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Livestock production and population census in Pakistan: Determining their relationship with agricultural GDP using econometric analysis

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ABSTRACT

Livestock is a subsector of Pakistan agriculture which contributes approximately 56% of value addition in agriculture and nearly 11% to the gross domestic product (GDP). Livestock production makes a major contribution to agriculture value added services. In order to highlight the actual performance of livestock production and livestock and poultry products, the study explored the relationship between agricultural GDP and livestock product output, including milk, beef, mutton, poultry meat, eggs, wool, hair, skins, hides and bones, in Pakistan over the 35 year period from 1980 to 2015. Time series data were collected from the National Food Security and Research, the Economic Survey of Pakistan and the Pakistan Bureau of Statistics (various publications). Livestock data were analysed using the ordinary least squares (OLS) method and the Augmented Dickey-Fuller (ADF) test, and the results were interpreted using the Johansen co-integration test. Our study found that the output of milk, fat, eggs, bones and mutton has a positive, significant relationship to the agricultural GDP of Pakistan, while the output of beef, poultry meat, wool, hair, skins and hides has a negative, insignificant relationship to the agricultural GDP of Pakistan. Therefore, the study suggests that the government of Pakistan initiates new funding schemes for the development of the livestock sector.

1. Introduction

The Pakistani livestock sector contributes about 56.3% of the value of agriculture and nearly 11% to the agricultural gross domestic product (AGDP). In the Pakistani livestock sector, milk is the single most important commodity. However, Pakistan is ranked fourth in milk production worldwide after China, India and USA. The share of livestock in the agriculture sector is significant due to its overall contribution. It plays an important role in poverty reduction strategies, and this sector may be developed very quickly as all required inputs for this sector are available in adequate quantities in the country. The overall performance of the agricultural sector recorded a growth of 2.9% in 2014–2015. However, the growth rate of livestock was recorded at 4.1%, crops at 1.0%, forestry at 3.3% and fishing at 5.8%. It showed a positive growth of

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56.3%, which is higher than that of the previous year. Other sectors, including forestry and fisheries, also showed significant growth at a ratio of 6.7% as compared to the previous year [1].

Pakistan has a total population of 165.51 million with a yearly growth rate of 2.6%. About 47% of the population is involved in the agriculture sector. The annual growth rate of the GDP is 3.7% [2] and livestock is 13.4% in the overall GDP over this period [3]. The monetary growth declined to 5.8% in 2008–09, and it was projected to decline in 2009–2010 to a 2.2% growth rate. The livestock sector is considered a subsector of agriculture. It requires macroeconomic preferences for the economy of Pakistan and the vigorous development of rural economic growth [4]. As a result of the increasing food demand over the past decade, animal husbandry has become the fastest growing sector of the agriculture base in terms of income growth and qualitative change [5]. In 1999–2000, it generated 37% of the value added in agricultural products and contributed to almost 9% of the GDP [2].

Furthermore, the livestock sector employs about 30 million people, the vast majority of whom live in the rural areas of the country [6]. But, as population and urbanization increase, the demand for livestock products will also increase; thus, it will be difficult to meet this demand over the next few years. During 1999–2000, to satisfy the market demand, Pakistan imported 1.080 M tonnes and 1.86 M tonnes of milk. Hence, its significance has declined in the view of policymakers over the past three decades, and the growth rate increased by only 2.9% per year. However, as for crops, there has been an annual growth rate of 4% [7]. The problem is that the economy will affect the livestock and agricultural sectors, and the structural transformation in the economy has been decreasing these sectors' share in the economy every year [8]. In addition, there is no land for people and farmers, and livestock is then a source of income. People protect livestock and earn 10–25% of their income from this sector. In order to improve livestock and poultry production and meet the population's demand for animal nutrition, as well as meet the needs of the agricultural sector, overall performance needs to be improved [9].

Pakistan's agricultural sector is its second largest sector, and it plays an important role in economic growth. It contributes to about 21% of the AGDP and utilizes 45% of the total labour force [10–13]. More than 62% of the population living in rural areas is directly or indirectly engaged in agriculture for their livelihood. The livestock sector comprises about 11.4% of the country's AGDP contribution and 53.2% of the value added products of agriculture. Also, in the form of capital, this sector provides raw materials to other industries. According to [14], the national herd includes 29.6 million cattle, 27.3 million buffalo, 53.8 million goats, 26.5 million sheep and 0.9 million camels. Yet, over the past three decades, the livestock sector has only experienced an average growth of 2.9% due to poor economic policies. The growth rate of population is increasing by 2.05% [15]. The demand for livestock products is increasing due to population growth and urbanization. Therefore, in the present situation, it is difficult to meet the demand for the required livestock products. From 1999 to 2000, the Pakistani government had expended 1213.5 M rupees for imported milk products according to the NCA (National Commission of Agriculture), and the government of Pakistan imported 1.08 M tonnes of meat to meet the domestic demand [16].

