

The role of AI in understanding consumer behavior in the utilisation of agrochemicals: A systemic review

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Abstract

Agribusinesses play a vital role in enhancing the agricultural sector through the supply of essential farming requisites such as agrochemicals. This study examined the role of artificial intelligence in the Nigerian agricultural sector and the impact of consumer behaviour on the agrochemical industry. The significance of agrochemicals in modern agriculture and the environmental challenges associated with their excessive use were reviewed. Furthermore, this study explored the application of Artificial Intelligence (AI) in understanding consumer behaviour and its implications for marketing strategies.

Keywords: Artificial intelligence; Agrochemicals; Understanding; Consumer behavior

1. Introduction

Agribusinesses play an important role in the development of a country's agricultural sector as suppliers of farming requisites such as fertilizer, agrochemicals, and feeds (Tersoo, 2014). The agrochemical industry in Nigeria falls into different categories such as insecticides, fungicides, and weedicides. Agrochemicals continue to be a significant and highly usable component in today's agriculture. The agrochemicals market is growing as the global economy recovers also becoming more prevalent. The agrochemical business is a highly competitive one due to a large number of agrochemical companies in Nigeria and they are distributing more than hundreds of agrochemicals under different trade names. Over the years agro-chemicals have sold themselves, but during the last decade, the market has become more competitive amongst local chemical producers as well as imported chemical products. There is a large market for agro-chemicals in Nigeria. It is estimated that the private sector agrochemical companies supply about 70 per cent of the total Crop Protection Products (CPP) demand approximately \$120 million (Pretty, 2012). The total CPP supply is usually composed of 30 per cent herbicides, 40 per cent insecticides, 15 per cent fungicides, 8 per cent growth regulators and seed treatment chemicals, and 7 per cent rodenticides, nematicides and others.

The need to understand the trends at which consumer utilizes agrochemicals is of great importance to the agricultural sector. The major reason why customers buy products and/or services is the value delivered. The realization of this fact has made marketers and marketing departments of firms pay attention to consumer value creation to retain customers' loyalty and capture potential customers through existing ones for profit maximization. Consumer behaviour research enables better understanding and forecasting not only of the subject of purchases but also of purchasing motives and purchasing frequency (Stavkova *et al.*, 2008; Raji, *et al.* 2020). One of the present fundamental presumptions for consumer behaviour research is the fact, that people often buy products not because of their main function but for their

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subjectively perceived value. Thus, today's role of the product exceeds its service limits. Even more often consumers do not rate products according to their cores, which means the main utility provided but above all according to the so-called real product, which means the particular products' qualities and the extended product, which represents the set of intangible factors bringing the demanded perceived advantage to the consumer. Thus, understanding the consumer purchase process is critical for a marketer to design marketing activities effectively (Stewart *et al.*, 2002; Raji *et al.* 2024).

Artificial intelligence has rapidly developed in recent years, and it is transforming how we perceive and understand marketing. AI is a resource given the advantages it has and will continue to have as long as we employ it properly. The main advantage is how well technology has impacted marketers' ability to examine and comprehend consumer purchasing behaviour (Saheed, 2022). To make their marketing plans and strategies more effective, marketers are researching how people behave online. The gathering of information on browsing habits, searches, and views has helped marketers better grasp the preferences of the target market. AI and marketing have been collaborating closely in recent years (Löwe, 2021). Agrochemical industries are quickly integrating artificial intelligence and machine learning. Technology is constantly evolving, and AI has undoubtedly altered marketing (Oke *et al.*, 2023). This study aims to review the role of AI in understanding consumer behaviour in the utilization of agrochemicals.

2. Overview of the Agrochemicals Used in the World

Agrochemicals are chemical formulations that are generally used to control pests, and pathogens, and supply nutrients to the soil. The use of agrochemicals (growth regulators, pesticides, and fertilizers) has increased the yield and growth of crops thus providing stability to agricultural production. The present population of the world is 7.2 billion which is supposed to increase to 9.3 billion by 2050 (Alexandratos and Bruinsma, 2012), which will raise the demand for food for survivability in the limited resources of agricultural land. A sustainable approach is required to meet the demand for food to a greater extent, despite facing challenges of decrease in farm sizes and environmental challenges. Currently, it has been estimated that about 25% of worldwide crop production is lost because of pests, diseases, and weeds, and in the control of pests and pathogens, traditional or easily available agrochemicals play an important role (Dalavayi *et al.*, 2021).

