EFFECT OF COVID-19 AND SOYBEAN UNAVAILABILITY SITUATIONS ON THE POULTRY INDUSTRY OF PAKISTAN: A COMPREHENSIVE ANALYSIS OF PROBLEMS FACED BY THE INDUSTRY AND ITS SOLUTION FOR SUSTAINABLE ANIMAL PRODUCTION

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ABSTRACT: The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has had a profound impact on various production sectors worldwide, including agriculture. Poultry production, a critical component of the global food supply chain, is also not spared from the effects of pandemic. Soybean, a versatile and widely consumed crop, plays a crucial role in global food security and is a key player of feed and food industries, however, in recent years, soybean unavailability has become a growing concern. This review article aims to examine the reasons behind the limited availability of soybean and its effects on different stakeholders, including farmers, consumers, and industries. Through a comprehensive analysis of the factors contributing to soybean unavailability and the consequences of COVID-19 and soybean shortage on poultry production, this article provides insights into the implications for agricultural systems, exploring potential genes, sustainable marketing, and sustainable development of poultry products. Additionally, it provides insights into the future adaptation strategies implemented by farmers and stakeholders to mitigate such negative impacts to ensure sustainable production.

Keywords: COVID-19, soybean import, ban, poultry industry, Pakistan.

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INTRODUCTION

The COVID-19 pandemic disrupted the global poultry industry, leading to significant challenges throughout the production chain (Attia et al., 2022) during the last few years. The infection had seriously affected animal production, especially poultry production throughout the world (Sharun et al. 2021) due to the misconception of the involvement of chicken meat and eggs in the spread of COVID-19. This rumor deteriorated the poultry production economics in all aspects (Das and Samanta 2021). Moreover, lack of labor, an increase in table egg consumption and its prices, decreased chick production, an increase in the retail price of meat, decreased global demand for poultry products, and less availability of poultry feed ingredients affected the industry during the pandemic. Soybean imports and utilization had already decreased by up to 15% over the past three years (Karlsson et al., 2021) due to several factors including the COVID-19 pandemic, which has disrupted global supply chains and reduced demand for soybean products (Hashem et al., 2020).
Pakistan’s poultry industry is on the threshold of serious downfall, as 50% of the poultry farms have shut down due to a huge increase in poultry feed prices. The industry was working smoothly, and playing a pivotal role in supplying eggs and chicken to the country’s people at affordable prices; however, the sudden increase in the price of soybean (an increment from Rs165/kg to Rs465/kg on average) due to unwise ban on soybean import has led to a huge increase in the prices of chicken eggs and meat (poultry meat selling @Rs700-750/kg) as the feed mills owners have increased the price of feed bag from Rs2,400 to Rs7,500 per bag (on an average) during the last few months which is expected to go further higher.

Due to the soybean unavailability and shortage of quality feed ingredients, a broiler that usually reaches market age within 32 days is now taking 50 days to reach market weight causing losses to farmers. The bad decision of the government has crushed the poultry industry and now the existence is based on the prompt permission for soybean meal import. Additionally, Pakistan’s poultry industry has been struggling to recover from the pandemic, which has further decreased demand for soybean meal (Kabir et al., 2021). The significance of soybean as a key agricultural commodity highlights its diverse applications and importance in the global food and feed industries (Oliveira et al., 2016). This article aims to provide an overview of the current devastating situation the industry faced due to the COVID-19 pandemic and soybean unavailability, exploring factors contributing to soybean unavailability and the future endeavors to support the industry to avoid such hurtful circumstances to ensure sustainable poultry production.

