Chapter

Global Perspectives of Intensive Animal Farming & Its Applications

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Abstract

Agricultural farming outputs are dependent upon the production type because different farming systems create different products. Intensive animal farming is widely used for the production of products that have societal importance, including meat, milk, wool, leather, fur, eggs, and honey. To ensure their timely production with limited cost, advanced technological processes, and chemicals (pesticides, herbicides, and fertilizers in large amount) are carried out in this intensive factory farming. Amongst animal farming, the livestock sector is the fastest-growing agricultural sector. The global shift toward intensive animal farming for high productivity yield has rendered a negative impact on the environment and biodiversity and is now an alarming sign for global warming. It has also resulted in soil, water, and air pollution due to the emission of greenhouse gases from the waste generated by these animals. Rapid use of antimicrobials in these farming systems has led to the emergence of drug-resistant pathogens. Therefore, an integrated and comprehensive approach covering the nonmarket outputs of the farming system is required for monitoring these global trends.

Keywords: intensive animal farming, factory farming, high production, technological processes, global warming

1. Introduction

Intensive animal farming [1, 2] or livestock farming is an intensive agriculture type that is destined to increase animal production by providing them all necessities and a favorable environment while reducing the rearing cost [3]. The environment provided to the animals here includes nutrition, shelter, water, optimum temperature and humidity, and veterinary management. It is also known as factory farming [4].

The term Factory farming means "any globally adopted farming system where flock of animals are kept under one roof in a confined setting, that is, a cage or stall" [5]. According to the United States Department of Agriculture (USDA), "a farm with 1000 cattle or 125,000 chickens is referred as factory farming system" [6]. However, according to the European Union (EU), "farm carrying 40,000 chickens is referred to as factory farm or macro-farm" [7]. The products of the animal farming industry are milk, meat, egg, and other animal products which are readily available for human

consumption and are much-liked food amongst people across the globe. Feeding the entire world is the sustainable development challenge in the coming few years. Meat plays a major role in this. The demand for meat has increased rapidly over the past 50 years and it has tripled now [8]. According to the estimates of Food and Agriculture Organization of the United Nations (FAO), approximately 68.1 billion animals were slaughtered in 2012 for meat [9]. However, this figure increased to 80 billion in 2018. Poultry meat is the most popular meat worldwide [8].

Based on the above estimates, every individual on Earth is provided with an average of 42.9 kg of meat. In developed nations, average 76.2 kg of meat is consumed by individuals and, on the contrary, in developing nations, 33.4 kg of meat is consumed by individual on average basis [10]. Asia (42.1%) is the largest producer of livestock followed by America (31.4%), Europe (19.0%) [11], and Africa (5.5%). Besides meat, animals also provided us with milk (5.7 billion tons) and eggs (72 million tons) [11]. Chicken laid 1.25 billion eggs; other poultry laid about 87 million eggs. Much of the animals' products discussed above came from those animals who were raised by someone else on our behalf and amongst them, the majority were reared using intensive animal farming [11]. Factory, intensive, industrial animal farming, and concentrated animal feeding operation (CAFO) all are used for a modern form of intensively rearing of fowl, fish for their various edible products, including their meat (i.e., flesh and fat) and other forms of animal protein (i.e., dairy and eggs). Intensive farming can also be defined as an economic pursuit involving domestic animals for human uses such as obtaining honey, fur, leather, wool, and fertilizer. The sole purpose of this type of farming is to ensure maximum production with maximum profit [12]. According to Archambeaud [13], intensive farming is a farming type where agricultural machinery is employed for achieving higher productivity, that is, the excessive usage of pesticides, fertilizer, or disease or weed-resistant chemicals. This high productivity yield also renders a negative impact on the environment and biodiversity [13] which will be discussed later in this chapter.

2. History

Intensive animal farming is the most recent advancement in agriculture history which is also the result of scientific and technological developments. In the late nineteenth century, innovations were made in mass production. Later, in early twentieth century; vitamin discovery and their associated role in animal nutrition was the hallmark of Industrial Revolution because it allowed poultry to be raised at the domestic level [14]. Moving further, antibiotics and vaccines discovery have further lightened the livestock by reducing the number of disease-causing pathogens [15]. Chemicals used in World War II gave the idea of synthetic pesticide discovery [14]. The development of transport networks and technology enabled the distribution of agricultural products over long distances.

