Proper hygiene and effective management of livestock as a Panacea for agricultural development and increase in Nigeria’s gross domestic product (GDP): a review

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Abstract

Increased livestock production and better food security will naturally follow from proper livestock management practices. Such management practices include the application of appropriate vaccination schedule, biosecurity, feeding regimen, and implementation and sustenance of improved and feasible livestock policies. In meat production, the abattoir needs to be well equipped for antemortem and postmortem procedures, hygienic processing of carcasses, and packaging, to improve the quality and quantity of meat and meat products. In Nigeria, about 90% of the livestock industry (cattle, sheep and goats) is managed extensively (nomadic management system) or semi-intensively (animals are taken out to graze and are brought home with little or no provision at home). These systems are greatly affected by insufficient grazing reserves, lack of cattle routes, and consequently, by conflicts between the livestock farmers and crop farmers due to invasion of livestock into farms during grazing. During the dry season, livestock animals tend to become emaciated due to insufficient food, which leads to health depreciation due to declined immune status, and decline in meat production and reproduction rate. Diseases possess a great challenge to meat and egg production due to illiteracy and lack of resources for proper management of livestock. In the poultry industry, where most of the meat is produced, typically no or only some biosecurity procedures are in place at the commercial farms. The backyard local poultry are kept without any form of care; they tend to scavenge for their food and are prone to all forms of diseases, parasites and predators. The hygienic status and carcass preparation at Nigeria’s abattoirs is very poor, which affects the meat industry. In general, livestock production in the country is greatly affected by poor management practices, diseases and poor meat processing strategies, which leads to the production of low-quality meat that can easily decompose, and the spread of food-borne and zoonotic diseases. Livestock policies in the country have not produced the desired economic growth due to their inadequate implementation. Also, the oil boom era relegated agriculture to the background from being the major part of the nation’s gross domestic product (GDP). There is need for new strategies and proper implementation of livestock policies — it is recommended to encourage stakeholders to participate and to diversify the industry into manufacturing and not just production. This study was carried out in order to assess state of livestock production, management systems including assessment of livestock policies, and challenges faced by this industry in Nigeria, and to identify the way forward for better livestock production and subsequent increase in the nation’s GDP.

Keywords: Livestock, Gross domestic product, Management practices, Diseases, Nigeria, Food security, Livestock policies

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Introduction

Livestock is one of the major contributors to Nigeria’s gross domestic product (GDP), accounting for one-third of the nation’s agricultural GDP, providing income, employment, food, farm energy, manure, fuel and transport. Livestock is vital to the economies of many developing countries and fulfill many roles for a substantial number of people in these countries. The livestock industry is a major source of government revenue, for example, through taxation and export earnings from hides and skins. Yet, planners and economists often underestimate the contribution of livestock to GDP. The role of livestock as a source of manpower in the northern savanna zone and as a source of organic manure to boost crop production, as well as their efficient utilisation of otherwise unusable plants to produce meat, milk and other products, are often not considered. For low-income producers, livestock can serve as a store of wealth. Enhancing agricultural productivity could contribute to industrial growth by providing capital investment, foreign exchange and markets for manufactured consumer goods [1].

In Nigeria, there are about 15.24 million cattle, 96.67 million goats, 51 million sheep, 6.87 million pigs and 140 million poultry. The livestock subsector (LSS) contributes about 15–20% of Agricultural GDP and 5–6% of the country’s total GDP [2]. While the country has some of the best cattle and associated resources in Africa, international demand for meat has been weakened by poor hygiene and welfare standards [3]. The total value of livestock, based on the mid-1991 market prices, is estimated to be about 60 billion naira – undoubtedly a major national asset and a renewable resource worthy of sustained future development [4].

The poultry sector in Nigeria accounts for about 58% of the total livestock production in the country [5]. The poultry sub-sector offers the quickest returns to investment outlays in livestock enterprise by having a short gestation period, high feed conversion ratio, and by being one of the cheapest, most common and best sources of animal protein in the country [6]. Poultry diseases remain one of the major threats to poultry production in Nigeria. A disease outbreak could result in severe economic losses within a short period of time [7]. In the past decades, there has been a recorded improvement in poultry production in Nigeria with its share of the GDP increasing in absolute terms. The contribution of poultry egg and meat production to the livestock share of the GDP increased from 26% in 1995 to 27% in 1999, with an increase in egg production alone accounting for about 13% [8]. The production contributed approximately 4.5% of the total livestock contribution to the GDP in 2004 [9].

Biosecurity means security from transmission of infectious diseases, parasites and pests [10]. It focuses on maintaining or improving the health status of animals and preventing the introduction of new disease pathogens by assessing all possible risks to animal health [11, 12]. Poultry disease management involves ensuring good hygiene, increasing the standard of cleanliness, and reducing the risk of introducing disease into the flock [13]. Application of standard biosecurity measures is vital for protecting poultry birds from disease [14].

In the 1960s, the agricultural sector provided the main source of employment, income and foreign exchange earnings in Nigeria. This followed from focused regional policies based on commodity comparative advantage [15]. Concerned about the country’s sole dependence on crude oil for its foreign exchange and food importation as a means of achieving food security, the Nigerian government made several forays at policies for the development of the agricultural sector [16]. Since 1980, several interventions, policies and programmes have been executed by different governments to redirect Nigerians to the farms. Examples include the River Basin Development Programme (RBDP), Operation Feed the Nation (OFN), Green Revolution (GR), the Directorate for Food, Roads and Rural Infrastructure (DFRRI) and Agricultural Development Programme (ADP). Regardless of these interventions, Nigeria imports approximately US$3.5 billion in food products annually, leading food imports to grow at an unsustainable annual rate of 11% (http://www.doreopartners.com).

To increase livestock production and ultimately the nation’s GDP, proper hygiene and effective management is very important. Also, the country’s livestock policies need reforms and proper implementation to significantly increase production. There is also a need to diversify the sector and to take a critical look at the manufacturing procedures.

Livestock Management Practices and Challenges in Nigeria

In Nigeria, cattle, sheep and goat production systems are predominantly traditional management systems, such as nomadic/pastoral systems, mixed farming, peri-urban and modern ruminant livestock husbandry. In general, the production and management systems vary from free-range in less populated areas to year-round confinement through the means of ‘cut and carry’ feeding of grass to the animals in densely populated areas [1].
Over 85% of all livestock in the LSS is traditionally managed, meaning that traditional systems dominate the production, processing and marketing of livestock in Nigeria. Most livestock is managed in ways that are low in costs and inputs. Nationally, the more intensively managed commercial sector accounts for 11% of the total chicken population, 3% of the pig population, and <1% of the cattle, sheep and goat populations [4].

In spite of the significance of the poultry industry to the national economy, poultry farms face challenges that make the growth of the industry difficult. Poultry production in general is facing low capital base, inefficient management, diseases and parasite, housing and marketing problems [17]. Diseases remain one of the major threats to boosting poultry production in Nigeria [18]. The major diseases are the Newcastle disease, Avian influenza, fowl pox, infectious bursal disease (IBD), colisepticemia, coccidiosis and worm infestation [19], with Newcastle disease being the most commonly recognized disease by farmers [20].

Over 90% of the cattle and a large proportion of the sheep and goat livestock are managed by nomadic and semi-nomadic pastoralists. Grazing has traditionally been on a communal basis, with no individual possessing the sole right to any grazing land. Pastoralists usually use uncultivated bush, fallow farms, forests and grazing reserves. Grass and water used to be considered free resources available to the livestock that got to them first. However, over the years there has been a progressive deterioration in the symbiotic relationships between farmers and pastoralists, and conflicts between the farmers and pastoralists have become regularly occurring events in the country [21]. Below, we discuss some further problems and challenges of livestock production.

**Land tenure and land use practices**

In Nigeria, land was traditionally held on a collective basis, and was used by communities and individuals on a 'first-come, first-served’ basis. For example, the use of inland valleys (fadama) in Northern Nigeria was not based on ownership, but rather some fadama sites were reserved for pastoralists who would spontaneously settle on them and utilize the available resources. However, increasing pressure on land has decreased the importance of communal rights and enhanced the significance of individual ownership of land [21]. Land tenure remains a major obstacle to livestock development, as herders have no secured individual access or rights to land. Communities and individuals who crop the land often claim ownership of the land. Rather than permanent land tenureship, only a concession to carry out agricultural activities is given to settled pastoralists. Little or no opportunity is available for pastoralists to invest and develop the land for a full return of benefits and expansion [22].

**Inadequacy of the existing grazing land**

In recent years, most of the grazing areas have been influenced by the expansion of farming activities as well as by land speculators and government development interventions. Virtually, all the grazing reserves are poorly developed, with little or no trace of grass on them, principally due to overgrazing and poor management. Consequently, the pastoralists move farther south in search of sources of fodder [21].

**Blockage and reduction in size of stock routes**

Over time, animal droppings on stock routes make the ground fertile, and therefore farmers encroach on the routes. The blockage of local cattle routes leading to watering points and increased activities in the fadama are major sources of conflict between pastoralists and farmers. The release of livestock by settled pastoralists and the arrival of nomadic pastoralists coincide with land preparation and planting periods in fadama lands (November–April). One of the problems the farmers face is how to police the scattered fadama from encroachment by the large influx of livestock to the fadama areas [21].