### FACTORS CONTRIBUTING TO SOYBEAN UNAVAILABILITY:

#### Soybean Production Challenges During COVID-19 and thereafter:
The primary challenges faced during soybean production includes unfavorable weather conditions, pests and diseases, limited access to quality seeds, and inadequate agricultural practices (Dogbe et al., 2013). Soybean is cultivated worldwide including Brazil, China, Japan, Korea, USA, and many South and Midwest countries are major producers. It is used vastly in poultry feed and agriculture subdue however, changes in climate due to green house gases and diseases have affected its production in recent years (Conner et al., 2011). Moreover, the COVID-19 pandemic affected soybean production at a challenging level and contributes to its unavailability as during COVID-19, concerns about disease risks of influenza and import restriction reduced the utilization of the soybean that resulted in lowered production. Inadequate agricultural practices, seedling not at the proper time, and having improper knowledge about environment requirement for Soybean has also led to a decline in production (Nair et al., 2023). Poor management of the crop, cutting not at the proper time, and chemicals used as a spray have led to a great crop loss. The lack of quality agricultural medicines and fertilizers are also one of the main cause of the low yield of the crop (Bhagat et al., 2015). The uncontrolled growth of pests and herbs make a competition for water and nutrients from the soil Soybean needs paved soil for their growth (Vencill et al., 2012). The quality of seeds is not proper which resulted in limited growth of the crop (Hartman et al., 2011). Diseases challenges on the other hand also serve as a hindrance to production (Ng et al., 2021). There is a need for implications of reduced surveillance and disease control focusing the enhanced biosecurity measures and plant protection and precise poultry diet formulation (Stoll et al., 2018; Obuene et al., 2021).

#### Availability of Land, Market Volatility and Consumer Demand:
The increasing competition for arable land, particularly for other crops and biofuel production, has resulted in reduced soybean acreage (Martin et al., 2010). The dynamics between soybean cultivation and competing land uses have also affected soybean availability. The unavailability of fertile land and other important crop cultivation has led to a decline in soybean production (Rathmann et al., 2010) and this has affected the poultry and agriculture industry both at the same time (Boyd et al., 2001). Unavailability of separate lands for soybean cultivation and small-scale cultivation of Soyabean led to failure to meet the market demands (Gras, 2009). However, use of proper fertile land without mixed cultivation may enhance the yield of the soybean crop (Wesz et al., 2022) that may led to economical poultry feed production. Currently, poultry industry experienced shifts in its product demand patterns due to changing preferences, reduced purchasing power, and disruptions in food service sectors (Nkuikwana et al., 2018) that has resulted to decreased poultry product demand causing losses to farmers and retailers. Farmers were compelled to sell chicken at a lower rates (Sohel et al., 2022). The poultry meat and egg market bore great loss because of the lockdown situation (Agius et al., 2021)

### Table 1: Showing the decreasing trend of soybean import and utilization in Pakistan due to COVID-19.

<table>
<thead>
<tr>
<th>Year</th>
<th>Soybean Imports (tonnes)</th>
<th>Soybean Utilization (tonnes)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020-21</td>
<td>1.9 million</td>
<td>1.8 million</td>
<td></td>
</tr>
<tr>
<td>2021-22</td>
<td>1.7 million</td>
<td>1.6 million</td>
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</table>
and the ban on social gatherings places like marriage halls, fast-food hubs like KFC and Mcdonalds etc. (Crothers et al., 2021) resulting in reduced soybean production worldwide.

**Trade, Market Factors, and Economy:** Global trade policies, export restrictions, and market dynamics had greatly influenced the availability of soybean during and after COVID-19 which disturbed the supply chain and negatively affect trade policies, prices, and market volatility on soybean availability. The recent Russian-Ukrainian war further harmed the trade policies of many countries. Export restrictions to developing countries led to an increase in feed prices and many farmers have shut down their farms now (Foyer et al., 2019). Market dynamics have changed to an extent that now farmers have started to use low-quality protein sources as replacements for soybean meal in poultry diets wherever affordability of Soyabean meal is a question. Pakistan had imported 2.5 million tonnes of soybean in 2021 which cost $ 1 billion in foreign exchange. Market uncertainty due to shortage of soybean meal is now a big risk affecting the seasonal profit of the farmers and due to this poultry farmers had faced numerous challenges, such as increased production costs, reduced prices, and market uncertainties. For example, if the cost of production is 360 PKR per kg and the farm rate is RS. 315 then the farmer is having a loss of 45 rupees per kg.

