

**DETERMINANTS TOWARDS INTENTION TO
USE OF SMART MOBILE LEARNING SYSTEM
ON PESTICIDE MANAGEMENT AMONG
NIGERIAN RICE FARMERS**

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UNIVERSITI SAINS MALAYSIA

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NIGERIAN RICE FARMERS**

by

HAMZA AMINU

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LIST OF ABBREVIATIONS

BI	Behavioral Intention
CHAT	Cultural Historical Activity Theory
CMB	Common Method Bias
DOI	Diffusion of Innovation
DV	Dependent Variable
DW	Deutsche Well
ECT	Expectation Confirmation Theory
FAO	Food and Agricultural Organisation of United Nations
FC	Facilitating Conditions
FI	Farmer's Image
FT	Flow Theory
HM	Hedonic Motivation
HT	Habit
IS	Information System
IV	Independent Variable
JR	Job Relevance
MGB	Goal-Based Behavioural Model
MM	Motivational Model
MPCU	Model of Personal Computer (PC) Utilization
NBS	National Bureau of Statistics
NCC	Nigeria Communication Commission
OQ	Output Quality
PDA	Personal Digital Assistant

PEOU	Perceived Ease of Use
PLS	Partial Least Square
PU	Perceived Usefulness
PUV	Perceived Ubiquitous Value
PV	Price Value
RD	Result Demonstrability
SDT	Self-Determination Theory
SEM	Structural Equation Modelling
SMLS	Smart Mobile Learning System
SN	Social Norm
SCT	Social Cognitive Theory
TAM2	Technology Acceptance Model 2
TRA	Theory of Reasoned Action
TTF	Task Technology Fit
TCMM	Time Continuum Model of Motivation
TPB	Theory of Planned Behaviour
TR	Trust
UTAUT2	Unified Theory of Acceptance and Use of Technology 2
WHO	World Health Organisation

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**PENENTU TERHADAP NIAT PENGGUNAAN SISTEM PEMBELAJARAN
MUDAH ALIH PINTAR UNTUK PENGURUSAN PESTISIDA DALAM
KALANGAN PESAWAH DI NIGERIA**

ABSTRAK

Walaupun penggunaan sistem pembelajaran mudah alih semakin meningkat di seluruh dunia, penggunaannya di kalangan petani padi Nigeria untuk pengurusan racun perosak adalah sangat rendah, disebabkan oleh isu kebolehgunaan, kos, manfaat yang dirasakan, keadaan yang memudahkan, isu sosial, tabiat dan kepercayaan. Oleh itu, masih terdapat kurangnya pemahaman tentang faktor-faktor yang mempengaruhi niat tingkah laku mereka untuk menggunakan sistem. Oleh itu, matlamat penyelidikan ini ialah untuk mengkaji niat tingkah laku petani Nigeria dalam menggunakan sistem “Smart Mobile Learning System” (SMLS) bagi latihan pengurusan pestisid. Kajian ini mengamirkan dua teori: (1) Teori Bersatu Penerimaan dan Penggunaan Teknologi 2 (UTAUT2) dengan (2) Model Penerimaan Teknologi 2 (TAM2). Kajian ini menggunakan sampel “proportionate cluster” untuk petani di timur laut Nigeria. Sampel terdiri daripada 356 petani yang mempunyai pengalaman menggunakan peranti mudah alih pintar dan aplikasi pestisid. Data dikumpulkan secara peribadi melalui soalan oleh penyelidik dan pembantu-pembantu beliau. Model ini diuji menggunakan perisian SmartPLS 4. Kajian menunjukkan sebanyak 31% daripada niat tingkah laku untuk menggunakan SMLS dijelaskan oleh model yang diubahsuai. Hasil kajian mendapati, “Social Norm” secara signifikan mempengaruhi “Behavioural Intention” (BI) bagi menggunakan SMLS, manakala “Farmer's Image”, “Output Quality”, “Results Demonstrability”, dan “Job Relevance” pengaruh yang signifikan kepada “BI” untuk digunakan didalam “SMLS” pada tahap “Perceived Usefulness”.

Hasil kajian juga menunjukkan bahawa “Perceived Ease of Use” memberi kesan yang signifikan kepada “Perceived Usefulness”. Di samping itu, kajian ini juga mendapati kesan pengendalian adalah signifikan terhadap “Trust” pada “Facilitating Conditions”, “Price Value”, “Perceived Ease of Use” dan “Habit” BI untuk menggunakan “SMLS”. Kajian ini adalah unik kerana ia memberikan pandangan baru tentang faktor-faktor pendorong di sebalik BI untuk menggunakan SMLS dalam pengurusan racun perosak dari perspektif petani padi dalam industri pertanian di Nigeria, dan membolehkan ujian serta pengesahan UTAUT2 dan TAM2 yang diselaraskan dalam konteks penyelidikan yang berbeza. Kajian ini telah menyoroti betapa pentingnya membina kepercayaan petani dalam menggunakan sistem SMLS. Justeru, hasil daripada kajian ini, Kementerian Persekutuan Pertanian dan Pembangunan Rantau (FMARD) mungkin perlu memikirkan penggunaan SMLS kepada kumpulan sosial petani segera seperti Persatuan Petani Rice Nigeria (RIFAN), dan agensi-agensi pertanian dapat menarik para petani dalam menggalakkan penggunaan SMLS.