The era of high-put farming began in Britain in 1947, when the new Agriculture Bill provided subsidies to farmers to promote more production by introducing new technologies to reduce Britain's dependence on imported meat. According to United Nations "the intensification of livestock production" was found to ensure food security [16]. In 1966, the United States, Great Britain, and other developed countries began large-scale farming of beef and dairy cattle and domestic pigs [17]. From the heartland of America and Western Europe, factory farming became globalized in the later twentieth century and continues to expand, replacing traditional livestock

farming practices in an increasing number of countries. In 1990, intensive animal husbandry accounted for 30% of world meat production, and by 2005 this had risen to 40% [17]. Worldwide meat production in 2020 was 328 million tons which suggests that the demand for meat has reached 90% [18].

3. Global perspectives

Globally, more than 70 billion animals are slaughtered every year for food. On the basis of data provided by UN FAO, the five major groups of animals slaughtered are cows, chicken, goats, sheep, and pigs [19]. It is expected that by 2050, intensive farming production will double with the major advancement taking place in less industrialized countries. This expansion has had serious consequences because only the livestock sector generates about 18% of greenhouse gas which is more than any kind of transport. Moreover, 70% of the Earth's surface is directly or indirectly involved in livestock production leading to land degradation, environmental pollution, and other health-associated issues [20]. These problems will not go away on their own if more and more extensive farming systems are being shifted toward intensive animal farms where animals are raised in confinement at high stocking density using advanced machinery and biotechnology. Intensive farming production systems were the norms of Europe and America, but now this practice is increasingly becoming common in Asia and Latin America. According to UN reports, the global shift of farming systems and environmental problems associated with these systems has not given much importance which is why they now have become a serious concern [21].

There are numerous problems associated with intensive animal farming system, a few of which is discussed below:

3.1 Increased emission

As in intensive farming system, animals are raised indoors, therefore large amount of energy is required for heating, cooling, and ventilation as well as for feed production and transportation producing more emissions of carbon dioxide and anthropogenic nitrous oxide (which stays in the atmosphere for up to 15 years) and has more global warming potential leading to depletion of ozone layer. The livestock sector generates 64% ammonia emissions thereby contributing to acid rain and acidification of biodiversity [22].

Worldwide, farm animals are also a source of methane emission. Methane has 23 times more global warming potential than carbon dioxide. The operation of intensive farm animals leads to increased emission of methane because of animal diet which also causes diseases in animals and emits 50% more methane than animals feed on grasses in open lands. The only reason is that in intensive system animals are raised on a concentrated high-protein diet (made up of 50% corn and 80% soybean). This food is cheap and easy to produce and animals by eating such diets put on weight faster. This emission of greenhouse gases will continue to increase as the intensive farming system spread to more and more developing countries [22].

3.2 Climate changes

Developing countries suffer more from the impact of climate change because of abrupt increase in hunger and disease. This is because developing nations have

limited coping capacities and they are dependent upon climate-sensitive food and water supply chains. Climatic changes are responsible for food scarcity in developing sectors. Excessive flooding, storms, loss in biodiversity, land degradation, and water and air pollution affect developing countries mostly because of health, poverty, and infrastructure constraints [23].

3.3 Loss in biodiversity

Animal waste and droppings are not treated properly, as farmers often dispose of their waste in rivers, where they pollute the water and impend the biodiversity of the ecosystem. Waste products of poultry emit ammonia and nitrous oxide leading to nitrogen pollution of water and soil [24]. Uneven use of pesticides and fertilizers can also pollute soil, water, and air [25]. The continuous degradation of environment and loss in biodiversity is an alarming sign for global warming [25].

3.4 Land degradation

Land degradation due to deforestation is also one of the major problems. Animals reared for meat, milk, and eggs production are already covering one-third of the Earth planet surface. Cattle ranching is the primary cause of deforestation because forested lands are cut and cleared for making proper room for animal grazing and meat production [26]. The meat thus produced is exported to developed countries. The high meat demand in developed countries is rendering negative impact on the meat-producing country both due to deforestation and soil erosion. Besides grazing, high-quality protein feed production is also putting pressure on land. The number of those protein diets continues to increase as intensive farming increases. The employment of large area of land for feed production is resulting in loss of biodiversity, soil erosion, and increased greenhouse gases emission [27].

