
THE ROLE OF MATHEMATICS AS AN IMPERATIVE TOOL FOR LIVESTOCK PRODUCTION IN NIGERIA: IMPLICATIONS FOR AGRICULTURAL EXTENSION

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<http://doi.org/10.35410/IJAEB.2019.4419>

ABSTRACT

The paper recognizes the fact that many Nigerians are unable to afford adequate dietary protein and as a result suffer some nutritional problems. The paper is of the view that pragmatic livestock production enterprise via mathematical applications should be employed. Concepts of mathematics and livestock production were clarified. Importance of livestock to Nigeria as well as individuals was stated. An array of contributions of mathematics in livestock production in Nigeria was articulated. Some challenges in livestock enterprise were also highlighted and implications for agricultural extension delivery were stressed. Finally, it was concluded and suggested that since a lot of benefits accrue from mathematical applications package to livestock sector, mathematics should also be taught at informal level through adult literacy programme among others.

Keywords: Mathematics, Livestock, Production, Agricultural Extension.

1. INTRODUCTION

Food is one of the major factors that contribute to the socio-economic well-being of nations, including Nigeria. According to Adah and Onoja (2005) any country whose citizenry is not well fed is socio-economically sick as the entire economy and quality of human life in such country would be badly affected. Orkar (2016) in line with this stated that as humans, there are basic requirements to life which include food, shelter, and clothing among others. For the purpose of this paper, emphasis is on food. Stressing further the significance of food, Olayide *et al.* (1972) recognized that adequate nutrition can make a great difference to the way people believe and feel, to their health and their ability to work effectively; and that low levels of productivity limit the quality and quantity of food supplies, and inadequate diets often contribute to poor performance and absenteeism by workers in agricultural and industrial sectors of the economy. They further stated that food, including meat and fish production in the country was and is still low and so very exorbitant. Many Nigerians now eat without animal protein and even those that are blessed with the opportunities cannot afford minimum requirement. The problem of providing better nutritional opportunities, including adequate dietary protein for the Nigerian people becomes more important and sacrosanct.

One way of providing better nutritional opportunities for the people is by embracing livestock production pragmatically and doggedly too. In the light of this fervent position or proposal, the paper is of the opinion that mathematics being the solution to problems be applied to make livestock production work better in the Nigerian state.

2. CLARIFICATION OF CONCEPTS

Mathematics

Mathematics is viewed as a service provider for all disciplines and it contributes immensely in deciding directions of activities in all areas of human endeavour such as economy, engineering, agriculture etc (Fadare and Ayeni, 2016) quoting Salman (2005), Odili (2006), Umar and Aliyu (2006) and Ugwuanyi and Agwagah (2014). Orkar (2016) defined mathematics as a service subject since it exists in all areas of human endeavour, that is, it can be applied in all facets of life including general economy of the nation.

Ndibe, Bello & Usman (2016) pointed out that life without the knowledge of mathematics would have been very difficult because mathematics is an important subject for the aspiration of scientific and technological development. They remarked that no nation in the world, including Nigeria has ever developed technologically (livestock production technologies inclusive) without putting mathematics in the appropriate position. From the foregoing, one could rightly state that it is an imperative tool for livestock production among others.

Livestock Production

Longman Dictionary (2009) refers to livestock as animals such as cows and sheep that are kept on a farm. Others include rabbits, goats and pigs. According to Omole (1983) livestock produced in Nigeria include cattle, sheep and goats, pigs, poultry, *equidae* (horses and donkeys) and camels. All these animals are domesticated and are collectively referred to as livestock (farm animals).

Longman Dictionary (2009) also refers to production as the process of making or growing things to be sold, especially in large quantities. Livestock production therefore refers to the rearing of animals that are domesticated and/or process of making animal products in large quantities for market as well as for the farmer's use. For the target of large quantities to be realized, mathematics, the bedrock of all life endeavours need to be embraced.

