

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 7; July 2025; Page No. 624-628

Received: 17-04-2025
Accepted: 19-05-2025

Indexed Journal
Peer Reviewed Journal

Mathematics and agricultural development: Mathematics as a veritable tool for restoring agriculture to the leading position in Nigeria economy

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DOI: <https://www.doi.org/10.33545/26180723.2025.v8.i7i.2192>

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Abstract

Agriculture had been the main stay of Nigerian economy before the oil boom. It was the major employer of labour and foreign exchange earner till 1970s. It was relegated to the background through bad practice, inapt use of technology, and poor research data analysis, inaccurate analysis of returns, lack proper forecast and prediction of likely outcomes of investment. There was poor knowledge of index values of produce and utilization of principal of comparative advantage. The nonuse of mathematics from the cultivation to marketing of products was the fundamental reason agriculture collapsed in Nigeria. In this paper the various facets which mathematics can be used to revive agriculture to ensure sufficient food supply, employment and foreign exchange are offered.

Keywords: Mathematics; agriculture; veritable tool; restoring; leading position; Nigeria economy

Introduction

The importance of Agriculture in the economy of Nigeria is immeasurable. Agriculture plays a leading role of providing food supply, employment, raw materials, foreign exchange, national economy diversification, food security, industrialization and poverty eradication (Agblekale, 2020) ^[2]. It contributes over 22% of the gross domestic product (GDP) of Nigeria and employs about 36% of the Nigerian work force (Oyarivem, 2020) ^[15]. Despite the importance and relevance of agriculture to the economy, it is in a sorrow state, still struggling. This is the reason that there should be ease of access to agricultural development loan (Halidu & Alfa, 2024) ^[9]. There is also the need for infrastructural development (Ohwofasu & Mathew, 2022) ^[13] for access to market. Above all, there exists the need for mastering and utilization of an indispensable tool in agriculture, mathematics.

Mathematics has a wide round impact on every sphere of human endeavours, agriculture not being an exception. Telford (2015) ^[16] stated that mathematics is essential in agriculture for the purpose of proper agricultural industrial revolution, in helping to progress project needs in agriculture, sustainable intensification without negative impacts and precision farming where observation measurement are used in farm management to respond to inter and intra-field variability in crops. Mathematics is important in agriculture for use in managing sales, budgeting for fertilizers, soil analysis, conversion in foreign market, measuring areas of different shapes, protection of market strategies, evaluation of retailers' performance, making financial decisions, transportation of produce, personnel and equipment through plane and other means (Beer, 2017) ^[4].

Mathematics plays quintessential role in agriculture and farming. It is impossible for agriculture to strive successfully without mathematics. Every aspect of agriculture requires and use mathematics. Madmin (2017) ^[10] enunciated that mathematics is used in agriculture to design better climate models, improve the accuracy of soil analysis, achieve accuracy in evaluation of chemical content of fertilizers, conversion of units, proper planning, plotting and laying out plot sizes and dimensions, improving estimation for expenditure and yields as well as lay sound foundation for innovation in agricultural methods. Mathematics is widely applied in agriculture. It is applied to sowing seeds, in application of fertilizers, combating diseases like rickettsic diseases in cattle and disease of coccidiosis in rabbits and chickens (Gerdes, 2014) ^[7]. Michell (2012) ^[11] stated that modern farming industries applies mathematics to livestock, dairy production, horticulture and agronomy by using mathematics and logic skill in production control and financial management. Mathematical modelling is an essential aspect of mathematics which good agricultural practice envisages in the stride to optimize. Application of modelling technique to agriculture help in defining research priorities and assessing basic interaction of the soil-plant atmosphere system (Dourado-Neto; Teruel; Reichart; Nielsen; Frizzzone; Bacchi, 1998) ^[6].

Mathematics is a key implement in fostering extensive agricultural development. Other agricultural equipment, tools, and additives such as enricher like fertilizers, weedicides and pesticides depend on proper use of mathematical skills and adepts to enhance them to function effectively. Mathematics is applied in every aspect of agriculture either consciously or unconsciously (Glydon,

2017; Okechukwu, 2017; Adah, Enemali, Adejoh and Edoka, 2015; Brooks, 2012) [8, 14, 1, 5]. Appropriate application of mathematics in agriculture would guarantee sustained productivity and leading position in national economy. In Nigeria, agriculture occupied premier status in the economy in the pre oil boom era but this position was lost when it was unable to compete with oil due professional lapses. It is the inadequacies that relegated agriculture to the background and made it to loss its position as the leading gross domestic product (GDP) earner that application of

mathematics should be made to correct.