In order to maintain standards and livestock production, most of the production processes in developed countries rely on technology to promote good livestock products in their countries. However, the production processes in developing countries depend on traditional methods of livestock production which provide a large number of products and by-products, but milk and meat are the two main products in the livestock category. Production scale savings in livestock production are important to subsidize the input of resources for livestock and to foster the technological progress required in feed production. Therefore, livestock sales are an important tool in developing countries because the products that investigate infrastructure at the same time do not sell completely compared to developed countries. In addition, public organizations, and in recent years private organizations, are also investing in this sector in order to develop the appropriate marketing [17].

2. Existing livestock Literature review

Livestock plays a significant role in the Pakistani agricultural sector; it accounts for about 56.3% of the agricultural value added. More than 35 million people are engaged in this sector which contributes nearly 11% to the GDP [18]. In order to increase and maintain sustainable agriculture development, it is particularly important for the government of Pakistan to expand its focus to include livestock and dairy production. Livestock includes meat, milk, eggs, manure, fibre, hides and horns. Livestock makes a significant contribution to agriculture value added services and holds a prominent position in the sector; in fact, livestock is one of the fastest-growing sub-sectors in most developing countries. The agricultural share of GDP was used to be 33% and is growing rapidly. Livestock demand is rapidly growing for livestock products, and this demand depends on population growth, urbanization in developing countries and increased revenue [19]. The global livestock sector is separated by conflict between developed and developing countries. Total meat production in developing countries tripled from 1980 to 2002 from 45.6 to 134 M tonnes [20].

Meat is a major livestock product which provides high nutrient content; it is considered an essential human food. Owing to the traditional ways of production, there has been no significant rise in meat production, and there are no incentives for the manufacturers to sell quality livestock due to established traditions. Problems are due to a deficiency of proper services, ancient traditional slaughterhouses which have non-hierarchical distribution systems, and meat distribution with no price structure [21]. Furthermore, animal leather and hides are used to provide income. Hides and skins have an important place in the local and export markets. However, in Pakistan, due to scant and outdated strategies and marketing, livestock producers are facing problems associated with skin processing and sorting [22]. Poultry has experienced a very fast growth at 11.3% in livestock products because of the high demand for white meat and eggs [23]. In recent years, the private sector has played an important

role in the livestock sector; it has initiated modern technology and strategies to build poultry businesses controlled by local providers [24]. According to the studies of Iqbal et al. [25] many by-products, including leather products, wool products, fat and butter, play a significant role in Pakistan's ability to earn foreign exchange.

Livestock production has value in Pakistan because of the increasing number of animals that do not produce variations. Under the current conditions, more and more agricultural livestock interest is caused by demand, but because of the advantages of traditional production, the structure has not changed [25]. Similarly, supported growth in the livestock sector encourages the reduction in poverty, and the food supply of small producers has implications for public health and the environment which must be addressed under the supportability implications discussed [26]. The livestock sector, the backbone of the agriculture sector, is often maligned, but it still plays a vital role in the Pakistan economy by providing draught power, valuable organic animal proteins and its by-products (bones, mohair, hides, skin, manure, wool, etc.). Manure and draught power provided by the animals enhance the supply of organic matter to improve land fertility and aid productivity, respectively. More than 10 million animals are engaged in agricultural activities and events. The alternative, mechanization, requires economic support equivalent to 5.12B rupees [27]. Due to the increasing population growth, increasing demand and the inadequate supply of livestock are obstacles to developing improved agricultural resources and management policies. In developing countries, such as Pakistan, sustainable growth has been difficult to attain under the current monetary and environmental policies because they do not improve and emphasize food safety and resources [28].

Moreover, livestock production contributes to the national economy as an employer of poor and landless people in small farming families. Women also play a significant role in the livestock sub-sector and are employed in domestic activities. Milk, eggs, butter, meat and oils are main sources of nourishment that are enormously important to the good health and adequate nutrition of both the rural and urban populations. Similarly, animal fat, vegetable oil and butter supplies are important sources of nutrition. Many products derived from livestock, such as wool products, leather products and animal hides, are exported and contribute significantly to the acquisition of foreign exchange [29]. Due to socioeconomic issues, the condition of livestock in developing countries is dissimilar to that of developed countries. The majority of livestock is held by small farmers, and mass production is not encouraged because of high transport costs, inadequate infrastructure and other expenses. Also, ancient, outdated methods, limited resources, limited access to land and lack of research and development are less supportive of change when compared to the situation in developed countries. Similarly, poor marketing services and resource shortages do not aid in the generation of effective agricultural resource practices. Monetary policy needs to support the young landholders and to be reorganized into new investments that contribute to a range of activities from the purchasing to the marketing of their products. Development of a sustainable growth system in livestock production is currently not given the attention it deserves [30,31] because the main focus has been on improving livestock production, not quantity and quality production procedures [32].