**DETERMINANTS TOWARDS INTENTION TO USE OF SMART MOBILE
LEARNING SYSTEM ON PESTICIDE MANAGEMENT AMONG
NIGERIAN RICE FARMERS**

ABSTRACT

Although the use of mobile learning system is increasing globally, its utilising among Nigerian rice farmers for pesticide management is very low, due to usability issues, cost, perceived benefit, facilitating conditions, social issues, habit and trust. Therefore, there is still lack of understanding of the determinants that influence their behavioural intention to use it. Accordingly, the objective of this study is to examine the determinants of Nigerian rice farmers Behavioural Intention (BI) to use SMLS on pesticide management, using a harmonized framework of Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and the Technology Acceptance Model 2 (TAM2). Analysis was conducted on 356 cluster sampled survey using SmartPLS 4. The results revealed, Social Norm significantly influenced the BI to use SMLS, while Farmer's Image, Output Quality, Results Demonstrability, and Job Relevance significantly influenced the BI to use SMLS at the Perceived Usefulness level. Perceived Ease of Use also significantly influenced Perceived Usefulness. While trust has significant moderating effect on Facilitating Conditions, Price Value, Perceived Ease of Use, Habit and BI to use SMLS. The model explained 31% of the BI to use SMLS. This study is unique in that it brings new insights on the driving forces behind the BI to use SMLS on pesticide management from the perspective of rice farmers in the agricultural industry of Nigeria, and allows for the testing and validation of the harmonized UTAUT2 and TAM2 in a different research setting. For

practitioners, the results highlight the significance of building farmers' trust in the application of SMLS. Secondly, the Federal Ministry of Agriculture and Rural Development (FMARD) may need to think about using the farmers' immediate social groups such as the Rice Farmers Association of Nigeria (RIFAN), in order to reap the benefits of their influence on the farmers' intention to use the SMLS.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This introductory chapter presents the study's background, problem statement, objectives of the study, as well as the scope of the study and its significance. Furthermore, operationalization of some very essential concepts that were used in the study has also been provided in order to make the research study more clear.

1.2 Background of the Study

The aim of this research is to find out what factors influence Nigerian rice farmers' behavioural intention to use Smart Mobile Learning System (SMLS) for pesticide management training and learning. Some studies on mobile learning acceptance have been carried out, as stated in the literature review portion of this study. However, before this study, rice farmers' behavioural intention to use SMLS, on pesticide management was unknown. In order to reduce the risk of pesticide poisoning, Nigerian rice farmers need to have the knowledge on how to manage pesticides appropriately. Farmers resort to the use of pesticides in a bid to control negative effects of undesired species on cultivated plants (Oesterlund et al., 2014). On the other hand, pesticides used incorrectly cause poisoning (Ntow et al., 2006). This happens because small-scale farmers do not understand how to apply and manage pesticides effectively (Jors et al., 2006). According to Adekunle et al. (2017), this is due to "lack of formal pesticide usage training, insufficient extension services, inadequate education, and safety mechanisms." Literature has revealed that ignorance affects how pesticides are applied (Pan, Ren & Luning, 2021). Consequently, training is required for farmers who

use pesticides in their farming operations... (Sabran & Abas, 2021). Therefore, in order to reduce the risk of pesticide poisoning, Nigerian rice farmers need to have the knowledge on how to manage pesticides appropriately.

One solution to the aforementioned rice farmers' problems is to employ smart mobile learning system, and teach the rice farmers how to properly manage pesticides in order to avoid poisoning. Sarrab (2015) defines mobile learning system as learning offered to learners via mobile devices like smartphones PDAs, and cell phones. The widespread availability of mobile handheld devices, and their relatively inexpensive price have created new opportunities for utilizing the strength and 'universality' of mobile devices to enhance learning and broaden educational opportunities (Iqbal & Bhatti, 2015). Smart Mobile learning is now changing the training and learning process of the rice farmers. The type of training to be provided with the SMLS is not a one-time training, but a constant one. Therefore, rice farmers will receive continuous training on how to handle pesticides in their farming activities via the smart mobile learning system.

The SMLS is a smart mobile phone-accessible, on-the-go platform, that functions both online and offline. Online learning materials on pesticide management can be downloaded from the Federal Ministry of Agriculture and Rural Development's (FMARD) database, into the rice farmer's mobile device while internet connection is available. This is to make sure that learning can continue without interruption using the resources on the rice farmer's mobile device, even if there is no internet connection. The SMLS is user-friendly it has very simple and easy to use navigation features. Smart mobile learning systems provide accessible resources wherever you are at any location, strong search capabilities, rich interaction, and powerful support for effective

learning. The SMLS allows rice farmers to review pesticide management techniques that will enable them to make informed decisions and have access to information and services that will increase their yield, without the risk of pesticide poisoning. It also has an inbuilt feedback function which allows rice farmers to send enquiries and receive responses to and from experts at the FMARD. Rice farmers and extension agents can discuss problems and difficulties while using the app to look for solutions. Therefore, rice farmers and extension agents will be in a good position to find and access information on pesticide management utilizing contemporary technology at our various locations with the help of this SMLS.

In this our active Mobile Learning atmosphere, technology has made several great advances to transmit knowledge at any point in time and location (Houlden & Veletsianos, 2019). ‘M-learning can also give just- in- time information where Nigerian farmers can actually access information at the place and time that they need it’ (Boyinbode, & Akintola, 2008).

Mobile learning is a contemporary trend in which one can gain access to learning content via a mobile device. The ease of learning associated with mobile learning, may have a variety of advantages, including increased reach, greater acceptance, better presentation, and advanced material assimilation, all of which contribute to the establishment of a new apex of online learning atmosphere (Swain, 2021). To compete favorably and effectively in global business and economy, developing countries should embrace digital technology. Essentially, in the field of education, developing nations should key into the 21st-century digital technology to greatly enhance and increase learning (Olanrewaju & Ikuereye, 2019). With mobile devices learners can access a wide range of educational content. This could benefit

people who previously would not have had access to it. Mobile Learning is capable of reaching those who live in distant areas without access to schools, or trainers (Ally, 2009). Accordingly, rice farmers who live in remote villages with no access to any formal education, can enjoy the services of the Smart Mobile Learning System to equip themselves with the requisite knowledge on pesticide management. One of the most significant qualities of mobile learning system is ubiquity, which allows learners to access technology from any location at whatever time, for learning while on the go (Sabah, 2016).

