INTERNATIONAL JOURNAL OF SOCIAL AND MANAGEMENT STUDIES (IJOSMAS)
Vol. 3 No 02 (2022) E-ISSN: 2775-0809

An Analysis on The Production of Livestock And its Impact on Food Security

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Abstract
Food security refers to both physical and financial access to food. Meat, like the economy, has supply and demand, with excessive demand driving up prices and a reduction in food supply driving up prices as well. This research focuses on the topic of rising hunger and malnutrition, which can be due to a lack of food security. Low food security refers to a lack of safe and nutritious food, which can be affected by a variety of factors mainly on the supply and production side of Livestock. This research project also intends to (1) assess the production trend, and then include substantial evidence that will aid in preventing meat overproduction/underproduction and ensuring its sustainability and sufficiency for future generations. (2) determine whether current livestock production satisfies current livestock demand using production data. (3) determine the country's food security for the past 30 years and the reasons to achieve it.

Keywords: pork production, cattle production, chicken production, livestock production, food security, economic growth

Introduction

Problems that arise from the accessibility and affordability of food may create economic implications (Capone, 2014) indicating that Food access is one of the food security pillars. Food security encompasses physical and economic access to food. Just like the economy, food also possesses supply and demand, wherein excessive demand for food may pull the price up, and a drop in the stock of food may also drive the price up, and vice versa. Demand for livestock products is progressively rising along with growing demographics and incomes, together with shifts in food consumption habits (Alexandratos, 2012) wherein he mentioned that according to forecasts, the average daily intake per capita is projected to exceed 3000 kcal globally by 2050 to reach 3500 kcal in developed countries and to exceed 2500 kcal even in the poorest sub-Saharan areas. From 229 million tons in 1999 to 465 million tons in 2050, global meat demand is estimated to more than double in just half a century. With up to 26 percent of terrestrial areas devoted to rangelands and about 33 percent of croplands dedicated to fodder production, livestock is by far the single largest anthropogenic land user (FAO 2015). Countries may bear a significant share of the cost of food safety by enhancing domestic production and reducing dependency on food imports unless they develop a strategy for food security (Manap & Ismail,

2019). Insecurity in foodstuffs will be the consequence of high dependence on food imports which will lead to high levels of chronic malnutrition, restrictions of the development of human capital, hunger, reduced production of labor, decreased life expectancy, and reduced economic growth. The objective of this paper is to examine the relationship between food security and increased economic growth in developing countries in dryland. Food security, climate change, and the depletion of biodiversity are the main problems facing humanity's sustainable growth. As mentioned by Cramer, Wolfgang (2017), sustainable development must provide nutritious food to all citizens; to achieve this, not only food production but also equal access to food for all people must be greatly improved. He inferred that biodiversity depletion and global food security are two of the most pressing issues of our time.

The ability of domestic production to meet local demand, especially of staple food crops, is known as food self-sufficiency. Food self-sufficiency would save money, which can then be used to buy other agricultural products that aren't grown locally. The assembly and cultivation of such food crops take place in a rustic setting, with little reliance on the foreign market to ensure that enough food is available to feed the local population; these activities will promote the growth of small and medium-sized businesses (SME). Meanwhile, countries that are self-sufficient in food can decide their production requirements based on international trade trends. Countries that adopt this strategy will import staple foods from the global market while local prices are lower. As a result, the land will be used for other uses, such as growing biofuel crops to replace fossil fuels. This concept aims to promote market liberalization and export-oriented agriculture while still benefiting from strong local markets, which can be accomplished by improving physical infrastructure and credit facilities. Increased local production and productivity, as well as increased food security, are often used to achieve food security. Food imports on a consistent and reliable basis, creating more jobs, raising incomes so that people can buy the food they need, and improving food delivery systems (FAO, 2002). Food security has a positive effect on economic development by lowering hunger, increasing overall jobs and life expectancy, and boosting economic growth. The only one that explicitly mentions the agricultural sector is Rostow (1960). In the transformation from a conventional to a new economy, the primary industry may be a leading sector. He distinguishes five phases of economic growth and development in his model: 1) conventional culture, 2) take-off preconditions, 3) take-off, 4) maturity push and 5) high mass consumption. In the first two phases, the primary sector, mostly subsistence agriculture, has a large share, and in the third stage, it begins to decline (see figure 2.1). Agriculture contributes very little to economic development in the fourth and fifth stages. Agriculture, according to Rostow (1960), plays a significant role in the economy.

The international community recognizes the idea of sustainable development as the prevailing paradigm of human life in the twentieth century as discussed in the UNESCO Earth Summit in 1992. As a result, a critical problem is developing modern regional food security policies that take into account market, social, and environmental factors (Shevchuk, Khvyshchun, 2016; Marques and Almeida, 2013). Sustainability is seen as a critical component for farming and rural areas to have a profitable long-term future (Passel et al, 2007). Environmental sustainability, economic efficiency, and social cohesion are widely recognized as the three main factors of sustainable development. Despite the complexity of farming activities, the majority of studies analyzing sustainability indicators focus on environmental sustainability

and omit socioeconomic aspects, necessitating a holistic approach to sustainability assessment (Dantsis et al, 2009).