3.5 Antimicrobial resistance

Increasing demand for animal protein in intensive farming system has led to an increase in antimicrobial use (AMU) leading to the emergence and spread of antimicrobial resistance (AMR) [28]. Antimicrobials are mostly used in intensive animal farming to prevent or treat infection and are also given in animal diets for rapid growth [29]. Previous reported literature has shown that 73% of the antimicrobials available locally are given to animals raised for food. AMU in food-producing animals can also affect humans, leading to antimicrobial resistance. The widespread use of antimicrobials in farms can also contaminate the environment, leading to the emergence of drug-resistant pathogens. Therefore, monitoring the global trends of antimicrobial use in intensive farming system is important to track progress associated with antimicrobial stewardship programs carried across regions [28].

4. Types of livestock farming

Based on the production processes, livestock farming is of different types which are described below in detail:

4.1 Intensive animal farming

It is also known as conventional or high-put farming system [2]. In intensive animal farming, to ensure healthy and faster animal production, animals are housed with adequate nutrients, feed, and temperature. Breed selection in this system is made up of different production types. It is both labor and capital-intensive. The primary goal of intensive farming is the attainment of high production [30].

4.2 Semi-intensive animal farming

In semi-intensive farming mode, animals are housed and fed but they are allowed to move or graze around the farm to forage within a confined area inside the farm premises [31].

4.3 Extensive animal farming

It is also known as a low-intensity or low-input farming system. In extensive farming systems, rearing is carried out on open areas of the lands, that is, pastures, meadows, and mountains so that animals can get maximum benefit from the natural products. The farming system is applicable to the animals who are intended to be adapted to the field [32]. This system supports the preservation of the ecological unit. In this type of farming, external resources like pesticides and fertilizers are used in low quantity [33].

4.4 Organic animal farming

Organic farming is a type of animal farming system whose primary aim is to produce high-quality food without the use of synthetic chemicals, that is, chemical fertilizers or pesticides, etc. Additionally, animals are grown in open spaces and fed on natural resources [34].

Livestock represents all animal types like buffaloes, cattle, goats, sheep, horses, and pigs, etc. and they are reared primarily for milk, meat, and wool production. Livestock farming is associated with the production of eggs, milk, and meat from domesticated animals [35].

The basic purpose of these farming systems is the production of agricultural products such as cereal, crops, rice, sheep, fish, and fowl. These all-farming systems are dependent on plants as their primary food source, which in turn, rely on the soil. Merely, the production of farming is influenced by the type of farming system and agricultural action chosen. **Figure 1** [36] depicts the typological classification of the farming system.

5. Pros and cons of intensive animal farming

Cattle farming has been an important part of society for years, ever seeing that people started domesticating animals to improve the quality of their life. However, as with most forms of farming, inclusive of agriculture, cattle farming too has strengthened, specifically in current many years. This has made livestock products more easily available and cheaper to buy; that is especially important in case one assumes that staples along with milk, honey, eggs, and meat are all merchandise in cattle farming [37].