According to statistics, the number of people using mobile handheld devices and wireless networks is growing (Yadegaridehkordi & Iahad, 2012). Based on BankMyCell statistics, in 2022, there are currently 6.648 billion persons worldwide who own mobile handheld devices (see Figure 1.1), this indicates that presently 83.72 % of the population in the world owns smartphones (BankMyCell, 2022). The report further stated that, a total of 7.26 billion individuals have ‘smart or feature phone’, accounting for 91.54 percent of the population of the world. With regard to Nigeria, Mobile technology is also rapidly advancing, according to statistics from the Nigerian Communication Commission (NCC), Nigeria has 224.7 million mobile customers as of March 2024 (NCC, 2024). With this high number of mobile subscribers, it is obvious that many people are using smart mobile handheld devices, therefore using these devices by rice farmers to acquire knowledge on pesticides management, in order to curtail the issue of pesticides poisoning will not be an issue.

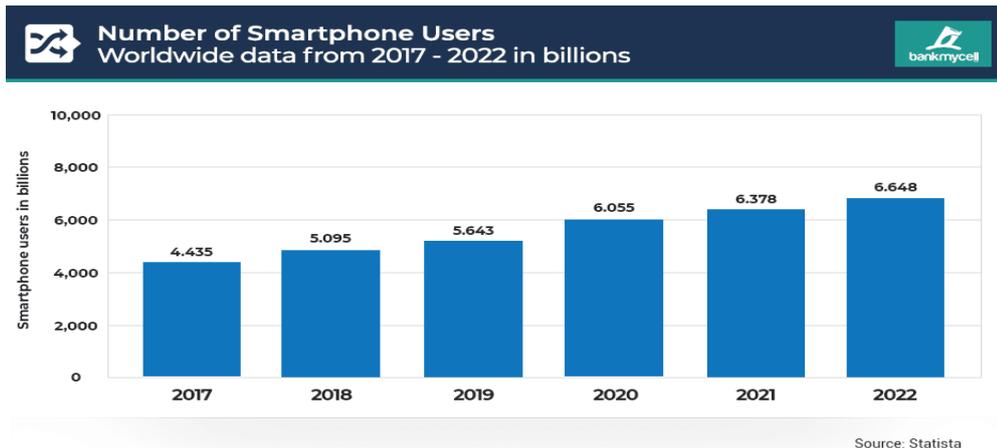


Figure 1.1 Worldwide Number of Smartphone users in 2022

Source: (BankMyCell, 2022).

In addition to the high rate of mobile subscribers, several Information & Communication Technology initiatives have been implemented by the Nigerian government, in order to lay a solid foundation and enable learners to access mobile learning (Edewor, 2023). Similarly, in Nigeria, the use of mobile devices by instructors and their students in the education industry has significantly increased (Agbi & Sengsri, 2021). Therefore, The revolutionary trend of Smart Mobile Learning System as a modern way of learning, which provides flexibility has been in Nigeria for a while in other sectors of the economy especially the education industry. For instance, there are several mobile learning systems that are being tested at various tertiary institutions in Nigeria, for example; at federal polytechnic Ile-Oluji (Iwayemi, Adegboye & Olowokere, 2021), and Collaborative Mobile Learning Environment (C-MOLE) (Akhigbe, Ogbonnaya & Owolabi, 2021). Mobile Learning initiative for Classroom Management in Usmanu Danfodiyo University (Abubakar, 2024).

On the other hand the agricultural industry is lagging behind in terms of using SMLS for agriculture-related knowledge. Therefore, there are very few mobile

learning initiatives in Nigeria that are specifically targeting farmers in the agricultural sector. Some of these few initiatives include; the East-West Seed Knowledge Transfer Foundation (EWS-KT) which brought a mobile learning project in Nigeria in 2020, in order to educate farmers who lacked access to field activities and other extension services on the fundamentals of vegetable production. According to the EWS-KT's result of the training, 89 percent of the farmers who attended the training were able to finish their course and receive certificate, with 88% of them receiving the best grade (EWS-KT, 2020). EWS-KT further stated that this result suggests that this enjoyable method of training is ideal for farmers in northern Nigeria. The Nigerian government had in 2021, also introduced a voice-activated interactive technology-based mobile learning tool for farmers across the nation. This initiative's main aim is to offer support systems that close information gaps, and to keep farmers' physical classroom involvements within the bounds of the "new normal." The platform is crucial especially for the officials who had to navigate through bushes, villages, and towns to complete their training tasks (Nnodim, 2021).

Despite some of the advantages of smart mobile learning, for the majority of Nigerians, internet price and accessibility is frequently a significant barrier to mobile learning (Ajayi, Ayo & Olusanmi, 2019; Iwayemi, Adegboye & Olowokere, 2021). The rice farmers are not spared from this. Other issues listed by Olanrewaju and Ikuereye, (2019) include negative attitude towards mobile learning, lack of trained manpower and inadequate skills to manipulate the mobile learning tools. Weak Internet connection, and inadequate phone memory are also identified as some of the issues with mobile learning use in Nigeria (Akhigbe, Ogbonnaya & Owolabi, 2021).