The nutritional needs of animals in Pakistan are mostly met by fodder crops, shrubs, grasses and agro-manufacturing wastes. In developed countries, ruminants are nourished with many grains: stationery forage contributes to about 75% of the nutrients, grain feeding is uncommon and more than 95% of ruminants derive nutrition from forage [33]. The livestock production trend is primarily determined by output trends in skins, wool, poultry, beef and mutton. In contrast, milk, hides and hair production have continued to observe reliably accelerating growth rates throughout the particular period under contemplation. The deceleration in growth rates since 1989–90 and actual decreases in output since 1994–95 for mutton, wool and skins are significant and can be credited to the deteriorating and adverse growth rates of sheep during the two respective periods [34]. Crop production and crop growth are necessary for sustainable livestock production, but refined land production has declined, and some land is not able to be utilized due to the lack of needed resources and conditions. However, if land is not suitable for crop production, it can be used for livestock and must accommodate animal husbandry production. In determining this problem with the worship of the land shortage it delivered confiscated human intake. In addition, livestock feed normally contains crop by-products, and if the livestock feed is the largest area of land to be imported, it is also intentionally a land in which the imported crop is arable land. Imported feed must be analysed economically, and it must contain by-products associated with core crop products [32].

The changes in livestock growth can be viewed in the light of the involvement of production factors, such as capital, land, labour and technological processes. However, it may be determined at the beginning that, because of duplication and technological variations, contribution and accurate calculation of the input neither is possible nor is not strained [35]. The decrease in the production of animals can also be credited to the prevalence of animal diseases and the lack of animal farming facilities, separated from the issue of poor forage quality [36]. According to Zhao et al. [37], poultry also plays a significant role; it includes broilers, layers, and turkeys usually raised indoors in the accumulation of manure and substantial contact with the bedding. Most layers are held in raised cages that are designed for the droppings to fall onto a conveyer belt that eliminates them from the structure [38]. The presence of manure characteristically erodes the housing value as a storage area [37].

The previous forage resources obtainable can only fulfil the preservation necessities of animals. Only 75% of livestock receive the required amount of total digestible nutrients (TDN), and there remains a 60% deficiency of digestible crude protein (CP). [39]. Forage quantity and quality could increase livestock growth up to 50% from the remaining genetic pool of animals [40]. Furthermore, livestock manure can be a resource, but it can also reduce conservational quality of surface and ground water if not handled properly [41]. The growth in poultry and livestock numbers leads to a surge in

the amount of animal manure that must be handled. As production has grown, more centralized operations, livestock and poultry operations have been a land base of feed resulting from the separation [42]. It provides animal and organic fertilizer to the crop sector and hides, skin, bone and blood to the fibre industries. The livestock sector also makes an important contribution to environmental protection: it restores income and other sources of crop production, absorbs income shocks caused by crop failures, generates a continuous income stream and employment opportunities, and reduces the seasonality of income, especially among the rural poor [43].

Concentration of livestock production leads to other nonnutrients that can contribute to environmental pollutants. Livestock and poultry antibiotics are used to treat or prevent disease and infection, to promote animal growth, to improve the efficiency of animal production and to fight against greater potential susceptibility to diseases due to concentrated and limited living conditions [44]. Some poultry and livestock have also been given steroid hormones to promote growth [45]. Cultivation methods for large animal feeding operations, shifting livestock and poultry production to regional establishments and large amounts of appearances are often relatively small land area for application generation [42]. In some cases, land use applications performed on areas that are too small for those actions result in a large amount of faecal matter that can have a significant impact on the environment and humans due to faecal run-off and discharge into surface and ground water. Most animal faeces are applied to farmland or untreated grasslands. Nutrients may also be assimilated by returning farmland to forests and grassland [46].

In larger, centralized operations, drainage ditches flow through beef cattle operations, conducting rainwater, manure, animal feed and other waste to nearby collection ponds or lagoons [38]. Cows may be located in a stalled barn, a free stall barn or outdoors. [47]. Dairy manure may be removed from the barn and temporarily placed in a steel or concrete tank or flushed from the barn's floor and discharged into a lagoon [37]. Swine are usually housed in stitched flooring, allowing faeces to flush and run out of the shelter facilities [38]. Furthermore, because mammals, including livestock, poultry and humans, produce and secrete hormones, the major sources of hormones in the environment include faeces and bile from livestock and poultry operations as well as bio-solids and effluent from wastewater treatment facilities. As previously discussed, fertilizers and biosolids are applied to the land, resulting in a concentrated release of hormones and other compounds into the environment [48].

3. Livestock population census in Pakistan

The Pakistani livestock sector includes a wide variety of animals: buffalo, cattle, goats, sheep, poultry, camels, asses, horses and mules. One main economic purpose of livestock production was to convert intermediate capital markets into roughage, feed and fodder inputs for which there is a more direct correlation than for the number of animals itself. It is determined that milk, beef, mutton, poultry meat, eggs, wool, hairs, skins, hides, bones and fat are important livestock products which increase the value of the growth trend. Figs. 1–3 show the population census of buffalo, cattle, goats, sheep, poultry, camels, asses, horses and mules from 1980 to 2015.

The graph trend in Fig. 1 shows that the population census of buffalo, cattle, goats and sheep increased over the period from 1980 to 2015.