Importance of Livestock in Nigeria

Livestock play very significant roles in human development in Nigeria. According to Okorie (1983) and Babayemi, Abu & Opakunbi (2014) the important functions of farm animals are as follows:

- i) Provision of Food: Meat, milk and eggs obtained from farm animals provide proteins and other nutrients that are beneficial for good health, growth and mental development.
- ii) Source of Manure: Faeces, urine and droppings from farm animals can be used to improve soil fertility for crops and forages.
- iii) Source of Income: Live animals and their products e.g. meat, milk, eggs, hides and skin, wool, pelt (skin of a dead animal) etc are sold as source of income.

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- iv) Generation of Employment Opportunities: Jobs are created through productive engagement in animal husbandry e.g. feed milling, farm animal breeding and management, slaughtering and processing, value addition, marketing etc.
 - v) Source of Power: Bulls and bullocks are used to till the land for crop production. Horses, camels, and donkeys are used for threshing of grains and extraction of vegetable oils. Dried manure is a source of fuel for cooking in some communities; wet manure is also a source of biogas for cooking.
 - vi) Means of Transportation: Horses, camels and donkeys are used to carry loads and transport humans especially in the hinterlands.
 - vii) Provision of Raw Materials: Agro-industries make use of hides and skins for the tanning industry; milk for dairy products; eggs for confectionery; bones for bone meal etc. Animal skins are used to make drums; horns and feathers are made into ornaments. Soap and candles can be made from animal fats.
 - viii) Entertainments, Sports and Games: Horses, chickens and dogs can be used for entertainments e.g. dog and horse racing. Cocks are also used in cock fights and as well decorated and used by football fans.
 - ix) Source of Insurance: Livestock and poultry offer insurance to crop failure in a mixed farming system i.e. where animals are incorporated into crop farming.
 - x) For Festival Activities: Animals are used in ceremonies and special occasions to meet obligations. For example during Eid-kabir, Muslims slaughter rams. Dogs are sacrificed during Ogun festivals. Pigeons are released into the air during celebration of special events e.g. at national Independence Day Celebration, games and weddings.
 - xi) As Messengers: In the olden days, pigeons and dogs are often used to deliver messages during wars and at peace times.
 - xii) For Security and Protection: Dogs are used to watch and guard homes and farms; for protection of lives and property. Bees and geese are also used as security, cat ward off rodents in stores, poultry farms and homes.
 - xiii) As Bride Price: Goats, sheep, cattle, camels, donkeys and horses are used as part of bride price in some places/communities.
 - xiv) For Companionship: Animals provide companionship as pets e.g. dogs, rabbits and cats.
 - xv) Source of Foreign Exchange: Live animals and their products can be exported to earn foreign exchange.
 - xvi) For Research Purpose: Animals are used for laboratory and field researches, e.g. rabbits, guinea pigs, rats etc.
 - xvii) As a Gift: Persons considered as very important are presented with gifts of live animals.
 - xviii) In Medicine: Honey is used to heal wounds; sinews from animals are used in surgery.
 - xix) For Circumcision: Traditionally, snail fluid is used for circumcision.

From the foregoing, it could be stated that livestock are very beneficial to individuals and the country at large. As a result of these monumental benefits arising from the sector, efforts geared towards expanding and enhancing the production of livestock via mathematical skills is imperative and worthwhile.

An Array of Contributions of Mathematics in Livestock Production in Nigeria

There are numerous ways mathematical applications can evolve enhanced livestock production for the benefit of individual livestock farmers and the nation at large. Olaitan (1984) in Enemali and Adah (2016) pointed out that the amount of feed needed per head of animal per unit body weight gain could be determined. Also, the profit or loss accruing from the farm enterprise after making deductions for capital expenses and labour costs could be determined using mathematics.

According to Amodu and Okpanachi (2015) mathematics is utilized in the following areas of livestock farming:

- i) Basic skills in simple mathematical calculations.
- ii) Counting and recording of various types are essential skills.
- iii) A livestock farmer (e.g. poultry farmer) needs to know the number of eggs his birds lay per day.
- iv) Knowledge of basic measurement skills is necessary in oral drug administration in livestock farming.