Furthermore, the development of the mobile learning system depends on whether the users will accept it or not (Ismail et al., 2016). The decision on whether to employ the services of mobile learning system or not is a complicated process, as there are numerous factors that influence this decision. Although the usage of mobile learning is increasing globally, there is still lack of understanding of the determinants that influence the behavioural intention to use the system in society, especially in developing nations (Arain et al., 2019). For that reason, research scholars need to continually advance the development of mobile learning by looking into issues like, what are the factors that influence rice farmers' behavioural intention to use the mobile learning system. More research into this aspect has the prospective to improve overall acceptance and readiness to use mobile handheld devices for learning (Fagan, 2019). Therefore, in order to assist towards the behavioural intention to use the system, it is important that a study is conducted to explore the predicting factors that will influence the behavioural intention of the Nigerian rice farmers as users of the Smart mobile learning system on pesticide management to accept it. This study is very necessary because the viewpoints of the rural farmers in Nigeria have been mostly ignored in scholarly researches, thereby making their needs not fully addressed in published research (Che et al., 2020). This study therefore, examines the behavioural intention to use smart mobile learning system that facilitates the rice farmers' learning process on agricultural activities with particular reference to pesticide management, to support the development of a sustainable farming in Nigeria.

Despite the fact that Mobile learning system provides learners with tremendous prospective abilities (Al-adwan et al., 2018a), various issues continue to impede its usage. One of such issues is the provision of facilitating conditions. When implementing new technologies such as Mobile learning applications, suitable

resources are required because insufficient IT resources and infrastructure can hinder its acceptance (Almaiah, 2021). Furthermore, enabling conditions such as technical support and training are critical for the behavioural intention to use technology (Ahmed & Kabir, 2018). As a result, this study explores its influence on Nigerian Farmers' Smart mobile learning system acceptance. Learner behavioural intention to use mobile learning technologies is also frequently hampered by issues of perceived usefulness (PU) and perceived ease of use (PEOU) (Merhi et al., 2019). Usability issues, according to Kukulska-Hulme (2007), include: physical characteristics of mobile handheld devices, such as tiny screens, insufficient memory, and limited lifespan of battery; limitations of software application and content, absence of 'built-in' functions, difficulty of installing programs, and differences in applications and usage scenarios; and network reliability and speed.

In addition, excessive pricing, privacy, and trust (Fagnant & Kockelman, 2015), are the new issues that are preventing people from using technology (Liljamo et al., 2018). The extra costs associated with mobile learning system must be considered. A significant amount of money will be invested in mobile learning system at first to cover infrastructural, training, mobile devices, content creation, and testing costs (Kant, 2012). On the other hand, studies have confirmed that habit has a strong influence on behavioral intention to accept mobile learning system (Moorthy et al., 2019; Nikolopoulou et al., 2021). However, the difficulty of how to represent technology habits and behaviors is a recurring issue in studying habit (Bayer & LaRose, 2018). Another impediment to the acceptance of mobile learning is social norms (Almaiah et al., 2016). Social norm (SN) issue relates to, a person's impression of executing a given conduct 'under social pressure' or in a specific social context (Lin et al., 2020). There are ethical and practical issues such as learner reluctance to change,

concerns regarding the impact of new social habits on learners' personal time; and an increase in the amount of data to be retained on the learner's device (Cushing, 2011). Mobile learning system also has social restrictions, like issues related to cost and accessibility, frequent device model changes, and learner distraction (Part, 2011). Therefore, this study investigates to see how the SN influences the behavioural intention to use Smart mobile learning system among Nigerian rice Farmers.

Hedonic motivation is a critical aspect for the hedonic system, as it has a significant impact on the BI of using it. Nonetheless, the impact of this variable concerning perceived enjoyment on BI is a subject of debate among academics, with inconsistent findings (Wu & Lu, 2013). Hence, the need to further investigate its influence on the behavioural intention to use smart mobile learning system among rice farmers. Furthermore, mobility (also known as ubiquitous value), personalization, and portability, according to study, are the most critical issues to overcome in order to increase Mobile learning application acceptance (Yuan & Zhang, 2003). Time and location constraints also impede the behavioural intention to use mobile technology.

1.2.1 Overview of Agricultural Industry in Nigeria

Nigeria, is a country that is located on the western coast of Africa with an estimated population of 225,954,000 in 2021, the country has a diverse geography, with three major tribes (Hausa, Yoruba and Igbo), the country is blessed with ample natural resources, especially the petroleum products (Falola, 2022). The author further revealed that Nigeria is bordered by Niger to the north, Chad and Cameroon to the east, the Gulf of Guinea of the Atlantic Ocean to the south, and Benin to the west (see Figure 1.2).