**GMO Soybeans Facts:** Soybean meal is an important feed ingredient obtained from soybean seeds GMOs (Genetically modified organisms) during oil extraction process. During the last year customs department hold 9 vessels without NOCs from the MCC (Ministry of Climate Change) making it difficult to allow the seeds. It is reported that an importing company had given an undertaking that 3000 MT Soybean seed loaded on the vessel (MV CI DAYANG HE) is non-GMO and is fit for consumption.

Minister for national food security and Research Mr. Tariq Bashir Cheema raised serious objections on GMO based soybean and said that it contains carcinogens substances, and that its use may cause antibiotic resistance, toxicity, and allergenicity. It is said that GMO’s also contain glyphosate and AMPA, both are toxic and cause digestive upsets (Domingo et al., 2007; Miyazaki et al., 2019) and that Pakistan biosafety rules require the registration of GMOs with National Biosafety council (NBC) and detailed scrutiny is required for these products (Tiwari et al., 2023).

**Other GMO crops:** GMO-modified soybean is widely being used throughout the world and the decision of banning GMO soybean is not right. Several other crops are also genetically modified like wheat maize and cotton and are being used to fulfill human demand. Moreover, GMO soybean has been used for many years, and there is not a single evidence of its side effects, therefore, there was no need to impose a ban on its import (Hansen et al., 2023). Most of the crops are GMO modified now to improve growth/yield with desired characteristics (Rana et al., 2022) to fulfill the demand of huge human population. Soybean is not easily replaceable, it is a great protein source and is used for a long time, however, addressing the problem is a big issue. Trade-associated problems can create a big gap, leading to the disruption of the food chain, closure of the market, and ban on imports.

**EFFECTS OF SOYBEAN UNAVAILABILITY ON POULTRY AND POULTRY BY PRODUCTS**

**Agricultural Systems and Food Security:** Although, the pandemic also affected the availability of skilled labor, leading to workforce shortages for agriculture and poultry operations. Currently, limited availability of soybean has affects agricultural systems, crop rotation practices, and overall food security severely (Islam et al., 2022) that led to exploring ways implications for crop diversification, soil fertility, and nutrition in both developed and developing countries. The feed and food industry affected abruptly being soybean a significant part and shortage of soybean in the market created a severe loss to feed and food industry. Pakistan must promote soybean cultivation in the country to bridge the gap through public campaign and training of the farmers (Hussain et al., 2021) preparing them using technology helping the country to be independent in soybean production and uplifting the country by reducing the import of soybean and its products. Labor unavailability for soybean production also remained a main issue during COVID-19 as people were not contacting and were frightened to work in the fields and farms, not going out and avoiding people which led to the recruitment of unskillful labor that caused a decrease in soybean and poultry production globally. The pandemic caused disruptions in the in soybean and poultry supply chain, including difficulties in procuring inputs, reduced availability of labor, and logistic challenges (Raj et al., 2022). Training and teaching of the labor may helpful for sustainable working conditions (Holmemo et al., 2020), also there is need of adopting sound strategies to avoid such situations in future.

**Livestock and Poultry Industry:** The livestock and poultry industries heavily rely on soybean as a primary source of protein in animal feed (Govoni et al., 2021). The impact of soybean unavailability on feed costs, livestock production, and prices of animal products was influential and the poultry industry was badly hit by the situation. Soybean is a major source of protein in animal and poultry feed. Necessary for proper weight gain. Due to unavailability the demand was increased but there is less supply which raised rate of poultry feed (Fukase et
In Pakistan, the feed bag is now going at 9000 PKR. This poses a serious effect on small farmers. For e.g farm containing 15000 birds will just close its farm due to increased feed prices. Meat prices have increased tremendously as farmer seeks to earn more than the cost of production (Kosgey et al., 2003). Also, shopkeepers having poultry meat increase their prices to earn profit. The industry is finding a source of protein to use as a substitute for soybean, increased feed rates and farm rate being low keeps farmer irritating (Galecki et al., 2021; Nierenberg et al., 2005). Feed conversion ratio of poultry production without soybean mixed rations remained between 20-27 at farm level (personal survey when visiting poultry farms). Hence unavailability of quality feed has led to shutdown of farms (50%) that may cause big vallilage for food chain (Kusi et al., 2015) and collapse of the poultry industry. Therefore, there is a dire need to provide incentives to the poultry producers to manage losses.