Another factor that leads to food insecurity is population growth, which was popularized by Thomas Malthus. The (dis)equilibrium between population and food is the subject of the Malthusian approach. Food availability should not increase faster than population growth to preserve equilibrium" (Burchi and DeMuro) (2012). On the demand side, high fertility rates and rapid population growth are the reasons why a number of the world's most populous countries face food insecurity. Given this, it is reasonable to conclude that a growing population growth rate has a significant negative effect on the environment. In the 20th and the beginning of the 21st centuries, this view was current and relevant. The challenge of feeding the people of the world is linked to human opportunities so that it cannot be compared to natural or ecological causes that are irreversible worldwide. This analysis envisions itself to provide a better understanding of how alarming the issues on food security are and construct a dataset that illustrates the implications of food security to economic sustainability.

From a research standpoint, connecting the fields of Livestock Production and Food Security and finding synergies between them is likely to yield several benefits for social, ecological, and economic growth (Jenkins & Scanlan, 2011). In particular, the cultivation of livestock and the rising demand for beef, eggs, milk, and milk products have generated a variety of environmental issues that pose a major challenge to food security (FAO-SFA, 2018). The focus of this study is on the issue of increasing hunger level and malnourishment which can be attributed to low food security. Low food security means that there is limited access to safe and healthy food, which can be caused by various reasons. But this study pertains to the sudden slump in livestock production. This research study also plans to 1) assess the production trend, and then include substantial evidence that will aid in preventing meat overproduction/underproduction and ensuring its sustainability and sufficiency for future generations. (2) determine whether current livestock production satisfies current livestock demand using production data. (3) determine the country's food security for the past 30 years and the reasons to achieve it.

Literature Review

Livestock Production to Food Security

The roles, whether good or bad, need to be accepted by the scientific community. Research agendas need to use the livestock negatives (greenhouse gas emissions, deforestation, large amount of carbon footprint) as opportunities for improvement while continuing to foster the positive aspects. These are essential ingredients for society to make better-informed choices about the future roles of livestock in sustainable food production, economic growth, and poverty alleviation. Value-adding to gross farm income amounts to 49% and if all backward linkages (e.g. farm machinery, livestock feed, fertilizers, pesticides, other remedies) and forward linkages (e.g. the much larger food industry) are taken into account, the contribution of agriculture to total GDP and economic activity becomes significant. (Meissner et. al, 2013) Since problems, opportunities, and resources differ greatly within and across regions, addressing global sustainability poses significant challenges. The Brundtland Report defines sustainable development as "meeting the needs of the present without jeopardizing future generations' ability

to meet their own needs," which is arguably the most commonly used concept as highlighted in the World Commission on Environment and Development's General Assembly. This means that, while maintaining human food security, resources must be used at rates that do not surpass the earth's capacity to replenish them. Given that 870 million people worldwide are deemed food insecure (FAO, 2012), global food production may be considered unsustainable under the first half of the concept. Nonetheless, a sustainable food system is reliant not only on the production of enough food but also on the food reaching the market. Restricted food supply due to low agricultural yields, a lack of producer knowledge, and inadequacies in transportation and sanitary infrastructure are currently the main farm-level sustainability concerns in developing regions (Godfray, 2010). Political instability, a lack of widespread education (particularly for women, who are often the primary agricultural workers), and military conflict are all major concerns (Pinstrup-Andersen, 2000). The value of animal-source foods in preserving the health and nutritional status of people in developing countries, where access to high-quality protein is often scarce, is well understood (Neumann, 2002).

In the developing world, livestock is produced in a variety of heterogeneous production systems. This can vary from pastoral/grassland-based systems, which occupy the majority of land area and have low human population densities, to mixed crop-livestock systems, which are typically found in areas suitable for both arable and livestock production and where the majority of the rural human population resides, to intensive systems, which are typically found in peri-urban/urban areas. In urban areas, landless systems are also popular. In developing countries, these systems developed approximately 50% of the beef, 41% of the milk, 72% of the lamb, 59% of the pork, and 53% of the poultry consumed globally (Herrero et al., 2009). These proportions are likely to rise, as the developing world is expected to account for the majority of future livestock production growth (Rosegrant et al., 2009). Mixed systems provide the majority of meat and milk in developing countries (Herrero et al., 2009). These systems play a critical role in global food security, as they produce nearly half of the world's cereal production (Herrero et al., 2010). The highest rates of growth in animal production seen in recent decades, and predicted for the future, are in the developing world's intensive pig and poultry sectors. (Steinfeld et al., 2006).

Since income level is crucial for access to social activities, economic sustainability is related to the social pillar (Van Cauwenbergh, 2007). The most widely used economic metrics are farm income, production, and productivity, which all contribute to a farm's profitability. Additional economic indicators, on the other hand, can be divided into three categories (Guillaumin, 2007): (1) Farming system autonomy concerning external inputs such as feed concentrates or mineral fertilizers, subsidies, and external financing; (2) agricultural income diversification by food production, non-food production (e.g., agritourism), and promotion, as well as non-agricultural diversification; and (3) the long-term viability of a farm, which is primarily determined by succession and transmission. Since the 1990s, international organizations have highlighted poverty reduction as a top priority. That is also the theme in the 2015 United Nations Sustainable Development Goals. In this regard, we believe that the ultimate goal of the poverty reduction strategy should be to eliminate the inequality, alienation, and segregation that are associated with chronic poverty. In this view, the income is a necessary but insufficient condition for poverty reduction, since the increased income must be maintained over a longer period, say one generation (Hirashima, 2019).

