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 Makerere University Business School

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**MAKERERE UNIVERSITY BUSINESS SCHOOL**  
**FACULTY OF COMPUTING AND INFORMATICS**

**DEVELOPMENT OF A WEB-BASED MARKET INFORMATION AND PRODUCE  
LISTING SYSTEM FOR CEREAL FARMERS IN NORTHERN UGANDAN DISTRICT  
OF GULU**

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**A PROJECT PROPOSAL SUBMITTED TO THE FACULTY OF COMPUTING &  
INFORMATICS OF MAKERERE UNIVERSITY BUSINESS SCHOOL IN PARTIAL  
FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE  
DEGREE OF BACHELOR OF BUSINESS COMPUTING**

**NOVEMBER, 2025**

## DECLARATION

We, the undersigned, hereby declare that to the best of our knowledge, this proposal is our original piece of work and has never been published nor submitted for any award at any other University or Higher Institution of Learning.

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### APPROVAL

This project proposal has been submitted with my approval as supervisor and my signature is here appended:

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## SECTION ONE

### 1.0 Introduction.

This section will be made up of the following: Background of the Study, Problem Statement, Project Goals, Project Objectives, Justification and Scope of the Study Geographical scope.

### 1.1 Background of the Study

Agriculture remains the backbone of Uganda's economy, contributing over 24% to the national GDP and employing more than 70% of the population, most of whom are smallholder farmers (UBOS, 2022). Such small-scale farmers are very important in the national food supply chain. However, despite their contribution, they remain marginalized in accessing profitable markets. Their continued reliance on traditional farming practices and informal trade networks has hindered their ability to maximize income from agricultural activities. In many parts of Uganda, especially in the Northern district, for instance, Gulu, farming communities experience systemic challenges such as limited access to reliable market information, lack of price transparency, post-harvest losses, and exploitation by middlemen.

They harvest crops without any information regarding the prevailing market demand or prices, and hence, the produce is sold off in a rush at very low prices, either to avoid spoilage or due to financial desperation. According to FAO (2021), post-harvest losses in Sub-Saharan Africa, including Uganda, stand at around 30–40%, especially for perishable crops, which include fruits, vegetables, and cereals. The emergence of mobile and digital technologies has opened up opportunities for a disruptive change in how markets function within agriculture. There has been increased access to internet and smartphones in Uganda, with more than 10 million internet users by 2023. However, such progress in digitalization has yet to be adequately translated into actual benefits accruable to the rural farmer. Most platforms are either inaccessible to farmers due to literacy or language barriers or fail to cater for the specific needs of the localized small-scale farmers.

Agriculture is both a livelihood and a pathway to poverty alleviation in the Northern region of Uganda. However, over two decades of conflict coupled with poor infrastructure and underinvestment have left farmers without systems that enable them to effectively connect with buyers, gain competitive prices, and accordingly plan their sales. This subsequently means the value chain is dominated by middlemen who often purchase farm produce at farm-gate prices



well below market rates and resell it at very high profits in urban centers (Mugisha et al., 2020). This demotivates farmers and perpetuates rural poverty. Such gaps raise the need for a centralized, user-friendly, farmer-oriented system that can support direct market linkages. A web-based platform, designed with local context in mind, would be able to avail timely market information, price trends, and space for farmers to list available produce. This can help farmers increase bargaining power and improve income and reduce post-harvest losses.

This research is thus motivated by the urgent need to utilize digital innovation in overcoming the perennial problem of limited market access for smallholder farmers. The study will seek to shorten the distance between farmers and markets, ensure fair trade, and contribute to sustainable rural development by designing and developing a web-based market information and produce listing system.

## 1.2 Problem Statement

The small-scale farmers in Northern Uganda are caught up in a vicious cycle of low productivity and low-income levels due to a problem of access to real-time market information and direct buyers. Consequently, this forces them into a heavy reliance on middlemen who exploit them by giving prices very far below the market value. Furthermore, they record massive losses of their produces at the post-harvest level due to poor market linkages and inefficient logistics (GNNA, 2024; FAO, 2021). This is exacerbated by the absence of a digitally managed, centralized platform that links farmers to markets and delivers exact pricing information.

## 1.3 Project goal

To design and develop a web-based market information and produce listing system to enhance market access, reduce middlemen exploitation, and minimize post-harvest losses among smallholder farmers in Northern Uganda.