Modern agriculture depends heavily on the use of chemicals (Lutzenberger and Halloway., 2019; Seleiman *et al.*, 2020). About 50% of all agrochemicals used in Nigeria are herbicides compared to insecticides and fungicides which is about 17% (Itinal *et al.*, 1993). Herbicide reduces the drudgery that is associated with persistent weeds and chronic labour shortages (Ogwoche *et al.*, 2011). It has been estimated that every year, 150 million tons of fertilizers and millions of tons of pesticides are applied to crop fields globally with the only objective of increasing agricultural production (Abrol and Shankar., 2014). While there is evidence that the use of herbicides can increase yields in many crops (Gaba *et al.*, 2013), there is also evidence that most fungicides and insecticides do not help increase such yields (Lechenet *et al.*, 2017).

In the last few decades, extensive use of these agrochemicals might have led to the deterioration of soil which is one of the most severe consequences of traditional agriculture. Before the Industrial Revolution, agricultural practices were comparatively environment-friendly. The crop yield mainly depended on internal resources, including organic matter recycling and crop rotation, for the maintenance of soil nutrients, biological pest control, and buffer zones at the edges of the farm. These types of farming maintain a natural balance between agriculture and the environment. Hence, symptoms of environmental degradation were rarely evident. With the progress of modernization in agriculture, the environment-farming balance has been frequently broken because of ignorance of ecological principles. The modernization of agriculture has resulted in the enhancement of productivity, often at the cost of environmental quality. The excessive and long-term usage of synthetic fertilizers (containing N, P, and K) with organic fertilizer rigorously affects soil, their native microflora, texture and productivity of soil, soil-enzymatic activity, environments as well as human health (Zhang *et al.*, 2015).

3. Effects of Agrochemicals

The application of agrochemicals has amplified intensely causing several environmental problems (Arora *et al.*, 2018). Researchers identified the problems including, extensive nutrient leaching, groundwater pollution, eutrophication, biodiversity loss, and decline of essential soil microorganisms (Tiwari and Pal., 2022). The scientific fact is that millions of tons of synthetic chemical nutrients which are loaded into the soil every year are not completely absorbed by plants, even up to 50% of N and 90% of P were reported to run from agricultural fields and released into the atmosphere, surrounding lands or water sources causing the greenhouse gas production, severe eutrophication, and reduction of soil quality (Bashir *et al.*, 2020).

Due to the continuous use of agrochemicals in agriculture, appreciable quantities of degraded products and residues accumulate in the soil environment, which may pose severe risks of soil and food chain contamination (Mandal, 2020). The long-term application of agrochemicals often resulted in heavy metal contamination of the environment and food chain as well, which consequently resulted in health-related problems and diseases in humans (Nasreddine and Parent-Massin, 2002). According to research, agrochemicals are known to cause serious health hazards in humans and some pesticides are found to affect the human endocrine and immune system for promoting malignancy (Gangemi *et al.*, 2016). Chemical fertilizers and pesticides which are used in agricultural fields, get transmitted directly or indirectly into the crops and vegetables and potentially affect human health after consumption. For example, nitrate-containing water can immobilize a fraction of haemoglobin in the blood. Phosphate pesticides show symptoms of illness such as dizziness, headache, nausea, vomiting, skin rashes, eye irritations, and even skin cancer (Jayaraj *et al.*, 2016). Studies also reported that contamination of soil and water with toxic agrochemicals generally remains in small quantities and, therefore cannot be examined at the right time as their detrimental effects do not manifest in humans for a long time but ultimately lead to a severe pathogenic condition such as chronic kidney disease (Valcke *et al.*, 2017).

4. Utilization of agrochemicals

It was estimated that the world population has increased from 1 billion to 7 billion during the 20th century and scientists speculate about hitting around 9.2 billion by 2050 (Smith, 2011; Nageri, 2013). There is no doubt that global food security concern is the most important socioeconomic issue in recent times. Of note, due to the rapid growth of the human population and the ever-increasing demand for food supply, there was an urgent need to apply different chemical fertilizers in the limited agricultural land. Therefore, fertilisers have become one of the most important inputs in agricultural practice and production.

4.1 Overview of the Agrochemicals Market in Nigeria

Nigerian companies consume more than \$3.58 billion worth of chemicals per annum but produce just \$380 million (Neves *et al.*, 2011). The base chemical sector, which consists mainly of petrochemicals, accounts for over 70 per cent of the total chemicals market in Nigeria. It has been reported that there is a large market for agrochemicals in Nigeria. It is estimated that the private sector agrochemical companies supply about 70 per cent of the total Crop Protection Products (CPP) demand approximately \$120 million. The total CPP supply, he said is usually composed of 30 per cent herbicides, 40 per cent insecticides, 15 per cent fungicides, 8 per cent growth regulators and seed treatment chemicals, and 7 per cent rodenticides, nematicides and others.