**Conflicts between farmers and pastoralists**

Conflicts can be violent, sometimes resulting in the death of farmers and pastoralists. Conflicts also generate feelings of insecurity and fear among the farmers and pastoralists when the immigration period arrives. The attendant uncertainty and insecurity have forced many farming families to emigrate from crisis-prone areas and villages [21]. In terms of conflict resolution efforts, the state governments and affected local governments attempt to help the situation by improving grazing reserves, land conservation, environmental protection, other facilities and veterinary and extension services. Nevertheless, while the objectives of the governments are sound, their efforts have not yielded many positive results. Conflicts have continued unabated, bringing insecurity, uncertainty, fear and disruption of production activities [21].

**Nutrition and feed supplies**

The provision of feed that is adequate both in quality and quantity and accessible to animals all year round is the most outstanding problem of livestock production in the tropics. The natural range resources that form the primary source of nutrients have been observed to rapidly increase in nutritive value at the onset of rains and decline shortly thereafter. The state of poor nutritive feed quality often lasts a longer period of the year than the period of forage abundance and high nutritive quality. Supplementation with

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crop residues from cropped farmlands hardly meets the requirements for animal growth. The unavailability of grazing feedstuffs is aggravated by widespread bushfires and the imbalance between the stocking rate and carrying capacity of the range. Overstocking may lead to high incidence of erosion and reduction in the carrying capacity of vast land areas, which are potentially available for high cattle production. Acute shortage of range resources during the dry season usually results in considerable losses in live weight and number of stock. The cyclical occurrence of feed deficit impairs animal growth rate and reproductive performance while prompting movement of stock from one place to another – a phenomenon that can lead to numerous problems including high susceptibility of animals to diseases and pest attacks, and often fatal clashes between herders and farmers [22].

Commercialisation of crop residues
Agro-pastoralists and nomadic and semi-nomadic pastoralists used to have rare access to crop residues, but now they use crop residues intensively. However, nowadays crop residues are treated as economic commodities, which limit herders’ opportunities to use them to meet their dry season pasture requirements [21].

Inadequate breeding programmes
Adoption of haphazard breeding programmes in which indigenous cows are crossbred with bulls by natural or artificial insemination at one time and massive importation of exotic breeds into the tropics at another time, have failed to make any tangible impact – local breeds of cattle have not responded well to improvements in their quantitative traits. It is still not clear whether local breeds of cattle should be categorized as dairy or beef types. They all exhibit dual or triple purpose traits, with productivity far below the expected average. The reproductive performance of cows, which is something important to consider in breeding, is hampered by long calving intervals rooted in poor management and inadequate feeding [22].

Theft of livestock
Stealing herds of livestock is a persistent problem in the Northern part of the country. Armed thieves – who usually come at night and defeat the typically poorly armed farm security guards – remove significant numbers of animals. This is a major setback to pastoralist and livestock farmers.

Disease and pest infestation
In tropical environments, a number of important epizootic diseases of livestock thrive. These diseases are so virulent that they limit production, increase morbidity, and cause widespread death of livestock. However, other diseases of less epizootic nature are presumably increasing in significance, and they may reduce the productivity of the national herd even if they are less virulent. Although much progress has been made in the diagnosis and control of some of these diseases, the increasing populations of vector pests that transmit diseases constitute a major threat to farm animal production in the tropics. For example, the tsetse fly alone, when covering about 75% of the country, reduces the areas with valuable feed resources available by making the areas where they fly present nearly inhabitable for cattle. Other pests of significant economic importance are enteric and helminthic parasites such as coccidia, *Eimeria*, flukes, roundworm, hookworms and ectoparasites (ticks, mange, mites and lice). They cause diarrhoea, loss of appetite, slow growth rate, unthriftness, damages to the skin, and generally debilitating mortality among stock, leading to grave economic losses [22].

Low investment potential
The slow growth rate of livestock industry especially in the tropics denotes a long gestation period for investment to mature. This is contrary to receiving quick returns on investments that financial institutions like banks and investment houses desire. Livestock projects, due to the time it takes to achieve growth and the high uncertainty associated with livestock production, are not as attractive options to investors as services and trades that may return the borrowed funds and interests more quickly. Collaterals and guarantee of substantial value are not easily available for livestock producers to secure sufficient loans in order to improve production even in the few instances where financial institutions are willing to offer support [22].

Institutional problems
Lack of genuine institutional support and political will to improve livestock production cannot be separated from the problems confronted by the industry. Policies are written but never implemented because abrupt changes are introduced, or when policies are implemented there is great difficulty to sustain them. In addition, the fact is that the producers are largely uneducated, conservative and highly mobile, poses another difficulty. Meaningful outreach can rarely accommodate producers who experience hatred, have a nonchalant attitude or are suspicious or reject the innovations that are put in place for adoption [22].

Challenges in abattoirs
Abattoirs tend to have passive disease surveillance and issues with producing quality meat for consumption. The surveillance of disease in the abattoir is of immense
importance to disease control and prevention. When there is proper surveillance in the abattoir, diseased animals will not be slaughtered or taken for granted. However, the hygienic situation in over 90% of Nigeria’s abattoirs is rather unacceptable, as carcasses are prepared in unhygienic conditions leading to easy decay of dressed carcasses [23]. Meanwhile, ante-mortem and post-mortem inspections are rarely carried out. The lairages are either damaged or simply not in use. Most animals are taken into the abattoir on the day they are slaughtered. Diseased and cachexic animals are brought in for slaughter. Cases of bovine tuberculosis, helminthoses and dermatophylosis are common in the abattoir. Meat easily decomposes because of poor meat quality and lack of storage facilities, and there are no meat vans for proper meat transportation to the locations where products are sold [24].

The hygienic state of abattoirs is generally poor, which is often demonstrated by a bad odour in the whole environment. Problems in the abattoir include: lack of compensation to animal owner, inadequate veterinary services, improper documentation (lack of adequate data which is essential in disease prevention), illiteracy (livestock owners and butchers) and peoples’ indifferent attitude. In fact, the whole abattoir system needs to be re-evaluated and re-scheduled if the issue of hygienic meat production is to be considered [24]. Similar problems are encountered in poultry meat production. Only very few of the privately owned abattoirs in Nigeria follow good hygienic standards in meat production.

Economic Losses in the Livestock Industry

Livestock diseases cause major problems in livestock production systems. These problems include lowered animal welfare, productivity losses, uncertain food security, loss of income and negative impact on human health [25]. Diseases reduce the productivity of sick animals resulting in lowered meat, milk and egg production. Diseased animals provide less draught power and poorer-quality food and fibre. In economic terms, outputs decline, costs rise and profits fall [26]. The estimated economic analysis of the annual financial burden of livestock diseases amounted to 29.2 billion naira in Nigeria [27]. Also, in 2009–2011 economic losses to poultry farmers amounted to over 3 billion naira due to IBD alone [28].

Standard Livestock Management Procedures

Standard operating procedures should be carried out in the management and control of disease in the livestock industry for better productivity and for subsequent increase in the quantity and quality of meat and meat products, egg production, and to increase the nation’s GDP. Livestock disease management can reduce disease through improved animal husbandry practices. These include controlled breeding, controlling entry to farm lots, quarantining sick animals, developing and improving antibiotics, vaccines and diagnostic tools and evaluating ethno-therapeutic options and vector control techniques [25]. Other areas that need appropriate attention are feeding and hygiene.

Good reproductive management

Techniques such as artificial insemination and embryo transfer are frequently used today, not only as methods to guarantee that females breed regularly, but also to help in the improvement of herd genetics. This may be done by transplanting embryos from high-quality females into lower-quality surrogate mothers, freeing the higher-quality mother to be re-impregnated. This practice vastly increases the number of offspring which may be produced from a small selection of the best-quality animals. It also improves the ability of the animals to convert feed to meat, milk or fibre more efficiently, and it improves the quality of the final product while decreasing genetic diversity [25].

Livestock vaccination

Veterinary vaccines have had, and will continue to have, a major role in protecting animal health and public health, reducing animal suffering, enabling efficient production of food animals to feed the growing human population, and greatly reducing the need for antibiotics to treat food and companion animals. Vaccines are a cost-effective method to prevent animal diseases, enhance the efficiency of food production, and reduce or prevent transmission of zoonotic and food-borne infections to people. Safe and effective animal vaccines are essential to modern society [29]. Vaccines work by exposing the immune system to antigens from a specific pathogen, tricking the body into thinking that it has encountered the actual pathogen. Exposure to an antigen stimulates an immune response, which creates memory cells for that pathogen without causing the negative effects of an actual first infection. Most vaccines are either modified live vaccines (ML) or killed vaccines. The ML contains live microbes that have been modified so that they have the antigen components of the disease-causing agent but do not cause disease; killed vaccines contain antigen components or pieces of the disease-causing agent [30].

Reasons for vaccine failure

The most common reason vaccinated animals get sick is because they fail to fully respond to vaccination. Procedures to maximize immune response include following label directions for timing, route of administration, and proper vaccine handling, and minimizing stress that can suppress immune function. Some vaccines, especially MLs, must be handled very carefully. Exposure to heat and sunlight, or being mixed too long prior to use can reduce a vaccine’s effectiveness.
effectiveness. All vaccines must be kept cool, even while the vaccine is in the syringe. Nevertheless, even when everything is done correctly, some animals fail to mount a sufficient immune response to create immunity to the disease. Factors contributing to this failure are poor nutrition (including micro- and macro-mineral imbalance or deficiency), congenital immunodeficiency and poor overall health [30, 31]. For younger animals there are blocking maternal antibodies (from colostrum) present that interfere with the ability of the animal to build immunity. This is the result of vaccinating animals that are too young, and label directions should be adhered to [30]. While it does not provide perfect protection, vaccination is the most effective tool available to prepare an animal’s immune system to respond to disease challenges. A sound vaccination programme developed with the veterinarian and carried out using proper timing and technique is critically important to maintaining the health and profitability of the herd [30].