Nworah (2015) pointed out that livestock producers use linear programming when making feed for cattle. He added that a variety of ingredients are mixed together to make feed and producers want the most nutritious combination of ingredients that is also cost efficient. According to Fadare *et al.* (2015) in Enemali and Adah (2016) mathematics is used for the following agricultural activities: plotting the demand and supply schedule and curve for farm decision-making, oestrus cycle, incubation period and gestation period in animals, interest on loan and credit facilities, litres of honey harvest in a bee box, making of in-let and out-let in a fish pond and their correct depth and height, quantity of water to be used for vaccine (e.g. Lasota, Gumboro etc), the ratio of the weight of egg lobe to the whole fish so as to determine the amount of chemical to be applied on the female fish in the process of fingerlings production, among others.

In intensive management system in sheep and goats, mathematics is imperative to achieving good results. Take feeding and watering of the animals for instance, Lakpini (2002) stated that since the animals are on zero-grazing, their feed and water have to be brought to them using the following prescription: total dry matter feed offered should be 3% to 4% of the body weight with the roughage constituting at least 60% and concentrate supplement of not more than 40%. For maintenance requirement, Lakpini (2002) recommended total feed to contain 15% protein and 2.7 Mcal/kg DM energy at the prescribed rate above. For pregnant and lactating animals, 15% protein and 3.2Mcal/kg DM energy are adequate to meet their requirements at the recommended rate of feeding; and he added that fresh drinking water should be provided to the animals ad-libitum.

To know the status of the enterprise, Lakpini (2002) and Babayemi *et al.* (2014) stressed that record keeping is basic; and an important tool for taking management decisions. Before record keeping, the animals have to be identified using numbered tags. The important records to be kept include: production records, labour use book, livestock record book, livestock products and disposal book, health records, cash/bank account book, farm purchases and sales book, profit and loss account book, animal identification records, farm diary and farm inventory. Records on date of birth, birth weight, dam, sire monthly weight, weaning weight, age at first lambing/kidding (if goat and sheep), date of death, date of deworming and dipping/spraying are

also kept. All these records would be properly and successfully kept using mathematical skill and knowledge.

In poultry, depending on the weight, eggs can be classified or categorized into the following grades:

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|------|-----------------|---------------|
| i) | Pullet (peewee) | 35g and below |
| ii) | Small | 42.5g |
| iii) | Medium | 50g |
| iv) | Large | 57g |
| v) | Extra-large | 64g |
| vi) | Jumbo | 71g and above |

(Babayemi *et al.*, 2014).

Note that the bigger the eggs, the higher the demand by the consumers.

Babayemi *et al.* (2014) also pointed out that egg size is a function of the following:

- i) Breed of Fowl – Large breed gives large eggs.
- ii) Feeding and Nutrition – Well fed fowls with balanced diet will give good eggs.
- iii) Health Status of the Fowl – Healthy fowl will give big and quality eggs.
- iv) Age in Lay – Young fowls tend to lay more but smaller or pullet eggs (peewees) while older layers lay large but fewer eggs.

Looking at the egg size variable, aspects of mathematics that have to do with weighing, measurement and counting are employed. In fish -cum- poultry farming (a type of integrated aquaculture) research, using mathematical skill has established that a chicken produces 40g of excreta daily (14-15kg/year) and therefore it is recommended that 10-30 chicken be stocked per 100m² pond area and this could yield 35-50kg/yr/100m² of *Oreochromis niloticus* and *Clarias gariepinus* when reared for 4-5 months (Bolorunduro *et al.*, 2013).

Depending on desire and taste, the rabbit farmer has a wide variety of rabbit cages/hutches which are mathematically designed and constructed. The husbandry equipment such as hay manger, oil-can feeder, feed troughs, tin can feeder etc are of varied mathematical dimensions. Young rabbits can be weaned at eight weeks of age, and the weight of the young should average 2kg/rabbit to avoid cannibalism (Bivin *et al.*, n.d.).