The Position of Agriculture in Nigeria Economy

Agriculture occupied the leading position as a major revenue earner and contributed more than fifty percent (50%) of the country's GDP before the oil boom (Odetola and Etumnu, 2013; Ahungwa, Haruna and Abdusalam, 2014) [12, 3]. Table 1 below gives the contribution of agriculture to Nigeria's GDP from 1960 to 2012.

Table 1: Contribution of Agriculture to Nigeria's GDP

	Total GDP (Million Naira)	Agriculture		Other Sectors	
		GDP (Million Naira)	Percentage Contribution	GDP (Million Naira)	Percentage Contribution
1960 - 1964	2568.4	1879.4	62	988.76	38
1965 - 1969	3088.5	1640.26	53	1448.32	47
1970 - 1974	9314.62	3268.4	40	6046.8	60
1975 - 1979	31233.22	7328.64	24	23904.58	76
1980 - 1984	51809.44	16426.78	31	35382.66	69
1985 - 1989	119632.2	4427.86	38	115204.34	62
1990 - 1994	539207.32	181622.32	33	357584.98	67
1995 - 1999	2668070	920018.08	32	1748051.02	68
2000 - 2004	7223539	2734641.3	37	4488897.7	63
2005 - 2009	205606030	6929310.4	34	13631319.6	66
2010 - 2012*	37129386.5	12368898.7	37	24760487.8	63

Source: CBN Statistics Bulletin 2010; *NPC (2013); *CIA Fact book (2012)

Table 1 can further be complemented by figure 1 and 2.

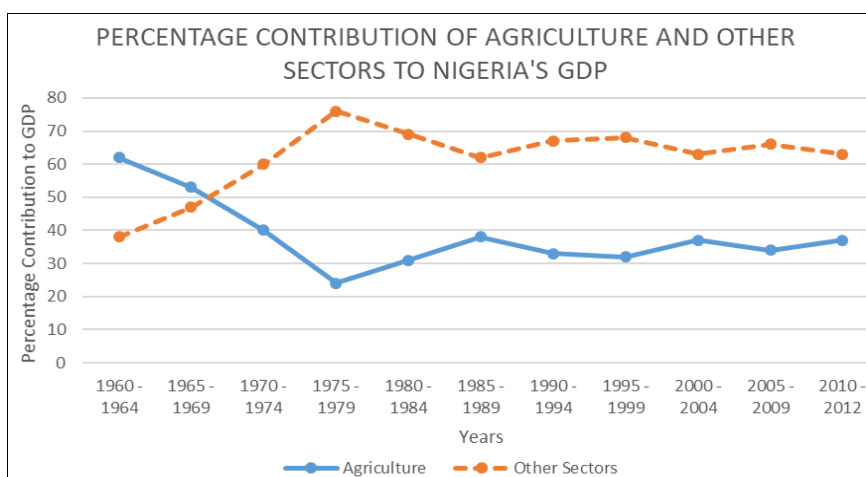


Fig 1: Percentage Contribution of Agriculture and Other Sectors to Nigeria's GDP

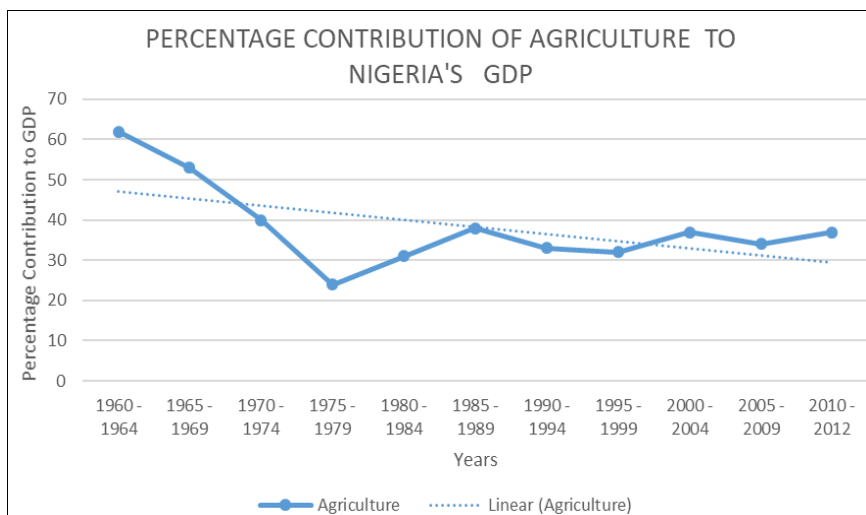


Fig 2: Percentage Contribution of Agriculture to Nigeria's GDP

Table 1 is extracted from Ahungwa, Haruna and Abdusalm (2014) [3] and modified. It gives a vivid picture of the status of agriculture as a major contributor to Nigeria's GDP between 1960 and 1970. Agriculture was responsible for more than 50% of the country's GDP before independence and a decade after. It was higher than all other sectors combined. Other sectors include mining and mineral oil, industry, building and construction, wholesale and retail trade, and services. The graphs in figure shows the competition between other sectors and agriculture. Other sectors combined overtook agriculture between 1970 and 1974. In figure 2 the trend line shows that if something positive is not done, agriculture may not contribute anything at all to the GDP in the next few years hence the country may face starvation - extreme food shortage. It is on this note that effective application of mathematics is required to tame the tide and revive agriculture.