In 1965, the average family spent about twice as much on fish as it did on meat; today, meat spending is somewhat higher than fish spending. Expenditures on meats have climbed by 4–5 percentage points, with the largest increases in prepared meats, followed by a slight increase in poultry, and very little change in swine and other livestock combined Over the last two decades, overall meat consumption per capita in the Philippines has increased by 55 percent or more, with pigs accounting for the majority (approximately 45 percent of annual per capita consumption), followed by poultry (29%), beef and offal (12% each), and goats (12%) (2%). Since 1990, the trend has changed slightly, with the proportion of pigs declining and the proportion of poultry increasing. These conclusions are based on BAS data. They reveal an average annual increase in meat intake of 2% over this time period, with annual fluctuations between –4% and +7%. Since 1990, the proportion of pigs has decreased while the proportion of poultry has increased modestly. BAS statistics were used to come up with these conclusions. Over this time, they show an average annual increase in meat intake of 2%, with annual fluctuations between –4% and +7%. Since 1990, the proportion of pigs has decreased while the proportion of poultry has increased modestly. BAS statistics were used to come up with these conclusions. Over this time, they show an average annual increase in meat intake of 2%, with annual fluctuations between –4% and +7%. Pigs make for the highest share of annual per capita meat consumption in the Philippines (approximately 45%), followed by poultry (29%), beef and offal (12% each), and goats (2%).

Competitiveness is determined by economies of scale, input prices, and technology, as all commercial producers use the same genetics and face the same international market prices for grains. Feed is the first step in the livestock value chain; it accounts for over 70% of total production expenses, making it a key predictor of profitability. Most livestock and poultry production in the Philippines is now uncompetitive on an international scale. A combination of high input costs (primarily maize for feed and energy) and low productivity has resulted in this situation (particularly in the pig and ruminant sub-sectors). Imports could be liberalized, lowering the cost of inputs. High feed costs in the Philippines are directly linked to the severely regulated and inefficient local maize market. The private sector will drive cattle and poultry development over the next three decades, but the government will be responsible for critical regulatory, policy, and investment activities that will determine whether the high or low performance scenarios are realized.

Beef/Cattle Production

Cattle, like carabaos, are raised in both backyards and commercial farms in the Philippines. According to BAS (2001) figures, over 90% of the cattle population in the nation is kept in private farms, with the remaining 10% being maintained professionally. Backyard and commercial production systems have different practices. The quantity of animals retained on the farm, food and management, genotype of animals raised, and animal use are all examples of these variances. The traditional technique of raising of cattle in the backyard is substantially comparable to carabaos. Animals utilized in this mode of production are often native breeds that have been improved with dairy or beef cattle obtained locally or via government dispersion programs. Animals are frequently tied in surrounding fields and unoccupied croplands throughout the day to forage on naturally existing vegetations under this method. The cut-and-carry technique of feeding is also used, especially on wet days. Normally, these animals are not

supplied with shelter, and they are shaded by trees on hot days. Cattle are normally housed in open meadows with hangings for the animals in commercial cow-calf operations. Salt/mineral supplements are generally offered. Breeding happens via single insemination or by several seeds. However, on certain farms, technological treatments are also employed such as artificial insemination, multiple ovulation and estrus synchronization. Some commercial farms are now exploring both the economic and technological viability of the method of embryo transfer.

The growth of small farms producing 75% projected food commodities and providing a source of nutrition and income for millions of people in South-East Asia is crucial in improving food safety and poverty (Lowder et al. 2016; Herrero et al. 2017). Cambodia witnessed one of the highest agricultural growth periods in the world, with average annual growth of 5.3% between 2004 and 2012. This was driven by rising commodity prices and increased output of basic commodities such as rice, maize and cassava (WorldBank 2015). But in recent years, agricultural development has stalled (1% in 2013–2014), and greater focus is needed if poverty continues. But in recent years, agricultural development has slowed (1% in 2013–2014), and greater consideration is needed for the sustained decrease of poverty, mostly driven by farmers. A realistic approach to tackle hunger and food security is sustainable animal development, including diversified livestock production. Asian buffalo has the biggest promise and potential for meat production of all domestic animals (Bubalus Bubalis) (Cockrill, 1994). In tropical or sub-tropical climate, the performance of this breed outperforms that of other bovine species in terms of quality. These differences are mostly due to the ability of buffalos to convert and digest low quality food (Ranjan, 1992). Their nutrient flexibility, great disease resistance and acceptance have also been recorded in respect of a broad variety of settings for housing, food and management (Wanapat and Kang, 2013). Buffalo is a valuable asset which is "undervalued" by the Food and Agriculture Organization (FAO, 2000). Buffalo meat acquired more appeal through less fat, lower cholesterol, and other healthy qualities in numerous Southeastern and Middle East Asian nations and in Africa. India is the world's most significant country in terms of buffalo production and population. India has become the biggest bovine meat exporter with more than 50 percent of the world's buffaloes.

Beef consumption has remained stable at roughly 2 kg per capita,9 with urban consumers accounting for the majority of the market. Beef imports for sale are effectively limited by the restriction on frozen meat in wet marketplaces. As a result, the majority of imported beef and carabeef ends up in the processing business, where it is used to manufacture corned beef and sausages, two popular meats among lower-income households. The ruminant sector's productivity is low because to extremely low calving rates (often less than 50%) and substantial calf mortality (between 10 and 20 percent). The government's 2010–35 road map aims to stimulate "local beef cattle production catering to the high-end markets," which includes the import of genetic material through grant-aid programs in the United States and Australia.