## 1.4 Project Objectives

1. To investigate the challenges of market access faced by smallholder farmers in Northern Uganda.
2. The aim is to design the system requirements for developing the web-based platform.
3. To design a web-based platform that provides real-time prices and supports the listing of produce.

4. To test the designed system.

### 1.5 Justification of the Study

This falls under Uganda's Vision 2040 and the Sustainable Development Goal 2 of zero poverty, which advocates for increased agricultural productivity and market access using technology. With this in mind, the present intervention addresses market inefficiencies and post-harvest losses through a web-based solution that could support the livelihoods of farmers and reduce the rate of poverty while extending agriculture digitally.

The system also supports digital inclusion in rural communities and empowers farmers to be active participants in the markets. The outcome can also be used for formulating national agricultural policies and extension programs.

### 1.6 Scope of the Study Geographical Scope

This study will focus on smallholder farmers in Gulu district, Northern Uganda.

**Content Scope:** Development of a web-based platform including produce listing, market prices, and buyer-farmer interaction.

**User Scope:** The users of the system are the smallholder farmers, agro-buyers, cooperatives, and extension officers.

**Time scope:** The study has focused on a period of five months.

### 1.7 Significance of the study to the Government

The study enables the government to achieve its SDGs on poverty and hunger.

The benefits derived from the creation of a web-based market information and produce listing system are multifold at both local and national levels.

**Improved Agricultural policy Formulation and Planning.** The system will generate real-time data on agricultural production, market demand, and pricing trends which the government can use to design evidence-based policies.

It helps identify the gaps in supply chains, guides subsidies, and ensures better planning of rural development programs.

Improvement of agricultural commercialization and market linkages: Linking farmers directly to buyers, the government advances its agenda of transforming subsistence agriculture into market-oriented farming. This is accomplished in line with national agricultural transformation frameworks such as the Uganda National Agriculture Policy and Vision 2040.

Poverty reduction and rural development: Supporting farmers to have access to better markets increases household incomes, hence contributing to poverty alleviation, food security, and rural economic growth.

Efficient monitoring and evaluation of agriculture programs: the platform can be used to monitor farmers' performances, adoption of modern farming practices, and market trends. This enhances transparency and accountability in government-funded agricultural programs.

Strengthening public-private partnerships: The platforms create opportunities for collaboration between government, NGOs, and private agribusinesses, reducing the burden on government in the provision of market linkages.

### **1.8 Importance of the study to the farmers.**

Improved market access: It gives them a direct platform to showcase and list their agricultural produce, reducing dependence on middlemen who mostly exploit them with low farm-gate prices. This system opens up broader market opportunities, including urban buyers, traders, and potential institutional clients.

Access to timely and reliable information: Through the system, farmers can get up-to-date information on commodity prices, demand trends, and buyers' requirements. This then empowers them to make informed decisions about what crops to grow, when to harvest, and where to sell for maximum profit.

Better prices and higher incomes: Farmers are in a better position to bargain, as market prices become more transparent. It reduces information asymmetry, hence exploitation, which in turn increases incomes and improves livelihoods.

Improved bargaining strength and collective selling. The system can act as a central location where farmers combine their produce to facilitate bulk sales. This collective approach enhances

their bargaining strength, lures bigger buyers, and heightens the level of competitiveness in the market.

Improved farmer-buyer relationship: Direct dealing with the buyers through the platform creates trust and long-term trade relationships. Farmers can also diversify their customer base and reduce dependence on local markets.

### **1.9 Significance of the study to the students.**

Acquisition of practical skills: The students are enabled to acquire practical skills in website designing. The study allows students to meet the criteria for obtaining the Bachelor's Degree. Practical Application of knowledge:

The students get to apply the theories they are learning in the classroom in ICT, agriculture, and business management to a real-world problem pertinent to smallholder farmers; thus enhancing their learning experience through hands-on practice. Skills development: Working on the development of a Web-based system equips learners with practical skills in software design, web development, database management, and user interface design.

### **Research and Innovation:**

The study encourages students to explore innovative solutions for community challenges, bridging agriculture with ICT; students are nurtured in critical thinking and problem-solving skills. Community Engagement: The students develop an understanding of the problems farmers face in Gulu City. Such exposure builds empathy and a sense of social responsibility, motivating them to utilize their knowledge for community transformation. Career Advancement: Experience with real-world projects enables students to be more employable. Their exposure to solving for agricultural markets adds value to their job prospects.

**1.10 Significance of the study to the future researchers.** To future researchers, it will serve as a reference for them.