Importance of vaccines

Safe and efficient food production. Veterinary vaccines are used in livestock and poultry to maintain animal health and to improve overall production. More efficient animal production and better access to high-quality protein are essential to feed the growing population [29].

Control of zoonotic diseases. Vaccines to control zoonotic diseases in food animals, companion animals and even wildlife have had a major impact on reducing the incidence of zoonotic diseases in people [29].

Control of emerging and exotic diseases of animals and people. Emerging and exotic animal diseases are a growing threat to human and animal health and jeopardize food security. Increases in human and animal populations, with accompanying environmental degradation and globalized trade and travel, enhance opportunities for transfer of pathogens within and between species [29].

Reduction of the need for antibiotics. Veterinary vaccines reduce the need for antibiotics to treat infections in food producing and companion animals. There are increasing concerns related to antibiotic resistance associated with the extensive use of antibiotics in veterinary and human medicine [32].

Food safety vaccines. Recently, vaccines have been developed to reduce the shedding of organisms that cause food-borne diseases in people. Vaccines for Escherichia coli – O157:H7 in cattle and Salmonella enteritidis in chickens – are available. These vaccines do not typically improve the health of the vaccinated animal, but they reduce the shedding of pathogens that may contaminate animal products for human consumption [29].

Immunooncontraception and immunocastration. Immunoneutering vaccines against sperm, egg antigens and the hormones of pregnancy have been developed and may form the basis of immunological contraceptives in the future [33]. Immunisation through the use of baited vaccines has already been used as a strategy for the control of rabies in wild animal reservoirs [34], and potentially, a similar strategy could be used for controlling the population of so-called ‘pest’ species. The possibility of preventing testis development through vaccination has been investigated. This can be done either by treating males with exogenous hormones that down-regulate the hypothalamic/pituitary/gonadal axis or by neutralizing these hormones with specific antibodies. Very few measurements of the welfare of treated animals have been carried out, but the behaviour of immunized male pigs was found to be similar to that of surgically castrated ones [35], who show reduced aggressive and mounting behaviours and increased feeding behaviour, compared with entire males. As well as on farms, vaccination can be used to manipulate the sexual activities of animals, and thus control populations, in other animal facilities such as animal sanctuaries, zoos and wildlife parks, and such interventions should improve the welfare of the animals [33].

Prevention of mass slaughter for disease control. For some diseases the policy has been to stamp out an infection on farms through the mass killing of animals. Vaccination of animals with appropriate measures to differentiate vaccinated animals from infected animals is a useful adjunct, even a viable alternative to mass killing [33].

Preservation of healthy environment. The use of vaccines includes the preservation of a healthy environment and fostering of economical livestock rearing, for food and recreation [36].

Chemoprophylaxis and chemotherapy

Chemoprophylaxis is relevant in livestock production for disease prevention, for example, the administration of anticoccidial drugs to poultry is essential in commercial poultry production. Also, in livestock production, there is need for proper medication in the prevention and treatment of diseases. Diseases such as helminthoses, ascariasis, babesiosis and parasitic infections can be effectively managed with drug administration. In general, the use of chemoprophylaxis and chemotherapy is essential in the effective management and increase in livestock production.

Biosecurity measures

Prevention is the most cost-effective way of managing disease, and it still remains the best approach towards maintaining healthy livestock and increased revenue. The following practices aid in disease prevention: selecting a well-known reliable source from which to purchase animals
and one that can supply healthy stock; monitoring new animals for disease before introducing them into the main flock, especially in intensive management farming systems; and carrying out wildlife and vector control to reduce the spread of diseases such as cowdriosis and babesiosis transmitted by ticks. Biosecurity encompasses a variety of activities on the farm: management of visitors, traffic control, employee training, management of replacement animals, technical services, storage and handling of feedstuffs, rendering practices and manure management, all impact biosecurity. Because of the vast array of potential threats, a Biosecurity Resource Group should be considered. The group should include operation supervisors, a veterinarian, a nutritionist, an extension specialist, and others who may have specific expertise. This group can work to fit a biosecurity management plan to livestock operation [37]. Biosecurity is classified into three major sections which are isolation, traffic control and sanitation.

**Isolation**

The most important step in disease control is limiting contact, co-mingling and movement of livestock. This issue is of special importance for new animals arriving on the farm, including replacement animals, breeding animals, or animals returning from livestock shows. Even co-mingling between established groups of livestock on the farm should be minimized. An important biosecurity option on ranches is to separate livestock by age and/or production groups. Isolation of animals can be particularly difficult during natural disasters because of damage to facilities and/or perimeter fences or lack of feed resources. It is important to isolate sick animals, especially animals with unfamiliar symptoms or those with symptoms that do not improve with usual treatment [37, 38].

**Traffic control**

Traffic control includes traffic onto an operation and traffic patterns within an operation. Traffic includes more than vehicles; all animals and people must be considered [38]. It is important to consider points where disease could enter the farm, and how it could spread. Traffic control within the operation should be designed to stop or minimize contamination of animals, feed and equipment. It is also important to restrict visitors to places where they need to be and limit visitors’ access to barns and lots. Posting a warning sign asking visitors to keep out and giving instructions or a telephone number to call instead of entering the operation is recommended, as well as keeping a record of all visitors that enter the premises. Consideration should be given to a visitor’s previous stops as both the people and their transportation are potential contaminants. Also, foreign visitors should be given careful consideration and footwear, clothing and other products from foreign countries should be banned. People who have travelled outside the country should be denied access to a farm for a minimum of 14 days to control accidental introduction of foreign animal diseases. Disposable boot covers may be a better option than footbaths to contain contamination from soil and manure. Other animal traffic concerns include pets, dogs, cats, horses, wildlife, rodents and birds. Traffic control within the operation should be designed to stop or minimize contamination of livestock, feed, feed handling equipment and equipment used on animals [37].

**Sanitation**

The sanitation component of biosecurity addresses the disinfection of people, equipment, animals and material entering the farm, and the maintained cleanliness of people and equipment [37, 38]. It is good practice to avoid using common syringes and needles for vaccination, blood testing or administering animal health product, and to be vigilant when working with sick animals, i.e. it is better to move from healthy to sick animals during the day, never vice versa. An important objective of sanitation is to prevent faecal contaminates from being ingested by livestock. The use of separate equipment for feed handling and manure and dead animal removal is optimal. If the same equipment is utilized for manure and feed handling, performing thorough cleaning and disinfection is necessary. Additionally, loaning of equipment or trailers presents another opportunity for pathogen introduction to the farm. Cleaning of facilities and equipment between groups of livestock during processing is a good management practice to reduce pathogen transmission [37].

**Biosecurity management practices**

Key farm biosecurity management practices prevent or reduce the below hazards to acceptable levels.

**Biological hazards:** There should be a plan for controlling risk from viruses, bacteria, parasites and other contaminants. These controls must be considered from the following standpoints: introduction to the farm, exposure and spread within the herd, general and specific measures for immunization, and minimizing the risk of export to other farms [38].

**Chemical hazards:** There should be a plan for handling and storage of pesticides, herbicides, feed additives, drugs, medicines and any potentially toxic materials for chemical usage, and staff should have appropriate training on safe chemicals use [38]. Application diary should be kept for livestock, pastures and crops, adherence to withholding periods (WHPs) and export slaughter intervals. Setting a livestock treatment schedule, record treatment dates and WHPs is also recommended [39].

**Physical hazards:** There should be a plan for animal handling and treatment to minimize trauma and maximize comfort and care. This includes ventilation, traffic flow, housing facilities and animal handling equipment [38].

**Disease transmission routes**

In order to perform the risk assessment and formulate biosecurity/biological risk management (BRM) plans, it is important to know how diseases are introduced
and spread. Disease agents can be spread from animal to animal, or from animal to human and vice versa, through a variety of transmission routes. Biosecurity/BRM considers five main routes: aerosol, direct contact, fomite, oral and vector-borne. The sixth route, zoonotic, can spread from animals to humans through one of the five previously listed routes. Many infectious agents can be transmitted by more than one route of infection [37].

**Aerosol transmission**

Aerosol transmission occurs when disease agents contained in droplets are passed through the air from one animal to another or from an animal to a human and vice versa. Most pathogenic agents do not survive for extended periods of time within the aerosol droplets, and as a result, close proximity of infected and susceptible animals is required for disease transmission [37].

**Direct contact**

Transmission by direct contact requires the presence of an agent or organism in the environment or within an infected animal. A susceptible animal becomes exposed when the agent directly touches open wounds, mucous membranes, or the skin through blood, saliva, nose to nose contact, rubbing or biting. It is important to note that depending on the disease agent, it is possible for direct contact transmission to occur between animals of different species including humans. For the purposes of the BRM information, reproductive transmission will encompass those diseases spread through venereal (breeding) and in utero routes (dam to offspring during gestation) [37].

**Fomite transmission**

A fomite is an inanimate object that can carry disease agents from one susceptible animal to another. Examples of fomites include contaminated brushes, clippers, needles, balling guns, clothing, milking units, teat dip cups, feed or water buckets and shovels. Traffic transmission is another special type of fomite transmission in which a vehicle, trailer or human spreads organic material to another location [37].