**Consumer Choices and Health:** Soybean and its products are widely used in the food and feed industry. The unavailability of soybean will affect consumer choices, dietary patterns, and nutritional outcomes (Yozu et al., 2021; Adegbusi et al., 2023). Dietary patterns can be affected such that soy-based food products being used now may not be available in the future. To minimize risks and compensate for market uncertainties, farmers should explore alternatives to soybean, diversify their operations, and focus on value addition through product diversification, direct marketing, and local collaborations (Barbieri et al., 2009). Processed and packed poultry products (Chicken cubes, nuggets, sausages, wings, rolls, etc.) have been proven delicious and value additive (Abdel et al., 2022) as these products provided a lot of diversity, making it easier for the consumer to have choices and can support the industry through foreign exchange and improved prices of poultry products.

**Sustainable solutions and future perspective to enhance soybean production and sustainable poultry production in the country:** Agricultural Research Institutes in the country should explore innovative agricultural practices, including precision farming, improved seed varieties, and sustainable cultivation techniques, that can enhance soybean yield (Shaikh et al., 2022). Seed quality affects crop yield and viability to combat diseases. Farmers must be aware to use separate fertile and arable lands to grow soybean (McFadden et al., 2023) and poultry farmers need to adopt good production practices to enhance sustainable poultry production (Blacksell et al., 2023). Efficient trade policies and market interventions, such as promoting fair trade practices, reducing export restrictions, and ensuring market transparency, can help mitigate the challenges of soybean unavailability (Fischer et al., 2020). Policymakers should consider the problems of the farmers and relevant stakeholders when considering such decisions as GMO Soybean. Promoting trade will lead to good diplomacy between different countries and if we meet their demands, we can overcome the political issues to a great extent. Governments and international organizations should implement various policy interventions and support measures to mitigate the impact of COVID-19 on poultry production (Sattar et al., 2021). Farmers should be trained to implement artificial intelligence tools and technology (Abbas et al., 2023) for efficient poultry production.

**Exploring the diversity of protein sources and precise formulations for maximum protein utilization for better environmental health:** To reduce reliance on soybean, diversification of protein sources in animal feed and alternative plant protein crops can be explored (Jahanshiri et al., 2022). Synthetic/crystalline amino acids along with probiotics, feed additives, organic acids and enzymes etc. are essential parts of diets to boost the ideal amino acid profile and gut health (Afzal et al., 2023; Abbas et al., 2021; Abbas et al., 2022; Han and Lee, 2000; Cmiljanić et al., 2003). Supplementation of poultry diets with synthetic amino acids (0.1–0.3%) could help to spare 2–3% of dietary protein and thus may be helpful for better environmental health (Han and Lee, 2000).

Plants are the primary protein source of the ecosystem (Abbas, 2020), however, Plant proteins contain some anti-nutrient factors that naturally exist within their structures, which can adversely affect the quality of the protein and limit its value in animal nutrition (Abbas, 2020; Akande et al., 2010). The most common plant protein source in animal/poultry nutrition is soybean although, other cereal grains i.e. canola meal, sunflower meal, peas meal, corn gluten meal, maize, azolla meal, algae meal, fungi meal, wheat, sorghum, and some plant protein meals such as are also extensively used. In poultry nutrition, soybeans are used as soybean meal. Various varieties of soybeans having high protein contents and a lower oligosaccharide level have also been developed (Baker et al., 2011), moreover, processed soybean products (soybean protein concentrates, soybean protein isolates), are also being added to poultry diets (Peisker, 2001). Replacing soybean meal with processed soybean products in poultry diets is reported to better production performance in broilers and turkeys (Philpott and Norton 2003; Saki et al., 2012; Van der Eijck, 2015).