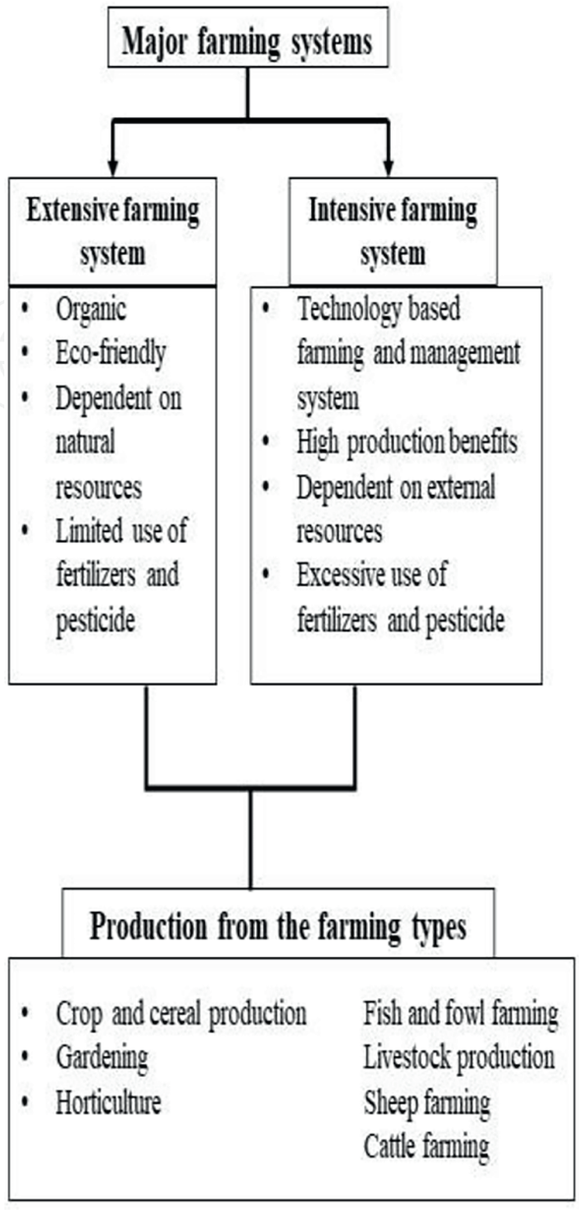

Figure 1.
Typological classification of major farming systems [36].

However, intensive livestock farming practices have on several occasions raised major concerns regarding food protection, animal welfare, and environmental effects—to the extent that cattle farming is often called "factory farming" [38].

5.1 Pros of intensive animal farming

The contribution of livestock farming to the country GPD (Gross domestic product) is about 883 billion dollars, but this amount does not include the services availed from retailers, butchers, and transport units and supplied to feed producers and equipment producers. Besides its role in economic development, the livestock sector increases the life expectancy of individuals by providing food security to about 1.3 billion people. Nowadays, it is the fastest-growing agricultural sector of the country's economy [39].

Intensive animal farming	
Advantages	**Disadvantages**
Cheaper and better-quality food products	Cost of external resources (pesticides and fertilizers)
Rational use of land	Cost of technical equipment
Limited manual work	Trained personnel are needed for technological operations
Faster production using the modern technology	Machinery replaces labor; hence less people are involved in agricultural operations
Global food safety and security	Damage landscape, environment, soil, and wild-life biodiversity

Table 1.
Advantages and disadvantages of intensive animal farming [40].

Intensive animal farming has been made possible by farming management practices that have helped to increase yield and production while bringing down the cost at a confined place. For example, farming units employing the practice of concentrated animal feeding operation (CAFO) have enabled farm owners to rear more animals in a restricted area, thereby maximizing the land potential [39].

5.2 Cons of intensive animal farming

Though animal farming has efficiently increased the production of animal products at a limited cost, yet the external products (cost-saving techniques) that have been used for ensuring the steady production of products have negatively impacted health and the environment [39].

In a confined environment, where flocks of animals are kept under one roof has increased the chances of animals becoming more susceptible to diseases. In low- and middle-income countries (LMIC), livestock diseases have been transmitted to about 2.4 billion humans. To reduce the burden of zoonotic diseases, farmers frequently administered antibiotics to their animals leading to the evolution of drug-resistant pathogens [39]. Besides this, some farmers kept animals to live in stressful conditions. Unfortunately, practices persist where animals are transported long distances to the market in inhumane conditions or slaughtered in painful ways.

Keeping in view the above-described pros and cons of intensive animal farming, a few more advantages and disadvantages are listed in the **Table 1** given below:

6. Methodology

6.1 Guidelines

A meta-analysis-based study was designed to review the intensive animal farming system in Pakistan. The study was carried out according to the guidelines of "Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRIMA)" (Page et al., 2021).

Source	Number of Articles
Google Scholar	300
Google	10
Total	310

Table 2.
Number of articles obtained from searching international databases.