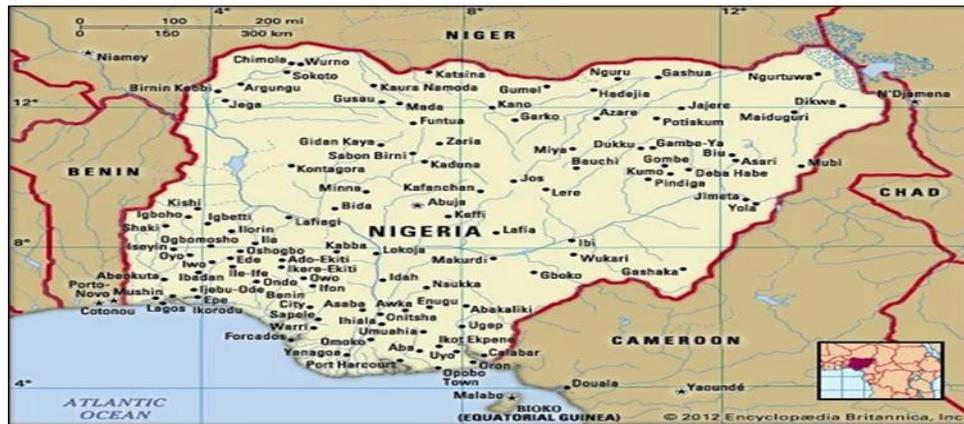


Figure 1.2 Map of Nigeria

Agricultural output provides a living for roughly one-fifth to one-half of all Nigerians. The northern Nigeria's major crops are grains and legumes such sorghum, millet, cowpeas, corn (maize), and rice. Peanuts (groundnuts) and cotton are also grown in northern Nigeria. The economic diversification of the Nigerian Government has given the agricultural sector a boost, as Agriculture is now a major activity contributing to the Nigerian economy after oil. For millions of Nigerians, farming and other agricultural pursuits have become a source of income, especially in the Northern part of the country where the soil is more fertile and suitable for farming. Consequently, the agricultural sector now makes significant contribution to the Nigeria's GDP. According to the National Bureau of Statistics [NBS] the contribution of the sector in the first quarter of 2021 was 22.35% to the total GDP of the country (NBS, 2021). Furthermore, the Food and Agricultural Organisation of the United Nations [FAO], reported that more than 70% of Nigerians work in the agriculture industry, primarily for subsistence (FAO, 2022).

1.2.2 Pesticide Poisoning

In spite of the agricultural sector's importance and contributions to Nigeria's economic progress, the Nigerian rice farmers are seriously being affected by issues of pesticide poisoning in the conduct of their agricultural activities. According to Osibanjo, (1994).Pesticides are still used in Nigeria because of their great effectiveness. However, Namiki et al. (2013), stated that pesticides that are for agricultural purposes have been linked to a variety of ecosystem ailments. Pesticides are typically environmentally stubborn and poisonous; mostly unchanging and live in the ecosystem for long period of time, and they are harmful (Ukalska-Jaruga et al., 2020). Pesticide poisoning kills between 200,000 and 300,000 people worldwide each year, with the bulk of the deaths taking place in developing nations (Sekiyama et al., 2007). Pesticide poisoning poses a very great challenge to the Nigerian rice Farmers as it affects human beings, animals as well as the environment. The consequences of this predicament on the environment and human are clear, as a recently reported incidence by a German satellite television, the Deutsche Well (DW), revealed that Pesticides in a neighboring river had poisoned hundreds of people in Benue State, Nigeria (DW, 2021). The report further stated that, at least 270 individuals died and many became ill after drinking pesticide-contaminated water. Adekunle et al. (2017) blamed this to the 'lack of formal training in pesticide use, poor extension services, inadequate education and safety systems'. Pesticides are widely used in Nigeria because nearly everyone is a farmer of some sort, therefore to successfully address the challenges associated with pesticide usage, and abuse in the country, we must first educate the users (Joshua, 2016).

In spite of the struggles to educate farmers about the consequences of using pesticide, farmers are not willing to change this is because the authorities are in short

of resources to follow them (Hall, 1999). Accordingly, it is obvious that these problems are mainly due to the lack of appropriate agricultural information and innovations accessible to the farmers. Farmers' learning on proper pesticides management can be extended, improved, supported, and facilitated using smart mobile learning system. Mobile handheld device innovation allows learners to access educational resources, according to (Chye et al., 2014). SMLS use by the rice farmers can tackle that issue of lack of knowledge on how they can manage the pesticides, in order to avoid poisoning. Hence, there is need for study to investigate the determinants of the SMLS among rice farmers.

1.2.3 Pesticide management

Pests, diseases and Weeds cause rice farmers' crop yield to be lost each year. That is why farmers cannot do without pesticides in order to control those pests, diseases and weeds in their farms to increase their farming yield. As such, they resort to using different types of pesticides which in most cases if not properly used and managed, results to pesticides poisoning with serious attendant consequences. Thus, effective management of these pesticides is very crucial for the rice farmers in Nigeria. Accordingly, rice farmers must have a comprehensive pesticides management knowledge to prevent pesticides' poisoning related illnesses, make informed decisions, and obtain high-quality harvests.

According to the world health organization (WHO) 'Pesticide management involves the regulatory control, proper handling, supply, transport, storage, application, use and waste management and disposal of pesticides to minimize adverse environmental effects and human exposure' (WHO, 2005). Based on this definition, pesticides management entails all the necessary measures taken to limit the negative

outcome of pesticides on human being, plants and animals as well as the environment, through appropriate official guidance, responsibly treating, storing, using, managing pesticides containers which now becomes waste, and disposing empty pesticides containers. Adhering to this effective pesticides management techniques limits the risks of pesticides poisoning being experienced among farmers. In a situation where pesticides poisoning occurs due to negligence, the smart mobile learning system equipped the rice farmers with information on how to handle the poisoning before seeking medical attention.

1.2.4 Current Trends of Pesticide Management

Currently the Nigerian government is using the agricultural extension officers to provide training to the rice farmers on pesticide management. The process involves sending agricultural extension agents to engage and educate the rice farmers at their various locations (Mojeed, 2021). However, the extension workers' conventional methods of training do have significant drawbacks, particularly in Nigeria. The ratio of extension workers to farmers is estimated to be one extension official for every 10,000 (1:10000) farmers in Nigeria (Falaju, 2021). When compared to the Food and Agricultural Organization (FAO) of the United Nations benchmark of one extension agent for every 800 farmers (1:800), Nigeria's ratio of extension workers to farmers is gravely deficient and worrisome (Sennuga, 2019). Therefore, direct communication between rice farmers and extension agents is challenging due to the wide gap in the current ratio, which makes it impossible to successfully meet the rice farmers' growing knowledge needs. As a result, the extension agents are unable to efficiently and promptly visit every rice farmer because they are not adequate enough.