Pork/Swine Production

Swine farming in the country is both done as home and commercial farms, like with other domesticated farm animals. According to 2001 figures, around 76.78% of the pigs in the backyard are kept while the other 23.22% are on commercial farms. The amount of advanced technology and the use of better genetic engineering for the production system show the

considerable diversity in production systems across behind and between commercial farms, which is attributable to the commercial subsector of the pig business. In recent years, however, smallholders / backyard swine farms steadily match their trade equivalent. Backyard pig farming may be further categorized into livelihood and production methods for small-scale companies in the Philippines. Lastly, in urban regions, there is growing popularity. The care and management of the pigs are carried out by family members in both forms of production of backyards. In contrast to big ruminant systems, women and children play an essential part in the backyard production of pigs (feeding and management). Commercial swine production is a multi-billion-weight sector in the Philippines characterized by a high level of complexity in its manufacturing system and well-structured distribution and marketing networks for inputs. In this system it's common practice to utilize exotic swine races and their hybrids, which are handled according to technology and procedures borrowed from industrialized nations. Housing facilities and other agricultural amenities are imported or foreign design adaptations are adjusted. Such imports also involve substantial amounts of feed and other inputs and to a lesser degree breeding stocks. Consequently, it remains and importing-dependent livestock company notwithstanding the amount of progress made by the commercial sector of the local swine business.

The economic downturn reflects the ways in which pig producers have adapted their activities to market conditions and, in particular, intensified competition (on a national, intra-EU and international basis). This means that the so-called invisible market hand is active and removes weaker enterprises so that the area available is controlled by stronger enterprises. The agricultural market becomes more competitive as a result of liberalization, which makes the aforementioned process increasingly difficult for economists and practitioners alike. Pork meat shortages are an explanation for the analysis of so-called food production self-sufficiency. Pork is regarded as key agricultural goods, apart from chicken and beef, among the three meats. The concept of autarkous economies separated from others (both naturally and by compulsion), and notably from the point of view of commerce, was used to refer to a term of self-sufficiency. Nevertheless, today's studies analyze the economical and physical availability, regardless of the origin of the food (domestic production or import), of food on the domestic market instead of focusing on the historical indicator of the degree of satisfaction of the populations' food demand with domestic production. Food safety is the continuing availability of enough world food supply to maintain a steady development of food consumption and counter changes in output and pricing according to conclusions of the 1974 World Food Conference. This word is occasionally increased by nutritional values and preferences to represent the strengthened efforts made around the world to achieve health and the environment and which are diverse in accordance with cultural sphere, tradition or prosperity (Pawołek, 2015).

The pig industry in the Philippines is fragmented, and its value is low. The pig sector's supply chain is underdeveloped, and the numerous pig sector groups do not cooperate well with one another. The majority of pig trading is done by middlemen (known as "viajeros"), who are also in charge of slaughter and retailing on the wet markets. According to local analysts, viajeros have an 80–85 percent share of the wet market. Pigs were once carried live from other parts of the country to Manila, but this resulted in significant losses and was costly. A "pork in the box" technique was implemented in 2008, in which animals are slaughtered in Mindanao and transported to Manila in boxes. This process is overseen by the National Meat Inspection Service (NMIS). A diverse spectrum of genetic material is used across the country, making it difficult to

build an open processing sector and export markets with a standardized and uniform output. Only one vertically integrated pork supply chain currently exists, accounting for less than 3% of total output and mostly supplying the upper end of the domestic fresh and processed pig market.

Chicken/Poultry Production

The population of chicken in the country is dispersed, like other domesticated animals, both to backyard and small farms and to huge commercial farms. The chickens are categorized as layers, broilers and native and improved inventories. In terms of scale, use of enhanced technology, usage of inventory breeding and marketing system, major commercial chicken production systems and backyard vary greatly. However, in recent years an enhanced chicken farming method in urban and peri-urban regions has gained appeal. The production system for the Backyard chicken may be classed by kind of agriculture to a small-scale chicken manufacturer. For survey purposes, production of chicken backyard is defined as one with a maximum number of 1000 heads or 100 layers at a certain moment on a farm. Status of animal genetic resources in the Philippines - Country Report 18 Subsistence method of production of chicken backyard is defined mostly by the application of native stocks kept on a free range for feeding natural feeding stuffs. These birds are, in fact, left nearly without input to increase their production performance in terms of feeding, health care, reproductive and breeding, housing and other types of operation. Rustic chicken production systems are mainly used by poor farmers in rural regions, who have small financial and material resources, with limited availability of knowledge and technical assistance. Chickens bred under this production style are used largely to consume home and make easy income for the household, especially during special events. The highly organizing and linked production and marketing systems define commercial broiler and egg production. Exotic commercial hybrids are used in this production system, originating from frank breeders and managed by sophisticated housing and facilities. The method uses intense production management. Virtually every breeder is imported as a parent and grandparent. Imported are also substantial volumes of food and other inputs utilized in the production of industrial chicken. Therefore, in the country, commercial chicken production is seen as excessively reliant on imports.