**Vector-borne transmission**

Vector-borne transmission occurs when an invertebrate acquires a pathogen from one animal and transmits it to another. Fleas, ticks and mosquitoes are common biological vectors of disease, and flies and cockroaches are common mechanical vectors [37].

**Oral transmission**

Pathogenic agents can also be transmitted to animals or humans orally through consumption of contaminated feed, water or licking/chewing on contaminated environmental objects. Feed and water contaminated with faeces, urine or saliva are frequently the cause of oral transmission of disease agents. However, feed and water can also be contaminated with other infectious agents [37].

**Environmental contamination**

Many disease agents can survive for extended periods of time in soil or other organic materials like bedding and old feed. Animals or humans can then acquire the disease agent as discussed in previous sections: from the environment through inhalation of aerosolized microbes, via oral consumption, or from direct contact with an animal or fomites. Therefore, environmental contamination should not be ignored but studied. The routes the disease agent uses to get into the animal can be controlled if the animal’s environment is controlled. It is important to remember that disease transmission can occur without animals exhibiting obvious signs of disease. That is why awareness of the various routes of transmission becomes so essential when assessing and developing a strategy to minimize the risk of disease for a facility or operation [37].

**Livestock enterprise security**

The other important aspect of biosecurity is the protection of the livestock enterprise from external threats or pressures whose goals are to prevent or stop the livestock enterprise. The reasons associated with the threat could include the desire to alter management practices, free the animals, destroy facilities and equipment, stop modern agriculture practices or ultimately to bring harm to individuals associated with agriculture enterprises. Agroterrorism refers to actions that are targeted against agriculture-associated industries with the intent to cause harm [37].

**Personnel**

Along with the implementation of basic biosecurity practices, additional employee screening and training is important. Careful selection, background checks and monitoring of new employees is crucial. There would be no easier way to bring a potential threat onto the livestock enterprise than through directly employing someone whose intent is to harm the enterprise. Likewise, adequate employee training is essential. Livestock enterprise employees are expected to be observant of their workplace and environment. Employees should be encouraged to adopt the philosophy that if a situation does not look right, they should question it. Owners, managers, and employees are the ones best suited to make judgments if a situation does not appear as it should or if things have been tampered or altered. Discovery and mitigation of a potential biological risk starts at the livestock enterprise — those associated with the farm are the first responders. The people and employees of the livestock enterprise are the first in line of active defence against mitigation of biological threats. Proper training in situation assessment and situation response is an extremely important aspect of employee training [37].

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Situation assessment
Situation assessment should evaluate the livestock enterprise from an outside perspective. The goal is to determine where the enterprise is vulnerable. The list below is just a place to start in order to aid assessment.

- What type of perimeter enclosure is utilized?
- What level of access can someone gain to the enterprise?
- Are control points for human and animal traffic established?
- Is there a policy for control of visitors?
- What level of access is there to chemicals and feed resources?
- Does regular inventory of animals, chemicals, machinery, etc. take place?

Once a situation assessment has been made, security measures should be put in place. Vigilant adherence to the BRM strategies and security measures must be maintained. The time and resources invested in making a plan will be wasted if that plan is not fully followed, maintained and regularly reviewed [37].

Communication

Finally, direct and effective cooperation with the local law enforcement is crucial. It is recommended to invite a law enforcement representative to help develop the enterprise security plan. Familiarity with how a livestock enterprise functions and its personnel will be important should local law enforcement ever need to respond to a situation. The first time to contact law enforcement should not be when the livestock enterprise is in crisis [37].

Importance of BRM plan

The BRM plan is useful for the following reasons: to prevent economic loss caused by production losses or premature animal depopulation; prevent theft of livestock, machinery, tools and equipment; protect the 'wholesome' image of the food animal livestock producers sell and to protect 'market access' of the products; prevent or minimize an interruption in cash flow or equity and change the attitude of ranchers/owners/employees to be aware of suspicious activities and suspicious people, and to 'harden' their operation so that their ranch would be a difficult target for people that would do them harm [37].

Biosecurity: best management practices

Best management practices for biosecurity should be able to fulfil the aspects listed below [37].

- Regularly evaluate activities management practices on the operation to assess the potential for biosecurity threats; it is recommended to be vigilant for signs of disease (coughing, weight loss, runny nose and eyes, difficulty breathing, abortions, stillbirths, etc.).
- Know and understand the warning signs of exotic diseases/foreign animal diseases.
- Minimize access routes onto the operation to control unauthorized vehicular and personnel traffic.
- Minimize unnecessary visitors to the operation as they can unknowingly distribute pathogens.
- Wash trucks and equipment to reduce contamination from outside sources and increase sanitation between uses.
- Report unexplained death, loss or illness affecting a high percentage of the herd.
- Quarantine new animals for a minimum of 3 weeks before introducing them into the herd.
- Ask feed suppliers about feed quality assurance programmes to verify ingredients and prevent introduction of prohibited feed sources.
- Consider using footbaths or plastic boot covers and hand washing stations to reduce contamination and improve sanitation.
- Not use feed equipment for manure handling because of likely faecal contamination.
- Dispose of dead animals properly to eliminate pathogen exposure of healthy animals.
- Control populations of rodents, birds and insects to prevent transmission of diseases and reduce feed spoilage.

Benefits of biosecurity

The benefits of implementing on-farm biosecurity practices are significant. For producers, these practices include: improving animal health and welfare; keeping out new diseases; cutting the cost of disease prevention and treatment; reducing the use of medication, such as antibiotics, with an associated reduction in the risk of emergence of resistant pathogens; producing safe, wholesome and high-quality products; increasing consumer and buyer confidence; protecting human health; minimizing the potential for farm income losses; enhancing the value of the herd; and maintaining and accessing new markets for genetics [40].

Trends in Nigeria's Agricultural GDP (1960–2012)

In spite of Nigeria’s rich agricultural resource endowment, there has been a gradual decline in agriculture’s contributions to the nation’s economy [41, 42]. This can be observed from the figures demonstrating how much agriculture contributed to the nation’s GDP and from the rising value of food import [43]. The contribution of the agricultural sector to Nigeria’s GDP has varied in the past decades. In 1960–1964 it was 61.65%, 1965–1969: 53.27%, 1970–1974: 39.69%, 1975–1979: 23.8%, 1980–1984: 31.3%, 1985–1989: 38.12%, 1990–1994: 32.55%,

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spending on agriculture in Nigeria during 2001-1999: 34.32%, 2000-2004: 37.05%, 2005-2009: 33.5% [43], and in 2010-2012 the sector’s proportion of the GDP was 37.02% [44]. Based on these figures, it seems that throughout the 1960s, agriculture was the main source of livelihood and income in the country, and since 1970 there has been a fluctuating decline in the sector’s proportion of the GDP, the lowest proportion being 23.8% (1975-1979). This may reflect the oil boom era the nation experienced, during which the government paid more attention to crude oil processing than agriculture. Nigeria has witnessed strong economic growth in the past few years, averaging 8.8% real annual GDP growth from 2000 to 2007. However, the agriculture sector has lagged behind GDP growth, growing at 3.7% in 2007. Reviewing the production and postharvest constraints affecting agricultural productivity in Nigeria is an important step in formulating policies to reverse these trends in the future [45].

In Nigeria, the livestock industry accounts for about 5% of national GDP and 20% of agricultural GDP [3]. The poultry sector accounts for about 58% of the total livestock production in Nigeria [5], indicating that poultry is the major source of livestock production in the country. Therefore, more attention should be paid to the development of the poultry sector.

International Food Policy Research Institute [46] carried out a study using empirical analysis to find out the public spending on agriculture in Nigeria during 2001-2005. The findings revealed that public spending on agriculture was exceedingly low. Less than 2% of total federal expenditure was allotted to agriculture, which was much lower than what was spent on other key sectors such as education, health and water. This spending contrasts dramatically with the sector’s importance in the Nigerian economy and the policy emphasis on diversifying away from oil. The amount of spending also falls well below the 10% goal set by African leaders in the 2003 Maputo agreement. Nigeria falls far behind in agricultural expenditure by international standards, even when accounting for the relationship between agricultural expenditures and national income. The spending is highly concentrated in a few areas. There is an urgent need to improve internal systems for tracking, recording and disseminating information about public spending in the agriculture sector [47].

Gradually the nation has come to realize that crude oil alone as a natural resource cannot sustain the needs of the nation with a growing population that is currently about 160 million people. Awareness of the need to revisit and remodel the agricultural sector has led the government to the agricultural transformation agenda (ATA) which is set to improve agriculture as well as livestock production in the country. In 2011, the Federal Government of Nigeria (FGN) came up with the Transformation Agenda identifying seven sectors of the economy as the main growth drivers during the transformation period (2011-2015), including agriculture, water resources, solid minerals, manufacturing, oil and gas, trade and commerce, as well as culture and tourism. The decision was prompted by the fact that the performance of these sectors had been constrained by several challenges including low productivity, low level of private sector investment, non-competitiveness, inadequate funding, shortage of skilled manpower, low investment in research and development, poor development of value chain, low value addition, poor regulatory environment, poor quality of goods and services, poor state of physical infrastructure, policy instability and discontinuity, low level of technology, paucity and poor flow of information and high cost of doing business [48]. The government thus assumed a baseline GDP growth rate of 11.7% per annum within the period, which will translate to real and nominal GDP of about N428.6 billion and N732.3 trillion, respectively, at the end of the programme period [44].