In housing goats and sheep, irrespective of flooring material, floors should be bedded down with straw or wood shavings which can be changed from time to time. Alawa (2002) however, recommended that spacing for sheep and goats is about 0.5-0.6m² per weaned kid/lamb. He further stated that a hut of about 6.2 x 3.0m can comfortably accommodate 20 animals.

On the significance of mathematics to animal production, Fadare *et al.* in Adesanya *et al.* (2017) explained that areas where mathematics is used in animal production include determination of oestrus cycle, incubation periods for eggs, gestation in livestock, number of eggs laid by fowls, the quantity of honey harvested in a beehive and the quantity of water required for effective vaccination. The authors stated further that other activities under animal husbandry where knowledge of mathematics is required include but not limited to calculating the ratio of weight of egg lobe to the size of the fish so as to determine the quantity of chemicals to be applied to the fish to produce the fingerlings. According to Adesanya *et al.* (2017) mathematics is utilized in budgeting for the cost of establishing a poultry or livestock farm,

estimating the stocking density, estimating the feed requirement for a particular number of birds, livestock or fish and determining the amount of vaccines and other drugs needed.

Feeding of broilers and pullets for good production requires mathematical skill. Obori (2005) advised that broilers should be fed at all times to maintain maximum growth using the following feed guide:

Feed Type	Quantity	Age
Broiler Starter	3,000kcal/kg M/E 22-24% Crude Protein	Day old to 5 weeks
Broiler Finisher	3,000-3,200kcal/kg M/E 20% Crude Protein	5 to 9 weeks
Feeding Pullets		
Chick Mash	2,650kcal/kg M/E 20% Crude Protein	Day old to 8 weeks
Growers Mash	15-16% Crude Protein	8 to 20 weeks
Layers Mash	2,600-2,700kcal/kg M/E 16.5-17% Crude Protein	20 weeks up to end of lay

An example of a feeding and management regime, using mathematical application for dairy stock in the northern Guinea Savannah zone according to Phillips (1977) is as follows:

- i) Calves (to 4-6 months of age)-Reared in 1m x 2m pens on concrete floors and bucket fed in line with limited whole milk until 68kg body weight plus 25% crude protein concentrate mixture: 50% groundnut cake, 50% ground guinea corn fed to appetite and free-choice soya bean hay.
- ii) Calves (4-6 months)-2.25kg per day per head of 21.5% crude protein concentrate mixture: 22% cotton seed, 27% groundnut cake, 51% ground guinea corn from self-feeder plus hay and bush grazing.
- iii) Calves (6 months plus: 136 kg live weight and above) – 1.36kg per dairy concentrate plus 9kg daily silage and bush grazing.
- iv) Milking cows- Ration consists of 70% cotton seed hulls, 20% guinea corn, 10% groundnut cake (av. 23.5% crude protein) at 3.6-4.5kg/day depending on production of milk. Dry season basic roughage is 36.3kg silage/day and some *gamba* hay. Wet season grazing includes unimproved fenced pastures of improved *Digitaria* pastures.

All above are supplemented with mixed mineral licks.

These are few examples of how mathematical applications could enhance livestock production. There are several other instances of other mathematical contributions to the sector.