6.2 Literature search

An online search of international database sources, that is, Google Scholar, Research Gate, and Google was carried out to identify relevant studies reported from Pakistan from 2015 to 2023. A total of 310 searches were carried out. The reference list of the searched studies was further reviewed for any relevant publication. The duplicate article found using the above-mentioned databases was removed using EndnoteX7 (Thomson Reuters, New York, NY, USA). The searched sources of 500 articles are given in **Table 2**.

6.3 Keywords

The following keywords were searched: Livestock farming, intensive animal farming, and application of intensive animal farming in Pakistan.

6.4 Studies inclusion criteria

The eligible studies were selected for inclusion in this meta-analysis when the following criteria were met. (1). Full-text articles available in English language. (2). Studies reported from different regions of Pakistan. (3). Cross-sectional and retrospective studies. (4). Sample size provided. (5). Studies reporting the effect of climatic changes and antimicrobial use in livestock.

6.5 Studies exclusion criteria

Studies were excluded based on the following exclusion criteria: (1). Duplicated data or review articles and conference abstracts. (2). Articles without full text. (3). Articles with abstract only. (4). Data reported from other regions of the world. (5). Research articles conducted before 2015.

6.6 Comparison of intensive and extensive farming system

For better understanding of the advantages of intensive farming system, a comparison was undertaken for analyzing the efficiency of intensive and extensive farming system. Different farming practices, that is, amount of milk production and farming technical efficiency were measured between the two farming practices.

6.7 Statistical analysis

This meta-analysis was computed using random effects model with Open-Meta Analyst version 10.10. The heterogeneity of the studies was checked using Cochran's

Q test. The variation across studies was observed by the forest plot as well as the inverse variance index (I2). Values of I2 (25, 50, and 75%) were considered as low, medium, or high heterogeneity, respectively. In this meta-analysis, the heterogeneity value was >75%, therefore, the DerSimonian and Laird random effects models with 95% CI. Funnel plot analysis was carried out if heterogeneity was of moderate to high level. Subgroup meta-analyses were then employed by publication year.

7. Results

7.1 Selection of studies

The aim of the present study was to determine intensive animal farming practices employed in Pakistan and investigate the effect of different factors on livestock production. Different international databases, including Google Scholar and Google, were searched (from 2015 to 2023) to identify studies that addressed the intensive animal farming activities in Pakistan.

For this meta-analysis, a total of 310 articles were identified in the initial search. Out of 310 searches, 254 articles were excluded because of their irrelevance and not being reported from Pakistan. Case reports, conference abstracts, and review articles were also excluded. 50 articles were also excluded for reasons of being duplicates, titles and not having full text. Six relevant articles were selected because they met the inclusion criteria, and their full texts were reviewed. The flow diagram of the selection process of the included studies is shown in **Figure 2**.

The characteristic of the included study is shown in **Table 3** given below:

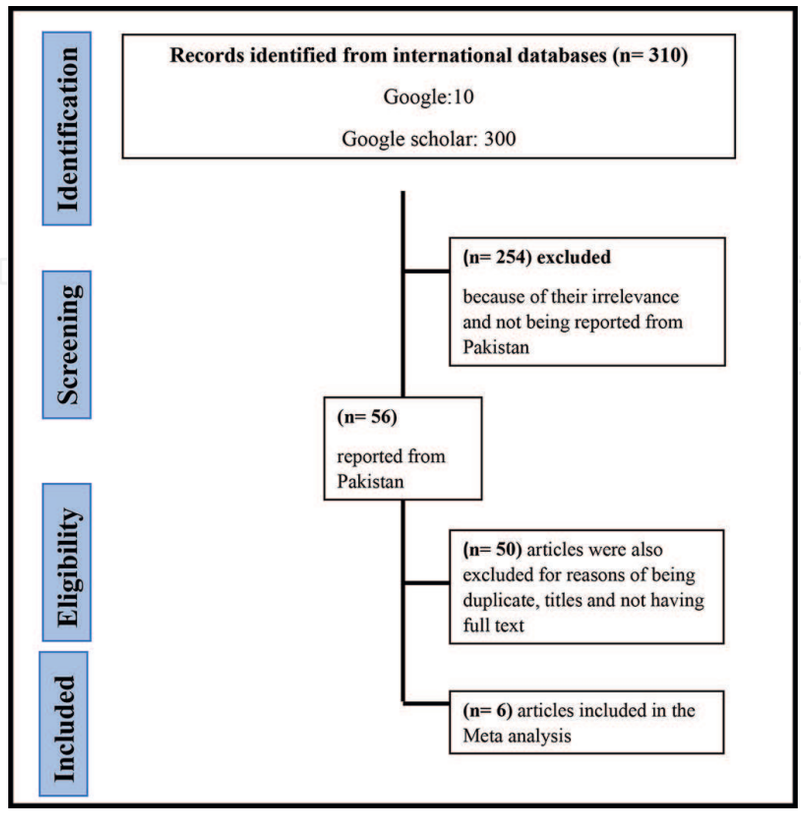

Figure 2.
Flow diagram showing selection criteria of the selected studies.

Researcher	Year	Study aim	Country	Results	Conclusion	Study Weight	Reference
Umair et al.,	2020	To determine trends of antimicrobial use in dairy farm.	Punjab, Pakistan	Defined daily dose was 47.71 out of 1000 cows tested.	Increased antimicrobial usage in dairy sector.	16.87%	[41]
Abid et al.,	2016	Impact of climate change on 450 farms.	Punjab, Pakistan	55% were vulnerable to extreme temperature, and insect attack, and 35% are vulnerable to soil problems.	Limited resources and lack of infrastructure are contributing toward climate changes.	16.82%	[42]
Mohsin et al.,	2019	Use of medically important antimicrobial in food-producing animals.	Punjab, Pakistan	High consumption of antimicrobials was seen in 30 flocks. The annual use of medically important antimicrobials was 250.84 mg/kg.	The frequent antibiotics used were colistin, tylosin, doxycycline, and enrofloxacin.	16.13%	[43]
Habib et al.,	2016	Analysis of food supply in livestock.	Pakistan	Crop residues (58.8%) were the predominant food source for livestock followed by crude protein (37.2%).	Indigenous food sources were rarely available for livestock.	16.65%	[44]
Shahzad & Abdulai	2020	Impact of extreme climatic conditions on crop.	Punjab, Pakistan	540 farmers were interviewed. It was found that climate-related risks had (Extreme temperature and rainfall) severely impacted soil, crop rotation, and farmers' income.	Mitigation strategies should be adopted to cope with the situation.	16.84%	[45]
M. Riaz	2022	Livestock-integrated farming practices.	Faisalabad, Pakistan	105 responses were collected from farm owners. Livestock sector is dynamic for Pakistan's agriculture, contributing 17% to energy and 33% to protein consumption.	Farmers in integrated system were using traditional methods for milk production. Modern practices and procedures were not common in integrated rural systems.	16.67%	[46]

Table 3.
Traits of the studies included in the meta-analysis.

7.2 Forest plot

Significant heterogeneity values were observed in the forest plot built for intensive animal farming activities carried out in Pakistan. included studies The heterogeneity values of the included studies was (Tau^2 = 0.178, P = <0.001, I^2 of 99.17%), as shown in **Figure 3**.

For analyzing trends in intensive animal farming practices being overtaken in Pakistan, a subgroup analysis was performed based on year. As depicted in **Figure 4**, substantial heterogeneity was seen during the study period.

7.3 Comparison between intensive and extensive animal farming

The animal feeding pattern and milk production system were compared in a study carried out in Sri Lanka where the author concluded that animals reared in the intensive farming system had highest herd size (3.7 animal unit) with better feeding level when compared with extensive farming system (2.7 animal unit). The average milk production under extensive systems was significantly lower (P < 0.01) at 3.9 animal units per day compared to 5.41 animal units per day under the intensive farming system. Livestock farming is an important source of income for peoples of Sri