A study conducted by Ahungwa et al. [44], examined different trends in how agriculture has contributed to the nation’s GDP within during 1960-2012 (53 years) using time series data emanating from National Bureau of Statistic (NBS), Central Bank of Nigeria, National Planning Commission (NPC) and CIA Fact book. The results showed that the share of agriculture to the total GDP had a downward trend, while maintaining a clear dominance over other sectors in 1960-1975. Further analysis depicted an undulating trend, intertwining with the industrial sector in 1976-1989. The regression results showed that agriculture has a positive relationship with GDP and contributes significantly to it with a coefficient of 0.664, implying that a percentage increase in the contribution of agriculture can increase the GDP by 66.4% which is higher than in any other sector. This cumulative effect of agriculture on GDP clearly affirmed the dominance of the sector’s contribution to the GDP of Nigeria. Therefore, the study recommended that the government should create an enabling environment by increasing the budgetary allocation and a friendly policies framework in order to support a strong and efficient agricultural sector that can accelerate the attainment of Nigeria’s goal of achieving the targeted growth rate and the proposed vision of becoming one of the 20 leading world economies by the year 2020 [44].

Livestock Policies in Nigeria

The LSS has always been an important component of the Nigerian economy. Despite the importance of the sub-sector growth in livestock output has been slow. In the face of constraints posed by disease and ecological problems, government policies have not been totally successful in introducing or encouraging the development of basic technological and institutional changes necessary to exploit the potential that exists for an efficient growth of the LSS [49].

Historical survey of government objectives and policies towards the LSS

A review of government objectives and policies for the LSS in Nigeria can be conveniently divided into five periods: the...
colonial period preceding independence in 1960, the immediate post-independence period up to the end of the Sahelian drought in 1974, the oil-boom period in 1975–1985, the period since 1986 marking the commencement of the structural adjustment programme [49], and currently, the period of ATA.

The colonial era

Initial colonial objectives with respect to the LSS were not explicitly stated, but the commitment to expand exports of livestock products had emerged prior to World War II. Early documents (cited in [50]) indicated that schemes for the collection of fresh milk from the Fulanis for cream separation and processing into clarified butter fat (CBF) for export began in the late 1920s in Northern Nigeria. Exports of CBF rose from 10 t in 1933 to 2400 t in 1939 [50]. The early 1940s also witnessed the establishment of dairy herds and milk processing plants in Vom and Agege to meet expatriate population demand in Jos and Lagos [51].

The colonial government objectives were primarily implemented through a policy of investment in both physical infrastructure and basic research. By 1950 an extensive internal rail and road network system had been completed. A number of Livestock Improvement and Breeding Centres (LIBCs) were established in different parts of the country in the late 1940s and early 1950s to carry out cross-breeding experiments – primarily to achieve increased milk production – using exotic bulls and artificial insemination [52]. However, most of the schemes embarked upon during this period were oriented towards ranching and thus had little impact on smallholder or pastoral systems. Furthermore, attention appears to have been focused mainly on cattle, particularly dairy production, to the exclusion of other livestock species [49].

The immediate post-independence period (1960–1974)

The onset of independence saw both a continuation and a shift in livestock development policy in Nigeria. On the one hand, some of the programmes initiated during the colonial period, such as the tsetse eradication and livestock breeding programmes, were continued. On the other hand, driven by a desire to improve the rate of growth of the economy and to achieve a more equitable distribution of income, the new regional governments initiated a number of programmes in an attempt to improve smallholder and pastoral systems. Thus in 1962, a supplementary feed programme aimed at introducing concentrate feeding to cattle in order to reduce seasonal weight losses was introduced in northern Nigeria. The scheme was also viewed as an attempt to encourage settlement among the nomadic pastoralists. The supplementary ration, the cost of which was subsidized, took the form of equal parts of groundnut cake and cottonseed cake plus 2% common salt and mineral licks [52]. Although the response of the pastoralists was favourable, the scheme did not have the desired impact due to inadequate supply and untimely distribution of the supplements [49].

In 1965, grazing reserves were introduced into the same region to protect the traditional grazing lands from crop farming, to secure a year-round source of fodder for ruminants and to encourage the settlement of pastoral nomads [53]. In the south-west, a smallholder steers fattening scheme was introduced in the early 1960s. Using semi-intensive management systems, participating farmers fattened trypanotolerant steers for supply to slaughter houses in the adjoining urban areas. The scheme proved successful and the experience led to the establishment of a Smallholder Fattening Scheme in 1979 as a component of the World Bank assisted First Livestock Development Project [52]. Aside the regional programmes, trade and production investment policies were also emphasized during this period. Trade policy towards the LSS initially took the form of import duty. In 1960, imported meat, butter and cheese carried a 20% duty rate. Within the next 5 years, tariff rates rose quickly, ranging from 35% for butter and cheese to 66.7% for meat. The 1961 budget speech provided a justification for what was to become the future direction of trade policy by claiming that increases were imposed upon goods consumed by the better-off sections of the community. The statement added that ‘one could reasonably maintain that imported meat, butter ... constitute indispensable or significant items in the family budget of the low-income groups which form the bulk of our population’ [54]. Thus, tariff increases were imposed to serve as an indirect consumption tax and raise revenue for the government.

The civil war of 1967–1970 brought a new dimension to trade policy. The dominant consideration during the war was the balance of payments position. A significant departure from the past was the introduction and liberal use of quantitative restrictions. Thus, between 1965 and 1970, importation of meat was controlled largely through import licensing. Freer trade did not resume at the end of the civil war. In fact, between 1971 and 1973, the use of quantitative import restrictions assumed greater importance as import bans were introduced to cover such products as beef and poultry meat. These measures provided an implicit protection for domestic livestock producers. During this period, the government attempted to provide a parallel production and marketing system. The Nigerian Livestock and Meat Authority (NLMA) was established in 1971 by the Federal Government, to do, for example, the following: to operate abattoirs, cattle farms and wholesale meat markets; to manufacture animal feeds; to trade in livestock and hides and skins; to control and regulate the interstate activities of traders in livestock and livestock products; and to carry on any business connected to the livestock industry. For most of this period, investment in direct production was a major policy instrument. Intensive feedlot fattening for beef, based on high intakes of molasses with supplementary feeding of cottonseed and restricted grazing, was started in 1972 at the Mokwa cattle ranch owned by the NLMA [52]. Bilateral assistance was initially provided by the Federal Republic of Germany. A significant development was the introduction

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of sugarcane molasses from the Bacita Sugar Factory. Under the scheme, local bulls and steers (mainly Sokoto Gudalis and Bunajis) were purchased as yearlings with average weights of 200–240 kg. Over a 3-month fattening period, the animals averaged 300 kg live weight. The dressed carcasses were sold through government-owned cold stores. Although the scheme was initially successful, the backward linkage with the sugar factory proved difficult to maintain and coupled with management problems at the ranch, only about 15,000 animals were fattened between 1972 and 1978 [55]. Just like during the colonial period, it appears that little attention was paid to the other animal species, apart from cattle, during this period [49].

The oil-boom period (1975–1985)

Policies instituted in the immediate post-independence period were largely continued in the 1975–1985 period. The basic economic objective remained to be income growth with some new concern for increased animal protein intake. The rise in government revenue as a result of the oil boom initially led to a relaxation of livestock trade policy. Between 1974 and 1977, quantitative import restrictions were removed and tariff rates were reduced such that, once again, customs duties on most livestock products fell in the range of 10–30% [49].

The trade liberalisation policy was, however, short-lived. With the sudden downturn in the world oil market between 1978 and mid-1979, customs tariffs were revised upwards and quantitative import restrictions were reimposed. Import prohibition orders covered fresh milk, eggs and live poultry, while frozen or chilled meat came under import licensing. These measures served to raise the domestic prices of imported livestock products well above world prices. Although the 1983 budget speech reiterated the ‘determination to make Nigeria self-sufficient in food production’ and thus provided a further justification for the trade restrictions, it is now well understood that those responsible for trade restrictions together with those who had access to import licenses and foreign exchange allocations were able to gain from the rents implied by the price differential between domestic and world prices. Thus, following Collier [56], a reasonable inference is that rent-seeking was at least partly responsible for the restriction of imports of livestock products [49].

In addition to the direct effects of trade policy on the availability of livestock products, there were also important indirect effects operating through the government’s exchange rate policy [49]. Oyejide [57] estimated that between 1973 and 1980, the real exchange rate appreciated by 61%, partly as a result of massive capital inflows associated with the oil boom and partly due to government’s failure to depreciate the naira to reflect Nigeria’s relatively high inflation rate. The overvalued exchange rate was sustained by periodic import restrictions and exchange control regulations. As noted earlier, short-term variations in quantitative import restrictions caused price instability for several livestock products [49]. Meanwhile, previously introduced investment and technical policies were continued. The Nigerian Livestock Production Company (NLPC) was established in 1976 to provide credit and technical services for the development of the Mokwa and Manchok fattening ranches. Following the dissolution of the Nigerian Livestock and Meat Authority in 1979, the NLPC was reorganized and enlarged to take over the former’s functions [49].

Various dairy processing plants were also set up as part of the government’s strategy to encourage the domestic dairy industry. Among these were Madara Limited in Vom, Nigeria Dairy Company in Kaduna and Minna Dairy Plant in Minna. All were established with daily capacities in excess of 20,000 l of fresh milk, some of which was to come from associated government dairy farms and the rest from local collection from surrounding farmers. However, inadequate prices offered by the plants made local milk collection difficult and the plants resorted to basing their production activities on reconstituting imported powdered milk [52, 58].