Assessing the antecedent of employment and other agents of life as at the time agriculture was a major contributor to the economy and comparing Nigeria to other countries, it would be understood that Nigeria was ahead of others. The real value of the GDP was also higher because the value of Nigeria currency was higher.

The apparent rise in GDP came as a result of the collapse in the value of Nigerian money, hence the status of agriculture in the economy dwindled notwithstanding the huge variation within the years. Export of agricultural produce like rubber, kernels and other outputs reduced drastically leading to low earning from that sector as well as unemployment, hardship and poverty. The palm oil mills that were commonly the dominant industries in the southern region of the country, responsible for large scale production of palm produce for local consumption and export, collapsed. The production of hide and skin shrunk, cotton farming equally crumpled with the textile industries in the country, hence the loss of status by agriculture.

Considering that agriculture is a very important machinery for development, which attract very high number of middlemen, provide raw material for local industries as well

as export, application of mathematics to revamp agriculture is inevitable. Mathematics need to be applied during planting, tending and harvesting. During marketing of agricultural produce, mathematics is indispensable. It is also important to bring mathematics in to ascertain the comparative advantage of engaging in a certain agricultural venture.

Application of Mathematics to Determine Pattern of Farming

One of the reasons agriculture is losing its position as a major revenue earner and contributor to GDP is inability of the farmers to decide the most profitable crop from which they can easily recoup their investment and have enough gain to sustain their families and selves. The use of simple mathematics can enable the farmers take decision on which crops has a comparative advantage to produce, can engender success. Many farmers discarded agriculture because of venturing into production of crops which they cannot assess their turnover. Poor returns to investment is the greatest challenge of farmers. Table 2 below give a simple case of a cereal farmer who cultivated beans, corn, rice, soya beans and wheat. The farmer needs component bar charts, to see at a glance the distribution of his expenditure, income and profit from each of the crops. He equally require index number to assess the relative worth of each product as compared to others.

Table 2: Distribution of Profit, Income and Expenditure of a Cereal Farmer

Produce	Expenditure N1000000	Income N1000000	Profit N1000000
Beans	1.2	5.3	4.1
Corn	0.8	4.5	3.7
Rice	2.5	7.8	5.3
Soya Beans	2.6	8.7	6.1
Wheat	3	9.5	6.5
Total	10.1	36.8	25.7

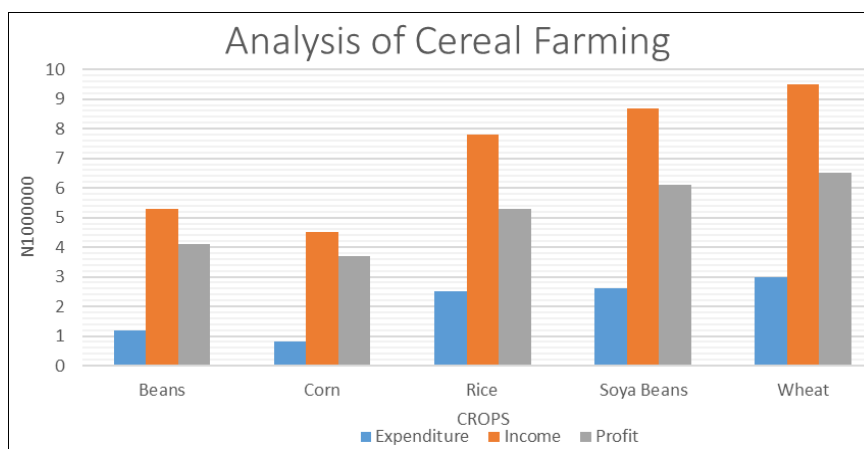


Fig 3: Profit, Income and Expenditure of a Cereal Farmer

Table 3: Profit, Income and Expenditure Relative Index Numbers of a Cereal Farmer

Crops	Expenditure Relative Index (%)	Income relative Index (%)	Profit Relative Index (%)
Beans	48	68	83
Corn	32	57.69	70
Rice	100	100	100
Soya Beans	104	111.54	115.09
Wheat	120	121.8	122.64

Table 3 shows the Profit, Income and Expenditure Relative Index Numbers of a Cereal Farmer. This should enable the farmer decide which crop is more profitable when compared to rice which is the base. The different between profit and

expenditure index for beans is 35%, corn 38%, soya bean 11.09% and wheat 0.84%. This declare corn the most sustainable product for the farmer. The claim is further clarified in figure 4 below.