Furthermore, most of the training programmes provided by the government span for a very short period of time. For instance, a one-day farmers training programme organised by the Nigeria Institute of Soil Science (Akinfenwa, 2021), Pesticide poisoning still lingers in Nigeria, due to lack of adequate extension services to train the farmers (Adekunle et al., 2017). Therefore, there is need for a constant and continuous training programme for these rice farmers. Lack of proper pesticides management techniques by rice farmers is adversely affecting the farmers through pesticides poisoning. Accordingly, researchers have come up with various pesticide management strategies in order to curtail the negative effect of this menace as summarized in Table 1.1.

Table 1.1 Current Trends of Pesticide Management

Author(s)	Pesticide Management Technique
Nehra et al. (2021)	Development of nanotechnology-assisted formulations, which include nano-formulations of pesticides and nano-pesticides, which have the potential to offer increasing benefits and fewer side-effects for management of pesticide residues.
Becker et al. (2021)	'Liquid Chromatography coupled to Quadrupole-Time of Flight mass spectrometry (LC-QTOF MS)' to examine and identify some pesticides in the sample of surface waters obtained from Paraguay and Brazil in order to prioritize on the stubborn ones
Umapathi et al. (2021)	Colorimetric based on-site sensing strategies for the rapid detection of pesticides in agricultural foods
Majdinasab et al. (2021)	Non-enzymatic (bio)sensors for detection of pesticide residues
Cros et al. (2021)	Pesticide use reduction through the use of pest monitoring networks that provides information for decision making as to whether or not to apply pesticides
Kalantary et al. (2021)	Using Monte Carlo simulation for detection and removal of pesticides from the surface water
Tang et al. (2020)	A simulation model to reduce the amount of pesticides released into the surface water. The model is used in the estimation of the fractions of pesticides emitted into the air (fair), surface water (fsw), and the fractions that leach vertically (fv1) applied in paddy fields for life cycle assessments (LCA).
Fisher et al. (2021)	Pesticides use and application on agricultural/horticultural land use areas that is coordinated with state and local agencies. They dug wells to monitor groundwater conditions (water quality and groundwater levels) regularly either by the U.S. Geological Survey (USGS) or the Suffolk County Department of Health Services (SCDHS). Each well is finished with a slotted screen in the upper part of the surficial aquifer (upper glacial aquifer). They collect and analyse samples from the wells through which identified pesticides are treated.
Rodríguez-Lizana et al. (2021)	Geostatistical simulation with spatial crown volume characterization to reduce the amount of pesticides applied in agricultural treatments performed with air-assisted sprayers.

Table 1.2 *Continued*

Li & Niu (2021)	First-order-kinetics-based screening model to evaluate the steady-state concentrations of pesticides in surface soils while considering degradation, volatilization, plant uptake, and precipitation processes.
Li (2021)	A screening-level regulatory framework that derives pesticide soil standards (PSSs) while considering the multiple uses of residential soil. The screening models simulate the risk from exposure to soil pesticides via direct and three major indirect (i.e., tuber crops, animal-sourced food, and groundwater) exposure pathways. Based on these models, the researcher derived PSSs for five types of residential soil.
Zhao et al. (2021)	Design, fabrication and functional verification of a novel, portable and automatic dual-readout device for carbamate pesticides detection applications with low detection limits. This device integrated a 3D printed, low cost and disposable microfluidic chip to deliver nanomaterials and pesticides samples.

Source: Researcher

1.3 Problem Statement

Smart Mobile Learning System represents a groundbreaking advancement in the agricultural industry. It also fosters digital literacy, enabling learners to use resources effectively in environments with limited resources (Vasuthevan, Vaithilingam & Ng, 2024). Ideally there is supposed to be adequate literature on the behavioural intention of rice farmers to use mobile learning especially from developing countries, but the review of the current literature has proven otherwise. Meaning that, the level of rice farmers behavioural intention to use this system for learning from the perspective of developing nations has been inadequately addressed in existing literature. This is evident because there is a Lack of studies in African countries like Nigeria. Most studies on behavioural intention to use mobile learning focus on Asia and Europe (Alsharida, Hammood, & Al-Emran, 2021; Valencia-Arias, 2024), creating a gap in knowledge regarding behavioural intention to use in African countries like Nigeria. Likewise, majority of the studies on behavioural intention to use mobile learning focus on the education industry, using students and instructors as respondents (Al-Rahmi et al., 2021), neglecting the rice farmers' population which clearly indicate the existence of a research gap. Consequently, the viewpoints of the

rural farmers in Nigeria have been mostly ignored in scholarly researches, thereby making their needs not fully addressed in published research (Che et al., 2020).

Rice farmers are supposed to be very knowledgeable on how they can responsibly handle, store, use, manage pesticides containers which become waste, and dispose them, in order to avoid the issue of pesticide poisoning. However, access to Agricultural information has been identified as one of the obstacles that these farmers face (Baumüller, 2012; Nwajiuba, 2012). According to a recent survey, majority of the farmers lack professional training or knowledge on how to use pesticides safely and effectively, thereby jeopardizing the health and lives of millions of Nigerians (Emmanuel, 2022). Therefore, farmers in Nigeria require learning and training in order to keep themselves abreast with latest agricultural information and skills (Fidelugwuowo, 2020). This has further been acknowledged by Ele et al. (2021) stating that “in this digital age, there is an urgent need for stress-free accessibility and operational use of agricultural information by rural farmers or agriculturists”. With the widespread use of mobile devices, Smart Mobile Learning System, is one such system that is implanted with the learning application, that can be used to address the educational demands of Nigerian rice farmers on pesticide management. Regardless of this trend, the problem is that farmers have yet to accept information system solutions (Fatusin & Oladehinde, 2018). Even with the widespread use of mobile devices, and that mobile learning systems have been heavily invested in, its utilising among learners is very low, and there is still significant room for improvement (Šramová, 2023).