A household is secured in food when it has access to food for its members (quality, quantity, safety and cultural acceptability) and is not in danger of losing access to nutritious foods for all its members (Sonaiya, 2007). Besides revenues generated by chicken meat and eggs, food supplies for the home are cheap and conveniently accessible. These birds provide high-quality and affordable animal protein for feedstuffs not eaten by humans. More than 18% of the eggs laid and 30% of the family flock are devoured in general (Ndegwa et al., 1998; Okitoi, 2000; Kaudia and Kitalyi, 2002). It was established that a family is nutritionally safe with only three adult chickens throughout a year (Okitoi et al., 2000b; Juma and Ondwasy, 2002; Kaudia and Kitalyi, 2002). Chicken eggs are an important supply of animal protein in times of droughts and associated disasters. IC is heavily eaten by homes in both rural and urban locations on special events (festivals, banqueting and ceremonies). Local hens mainly serve meat, eggs and revenue from time to time. Local chickens also have certain social-cultural features. Chickens are offered at marriage, for instance in the Acholi custom, as part of the "price" bride. When a chicken is slain, the gizzard must be presented to the male guest. The indigenous chickens also have a high heat and cold tolerance, greater scavenging ability, greater mothering abilities and

greater protection against deception of children for the following reasons. They are more resistant to illnesses (Bushra 2012, King'ori et al 2010). These features make them more village-friendly. The flavor of eggs and meat which boosts their market worth also includes other preferences ascribed to local birds.

The sector is now growing at a rate of 3–4% per year in terms of volume. Poultry consumption has grown at a pace of 3.7 percent per year for the last 20 years, but has accelerated to 6% in the last five years, owing in part to the high cost of beef and pork. The chicken sector has seen significant development since the late 1990s, and consumption has been the fastest increasing (among meat products in the Philippines). In part because the Philippines is also a significant pork eater, current consumption is projected to be around 10 kg/capita5, which is well below levels in countries like Brazil (40 kg/capita) and Malaysia (32 kg/capita) (therefore meat consumption is divided between pork and poultry). The local chicken industry has seen a number of crises that have resulted in its downfall. The broiler market crashed in 1996 due to domestic excess and large-scale imports of frozen chicken thighs, which the industry saw as a detrimental result of globalization at the time. The Asian financial crisis then followed, putting poultry integrators in even more financial difficulty. It did, however, reveal a lack of worldwide competitiveness in the broiler business, which is still producing at 20–30% above world market pricing today.

Research Method

This study aims to identify the relationship of livestock production to food security using metric data of the country's livestock protein; Pork production, Chicken production, and Beef production. The production output of meats which are measured through metric tonnes a year, will then be used as an input on the multiple regression model that assert the impact of livestock production to Food Security. The output produced by the model measures the relationship as well as the strength and the corresponding value of each variable to the Food Security output. This study focused on the 30-year livestock production of the Philippines dating back from the 1990s. Livestock production covers backyard and commercial pork production (Landrace, Large White, Pietrain, Duroc, Hampshire, and the Philippine native pig), beef production (local grass-fed and local grain-fed) and poultry (45-day-old broiler chickens). The data are provided by the Philippine Statistics Office-Bureau of Agricultural Statistics.

The data that will be used in this study are provided primarily by the Philippine Statistics Office-Bureau of Agricultural Statistics. Pork production, Chicken production, Beef production are all measured by metric-tonnes per year. The annual production volume of livestock output based on both backyard and commercial raisers from small scale (<10 heads on swine, <100 heads on poultry, and <10 heads on cattle/cow) to big time meat producers. To accurately measure Food Security from the research standpoint. We used the data provided by the Philippine Statistics Office-Bureau of Agricultural Statistics' database links of Selected statistics of Agriculture and the Livestock and Poultry Statistics of the Philippines. The Multiple regression model was formulated by the researchers to establish the relationship and the importance of each kind of meat to our national food security.

Equation (1):

$$Food\ Security = \beta_0 + \beta_1\, pp + \beta_2\, cp + \beta_3\, bp$$

where Food Security would be our measurement for the food affordability, *pp* would be Pork Production which is measures the total annual production of pork inside the country which is measured by production volume of swine in million metric tonnes. *cp* would be Chicken Production to be measured by production volume of poultry in million metric tonnes. And lastly the *bp* which stands for Beef Production which is measured by production volume of cattle in million metric tons.

Nutritional sufficiency would also boost employment, household purchasing power power, minimize poverty, and boost economic growth (Ramachandran, 2007). This topic is backed by a World Bank survey from 2005, which indicates that greater dietary consumption leads to healthy human bodies and higher productivity. Furthermore, good diet will result in well-nourished youngsters, which will improve their maturity and capacity to succeed in school. It would also lead to higher family wages, lower crime, and faster economic growth.

Augmented Dickey-Fuller (ADF)

Most economic time series data have unit roots which show that their means and variances are not time-invariant. If this is the case, a univariate series is said to be non-stationarity and cannot be used for regression with other non-stationary univariate series because of the risk that their results maybe spurious. The only exception to this rule is when the time series data of all variables have identical unit roots. The widely used unit root test is the so-called Augmented Dickey-Fuller (ADF) test. The basic equation for testing the stationarity of a time series is given by the following:

$$\Delta x = \alpha_o + \alpha_1 t + \beta x_{t-i} + \Sigma\varphi \Delta x_{t-i} + \varepsilon_t$$

where the first difference of the series, Δx_t, is regressed against lagged of its original level series, time, and lagged values of itself. If the estimated value of β is more negative than MacKinnon critical values, the series is said to be stationary. Otherwise, it is non-stationary and therefore has a unit root. The augmented portion of the test is to correct for any serial correlation in the variable.

Optimal Lag Length

An efficient test in determining the optimal lag length is to minimize the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), or Bayesian Information Criterion (BIC) for each lag length on a trial-and-error basis. For the Akaike Information Criterion (AIC) which is a popular test, the formula is as follows:

$$ln\ AIC = (2k/n) + ln\ (RSS/n)$$

where k is the number of regressors including intercept, n is number of observations, and RSS is regression sum of squares. After experimenting with a sufficient number of lags in the model, the one which produces the smallest AIC would indicate the appropriate or optimal lag length.