Animals and animal by-product (good quality protein and energy, reasonable EAA profile etc.) which are part of a slaughtered animal obtained from rendering operations (Meat and bone offal, blood, bones, intestines, rumen content, rejected carcasses of animals/poultry, milk and dairy processing wastes, fish and fish processing waste, earthworm meal, black soldier fly larvae meal, snail meal, poultry litter, hatchery wastes meal, locusts meal, dung beetle meal, single cell proteins,
insect meal, meal worm scales, fungi meal, algae meal etc. are potentially used in poultry nutrition (Hazarika, 1994; Konwar and Barman, 2005; Denton et al., 2005; Abbas et al., 2020a; Abbas et al., 2020b; Abbas et al., 2020c; Khan et al., 2022; Arshad et al., 2022; Arshad et al., 2022a). Blood meal has been reported to be included in poultry feeds up to 25% level (Hazarika, 1994). Whilst Anang et al. (2001) and Nuarautelli et al. (1987) reported that 1–4% dietary inclusion of blood meal can improve production performance of poultry birds. Further its higher inclusion levels did not report adverse effect broiler performance (Khwaja et al., 2007; Donkoh et al., 2002). Various processing technologies has been introduced to the blood forthe production of various blood-derived products i.e. spray-dried plasma protein (SDPP) and spray-dried blood cells (Stein, 1996). SDPP is produced by separating whole blood into plasma and cell fractions (Stein, 1996). SDPP are highly digestible protein sources with good amino acid profiles (Castelló et al., 2004, Torrallardona, 2010) and has been reported positive influences on immunity and intestinal wall functions in non-ruminant animals (Shahidi et al., 1984; De Rodas et al., 1995; Godfredson-Kisic and Johnson, 1997; Quigley and Drew, 2000; Coffey and Cromwell, 2001; Campbell et al., 2003, Campbell et al., 2004a; Campbell et al., 2004b; Nofrarias et al., 2006; Rodriguez et al., 2007; Moretó and Pérez-Bosque, 2009; Campbell et al., 2009; Jamroz et al., 2011; Jamroz et al., 2012). Since the late 1980s, these products have been used in North America and Asia (Gatnau and Zimmerman, 1990) and their use into European animal rations is being re-considered (Castelló et al., 2004).

Conclusions and Recommendations: The unavailability of soybean poses significant challenges for various stakeholders, including farmers, the feed industry, and consumers. Understanding the underlying factors and their effects is crucial for developing sustainable solutions. By implementing innovative agricultural practices, promoting fair trade policies for soybean and other feed ingredients, and diversifying protein sources, the challenges of soybean unavailability can be addressed, ensuring a more resilient and sustainable food production system. Farmers needs to be trained through efficient media channels, workshops and seminars to search for methods for better production using advanced technology and consistent production strategies. Government must devise a policy to solve the problems of farmers at the root level like its role in the past to promote poultry production in the country. Incentives should be provided to all stakeholders of poultry farmers to maintain the equilibrium. Government should also make efforts to support the backyard industry to support sustainable eggs and meat production in the country like the EX-Prime Minister Imran Khan’s past initiative of promoting backyard Poultry production under the National Agricultural Emergency Program aimed at the economic development of villagers, especially women, and children to raise backyard poultry using kitchen residue (It will help to cut down use of soybean). Efforts should be made to keep the prices of poultry and its by-products uniform, and the import/export subsidies of poultry and the related facilitating items. Based on the findings and analysis it is concluded that potential strategies and recommendations are needed for the resilient and sustainable poultry production in the country. As the poultry industry is the largest industry in the country therefore government is requested to play a positive role to prevent the industry from being crushed by unwise decisions. The government should also focus on indigenous breed improvement because if the supply of grandparent stock disturbs then how to provide cheap poultry products to the 240 million population of Pakistan?

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