## **SECTION TWO**

### **LITERATURE REVIEW**

#### **2.0 Agriculture**

According to Finella, (2025), Agriculture is the practice of applying different methods of growing plants and rearing animals to produce food, clothing, and other useful products for human survival. Agriculture is how people use different farming resources like land and natural resources to provide for their basic needs. This has become the backbone of Uganda's economy, contributing to 24% to the Gross Domestic Product (GDP) and employing over 70% of the population. 80% of the total land is arable and 35% is being cultivated. Uganda has fertile soils, favorable climatic conditions, which favor the growth of a wide range of crops, including coffee, bananas, maize, and tea, which are the country's key agricultural products. This has created great opportunities for its agricultural growth leading to economic development.

However, according to, Lydia Nabyonga et al, 2025, it is stated that Agriculture is the practice that supports human life due to its produces-for example, food, fodder for livestock, medicines, and biofuels.

#### **2.1 Agriculture in northern Uganda**

Research done by Shikuku et al, (2019) reports that in Northern Uganda, people are facing a problem of feeding a large population that is growing at a high faster rate of 9% compared to the country's average population growth rate of 3% and to help reduce poverty levels that are at a higher rate in the country, farmers grow a large number of crops but due to outbreak of diseases, land grabs, and prolonged seasonal drought have caused reduction in food productivity. Maize and groundnuts are the most grown crops in the region. However disease-resistant and drought-tolerant crops like coffee and cotton are being grown as well as promoting technologies that could help to conserve soil moisture. However, a large number of these farmers are not aware of the existence of these technologies and very few who have heard about them lack exposure and knowledge on how to use and maintain them forexample agricultural websites. There have been reforms and measures done by the government to establish the extension system and recognize the role of farmer-to-farmer knowledge and technology transfer to create awareness amongst farmers. However a random evaluation was carried out to assess the effects of different incentives for diffusion of agricultural knowledge by smallholders in northern Uganda.

Randomly-selected farmers from a large sample of villages are assigned to one of three experimental arms: (a) training about climate smart agriculture, (b) training plus a material reward for knowledge diffusion, and (c) training plus a reputational gain for knowledge diffusion. This has helped to acquire information needed for agricultural development in northern Uganda.

## **2.2 Challenges facing Agriculture in Northern Uganda.**

Findings of Finella, (2025) identified the following as the problems facing agriculture in northern Uganda and are discussed as follows; Climate Change and Environmental Degradation; Unpredictable rainfall patterns such as prolonged droughts and floods due to rapid climate change have disrupted agricultural activities for example soil degradation from over-cultivation, deforestation and poor land management practices have led to reduced agricultural productivity. Limited Access to Agricultural Inputs; Farmers struggle to get quality seeds, fertilizers and pesticides because of the high costs and this leads to low crop yields thus farmers cannot compete in local and international markets effectively. Limited Access to Markets; Most of the farmers sell their produce at low prices due to a lack of access to reliable and available markets and therefore farmers are being cheated by middlemen leading to low prices.

However, According to Bamwesigye, D. et al, 2020, the following are the challenges facing farmers in Northern Uganda; Finance related problems. Many farmers in Uganda do not have the required capital that can help them acquire their agricultural output for example quality seeds and healthy breeds of livestock. Land Ownership; Land ownership systems in Uganda are complicated and thus many people in the country have many cases of land grabbing and disputes leading to low agricultural output. Price Fluctuation; Most Ugandans have considered agriculture to be the main source of employment opportunity that limits farmers from achieving the sustainable agricultural goals and participating in other income generating projects.

## **2.3 Solutions to the challenges facing Agriculture in Northern Uganda**

Research findings of Finella, (2025) report the following as the solutions to the problems facing agriculture in Northern Uganda; Climate Adaptation Strategies; The government and stakeholders should promote climate smart agriculture such as agro forestry, conservation farming and introduction of drought-resistant crops. Invest in irrigation systems which will reduce reliance on rainfall thus ensuring consistent production even during dry seasons.

Extending training on modern farming practices through extension services will boost productivity and raise awareness among farmers. Promote Technology and Education; Introduction of affordable technologies such as mobile applications like websites for weather forecasting and pest management will improve decision-making among farmers.