The population census of camels, asses, horses and mules also increased over the period from 1980 to 2015 as trend graph in Fig. 2 shows. Similarly, the poultry population census also increased during this period as shown in Fig. 3 below.

4. Materials and methods

4.1. Data sources and study variables

In order to examine the relationship between livestock products and the AGDP, the annual time series data from 1980 to 2015 have been used. The data were collected from the National Food Security and Research, the Pakistan Bureau of Statistics and the Economic Survey of Pakistan (various publications). The variables used in this work's analysis of livestock products include milk production (000, tonnes), beef production (000, tonnes), mutton production (000, tones), poultry meat production (000, tones), egg production (000, tones), wool production (000, tonnes), hair production (000, tonnes), skin production (000, tonnes), hide production (000, tonnes), bone production (000, tonnes), fat production (000, tonnes) and AGDP (in millions of rupees), respectively.

4.2. Econometric methodology

In this study, to check the stationarity of the series, the Augmented Dickey-Fuller (ADF) [49] unit root test has been applied. After checking the stationarity of the series, the Johansen co-integration [50] test has been used to examine the long run relationship between AGDP and the production of livestock products in Pakistan over the period from 1980 to 2015. Furthermore, in order to examine the relationship between livestock products and AGDP, an econometric ordinary least squares (OLS) method has been used, and the following estimated model that was used is as follows:

$$Y = AXi^{bi} \tag{1}$$

Eq. (1) can also be written as follows:

$$Y = AX_1^{\beta 1}X_2^{\beta 2}X_3^{\beta 3}X_4^{\beta 4}X_5^{\beta 5}X_6^{\beta 6}X_7^{\beta 7}X_8^{\beta 8}X_9^{\beta 9}X_{10}^{\beta 10}X_{11}^{\beta 1}. \tag{2}$$

Taking the natural logarithm of Eq. (2) and its eleven explanatory variables converts Eq. (2) as follows:

$$LnY = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_6 LnX_{6+}\beta_7 LnX_{7+}\beta_8 LnX_{8+}\beta_9 LnX_{9+}\beta_{10} LnX_{10+}\beta_{11} LnX_{11+}\mu \tag{3}$$

where

β_0 = Natural logarithm of A, the intercept

$ln\ Y$ = Natural logarithm of AGDP per year in (millions of rupees)

$ln\ X_1$ = Natural logarithm of output of milk production in (000, tonnes)