Some Challenges in Livestock Husbandry in Nigeria

Some challenges bedevilling livestock production in Nigeria according to Babayemi *et al.* (2014) include:

- i) **Inadequate Finance:** Most livestock farmers are poor and cannot purchase modern machines and implements hence they do not operate large animal farms.
- ii) **Poor Land Tenure System:** Traditionally, land is shared among family members leading to land fragmentation. It is therefore difficult to acquire large hectares of land for animal production. Related to this, Fulani herdsman and crop farmers incessantly clash over crop farm destruction by cattle.
- iii) **High Pest Infestation:** Pests transmit diseases from one animal to another. Pests reduce the quality and quantity of animals and their products. This requires huge money to control.
- iv) **Disease Infection:** Spontaneous incidence of disease outbreaks causes sickness and deaths of farm animals e.g. avian influenza (bird flu) causes death of birds in large numbers.
- v) **Low Level of Technical Know-how:** There is low acceptance of new methods of production because of low technical-know-how of livestock farmers which lowers production.
- vi) **Socio-cultural Constraints:** Religious beliefs, norms and taboos of some people may limit production of certain farm animals. E.g. Muslims and Jews will not eat pork for religious reasons.
- vii) **Inconsistency in Government Policies and Political Instability:** Banning and unbanning of livestock production inputs affect planning of livestock business. High tariffs and double taxation on importation of livestock inputs such as battery cages, drugs, grains, vaccines etc discourage livestock production. Unstable government and policy reversals cause problems to animal husbandry.
- viii) **Poor Research and Training:** Most research and training institutes are poorly funded by government. At present, in Nigeria, National Animal Production Research Institute (NAPRI) and National Veterinary Research Institute (NVRI) are the only available research institutes for animal production, whereas there are many institutes dedicated to crop production.
- ix) **Lack of Infrastructural Development in the Rural Areas:** Bad roads, lack of markets, poor social amenities etc impact negatively on livestock improvement.
- x) **Disposal of Manure:** Manure can become unsightly and emit foul odour causing pollution especially in urban areas.

Implications for Agricultural Extension Delivery

Extension is impossible to define in a short, concise phrase or sentence and that any attempt to define it properly involves a lengthy explanation of several principles (Daluba, 2005). Maunders (1972) in Akubuilu (2008) defined agricultural extension as a service or system which assists farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living and lifting the social and educational standards of rural life. According to Agbarevo and Obinne (2010), extension is designed to change the farmers' way of thinking, his attitude and habits, so that he becomes receptive to change or innovations in agriculture, leading to a more productive farming, and consequently, a higher standard of living.

In the light of the foregoing, it behooves the extension practitioners to rise up to the challenge of putting across to the farmers mathematical applications in livestock production to enhance productivity. This could be realised via their various training programmes like the popular forth nightly training (FNT) meeting. As a result of their professional upbringing, extension agents are well equipped with what it takes to convince livestock farmers to accepting mathematical knowledge and skills in their livestock farming enterprise. Hence, Agbarevo and Obinne (2010) stated that success of extension work depends on thorough training of extension workers and local leaders. The extension staff should therefore be soundly trained to be able to cope with the latest research findings (like mathematical applications) and technologies from various research stations and institutes aimed at developing farming enterprise.

3. CONCLUSION AND RECOMMENDATIONS

It is obvious that majority of Nigerians are unable to afford adequate dietary protein in their daily meals. One very sure way of addressing this state of affair is by doggedly embracing livestock production enterprise. For the livestock industry/enterprise to meet the required adequate dietary needs of the citizenry, mathematics known to be the solution to all problems need to be applied to the sector through researches. Therefore some of the various ways mathematics has contributed to the livestock sector have been x-rayed. The following recommendations were made, taking cognizance of the numerous benefits accruing from mathematical applications package to livestock sector:

- i) Apart from effectively teaching mathematics at the formal level, it should also be taught at the informal level, especially at the level of the livestock farmers through adult education programme.
- ii) Many farmers are untrained in good or modern farming techniques. The extension practitioners should as a matter of clarion call, undertake to educate the livestock farmers on the modern and new techniques, to enable the citizenry have enough and adequate animal dietary protein, that is affordable at their disposal.
- iii) Awareness campaign on the new package of livestock production should be mounted through National Orientation Agency and other media through which information can reach people and the end users of the package.
- iv) The various requirements for enhancement of livestock production enterprise such as adequate credit to purchase the new package, provision of good marketing and roads etc should be put in place by government and/ or its relevant agencies.

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