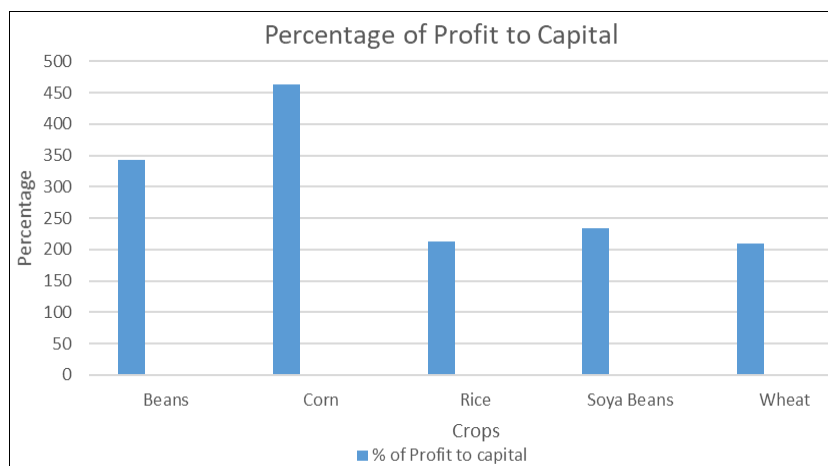


Fig 4: Percentage of Profit to Capital of a Cereal Farmer

Figure 4 gives a simple bar to demonstrate the percentage of profit to capital (expenditure) of a typical grain farmer. The chart shows that corn is the most lucrative with an income of over 450% profit to capital. This type of analysis is very important to help farmer stay afloat in his business and

make positive contribution to growth and development in agriculture.

The Application of Mathematics to Forecast and Project Revenue in Agricultural Investment

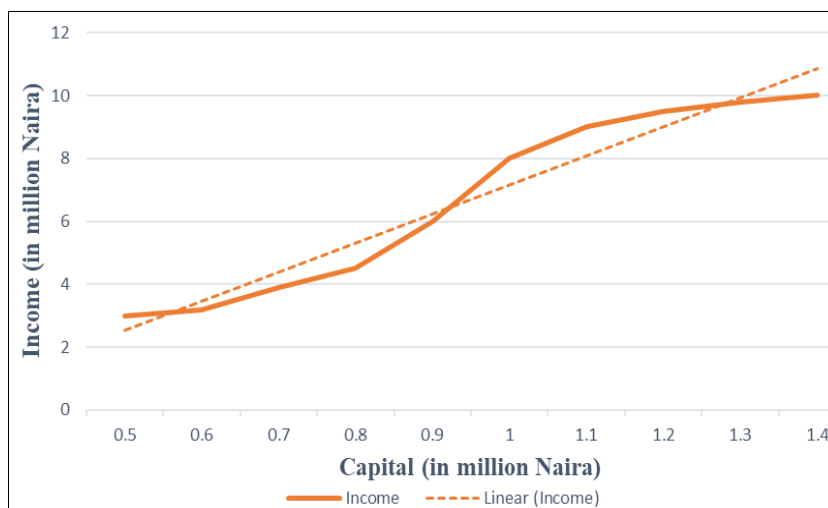


Fig 5: Projection of Capital and Revenue for Agricultural Projects

Forecasting and making projection correctly is one of the cause of decline in agricultural development. Simple graph of capital on the horizontal and income on the vertical is an example of how farmers can forecast their investments. The graphing of both capital and income make it possible to forecast the future using the trend line. Simply graphing of the input and output to forecast the outcome enable the farmers to properly work toward defined goals and offer inducement and intrinsic motivation which are very essential in successes of projects, including agricultural development projects. The trend line in figure 5 is a mathematical tool which farmers can use to predict the likely outcomes of their investments. Such predictions are capable of propelling the farmers to achieve higher productivity. This would in turn have positive impact on

agricultural development.

Conclusion

The success of agricultural sector implies the success of many other sector of the economy. This is because agriculture provide food that give energy and strength to operators of other segment of the economy. Agriculture equally produce raw materials for the local industries and also for export. When the number of people involved in agriculture and agro related trade, such as marketing of agricultural products are considered it become imperative to do all that is possible to promote agriculture and restore it to the rightful position as the leading GDP earner. It is in this cause mathematics should be used to plan and carry out agricultural activities efficiently.

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