Institutional policies involving land and credit were introduced during this period. The 1978 Land Tenure Decree vested all rural land not under active exploitation in state governors. Although an official title to land (i.e., certificate of occupancy) can be obtained through this decree, the process is both time consuming and expensive and, thus, out of the reach of most pasto-ralists. Further, it has been argued that the decree with its recommended high levels for land compensation has militated against land acquisition for the establishment of new grazing reserves [59]. The Agricultural Credit Guarantee Scheme (ACGS) was also introduced in 1978. The scheme was established to guarantee loans granted by commercial and merchant banks for agricultural purposes. The lending, however, has been lopsided and has tended to favour mostly the modern poultry sector. Loan guarantee statistics showed that between the inception of the scheme in 1978 and 1986, total guaranteed loans amounted to N316.86 million. Out of this total, N173.90 million or 54.9% went to livestock and out of the livestock loans, N149.04 million or 85.7% went to poultry production. Commercial banks were willing to lend for poultry projects not because such projects were intrinsically more profitable, but due to the short interval between loan advance and repayment. The scheme also appeared to have catered mainly for the large commercial poultry producers [49].

The period from 1986 (post oil boom era)

The Structural Adjustment Programme (SAP) initiated in September 1986 has brought about a variety of sectoral reforms in the Nigerian economy. As it affects the LSS, it involves a reduction in the role of the state in production activities with a corresponding emphasis on using the private sector as an instrument for production and input supply. It has led to the scrapping of the NLPC and its subsidiaries. Following the massive devaluation of the naira from around parity with the US dollar to the rate of
4.6 naira to the dollar in September 1986, prices of imported livestock products, particularly dairy products, rose substantially [49]. In general, the new programme has not led to freer trade. When the programme started the ad valorem duty on imported meat was 30%. Since early 1988, a ban on imports of fresh, chilled or frozen meat has been applied to protect domestic producers. For live animals, except poultry, import duty rose to 20% in 1986 from the 15% duty applied in 1984. However, since most live animals are trekked across the border from neighbouring countries, the herders avoid official crossing posts and the animals are therefore, not directly affected by these tariff rates. Live poultry imports were banned in 1986, except for foundation and grandparent stock used for research or multiplication purposes. Increased interest rates since 1987 have also limited the number of livestock producers applying for loans from commercial banks [49].

The Nigeria ATA Nigeria’s investment in agriculture is exceptionally low averaging approximately 2% of government expenditure [48]. The ATA was designed for the following purposes: to establish a Federal Department of Agricultural Extension (FDAE) which will oversee, monitor and provide the leadership needed for an efficient and effective agricultural extension and advisory service delivery in Nigeria; review the agricultural extension policies within the subsisting agricultural policies and recommend appropriate policies, which will ensure the effective participation of all stakeholders in a stable policy environment and adequate funding for the delivery efficient and effective agricultural extension and advisory services; recommend appropriate institutional structures and arrangements for the delivery of effective and efficient multi-plural agricultural extension and advisory services in Nigeria, using the value chain approach; and recommend demand-responsive extension systems/ approaches and tools that will ensure the delivery of efficient and effective agricultural extension and advisory services for all the multi-actors in the targeted commodity value chains of interest to government [60]. So far, the ATA has raised the agricultural GDP. It is hoped that the programme will be sustained and will lead to subsequent increase in the GDP of the LSS.

Analysis of livestock production by time period

The statistics of livestock production index in Nigeria

The statistics of livestock production index in Nigeria by time periods are presented in Tables 1 and 2. As shown in the Tables, the mean of real output of livestock was highest for the 1999–2005 post-SAP period and lowest during the 1970–1985 pre-SAP periods. The mean output for the entire period (1970–2005) was 4.37% higher than the 1990 level. During the SAP era (1986–1998) the mean of real output was higher the 1990 base year by 19.36% but slightly lower than the real output during the post-SAP era of democratic rule in Nigeria (1999–2005). The higher index recorded during the 1986–1998 period was mainly accounted for by the post-1990 real output level. The average real output of livestock for the 1986–1998 periods was 16.25% lower than the 1990 base year level while the 1991–1998 showed an average 8.71% increase over the 1990 base year index [61].

Table 1 Test of significance of mean livestock production between different periods and entire period

<table>
<thead>
<tr>
<th>Period</th>
<th>Mean (1990 = 100)</th>
<th>Std. dev.</th>
<th>Mean difference</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970–1985</td>
<td>55.89</td>
<td>13.02</td>
<td>48.48***</td>
<td>4.89</td>
</tr>
<tr>
<td>1970–2005</td>
<td>104.37</td>
<td>56.13</td>
<td>187.34</td>
<td>3.71</td>
</tr>
<tr>
<td>1999–2005</td>
<td>187.34</td>
<td>39.78</td>
<td>82.97***</td>
<td>3.71</td>
</tr>
</tbody>
</table>

***Significant at 1%; **Significant at 5%; *Significant at 10%; NS, not significant.

Source: [61].

Table 2 Test of significance of mean livestock production between different periods

<table>
<thead>
<tr>
<th>Period</th>
<th>Mean (1990 = 100)</th>
<th>Std. dev.</th>
<th>Mean difference</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970–1985</td>
<td>55.89</td>
<td>13.03</td>
<td>63.47***</td>
<td>7.50</td>
</tr>
<tr>
<td>1999–2005</td>
<td>187.34</td>
<td>39.78</td>
<td>87.98***</td>
<td>4.46</td>
</tr>
</tbody>
</table>

***Significant at 1%; **Significant at 5%; *Significant at 10%. Source: [61].

The results tend to suggest that there has been a progressively increasing trend in livestock production [61].

Estimated trend equations

The estimated trend equations for livestock for selected study periods are presented in Table 3. The coefficient of the time trend is positive for all four periods. However, whereas the coefficient is highly significant for the 1986–1998, 1999–2005 and the 1970–2005 (aggregated) periods, indicating significant increases (or growth), it is statistically non-significant for the 1970–1985 pre-regulation period, indicating sameness in output. Table 3 reveals further that
the coefficient of determination is high ($r^2 > 0.85$) and significant ($P < 0.01$) during the three periods of significant growth in output [61].

**Compound growth rate in livestock output**

The calculated annual compound growth rates are presented in Table 4 for four study periods. The table shows that the compound growth rate in livestock output was <1%, which is not significant, during the 1970–1985 pre-SAP eras. The rate increased to 6.44% per annum during the 1986–1998 SAP periods and increased further to 8.92% during the post-SAP period. The compound growth rate for livestock was computed to be 4.83% per annum during the entire period under study [61].

**Investigating acceleration, deceleration or stagnation in livestock output**

To confirm existence of acceleration, deceleration or stagnation in livestock output, quadratic equations in time variables were estimated as reported in Table 5. The results show that the coefficient of $t^2$ is positive and highly significant ($P < 0.01$) during the entire period (1970–2005) confirming statistical significant acceleration in growth of real livestock output. Contrarily, the coefficient is negative and highly significant ($P < 0.01$) for the 1986–1998 SAP period reflecting a case of statistical significant deceleration [61].

For the 1970–1985 and 1999–2005 periods, however, the coefficients of $t^2$ are positive but only significant at 10%, which is not an acceptable high level of significance to qualify for confirmation of acceleration. In other words, the non-acceptable significance of the coefficients of $t^2$ is a confirmation of stagnation or lack of acceleration or deceleration in the growth of livestock output during these periods.

The results reveal that the growth rate, which was <1% per annum during the 1970–1985 pre-SAP period increased to 6.44 and 8.92% per annum respectively, during the 1986–1998 SAP and 1999–2005 post-SAP eras. The compound growth rate was computed as 4.83% per annum during the entire period under study. Presence of statistical significant acceleration ($P < 0.01$) was found during the entire 1970–2005 period. However, whereas the 1986–1998 period recorded statistical significant deceleration ($P < 0.01$), the periods 1970–1985 and 1999–2005 had confirmed cases of stagnation. This suggests that for deregulation policy to result in desired accelerated growth in livestock production, it should be accompanied by relevant farm support policies, like provision of accessible credit and subsidization of agricultural inputs, to produce the desired multiplier effects on agriculture and food production [61].

**Impact of policies**

**On livestock output and protein consumption**

Animal productivity is defined as total output divided by all the animals of that species in the herd. Because the index is derived from data sets that are remarkably weak, the true extent of productivity growth is hard to establish. According to food balance sheets estimated for the period 1961–1985, the share of animal protein in total protein intake has remained more or less unchanged over the 25-year period. Even during the peak of the oil boom, i.e. in 1975–1981, the increase in animal protein consumption was minimal. Given the daily requirement norm of 75 g of protein [62], it is obvious that both aggregate and animal protein consumption levels have been markedly below the norm [49].