Currently, only developed countries and Asia have seen such widespread adoption of SMLS, which includes higher behavioural intention to use it for

agricultural knowledge. However, in developing nations like Nigeria, this acceptance is relatively low. Although the usage of mobile learning is increasing globally, there is still lack of understanding of the determinants that influence the behavioural intention to use the system in society, especially in developing nations (Arain et al., 2019). Furthermore, the influence of factors pertaining to user behaviour and surroundings, may differ on how learners view and feel about mobile learning (Alfalah, 2023). Additionally, there is currently minimal research on farmers' acceptance of agriculture-related technologies like apps imbedded mobile devices (Barnes et al., 2018). Therefore, in order to assist towards the behavioural intention to use the system, it is important that a study is conducted to explore the determinants that will influence the behavioural intention of the Nigerian rice farmers as users of the Smart mobile learning system on pesticide management to use it. Based on Akbari et al. (2020a), there are “insufficient in-depth discussions of intention to use from the potential user perspective” (p. 10). Notably, there are few empirical studies on the factors that influence behavioural intention to use mobile learning (Al-adwan et al., 2018). Therefore, there is still lack of understanding of the determinants that influence their behavioural intention to use the system. Hence, exploring the factors that influence the rice farmers' behavioural intention to use the smart mobile learning system for their learning and training on pesticides management is needed.

Despite the fact that Mobile learning system provides learners with tremendous prospective abilities (Al-adwan et al., 2018a), various issues continue to affect the behavioural intention of users to utilise it, to improve teaching and learning (Jinot, 2019). Numerous researchers of Information System are up to now working on identifying the factors that predict the behavioural intention to use mobile learning, which is one of the most burning issues (Almaiah et al., 2016; Al-Emran et al., 2018).

The most pressing issues about IS mobility is whether the existing theories are still appropriate or require some changes to match the ubiquitous design of mobile IS (Yuan et al., 2010). Some of the distinct problems and opportunities presented in the context of mobile technologies are mobility, personalization and portability (Yuan & Zhang, 2003). Hedonic motivation is a very important factor for hedonic system, as it significantly influences BI of using hedonic system. Nevertheless, the influence of perceived enjoyment on BI is a subject of debate among scholars, as they have contradictory findings (Wu & Lu, 2013).

Most importantly, Perceived usefulness (PU) and Perceived ease of use (PEOU), according to TAM, represent issues that affect the acceptance of any IS (Davis, 1989). This issue has also been reiterated by a recent study which states that, Perceived usefulness (PU) and Perceived ease of use (PEOU) of Mobile learning technology are prevalent barriers to learner acceptance of the learning system (Merhi et al., 2019). More so, inclination to automatically utilize technology for learning is an example of Habit behavior (Lankton et al., 2010). The dilemma of in what manner to describe technology habits, and also the behaviors is a recurrent issue in studying habits (Bayer & LaRose, 2018). Additionally, facilitating conditions like technical support and training are very vital in technology acceptance (Ahmed & Kabir, 2018). In view of that, it has been stated that when learners migrate to mobile learning they encounter some technical issues (Iqbal & Qureshi, 2012), which hinder the acceptance of mobile learning by learners. User interfaces that are not user friendly, tiny sizes of screen, inadequate bandwidth, limited lifespan of battery and inadequate memory are just a few of the technical issues (Huan et al., 2015). Other roadblocks that affect the acceptance of Mobile learning can be technological or otherwise in nature, like, network coverage, capability of the device, social influence, facilitating conditions,

and so on (Almaiah et al., 2016). A number of new issues have also emerged, that hinder the use of technology (Liljamo et al., 2018), including excessive prices, privacy, and trust (Fagnant & Kockelman, 2015).

Although perceived ubiquitous value is a crucial component of mobile services acceptance, it has received very little attention from researchers (Mensah & Mwakapesa, 2022). This factor has the potential to increase the use of SMLS in different contexts, but it is not sufficiently taken into account in many studies on the use of mobile learning. The importance of trust in the SMLS's functionality and reliability, as a moderating factor in the interactions between determinants and behavioural intention to use SMLS, is not sufficiently taken into account in many studies on the use of mobile learning system. Exploring the moderating effect of Trust in future studies has been recommended by (Taneja & Bhqrti, 2021). This study seeks to address these gaps by developing a harmonized framework of UTAUT2 and TAM2, to investigate the factors influencing rice farmers' behavioural intention to use SMLS for learning on pesticide management, in Nigeria's agricultural industry.

Findings from this study will assist policy makers in the Federal Ministry of Agriculture and Rural Development to concentrate on the factors that really influence the behavioural intention of the rice farmers to use smart mobile learning system in the country. Similarly, it will also contribute to the already exiting literature in the field of smart mobile learning system for farmers. Likewise, it will re-validate the predicting strength of the theories (UTAUT2 and TAM2) used in the study.

1.4 Research Objectives

The main objective of this study is to investigate the predicting factors influencing the behavioural intention to use smart mobile learning system among Nigerian rice farmers. The specific objectives are:

1. To examine the relationship between Social Norm, Perceived Ease of Use, Perceived Usefulness, Habit, Hedonic Motivation, Price Value, Facilitating Conditions, Perceived Ubiquitous Value, and Behavioural Intention to Use SMLS on pesticide management among Nigerian rice farmers.
2. To examine the relationship between Social Norm and Farmer's Image among Nigerian rice farmers.
3. To examine the relationship between Farmer's Image, Job Relevance, Output Quality, Result Demonstrability, and Perceived Usefulness among Nigerian rice farmers.
4. To examine the relationship between Perceived Ease of Use and Perceived Usefulness among Nigerian rice farmers.
5. To examine the moderating effect of trust on SMLS' functionality and reliability on the relationship between Social Norm, Perceived Usefulness, Perceived Ease of Use, Habit, Price Value, Hedonic Motivation, Facilitating Conditions, Perceived Ubiquitous Value, and Behavioural Intention to Use SMLS on pesticide management among Nigerian rice farmers.