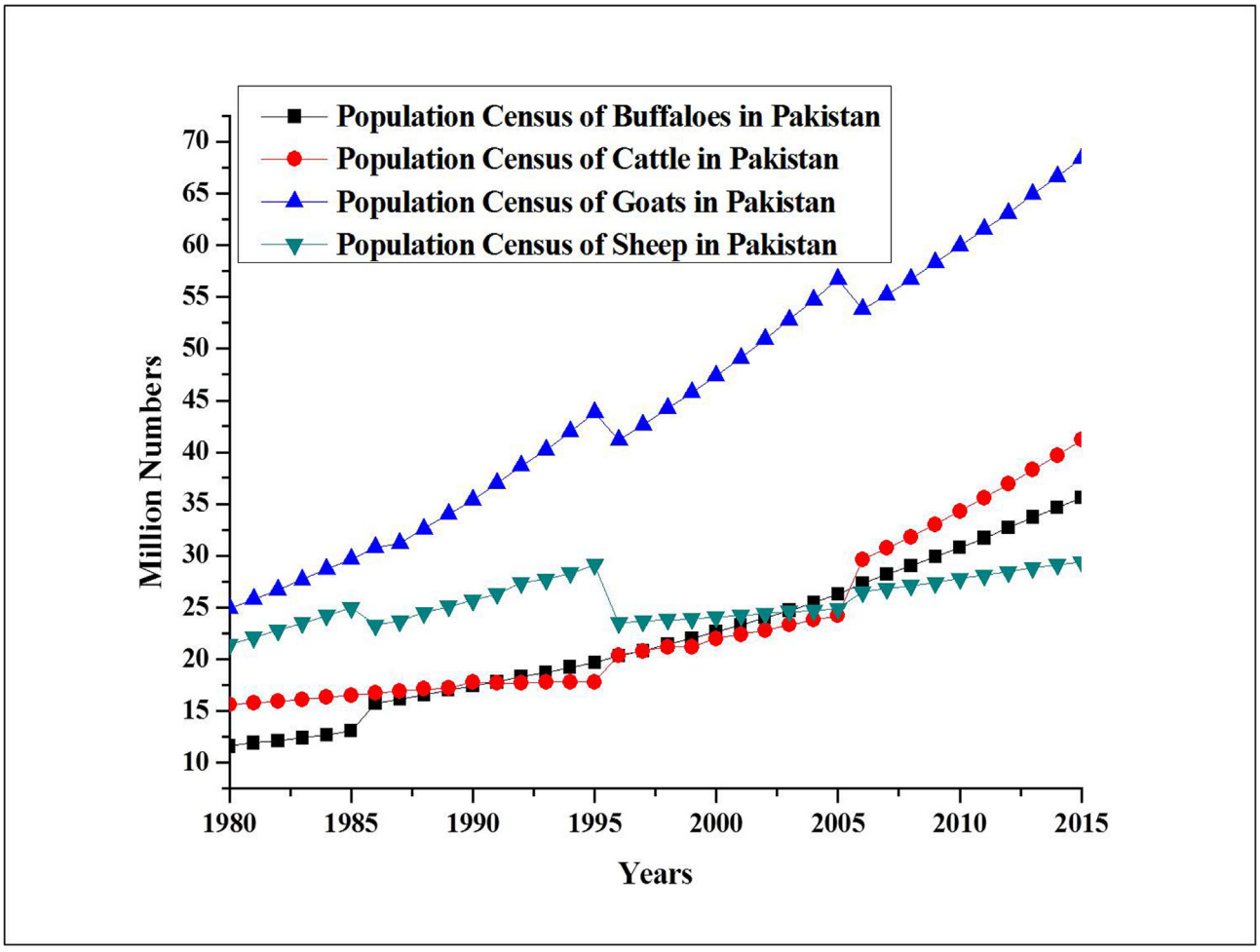

Fig. 1 – Population census of buffalo, cattle, goats and sheep in Pakistan.

$ln\ X_2$ = Natural logarithm of output of beef production in (000, tonnes)
$ln\ X_3$ = Natural logarithm of output of mutton production in (000, tonnes)
$ln\ X_4$ = Natural logarithm of output of poultry meat production in (000, tonnes)
$ln\ X_5$ = Natural logarithm of output of egg production in (000, tonnes)
$ln\ X_6$ = Natural logarithm of output of wool production in (000, tones)
$ln\ X_7$ = Natural logarithm of output of hair production in (000, tonnes)
$ln\ X_8$ = Natural logarithm of output of skin production in (000, tonnes)
$ln\ X_9$ = Natural logarithm of output of hide production in (000, tonnes)
$ln\ X_{10}$ = Natural logarithm of output of bone production in (000, tonnes)
$ln\ X_{11}$ = Natural logarithm of output of fat production in (000, tonnes)
μ = error term.

Thus, Eq. (3) can also be written as follows:

$$\begin{aligned} ln\,(AGDP) = {} & \beta 0 + \beta 1\ ln\,(Milk) + \beta 2\ ln\,(Beef) + \beta 3\ ln\,(Mutton) \\ & + \beta 4\ ln\,(PoultryMeat) + \beta 5\ ln\,(Eggs) \\ & + \beta 6\ ln\,(Wool) + \beta 7\ ln\,(Hair) + \beta 8\ ln\,(Skins) \\ & + \beta 9\ ln\,(Hides) + \beta 10\ ln\,(Bones) + \beta 11\ ln\,(Fat) \\ & + \mu \end{aligned} \tag{4}$$

The present study is based on the annual time series data for the period from 1980 to 2015. First, we checked the stationarity of the variables using the ADF unit root test. After checking the stationarity of the series, we checked the long run relationship between the dependent and independent variables using the Johansen co-integration test. Finally, the OLS econometric technique was used to examine the relationship between livestock products and the AGDP.

4.3. *Ordinary least square method (OLS)*

The results of this method were used to indicate the predictive ability of the model, as well as the relative statistics about the variables in the short run. To check the long-run relationship between the dependent and independent variables, the Johansen co-integration test was used.