**Impact of policies on prices and incentives**

Unlike the pre-1986 situation in the crop subsector when commodity marketing boards used to set producer prices for export crops and guaranteed minimum prices for food crops, direct price intervention has not featured as a major policy instrument in the LSS. However, government’s restrictive trade and exchange rate policies have indirectly affected livestock prices through their impact on the entire

---

**Table 3** Estimated trend equations for livestock production in Nigeria, 1970–2005

<table>
<thead>
<tr>
<th>Period</th>
<th>Parameter ($\beta_0$)</th>
<th>Parameter ($\beta_1$)</th>
<th>$r^2$</th>
<th>$F$</th>
<th>Sig (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970–1985 ($n = 16$)</td>
<td>3.9332*** (37.9088)</td>
<td>0.0083** (0.7713)</td>
<td>0.0408</td>
<td>0.59</td>
<td>0.453</td>
</tr>
<tr>
<td>1986–1998 ($n = 13$)</td>
<td>4.3160*** (73.7806)</td>
<td>0.0624*** (8.4661)</td>
<td>0.8669</td>
<td>71.67</td>
<td>0.000</td>
</tr>
<tr>
<td>1999–2005 ($n = 7$)</td>
<td>4.8734*** (89.0217)</td>
<td>0.0854*** (5.4107)</td>
<td>0.8541</td>
<td>29.27</td>
<td>0.003</td>
</tr>
<tr>
<td>1970–2005 ($n = 36$)</td>
<td>3.6364*** (54.1699)</td>
<td>0.0472*** (14.9195)</td>
<td>0.8675</td>
<td>222.59</td>
<td>0.000</td>
</tr>
</tbody>
</table>

***Significant at 1%; **Significant at 5%; *Significant at 10%; NS, not significant; t-values are in parentheses.

Source: [61].

**Table 4** Exponential growth rates in livestock output in Nigeria, 1970–2005

<table>
<thead>
<tr>
<th>Period</th>
<th>Parameter ($\beta_1$)</th>
<th>Exponential growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970–1985 ($n = 16$)</td>
<td>0.0083** (0.83)</td>
<td>0.833454</td>
</tr>
<tr>
<td>1986–1998 ($n = 13$)</td>
<td>0.0624*** (0.85)</td>
<td>6.438801</td>
</tr>
<tr>
<td>1999–2005 ($n = 7$)</td>
<td>0.0854*** (0.89)</td>
<td>8.915264</td>
</tr>
<tr>
<td>1970–2005 ($n = 36$)</td>
<td>0.0472*** (0.84)</td>
<td>4.833165</td>
</tr>
</tbody>
</table>

***Significant at 1%; **Significant at 5%; *Significant at 10%; NS, not significant.

Source: [61].
domestic cost structure. It will be argued that the oil boom, import restrictions and the overvaluation of the currency have all combined to trigger mechanisms which have produced two important consequences for prices and incentives in the LSS [49].

First, restrictive trade policies which were designed to address the balance of payments problem and prop up the overvalued exchange rate appeared to have raised domestic prices above world equivalent prices. The other major consequence for livestock prices and incentives came about as a result of the inflows of foreign capital associated with the oil boom. The sudden increase in oil-related capital inflows created a standard case of the ‘Dutch disease’ [63]. The influx of foreign capital augmented not only the supply of tradables, but by raising incomes, increased the demand for all goods and services. The ensuing excess demand for non-tradables was curtailed by an increase in their price relative to tradables, which induced reallocations of expenditure and production. Over the period 1975–1985, animal product (tradeable) prices declined by about 50% relative to the price of millet (a non-tradeable grain that is commonly exchanged for animal products in Northern Nigeria). The devaluation of the naira following the introduction of the SAP in September 1986, has slowed down the relative price decline. Nevertheless, it is clear that one consequence of the oil boom was a perceptible change in relative prices in favour of non-tradeable goods and services and against the producers of tradeable goods [49].

The overall effect of government policies has been to raise the domestic prices of most livestock products above their equivalent world prices with the result that varying degrees of protection are provided for domestic production. However, it appears that up till 1985, domestic prices for most livestock products were simultaneously high by international standards but low in terms of being able to attract domestic resources to increase production. This picture which largely depicted the situation for agricultural tradable products as a whole, was in sharp contrast to the enhanced profitability of investments in the construction and service sectors during the same period [56].

Lessons and policy directions for the future

The government’s direct production programmes have been largely ineffective in expanding livestock output in Nigeria. The production increases generated by such programmes have been minimal. What is worse, by diverting resources away from the pastoralists and agropastoralists, such programmes have tended to hinder the development of the traditional sector [49].

For most of the period under review, trade policy more or less substituted for an explicit price policy for the LSS. Trade policy, however, failed to provide appropriate incentives for domestic livestock production. Trade restrictions resulting from policy changes in response to macroeconomic concerns provided protection for most livestock products. Because it ensued as a by-product of other concerns, the resulting protection lacked important features of an appropriate production incentive system, such as stability and consistency [49].

Since the inception of the SAP, a number of changes have taken place to redress some of the past mistakes. Two specific issues in addition to the changes already implemented deserve mention and should help to facilitate the growth of livestock output [49]. First, government investment policy within the LSS needs to be reviewed. All too often in the past, government provided funds for production programmes with little or no consideration being given to the past performance record of such programmes. A shift from this approach to a strategy that promotes research on new technologies and strengthens the extension services to disseminate the results of this research is needed. At the same time, complementary incentive policies that will facilitate the uptake of new innovations and induce private capital investment in the LSS should be instituted [49]. Secondly, in designing government policies, the full implications of these policies for the different sectors of the economy need to be explicitly recognized and taken into consideration. The fact that most livestock products are tradable means that livestock, trade and exchange rate policies are inevitably interlinked. The upshot is that better coordination of policy decisions is necessary. However, proper coordination and informed policy-making call for a good data base. A significant feature of policy-making in the past has been that crucial decisions were made on the establishment of new projects, support for all goods and services. The ensuing excess demand for non-tradables was curtailed by an increase in their price relative to tradables, which induced reallocations of expenditure and production. Over the period 1975–1985, animal product (tradeable) prices declined by about 50% relative to the price of millet (a non-tradeable grain that is commonly exchanged for animal products in Northern Nigeria). The devaluation of the naira following the introduction of the SAP in September 1986, has slowed down the relative price decline. Nevertheless, it is clear that one consequence of the oil boom was a perceptible change in relative prices in favour of non-tradeable goods and services and against the producers of tradeable goods [49].

The overall effect of government policies has been to raise the domestic prices of most livestock products above their equivalent world prices with the result that varying degrees of protection are provided for domestic production. However, it appears that up till 1985, domestic prices for most livestock products were simultaneously high by international standards but low in terms of being able to attract domestic resources to increase production. This picture which largely depicted the situation for agricultural tradable products as a whole, was in sharp contrast to the enhanced profitability of investments in the construction and service sectors during the same period [56].

Lessons and policy directions for the future

The government’s direct production programmes have been largely ineffective in expanding livestock output in

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Finally, the economic reforms of the last 2 years and the steep devaluation of the naira have raised domestic prices and created an environment that will reward producers who are able to curtail the use of imported inputs in their production activities. The implications of this for poultry producers who depend on imported stocks, feeds and drugs are clear. But given the low value of such inputs in the total cost of production of ruminant livestock in Nigeria, the opportunity now exists for increased output of beef, mutton and goat meat. However, this opportunity will be turned into the country’s advantage only if a consistent mix of policies is put in place to encourage improved animal husbandry, feeding and delivery of farm inputs and veterinary supplies. These issues should form part of an overall package of measures to promote structural changes within the LSS [49].

For livestock policy to be effective enough to transform traditional agriculture, particularly the LSS to a mechanized one, proactive and pre-emptive steps need to be taken to ensure effective and efficient implementation of macro-economic livestock policy objectives [64].

**Partnership with Relevant Institutions and Organizations**

Partnership with relevant institutions and organizations is aimed at promoting synergy and participation, as well as to foster policy dialogue and multi-disciplinary approach. To do this, the Livestock Policy Hub (LPH) will need to network and establish partnership with the following stakeholders: regulatory bodies such as Veterinary Council of Nigeria (VCN), Nigerian Institute of Agricultural Science (NIAS), etc., for effective collaboration in areas of review and enforcement of existing laws; standards and food safety agencies for setting, establishing and enforcing food safety standards [2]; animal health product manufacturers for strict compliance with product requirements and standards; research institutes for developing new technologies, extension packages and dissemination of information; cooperatives and civil society organizations for better understanding of issues involved in VET-GOV and administration; relevant government agencies for creating conducive business environments providing the necessary policy drives; the media to create the necessary publicity and awareness to the public; farmers’ organizations for adoption of best practices and adherence to laws; and women and youth organizations as well as the vulnerable for an all-inclusive approach to livestock development [2].

**Gaps Identified in the Nigerian Livestock Policies**

The history of livestock development in Nigeria reveals a long-standing effort to find a strategy to improve productivity and raise output. Policies that have been instituted to achieve these goals have not been totally consistent. Trade and exchange rate policies, in particular, appear to have been driven by macro-economic concerns rather than by a desire for livestock development. The support given to various categories of producers and to different livestock species has also been lopsided. Large commercial producers appear to have benefited at the expense of the bulk of small-scale pastoralists, while small ruminants seem to have been neglected. These problems put the attainment of government objectives into question [49].

**Non-interaction between and among stakeholders**

The continued absence of progress in livestock policies and programmes in agriculture in Nigeria is the consequence of non-interaction between the government and the various stakeholders within a particular programme as well as lack of opportunities for decision-making and policy dialogue with other stakeholders. Agriculturists, scientists, researchers and more importantly the farmers/rural dwellers are normally ignored during planning and implementation of agricultural/rural development policies and programmes. These stakeholders are in a better position to identify the policies and programmes that will be tailored to the need of the farmers/masses. However, their non-participation has led to failure of intervention programmes, increased poverty and inaccessibility of basic social amenities with dwindling economic fortune [65].

