays the average annual growth in chicken meat output. The regression result indicated that the output of chicken meat varied by 23353 tonnes annually (independent variable).

According to the computed coefficients, the number of years had a substantial influence on the rise in the output of chick meat at industrial chicken farms. According to the application of the demand/supply rule, a price increase is eventually anticipated if output drops or remains constant.

It has been established in the past that management choices at breeder farms and hatcheries have an impact on egg and broiler wholesale rates. Furthermore, the market rate for chicken goods was significantly impacted by flock age, egg weight at hatching, egg features, fertility, hatchability, and the generation of saleable chicks (Poultry Research Institute Punjab).

Table 8. *Chicken meat production for 2017-2021 period (million birds) at the commercial poultry farms*

Years	**Number of Chicken meat at farms (Million birds)**
2017-18	12785.98
2018-29	1,395.02
2019-20	1,531.60
2020-21	1,681.64

Table 9. *Regression model to predict the chicken meat production in Pakistan.*

Predictor	**Co-efficient**	**S.E**	**T**	**P-VALUE**
Constant	118630	25262	4.62	0.001
X	23353	3890	6.00	0.0001

2.11.5. Seasonal variation in the prices of poultry products in Pakistan

In Pakistan, the price of chicken goods was determined by the supply system and demand, but there has always been a significant monthly variation in price, indicating that seasonal variations had a greater impact on poultry pricing than on any other commodity (Figure 4). Day old chick

costs were lowest from May to July and from November to January, when temperatures were at their highest. This may have been caused by greater winter death rates and higher winter brooding expenses. The months of March and April had the highest farm gate rates for commercial broilers since these are the months of weddings in Pakistan, which raised demand for broiler meat (GOP, 2013). The coldest months, December, and January, led to higher egg consumption and related expenditures. Seasonal price swings for chicken products have become a common occurrence and must be addressed in order to maintain the industry's stability.

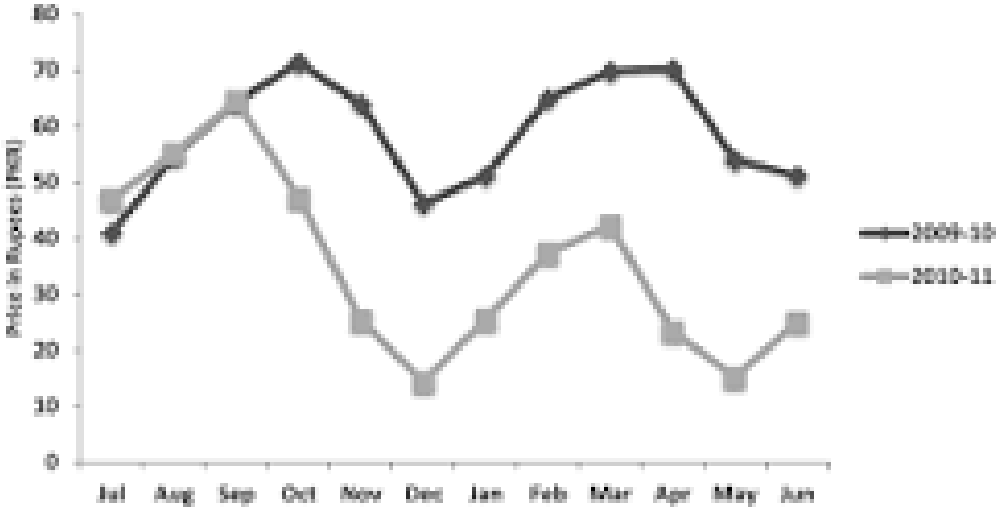

Figure 6. Seasonal variation in the prices of poultry products

3. CONCLUSIONS AND RECOMMENDATIONS

Over time, the proportion of chicken meat in the nation's meat output has surpassed that of mutton, and it has begun to replace mutton in peoples' diets. Currently, Pakistan's meat supply is made up of around a quarter chicken. In comparison to both small and big ruminants, poultry has much better feed efficiency, as it requires lower amount of feed for shorter period of time to reach slaughter weight.

Although only minor changes in poultry production technology have been seen over time in Pakistan, the country's output of chicken meat has recently increased due to the quick uptake of controlled house broiler farms. Rapid adoption of controlled house broiler farms has made it extremely difficult for open house farms to survive, discouraging small farmers from making fresh investments in the industry. The output of poultry meat is anticipated to increase, but hopefully at a somewhat slower rate than in the past. Therefore, long-term policy changes would be necessary to increase the nation's output of chicken meat. These might include providing assistance to farmers so they can transform open-air farms into controlled-access farms by facilitating better access to institutional loans and production inputs.

4. SUMMARY

The poultry industry in Pakistan is one of the most vibrant and exciting sectors of agriculture, contributing significantly to the national economy (1.5% of the country's GDP). Beginning in the 1960s, commercial poultry farming in Pakistan saw several ups and downs. The poultry industry initially benefited from several business-friendly government regulations, but eventually encountered numerous difficulties such as disease outbreaks, various prohibitions, and changes in retail prices. By bringing in major investors and using contemporary technology, the poultry sector was able to stabilize itself adequately in the late 1990s and increase its profit margins on chicken goods. Over 1.5 million people are now employed by Pakistan's chicken sector, the country's second largest employer. With an annual output of 1.02 billion broilers, 11.8 million breeding stock, and 48.83 million layers, Pakistan is the 11th-largest producer of poultry in the world. Over Rs.700 billion is now invested in the poultry business.

A recent economic survey (2017–2021) estimates that the breeder, broiler stocks, and commercial layer will expand by 7.0 percent, 5.0 percent, and 10 percent year, respectively. According to WHO (World Health Organization) guidelines, the average person consumes 27g of animal protein per day, compared to 17g in Pakistan. This discrepancy highlights the need for the chicken business to expand in order to supply enough animal protein to meet WHO criteria. In recent years, the government has made a number of actions to advance poultry, duck, ostrich, and quail production in Pakistan. In this approach, the government also offers farmers subsidies. To fulfil local and international demand, information about the production and processing of chicken meat is still necessary. This analysis aims to cover the background, current situation, potential future developments, and difficulties of Pakistan's poultry sector. In order to build strategic planning for the further expansion of this business, it will also serve as a foundation for poultry specialists and policy makers.

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