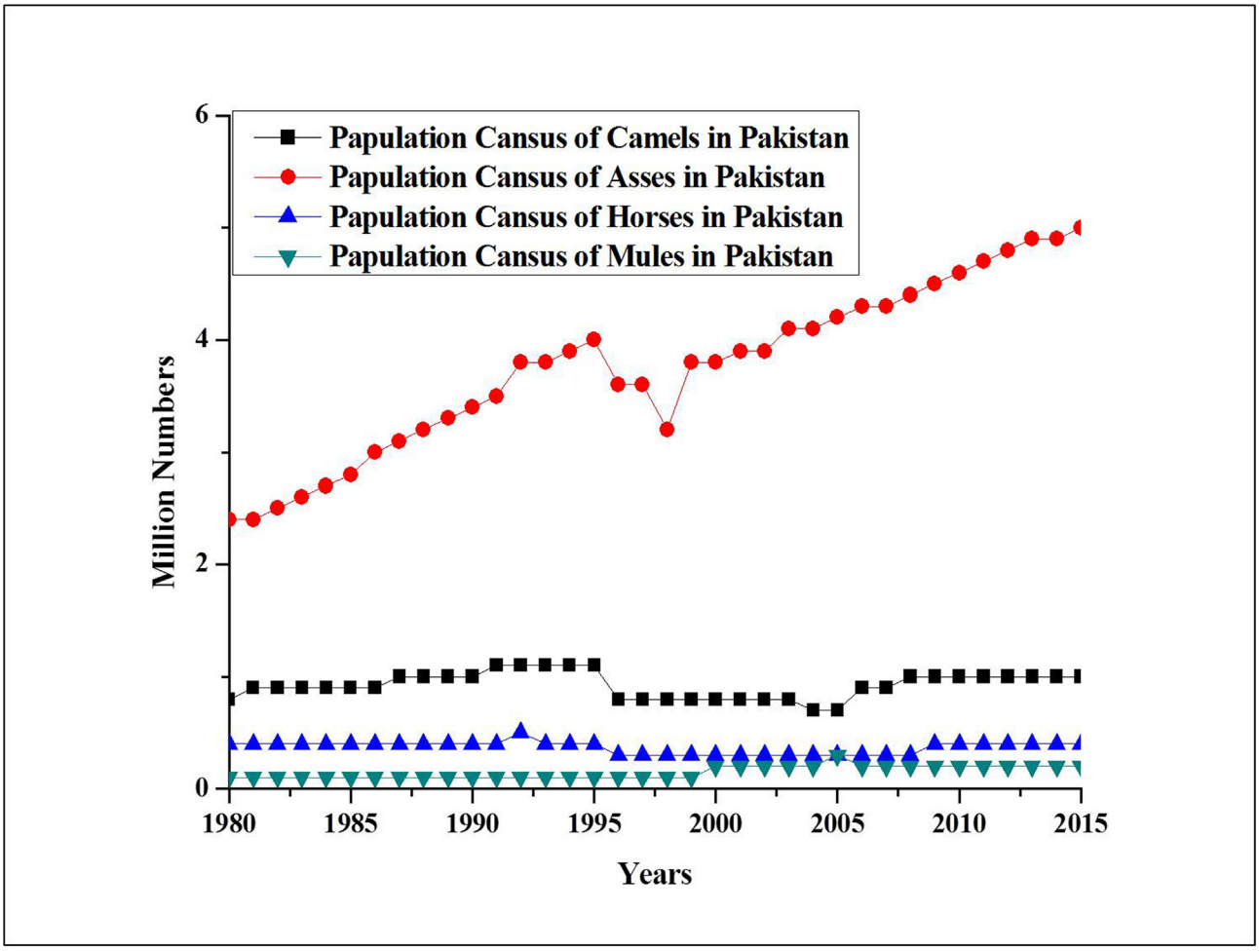

Fig. 2 – Population census of camels, asses, horses and mules.

4.4. *Empirical results and discussion*

4.4.1. *Results of unit root test*

This study applied the ADF unit root test to check the stationarity of the series. The estimated results of the ADF unit root test are shown in Table 1. In Table 1, stationarity of the series has been checked containing trend and intercept. According to Table 1 data, it appears that all variables did not attain stationarity at their level, while all variables became stationary after taking the first difference 1(1), demonstrating that the values of the ADF statistics test are greater than the critical values at a 5% significance level.

4.4.2. *Results of co-integration test*

In this study, our regression results may be uncertain due to no co-integration among the study variables. For this determination, a co-integration test containing the trace statistic and the Max-Eigen statistic has been applied to examine the long-run relationship between livestock products (milk, beef, mutton, poultry meat, wool, hair, bones, fat, eggs, hides and skins) and the AGDP of Pakistan over the period from 1980 to 2015. The estimated results of the Johansen co-integration test are shown in Tables 2 and 3 and revealed that a long-run relationship exists among livestock products and the AGDP. The null hypothesis of no co-integration is rejected. The values of the trace statistic and the Max-Eigen statistic are greater than their relevant critical values which indicate the existence of nine co-integrating equations at 5%.

4.4.3. *Results of regression*

To examine the relationship between livestock products and the AGDP in Pakistan, an econometric OLS method was employed. The results of the OLS model are presented in Table 4. In the OLS regression results, the high value of R^2 is 0.986 or 98.6%, and the Adjusted-R^2 is 0.980 or 98.05%. This implies that about 98% of the total variation in AGDP is explained by the eleven explanatory independent variables. The calculated value of the *F*-statistic is 162.03 with a *p*-value < 0.001, which verifies that the overall goodness of the model is significant.

The regression analysis results revealed that the coefficient of the output of bones was highly significant at both 1% and 5% significance levels, which indicated that there is a strong and positive relationship between AGDP and the output of bones. This implies that a 1% increase in the output of bones in the AGDP increased by 16.78%. The results further