**Weak agricultural policy**

In Nigeria, the livestock policies are either inadequate or obsolete and there is a lack of enforcement of existing animal health laws and standards [2]. Agricultural policies are not specific and they are handled as cross-sectoral policy related to forestry, in which environmental factors also come into play (e.g., the forest policy of 1945). Developed economies have their agricultural policies publically displayed. Also, a policy should have a strategy, targets, goals, specific objectives, and most importantly programme or projects, geared towards accomplishing the goals.

Nevertheless, this is not the case in Nigeria, as was seen in 1960–1966 when there were several agricultural policies but no agricultural programme or project to carry out the directives of the policies. Sometimes, agricultural programmes and projects are not consequences of agricultural policies. For example, in the military era there were few agricultural policies, decrees and acts that existed with invention of numerous agricultural programmes such as National Accelerated Food Production Programme (NAFPF), Operation Feed the Nation (OFN), Agricultural Development Projects (ADP), River Basin Development Authorities (RBDAs), Green Revolution (GR), Directorate for Food, Roads and Rural Infrastructure (DFRRI), Better Life Programme (BLP) For Rural Women, Family Support Programme (FSP), Family Economic Advancement Programme (FEAP), National Fadama Development Project.
(NFDP), and National Agricultural Land Development Authority (NALDA) which was initiated in 1992 much later than the decree (1978) and an act (1979) supporting it. There is urgent need to reverse this situation to ameliorate the persistent failure of agricultural policies and programmes in Nigeria [65].

Conflicts between different programmes and projects

Conflicts between different programmes and projects may be linked to new administration, lack of interest, and invention of new policies and programmes. There has been conflict between FSP and FEAP, and the conflict between DFRRI and ADP was pronounced in many states. Apparently, DFRRI merely removed the sign posts of some ADPS and replaced them with its own to take merit for the construction of certain rural roads and boreholes [66], and reportedly significant amounts of resources had also been wasted [65].

Short duration of agricultural policies and programmes

Continuity of existing programmes and new administration has not been sufficient for the policies and programme to have an impact. Examples of such cases are FSP (in 1994), FEAP (1996), OFN and RBDAS (1976), NAFPP (1972), OFN (1976) and GR (1980). Changes retard development progress and do not allow the development policies and programmes to fulfil their mission and mandate to overcome the food crisis in Nigeria [65].

Inconsistency and incompatibility of regional policies and programmes with the national policies and programmes

It should also be recognized that programmes and policies can have different impacts on different people (clientele) because a given programme or policy has different effects on the various target audiences. Alternatively, different policies and programmes may exist at the same time, as was the case with RBDA (1976) and OFN (1976), and DFRRI (1986) and BLP (1987). New policies and programmes should be consistent, work in harmony and collaborate closely with regional and national policies and programmes. Good rapport and relationships, as well as a peaceful atmosphere increase the chances to achieve success of agricultural policies and programmes, and consequent agricultural development [65].

Emphasis on mainly food and animal production

Agricultural growth and development need diversification into different sectors like manufacturing and services. Relying exclusively on farm output, which the most agricultural policies and programmes emphasize, means subjecting the inhabitants of the nation to chronic poverty, marginalisation and stagnation. Policies should aim at mobilizing resources (human and material) with the aim of developing programmes or projects in rural non-farm employment (such as fee fishing, hunting lodges and growing ornamental plants) and in secondary and tertiary sectors (such as tourism, recreational and environmental services or preservation). Many of these activities that were previously overlooked and geographically quite dispersed have become true productive links involving agroindustrial operations, and sophisticated systems of distribution, communication and packaging [65].

Delay, embezzlement, misappropriation and lack of funding to pursue specific policies and programmes

The Nigerian government may need to channel funds from the informal sector to the formal sector of the economy to make development policies and programmes both workable and more effective. The government abruptly withdrew the funding from NAFPP, which contributed to the failure of the project, and lack of funding delayed the implementation of ADP – this lack of funding persists in ADP today. Misplacement of priority or misdirection of funds to unnecessary components of agricultural programmes should also be avoided to avoid wastage of resource that hamper programme success. For example, in FSS expenses incurred mainly on infrastructure – which did not directly increase agricultural output – and it was one of the problems that led to the failure of the scheme [65].

Inadequate virile technical advisory and extension services

The United States Department of Agriculture (USDA) is successful partly because of their systematic and timely technical advisory services are provided within universities or Land Grant colleges of agriculture. Provision of extension services can help smallholder farmers to acquire entrepreneurial skills, and teach and convince farmers to adopt and diffuse innovations. Not educating participants and beneficiaries on the meaning and goals of OFN, FSS and BLP, contributed immensely to their failure [65].

Lack, and inadequate monitoring and evaluation of programmes and projects

Evaluation helps determine achievements of rural development programmes to set aims and objectives. Evaluation techniques can serve to improve implementation and efficiency of programmes after interventions have begun, and provide evidence as to the cost efficiency and impact of a
specific intervention within and between policy sectors [67]. Especially continuous, on-going and stage-by-stage evaluations are important because they expose gaps in programme objectives, thereby affording opportunities for adjustment. Unfortunately, the importance of monitoring and evaluating projects has not been fully recognized in Nigeria. In GR, for example, no monitoring or evaluation was carried out, but huge sums of money were spent on executing the programme [65].

Other factors

Other indicators of weak agricultural policies in Nigeria are poor state of animal health services and infrastructures, inadequate budgeting for animal health programmes, desert encroachment, soil erosion, overgrazing, bush burning, presence of endemic livestock diseases, inappropriate tariffs and pricing of livestock [2].

Recommendations and the Way Forward

Various stakeholders, including farmers and rural people, should be involved in the planning and execution of agricultural policies and programmes. There is need for a communication strategy to be developed and implemented to support the establishment and operations of LPHs at national levels, to create necessary awareness on sustainability at national levels, and to bring the issue to the attention of decision makers and development partners [2]. Establishment and strengthening of LPHs at both national and state levels as a mechanism to generate evidence for livestock policy formulation and the role of livestock in the economy should be undertaken, and the existing institutional culture and diversity of stakeholders should be considered in the establishment of LPHs. Also, functional linkages with Commercial Agriculture Development Programme (CADP), national and state teams should be established, as well as other agriculture/livestock policy and strategy formulation mechanisms, and the structure and institutionalisation of LPHs should be addressed at the national level for further elaboration and validation [2].

Also, agricultural policies and programmes should be open, transparent, and they should be framed within a context in which agricultural development policies and programmes are national issues based on a broad enough consensus to guarantee continuity and freedom of expression for the opinions on decisions of individuals. The government should promote a virile extension liaison service that is empowered and supported by adaptive research and mobile personnel equipped with necessary media facilities and information. This would help the target audience solve any misconceptions related to the objectives, relate to the information to and from the research and government, and increase participation in the programme since the government would be in closer contact with the target audience. This would consequently improve the chances of the programme becoming successful [65].

Programmes should be monitored and their efficacies evaluated in terms of specific geographical impacts. This would provide a highly useful approach for evaluating the direct and indirect impacts of different programmes and projects interacting simultaneously. Policy makers and planners should also identify and evaluate alternative or different intervention programmes in terms of both their immediate and long-term impacts and their implications to the communities and society at large [65].

The philosophy of policy/programme consistency should be adopted in Nigeria. This would be the easiest way to streamline, direct and focus to agricultural development. This philosophy should be a critical issue for our future policies and programmes. Government should provide an enabling environment for private sectors to become involved in agricultural development especially in areas such as processing, preservation, exportation, tourism, recreational and environmental services. This would promote agricultural development and project the country to the entire world. Tourist centres such as Yankari game reserve, Obudu cattle ranch and museums, could serve this purpose [65].

The government and private sector should invest in animal health services by providing adequate budgeting for animal health programmes and infrastructures; reviewing and amending all existing legislations, developing human and infrastructural capacities for enforcement of animal health laws and standards; ensuring sustainable land use management to address desert encroachment, soil erosion, overgrazing and bush burning; supporting strategic control of endemic livestock diseases; reviewing existing tariffs and reinforcing guaranteed minimum price for livestock and livestock products; and supporting efficient land acquisition and management of grazing reserves through Private Public Partnership (PPP) [2]. The governments’ ATA should be considered a priority, and partnerships should be established with relevant institutions and organizations to promote synergy and participation, as well as to foster policy dialogue and a multi-disciplinary approach.

Conclusion

Diseases, management practices, farming systems, abattoir management (in terms of disease control and poor control of animal movement within and out of the country), poverty, low capital, and illiteracy, have contributed massively to the slow growth of the livestock industry in Nigeria. A lot needs to be done in the livestock industry in order to increase production that could lead to the subsequent increase in the nations GDP. Looking at the poultry industry, poultry farmers need to be empowered in terms of capital and management practices to ensure efficient production. There is a need for associations to be formed to prevent disease outbreaks and to provide mutual
assistance. The local poultry needs to be properly taken care of and routinely vaccinated. The traditional free-range or backyard poultry system also needs to be addressed. Difficulty in feed provisioning during the dry season is also a problem that affects the farming system. Land laws need to be revisited and properly instituted. There may be need to commercialize the industry where applicable, and also have semi-intensive management systems where possible. Pig farms which are usually semi-intensively managed also face other livestock. Livestock policies need to be reformed and strategically implemented. In conclusion, proper hygiene and effective management of livestock is the only way to achieve success in livestock production which could lead to agricultural development, better international trade, and increase in the nation’s GDP.

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