Structural Stability test

Structural stability test refers to the stability of the coefficients of a regression model between different time periods. In this study, such test will be performed using Chow Breakpoint Test. A structural change could mean a change in the intercept, a change in the slope coefficients, or a change in both the intercept and slope coefficients. Either way, the results would imply structural instability and the model therefore cannot be used for policy analysis and forecasting.

The formula for testing the structural stability of the regression parameter involving time series data is as follows:

$$F = \frac{\left(RSS_R - RSS_{UR}\right)/k}{RSS_{UR}/\left(n_1 + n_2 - 2k\right)}$$

where k is the number of regressors including intercept, n is the number of observations, RSS_R is the regression sum of squares restricted, and RSS_{UR} is the regression sum of squares unrestricted. If the computed F-statistic exceeds critical value, there is structural instability. Otherwise, the model is said to be structurally stable.

Test for Heteroskedastic Disturbances

If the variance of the regression residuals of the model is time varying, the parameters and their standard errors are said to be biased and inefficient. This condition is known as heteroskedasticity and if uncorrected could lead to wrong conclusions and decisions on the part of the investigator. To detect the presence of heteroskedastic disturbances in the residuals, the White Heteroskedasticity Test will be used.

$$u^2 = \alpha_o + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_1^2 + \alpha_5 X_2^2 + X_3^2 + \alpha_6 X_1 X_2 + \alpha_7 X_1 X_3 + \alpha_8 X_2 X_3 + v_t$$

where u^2 is the squared regression residuals regressed against the explanatory variables, their squares, and cross products.

Johansen Cointegration Test

In applying the Johansen Cointegration Test which consists of five options, although options 1 and 5 are avoided because of their explosive values which are not consistent with economic realities, such options were utilized according to the Dickey-Pantula principle by beginning with the most restrictive (Option 2) down to the least restrictive (Option 4). If the computed *trace statistics* and *maximum-eigenvalue statistics* exceed their critical values, then there is cointegration among the variables. The hypothesized relationships cannot be deemed spurious and therefore genuine equilibrium relationships existed.

Specification Error Test

The Ramsey regression equation specification error test (RESET) will be used to test whether non-linear combinations of independent variables help in explaining the dependent variable. This will also help determine if there is no misspecification error in the data used in the study.

A Specification error test is associated with the specification of the model regarding the inclusion of an irrelevant variable, the exclusion of relevant variable, or the functional form of the model. A Specification error creates biased or inconsistent regression estimators, and the inconsistency can still be there even when the sample observation increases. To determine the specification of the model, this study used the equation:

$$\hat{Y}_i = \hat{\beta}_1 + \hat{\beta}_2 X_{2i} + \hat{\beta}_3 X_{3i} + \gamma \hat{Y}_i^2$$

Results and Discussions

To measure one's Food Security, there are aspects set by The Economist Group; Affordability, Availability, Quality and Safety, Natural Resources and Resilience. Since one of the major conditions of Food Security is Food Affordability, we pertained Food Availability to Food Security to tackle the economic aspect of the Global Food Security Index variable D_CPI represents the weighted average of prices paid by the consumer for household goods. Variable D_CPI would be representing Food Security for this study as the historical data was gathered from the Philippine Statistics Authority. An upward trend has been observed for the D_CPI for the 30-year span according to its time-series plot. Since 1980, the weighted average price of consumer goods and services continue to rise every single year.

Livestock Production portrayed an upward trend as well, but it hasn't been consistent throughout the 30-year span. The production of meat type came to a point where it regressed in terms of total volume of output. As these variables are measured through the annual production volume of livestock output (in thousand metric tons). Although inconsistency shadowed the industry's growth. Livestock is essential to the food chain, which links its importance towards food security. Animals can provide essential supply of food, which must be balanced against the quantity of cropland-based feeds they consume — these two elements are interconnected and have opposing effects on food security. Meat and dairy products are high in high-quality protein, minerals, vitamins, and micronutrients. Animal protein has a higher total nutritional value than basic foods (e.g., cereals, roots and tubers). As a result, even little quantities of animal products in a cereal-based human diet can restore amino acid deficits. Furthermore, animal-sourced proteins are easier to digest than plant-based proteins (Neumann et al., 2010).

In 1997 Livestock and poultry industry posted the highest growth rate value added to the whole agriculture sector. Compared to the level from 1996, the Livestock and Poultry Industry improved their growth rate to 8.7 percent and 12.6 percent respectively. But Philippines experienced the most notable event in the world for 1997, The Asian Financial Crisis, which

spread and swept rising economies from the region. Being labeled as a "Tiger Economy" the Philippines' growth came to a downturn as the government tries to tighten its belt and reassess the nations budgets for each of its agencies. As this crisis devastated the whole economy, Livestock Industry wasn't saved, the input of production for the livestock Industry is mainly animal feeds, which we dependently outsource internationally, the price of these raw materials significantly rose. The recent increase on the input of production caused the meat prices to increase as well, raising the price of the consumer basket on the process.