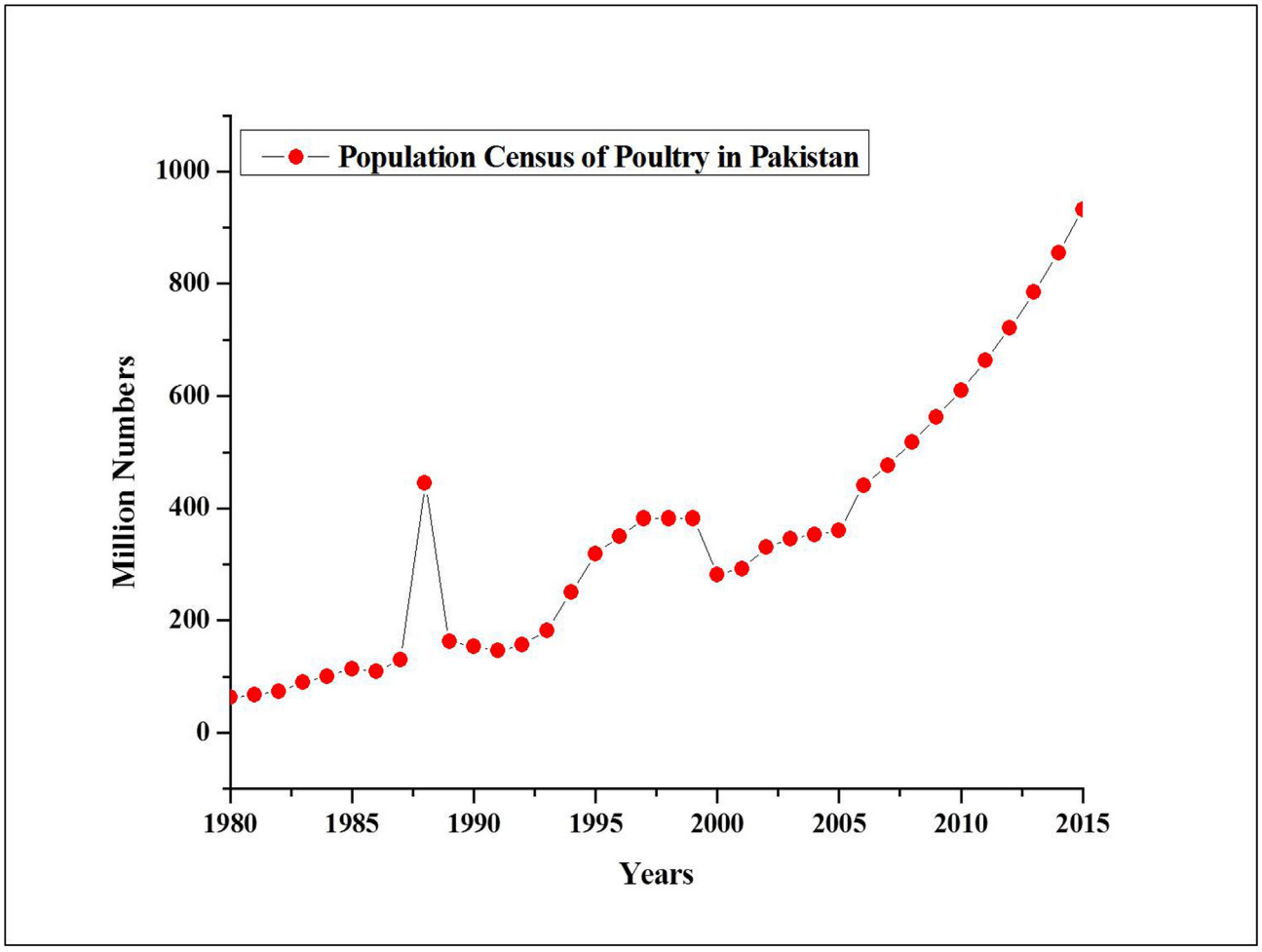

Fig. 3 – Population census of poultry in Pakistan.

showed that the coefficient of the outputs of milk, mutton, eggs and fat is also highly significant at both 1% and 5% significance levels, which indicates that there is strong and positive relation between the outputs of milk, mutton, eggs and fat and the AGDP. This suggests that a 1% increase in the outputs of milk, mutton, eggs and fat leads to increased AGDP by 7.58%, 16.36%, 6.85% and 3.49%, respectively, whereas the outputs of beef, poultry meat, wool, hair, skins and hides show a negative relation with AGDP. Also, when there was a 1% increase in the outputs of beef, poultry, meat, wool, hair, skins and hides, this decreased the AGDP by −27.27%, −0.56%, −18.65%, −5.77%, −6.22% and −0.92%, respectively, which was statistically insignificant.

Recently, the Pakistani livestock sector has faced several problems such as the lack of an adequate better environment, insufficient production, lack of funding and the rising prices of livestock products. Furthermore, the results showed that there is a negative relationship between the outputs of beef, poultry, meat, wool, hair, skins and hides and the AGDP. This result was not expected, and the reason for this negative relation undoubtedly is due to the lack of funding and the rising prices of livestock products.

5. Conclusion and recommendation

Livestock production is an important component of agriculture and performs a very supportive economic role in the country. It is considered a sub-sector of Pakistan agriculture and contributes to about 56% of the value addition in agriculture and nearly 11% to the GDP. To determine the actual performance of livestock production and livestock and poultry products, and its relationship to AGDP, time series data were used from 1980 to 2015. These data were collected from the National Food Security and Research, the Pakistan Bureau of Statistics and the Economic Survey of Pakistan (various publications). Livestock data were analysed using the OLS method and the ADF unit root test, and the results were interpreted using the Johansen co-integration test. Study results show that the outputs of milk, fat, eggs, bones and mutton have a positive, significant relationship with Pakistan's AGDP, while the outputs of beef, poultry meat, wool, hair, skins and hides have a negative, insignificant relationship with Pakistan's AGDP. Hence, the study recommends that the government of Pakistan identifies novel funding schemes to increase the production of beef, poultry meat, wool, skins, hair and

Table 1 – Results of ADF test. Source: Author's own calculation using Eviews 9.