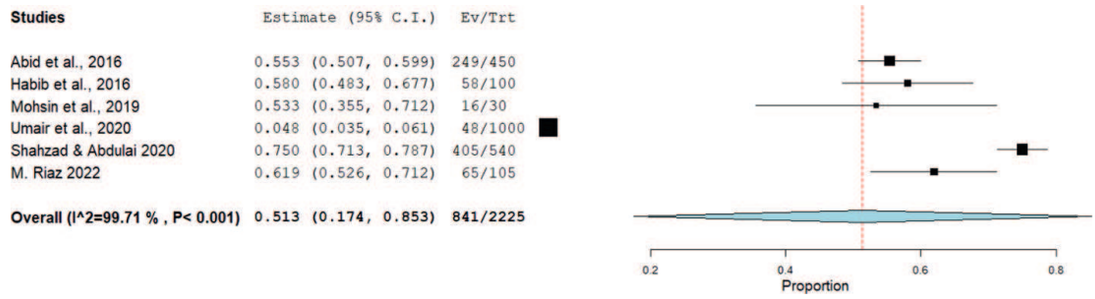

Figure 3.
Forest plot of intensive animal farming and its 95% confidence interval (CI). The pooled prevalence was calculated using a random-effect model. Ev/Trt = No. of VRSA positive isolates/Total no. of samples.

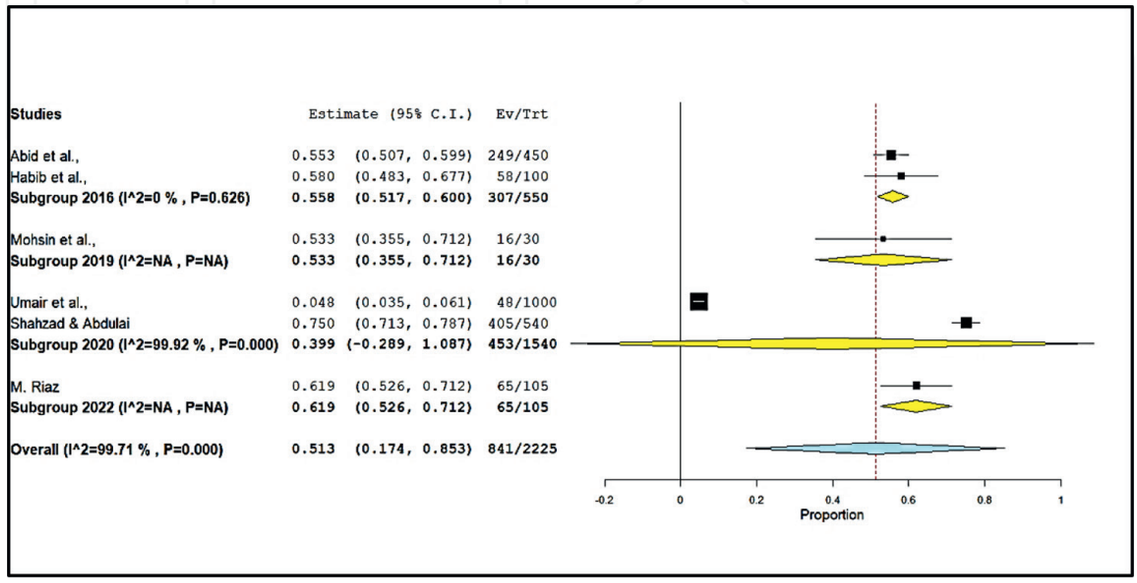

Figure 4.
Subgroup analysis of intensive animal farming carried out in Pakistan in different time periods.

Lanka and dairying under an intensive farming system is proven more profitable than an extensive farming system [47].

In Bangladesh, performance traits of buffalo selected randomly from 14 farms under both intensive and extensive systems were evaluated and it was found that dry milk yield and live weight were considerably higher in the intensive farming system. Reproductive traits were moderately higher under the intensive farming system. Intensive farming system is currently under application in Bangladesh for better milk production [48].

8. Conclusions

Intensive animal farming has both positive and negative impact on the environment and biodiversity depending upon the agricultural production. Intensive animal farming has provided society with marketable goods which can also be exported to foreign countries. The farming output uses market values which are limited because positive and negative outwardness are created along with the product goods and services in the agricultural activities. Therefore, the integrated/comprehensive approach covering market and nonmarket farming system output is required.

Acknowledgements

Replace the entirety of this text with acknowledgments. Usually, the acknowledgments section includes the names of people or institutions who in some way contributed to the work, but do not fit the criteria to be listed as the authors.

Conflict of interest

The authors declare no conflict of interest.

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