Over the years, there has been little growth in the size (in quantity terms) of the CPP market. Researchers have been worrying that "the market and marketing of CPP in Nigeria are unorganised and not properly regulated. The trade deregulation has brought all kinds of traders into the CPP market, making it difficult to determine various market shares and sizes. Reports have revealed that the registered distributors supply to large-scale farmers either directly or through their local agents at the retail level. Thus, it is estimated that by volume, 60 per cent is sold to large-scale farms through direct sales by the companies and distributors and 40 per cent through government agencies and ADPs to small-scale farmers. The total export of the items covered under the purview of CHEMEXCIL to Nigeria during 2012-2013 had been \$90.3 million as against \$85.5 million during the corresponding period last year, registering a growth rate of 5.6 per cent.

4.2 The Concept of Consumer Behavior

Lee (2005) carried out a study to learn the five stages of the consumer decision-making process in the example of China. The researcher focuses on the facts that affect the consumer decision-making process on purchasing imported health food products, in particular demographic effects such as gender, education, income and marital status. The author employed a questionnaire method to reach the objectives of the research. Analysis of the five stages of the consumer decision-making process indicates that the impact of family members on the consumer decision-making process of purchasing imported health food products was significant.

Variola (2010) analyzed the influence of packaging on the consumer decision-making process for Fast Moving Consumer Goods. The research aimed to analyse the impact of packaging on the decision-making processes of low-income consumers in retail shopping. A survey method has been used to reach the research objectives. In a survey conducted in Star Hyper in the town of Centerville, 250 respondents participated. The research findings indicate that low-income consumers have more preferences towards premium packaging as this can also be re-used after the product has been consumed. However, the findings indicate that there is a weak relationship between product packaging and brand experience. However, it has been proven by the findings of the research that low-income consumers have greater brand

experience from the purchase of 'premium' products when compared to their experience from purchasing 'cheap' brand products.

5. The Role of AI Analysing Consumer Behavior

Artificial intelligence (AI) has become a powerful force in the era of digital transformation, significantly altering several aspects of marketing and consumer behaviour. Research on the influence of artificial intelligence (AI) on consumer behaviour is marked by a diverse array of studies that delve into the multifaceted implications of this technological integration. Olan *et al.* (2021) utilize the fsQCA technique to predict consumer behaviour, revealing a positive influence of AI on attitudes and knowledge-sharing. Chen *et al.* (2022) contribute empirical evidence, cautioning against potential information cocoons stemming from AI recommendations. of AI on attitudes and knowledge-sharing. Chen *et al.* (2022) contribute empirical evidence, cautioning against potential information cocoons stemming from AI recommendations.

Rohden and Zeferino (2023) focus on AI-driven recommendation agents and their impact on consumer perceptions of data privacy risk, emphasizing the role of consumer trust. Kumar *et al.* (2019) and Raji *et. al* (2024) explore personalized engagement marketing, highlighting AI's role in reshaping consumer engagement and predicting its impact on branding.

The intersection of AI and fashion evaluation is addressed by Sohn *et al.* (2021), who compare consumer evaluations of products generated by generative adversarial networks (GAN). Peng and Krutasaen (2022) shift the focus to ethnic clothing consumption, employing AI decision-making and the Internet of Things (IoT) to identify factors influencing consumer psychology.

Xian (2021) examines the adoption of AI in the leisure economy, introducing personal innovativeness as a determinant. Tchelidze (2019) and Raji *et.al* (2024) emphasizes the role of AI in digital marketing, underlining the skills required for effective utilization. The automation of services using AI in Industry 4.0 is discussed by Flavian and Casaló (2021), while Wei and Prentice (2022) explore AI-powered applications in the service profit chain.

6. Conclusion

The study concluded that agribusinesses play a vital role in enhancing the agricultural sector through the supply of essential farming requisites such as agrochemicals. The Nigerian agrochemical industry, comprising insecticides, fungicides, and weedicides, is substantial, with private sector companies supplying a significant portion of the demand. However, the excessive use of these agrochemicals has led to environmental concerns, including soil degradation and water contamination. Understanding consumer behaviour is crucial for marketers, and AI has revolutionized this process by enabling the analysis of factors influencing consumer choices.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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