Results of ADF test

Variables	ADF Statistic	Critical value	Probability	Level of significance	Order of integration
Ln(AGRGDP)	−6.064239	−3.548490	0.0001	5%	1(1)
Ln(Milk)	−5.370612	−3.548490	0.0006	5%	1(1)
Ln(Beef)	−4.569074	−3.603202	0.0065	5%	1(1)
Ln(Mutton)	−5.860742	−3.548490	0.0002	5%	1(1)
Ln(Poultry Meat)	−4.620172	−3.552973	0.0042	5%	1(1)
Ln(Eggs)	−5.336054	−3.562882	0.0008	5%	1(1)
Ln(Wool)	−5.547084	−3.548490	0.0004	5%	1(1)
Ln(Hair)	−5.703154	−3.548490	0.0002	5%	1(1)
Ln(Skins)	−6.621372	−3.548490	0.0000	5%	1(1)
Ln(Hides)	−6.417990	−3.548490	0.0000	5%	1(1)
Ln(Bones)	−6.107155	−3.548490	0.0001	5%	1(1)
Ln(Fat)	−5.304123	−3.603202	0.0013	5%	1(1)

Table 2 – Johansen co-integration test using trace statistic. Source: Author's own calculation using Eviews 9.

Johansen co-integration test using trace statistic
Lags interval: 1–1

Eigenvalue	Trace statistic	5 per cent critical value	Prob**	Hypothesized No. of CE(s)
0.999788	1104.188	285.1425	0.0000	None*
0.999313	816.5486	239.2354	0.0001	At most 1*
0.990818	568.9042	197.3709	0.0001	At most 2*
0.979218	409.4273	159.5297	0.0000	At most 3*
0.959868	277.7226	125.6154	0.0000	At most 4*
0.771341	168.3926	95.75366	0.0000	At most 5*
0.712819	118.2247	69.81889	0.0000	At most 6*
0.607946	75.80488	47.85613	0.0000	At most 7*
0.590503	43.96877	29.79707	0.0006	At most 8*
0.325691	13.61266	15.49471	0.0942	At most 9
0.006286	0.214394	3.841466	0.6433	At most 10

* Indicates at a 5% level of significance.
** Indicates values are accurate.

Table 3 – Johansen co-integration test using Max-Eigen statistic. Source: Author's own calculation using Eviews 9.

Johansen co-integration test using Max-Eigen statistic
Lags interval: 1–1

Eigenvalue	Max-Eigen Statistic	5 Per cent Critical Value	Prob**	Hypothesized No. of CE(s)
0.999788	287.6391	70.53513	0.0001	None*
0.999313	247.6444	64.50472	0.0001	At most 1*
0.990818	159.4770	58.43354	0.0000	At most 2*
0.979218	131.7046	52.36261	0.0000	At most 3*
0.959868	109.3301	46.23142	0.0000	At most 4*
0.771341	50.16782	40.07757	0.0027	At most 5*
0.712819	42.41986	33.87687	0.0038	At most 6*
0.607946	31.83611	27.58434	0.0133	At most 7*
0.590503	30.35610	21.13162	0.0019	At most 8*
0.325691	13.39827	14.26460	0.0682	At most 9
0.006286	0.214394	3.841466	0.6433	At most 10

* Indicates at a 5% level of significance.
** Indicates values are accurate.

Table 4 – Regression analysis.

Regression analysis
Dependent variable: ln(AGRGDP)
Method: Least squares
Sample: 1980 2015 Included observations: 36

Corresponding Coefficients	Coefficient	Std. Error	t-Statistic	Prob.
C	−43.54985	33.31604	−1.307174	0.2035
Ln(Milk)	7.585765	6.068337	1.250057	0.2233
Ln(Beef)	−27.27458	9.149997	−2.980829	0.0065
Ln(Mutton)	16.36672	5.499664	2.975950	0.0066
Ln(Poultry Meat)	−0.565287	0.517073	−1.093243	0.2851
Ln(Eggs)	6.856749	1.223396	5.604684	0.0000
Ln(Wool)	−18.65549	3.436895	−5.428008	0.0000
Ln(Hair)	−5.775353	2.308570	−2.501702	0.0196
Ln(Skins)	−6.223868	3.707360	−1.678787	0.1062
Ln(Hides)	−0.924099	2.878519	−0.321033	0.7510
Ln(Bones)	16.78195	4.436930	3.782333	0.0009
Ln(Fat)	3.491181	4.291977	0.813420	0.4240
R-squared	0.986714	Adjusted R-squared		0.980624
F-statistic	162.0361	*p*-value		<0.001

hides and adopts better policies for the production and development of the livestock sector.

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