1.5 Research Questions

These research questions were formulated with a view to accomplish the above set objectives.

1. What is the relationship between Perceived Ease of Use, Perceived Usefulness, Social Norm, Habit, Hedonic Motivation, Price Value, Facilitating Conditions, Perceived Ubiquitous Value, and Behavioural Intention to Use SMLS on pesticide management among Nigerian rice farmers?
2. What is the relationship between Social Norm and Farmer's Image among Nigerian rice farmers?
3. What is the relationship between Farmer's Image, Job Relevance, Output Quality, Result Demonstrability, and Perceived Usefulness among Nigerian rice farmers?
4. What is the relationship between Perceived Ease of Use and Perceived Usefulness among Nigerian rice farmers?
5. Does trust on SMLS' functionality and reliability moderates on the relationship between Social Norm, Perceived Usefulness, Perceived Ease of Use, Habit, Price Value, Hedonic Motivation, Facilitating Conditions, Perceived Ubiquitous Value, and Behavioural Intention to Use SMLS on pesticide management among Nigerian rice farmers?

1.6 Scope of Study

This study focused on investigating the determinants of behavioural intention to use smart mobile learning system among Nigerian rice farmers. In addition, it analyzed the moderating role of trust on the relationships between social norm, perceived usefulness, perceived ease of use, habit, hedonic motivation, price value, facilitating conditions, perceived ubiquitous value, and behavioural intention. The determinants of rice farmers' behavioural intention to use smart mobile learning system remain unknown, in contrast to the factors that have been well documented as influencing students in educational institutions' intention to use it. The scope of the study is limited to engaging rice farmers in North-eastern Nigeria, who have experience using mobile handheld devices, and apply pesticides in their farming activities. It does not include rice farmers who do not use mobile handheld devices and pesticides. North-east is one of the Nigeria's geopolitical zones, and it includes the following states: Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe. The north-eastern part of the country houses most of the rice farmers because of the fertile nature of the soil in the region. This is what informed the decision to select the target respondents from the northern part of the country. The data for the study was collected within the second quarter of 2023. The study was carried out using questionnaire as a survey, where the rice farmers were physically contacted and requested to complete the questionnaire in order to identify the determinants of their behavioural intention to use SMLS.

1.7 Significance of the Study

This current study makes contribution to the extant literature on behavioural intention to use smart mobile learning system for learning on pesticides management

among rice farmers. The contributions of this study are in twofold (theoretical and practical) which are discussed as under.

1.7.1 Theoretical Significance

To the academia, the study provides empirical support of the background theories (TAM2 and UTAUT2) outside the context of developed countries. It also adds value and volume to the existing literature in the field of smart mobile learning system. The behavioural intention to use SMLS in Nigeria is investigated in this study. First of all, data from the Asian region has been used in a large number of research studies on behavioural intention to use mobile learning system. In comparison to the Asian region, there are less studies based on data from Africa. Given the cultural and environmental differences, the current study has brought unique insights from the Nigerian context. Secondly, the harmonization of the core theories of TAM2 and UTAUT2 in this study, which has not been examined by previous studies, distinguishes this research from other studies on behavioural intention to use mobile learning that have been conducted. Furthermore, perceived ubiquitous value (which represents one of the unique characteristics of SMLS) has received little attention from researchers, and its relationship to behavioural intention to use SMLS appears to be unexplored. In the context of Africa in general, and Nigeria in particular, research on the relationship between PUV and SMLS is unknown. Therefore, this thesis contributes to the existing literature by extending the harmonized framework to investigate this unique variable to see if it influence rice farmers' behavioural intention to use SMLS in Nigeria. This sheds light on the driving forces behind using this system and allows for the testing and validation of UTAUT2 and TAM2 in a different research setting. Additionally, this study focused on area of study that is increasingly becoming

very significant for both scholars and the various parties involved in the development and spread of mobile learning models in the agricultural sector.

Furthermore, previous studies contradict themselves on the relationships between several independent variables and BI to use mobile learning system. This has been observed in the results of variables such as; PEOU (Al-Emran et al., 2020 vs Kumar et al., 2020), Social Norm (Al-Azawei & Alowayr, 2020 vs Wu et al., 2021), Facilitating Conditions (Açıkgül & Sad, 2021 vs Nikolopoulou et al., 2020), and Price Value (Al-Azawei & Alowayr, 2020 vs Nikolopoulou et al., 2021). With the addition of trust as a moderator, this study contributes to the literature by resolving the inconsistent results. This moderating variable is expected to improve the relationship between the independent variables (social norm, perceived usefulness, perceived ease of use, habit, hedonic motivation, price value, facilitating conditions, perceived ubiquitous value), and the dependent variable (behavioural intention).

Majority of the earlier studies on behavioural intention to use mobile learning focused on the academia, using either students or their teachers, while scholars rarely looked at the agricultural sector. Findings of this study provide understanding into the theoretical model of behavioural intention to use in the agricultural sector, where behavioural intention to use SMLS for learning on pesticide management has not been examined. For that reason, this study also contributes theoretically by conducting a study on the determinants of behavioural intention to use SMLS for learning on pesticides management, in the agricultural sector using the population of rice farmers which has been neglected.