Table 1. Regression Results
Dependent Variable: D_CPI

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	3.224434	0.363115	8.879915	0.0000
Pork Production	-10.59822	5.269576	-2.011210	0.0548
Chicken Production	1.980010	5.882779	0.336577	0.7391
Beef Production	-0.021209	5.000965	-0.004241	0.9966
R-squared	0.162376			
Adjusted R-squared	0.065727		Durbin-Watson stat	1.746081
F-statistic	1.680062			
Prob(F-statistic)	0.195730			

Table 2. Augmented Dickey-Fuller

Variable	Level	Prob
DCPI	-4.979235	0.0020
DLPP	-9.313569	0.0000
DLCP	-3.055034	0.1368
DLBP	-3.028253	0.1421

Table 3 Optimal Lag Length
VAR Lag Order Selection Criteria
Endogenous variables: DLPP DLBP DLCP

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-52.43763	NA	0.010528	-3.959831	-4.102567*	4.003466
1	-45.37887	12.10073	0.012164	4.098491	4.669436	4.273034
2	-28.93072	24.67223*	0.007338*	3.566480*	4.565633	3.871931*

indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 4; Test for Heteroskedastic Disturbances
Breusch-Godfrey Serial Correlation LM Test
Null hypothesis: Homoskedasticity

F-statistic	1.758436	Prob. F (3,26)	0.1798
Obs*R-squared	5.060197	Prob. Chi-Square (3)	0.1674
Scaled explained SS	3.378715	Prob. Chi-Square (3)	0.3368

Table 5; Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.692345	82.67934	47.85613	0.0000
At most 1	0.661290	49.67362	29.79707	0.0001
At most 2	0.362003	19.36051	15.49471	0.0124
At most 3	0.214964	6.776719	3.841465	0.0092

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.692345	33.00572	27.58434	0.0091
At most 1	0.661290	30.31311	21.13162	0.0019
At most 2	0.362003	12.58379	14.26460	0.0906
At most 3	0.214964	6.776719	3.841465	0.0092

Table 6; Specification Error Test (Ramsey Regression Equation Specification Error) Ramsey RESET Test

	Value	df	Probability
T-statistic	2.144206	25	0.0419
F-statistic	4.597618	(1, 25)	0.0419
Likelihood ratio	5.064542	1	0.0244

Table 7; Structural Stability Test (Chow Breakpoint Test)
Chow Breakpoint Test: 1995
Null Hypothesis: No breaks at specified breakpoints

F-statistic	1.087673	Prob. F (4,22)	0.3869
Log likelihood ratio	5.413563	Prob. Chi-Square (4)	0.2474
Wald Statistic	4.350693	Prob. Chi-Square (4)	0.3606

Livestock plays a critical part in food security, directly through food provisioning, they benefit local nutrient cycles by providing work, money, a capital stock, draft power, and manure. Animal can also have a detrimental impact on food security, especially when livestock feedstuff is made up of biomass that can also be utilized for human nutrition. The affordability of food relates to the issues of distribution that arise from food security, (Ingram; 2009) implicates that the distributional issues can be rooted to affordability, allocation, and preferences. Affordability refers to a person's food costs, and the percentage of family income spent on food purchasing power. Other concerns of availability and cost, such as food supply by season (for example, in drylands according to wet and dry seasons) and related issues such as suitable food storage facilities, are rarely addressed. Natural catastrophes, climate change, economic crises, and war, all of which produce temporal or transitory food shortages, are examined (Erb et. al., 2012). Several functions for society are fulfilled by livestock production systems. and hence has a direct and indirect relationship with food security. The significance of livestock, particularly in rural civilizations, extends far beyond its role in nutrition (Swanepoel, 2010), and many of these tasks are indirectly related to food security. Livestock and agricultural production have positive and negative interactions. Livestock aids agricultural development by providing draught power and waste for fertilization, soil properties, moisture retention, and fuel. Animals are trash recyclers and may graze or browse marginal pastures that may have no other value in terms of food security. In times of scarcity, they assist to stabilize food supply across different seasons, and they provide a substantial source of income and wealth for smallholders, so indirectly giving access to food.

The regression analysis results suggests that there is a significant relationship between DLPP and DCPI. According to Ayuub et. al. (2011), meat costs are getting more volatile, world prices differ from domestic prices due to predetermined price margins that are established for each nation group and capture the effect of protectionist tariffs or significant transportation costs to distant markets. Domestic prices in equilibrium for meat and feed may always be above or below global prices, depending on the nation group in issue, but they are always impacted in the model by world price movements. According to Liu R., & Xing L. (2021) Meat and meat products are one of the most critical constituents in the food sector and are highly associated with the consumer price index (CPI). At 0.0548 probability, Pork Production is deemed to be statistically significant in the regression analysis. According to the regression output, Pork Production and DCPI has a negative relationship. In the event that Pork Production decreases by -10.5982 metric-tonnes, DCPI decreases by 1. With probabilities of 0.7391 and 0.9966 for variables Chicken Production and Beef Production respectively, both variables are considered to be statistically insignificant. For the Augmented Dickey-Fuller Tests, at 0.0020 probability for variable DCPI, the variables are said to be stationary and has no unit root. With probability of 0.1421 greater than any alpha for variable DLBP, the variables are said to be nonstationary and has unit root. With probability of 0.1368 greater than any alpha for variable DLCP, the variables are said to be nonstationary and has unit root. At 0.0000 probability for variable DLPP, the variables are said to be stationary and has no unit root. While for Breusch-Godfrey Test, which is to Test for Heteroskedastic Disturbances; Given the 0.1798 probability, it is concluded that the data does not suffer from heteroskedasticity and proved to be homoskedastic. For the Ramsey Regression Equation Specification Error Test (Ramsey RESET), With a probability greater than 0.01 alpha, the functional form is correct, and our model does not suffer from omitted variables and shows no nonlinearities or misspecification in the data.

Due to the results garnered, as well as the significant relationship between Pork Production (DLPP) and Food Security (DLCPI), Livestock Intensification would primarily benefit the producers as well as the community. Intensification of livestock grants small-time raisers/backyard raisers a support from the government to ensure profitability as well as market disposal of these livestock. This support could be in form of Livelihood assistance, seminars, and providing the right market at the right price for the raisers.

Having a secure access to livestock health services since livestock producers are on a restricted budget. Being able to have sufficient and necessary medicines or any animal health services would greatly decrease the possibility of death within the livestock farm. It would also increase production and productivity. It would also be economically beneficial for the producer and the consumers since there would be an unlikely chance of shortage. The government can aid by sending veterinarians to perform mandatory inspections, to ensure proper raising and proper management as well as safer meat.

Another would be financial assistance for livestock producers in cases where a certain number of livestock has unexpected deaths. For example, a livestock producer lost 30% or a certain percentage of livestock where the business operations would be gravely affected due to the death of its livestock. The livestock producer would receive from the government a financial grant to avoid bankruptcy on the part of the livestock producer. It would also be able to avoid a

possible shortage on livestock therefore an increase in price. Livestock Insurance may be too big of a budget, but it can prevent raisers from quitting the livestock livelihood hence ensuring our meat supply.

Reduced tariffs on the importation of raw materials for livestock feeds would massively improve profit and could possibly cut the prices of meat. Production cost of producing livestock good compromises 80% of the sale, substituting or purchasing sub-standard ingredients for livestock feeds could endanger the quality and safety of the meat. The government can either reduce the tariffs or improve international relations to create more investments and reduce the importation cost of raw materials.

Financial security worries producers for the future of their business, concernment towards their projected return/profit, while establishing a running capital might concern them, government can provide secure access to credit and other inputs, creating a pro-poor financial market, as they increase their input it directly increases the production of the livestock. Output security should also be a priority, this is to increase investors and greatly increase the kick-starting domestic livestock markets this means we should divert our attention to the improvement of local slaughterhouses and processing plants as they are a highly indivisible component which can create frictions on the production chain.

To further increase meat quality and competitiveness of meat products, government agencies must promote; food safety and food research. Promoting food safety means surveillance of diseases originating from foods, livestock quarantine, animal welfare, and food safety regulations. Some livestock-associated goods are underprovided by the markets, this helps local producers not to be stepped on by foreign competitors as these products are non-rivalry and non-excludability. For food research, investment on private research centers should be prioritized to garner newly discovered techniques on profitable breeds and/or technologies.

Lastly it is recommended that concerned agencies primarily the Department of Agriculture continues its plan of the digitalization of a digital traceability system for meat products. Also following the One DA Reform Agenda, one of the objectives of the National Meat Inspection Services is the setting of laboratories to “weed out the bad apples denigrating the harvests of farmers and fishers”. The benefits would be a better meat quality and faster transactions since it is already the digital era. It would be a perfect time the Department of Agriculture would start to implement this especially on a pandemic.

Conclusion

The curiosity to analyze the production of the three primary meat in the Philippine economy has drove the researchers to utilize their time and resources to create a better understanding and give out knowledge and information that would help the country combat hunger and malnutrition. The researcher’s first objective is to assess the production trend, and then include substantial evidence that will aid in preventing meat overproduction/underproduction and ensuring its sustainability and sufficiency for future generations. Which made possible through the use of time-series plot, wherein the researchers

easily identified which point in the last 30 years have we produced excessively and produced below the nation's demand. The second objective is to determine whether current livestock production satisfies current livestock demand using production data. Through the help of the regression analysis, we determined the relationship of each independent variable to the dependent variable, which means to say that Beef, Chicken, and Pork Production has been tested to prove their relationship to The Consumer Price Index, furthermore, to analyze the production in contrast to the prices, and whether the country produces enough for the demand at hand. And the last objective is to determine the country's food security for the past 30 years and the reasons to achieve it. To fulfil this goal, we analyzed the economic standing of the Philippines throughout the 30-year span, and the programs implemented by various administration that benefit livestock producers.

The outcome of the statistical tests provided answers to our objectives, Regression analysis identified the relationship between the variables which made it easier to identify which variable gives the greatest significance to D_CPI, with a negative relationship. Wherein if the supply of pork decreases, it will immediately cause the prices of pork to rise and as the primary protein Filipinos consume it is being reflected to the consumer price index. The evident result of this in the modern day is the recent African Swine Fever which infected most of the commercial and backyard producers of Pork. This caused the price of Pork to be pushed to record numbers. The inconsistency in the production can be seen as a result of "livestock epidemics" such as Aviary Flus, African Swine Fever, and other intestinal infections for Cattles. Another reason for reduced annual growth can be caused by economic crises, in which animal feed prices are rising since those inputs aren't produced locally, for the past years, The Philippines has been importing raw materials in which we process and distribute here in the country.

The regression test alone produced the answers we are looking for, the significant relationship of Pork Production (DLPP) and Consumer Price Index (D_CPI), although Chicken and Beef Production rendered insignificant relationship. The Chicken Production rendered insignificant relationship with Food Security (D_CPI) thus accepting the null hypothesis *Chicken Production does not affect Food Security*. On the other hand, The Pork Production-Consumer Price Index relationship can be explained by the bare laws of economics. Thus, rejecting the null hypothesis *Pork Production does not affect Food Security*. While in contrast, Beef Production had similar results with Chicken Production, the regression test rendered insignificant relationship with Food Security (D_CPI) hence failing to reject the null hypothesis *Beef Production does not affect Food Security*.

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