According to Turyasingura & Chavula, (2022). The following are the solutions to the problems facing agriculture in Northern Uganda; Meetings of the Climate Group; Farmers are formed in groups in various regions of Uganda, such as Gulu, Kasese among others to link them with climate-related information to them in a group so that they know the right time for planting and harvesting crops. Educational and Methods approaches; These approaches focus on education of farmers and use of various extension methods to teach them such as training at District Farming Institutes, exposure visits, field days, radio and television programs to increase awareness. Farmer cooperatives as essential extension services; This is done by providing free agricultural inputs forexample agricultural lime to change the soil (ph) from acidic to alkaline in order to increase soil fertility and crop yields.

Besides, Waaswa & Satognon, (2020) established the following as the solutions to the problems facing agriculture in Northern Uganda; Use of manures from livestock to improve soil fertility. Adopting practices like the use of multipurpose crops that enhance binding of soil particles together in controlling erosion and increasing soil fertility. Dual-purpose breeds of cattle like Oxen should be adopted to help in farm activities like ploughing of the land that increases soil fertility and crop yields leading to high productivity among farmers.

Mirembe, (2023), identified the agricultural sector as the largest employer in Uganda, despite the advancement in Information Communication Technology, the majority of small-holder farmers have limited access and usage of Information Communication Technologies (ICTs). The limited access and usage of ICTs such as smart phones constrains farmers in access to information, extension services, quality markets among others resulting into low productivity. The use of ICTs in agriculture has been linked to farmers' enhancement in decision making, access to quality markets, improved price determination, enhanced farm level decision making and access to quality inputs, among others. The use of ICTs enables farmers to make informed decisions, supports adoption of new innovations and improvement of farmers entrepreneurs' abilities. This study focused on establishing the extent of farmer's usage of digital platforms to acquire

knowledge and awareness. A mixed methods approach was adopted for this study, which included qualitative - interviews and focus group discussions - and quantitative - surveys - data collection methods. Qualitative data were analyzed using thematic content analysis while quantitative data were analyzed using descriptive statistics. The study found that through trainings and sensitization, farmers were able to access information using ICT such as television and social media to access and share important information about their produce. The platforms range from social media platforms, farming television programs and digital media platforms in public places.

Digital agricultural platforms have great potential to provide flexibility both to farmers and traders (Ajambo et al, 2023), but most farmers may lack sufficient digital literacy, skills, or even technology use to access such platforms. This results in the exclusion of groups based on their ability; for example, those with disabilities, and those who do not make use of smartphones. A study was conducted to investigate the access needs of different user groups. These included women, youth, and people with disabilities, and those with low levels of education. The study examined their attitudes, competence, and access to digital technology in relation to the use of digital platforms such as websites. We undertook a cross-sectional design with a qualitative approach study. Our data collection involved informant interviews and focus group discussions separated by gender to capture different responses concerning the use of digital platforms like websites in agriculture.

## 2.4 Website

Dutonde. P et al., 2022 defines a website as a collection of related web pages that are accessed through the internet using a web browser like Chrome and Firefox. Web design involves website development, client-side /server-side scripting, net server and network security configuration. Web development refers to the design aspects of building websites, net development could use content management system to create content changes easier and on the market with basic technical skills. Larger organizations and businesses will need net development groups which include Web developers who follow customary ways like agile methodologies while developing internet websites. For Smaller organizations could acquire one developer like a graphic designer or data systems technician. There are three types of web developer specialization namely; front-end developer, back-end developer, and full-stack developer. Front-end developers focus on



behavior and visuals that run within the user browser, whereas back-end developers manage servers on the websites. Internet sites help in communication and social networking which offer users with a platform to speak and interact with the general public.

On the other hand, electronic media resources in the form of websites refer to an online collection of interlinked web pages and digital resources which provide information, services, and are accessible through a web browser. Websites have much shorter life compared to printed versions of means of communication between users. However, the focus on computers, electronic devices, and software together with the Internet has caused an unprecedented development of the technical and software parts that led to rapid growth of active users, global and relatively short-time distribution of sites, as well subjective preferences of the developers generate significant problems of high-quality nature because different developers have different preferences. This revealed the essence of the information approach to the development of alternatives and finding optimal options for high-quality website design for users.

The use of websites in educational contexts is increasing daily (Majid & Lakshmi, 2020). A website is an online tool which assists the user in performing tasks such as reading articles, watching videos, shopping, learning, and socializing. There is a great effect of technology on the educational system, and it has increased the usage of websites in educational contexts. Websites are capable of delivering content with the assistance of the World Wide Web. It acts as a base for making the content available to the users in no time. Many people are using the Websites as a communication tool. The Website that works on the principles of the World Wide Web caters to the needs of the students virtually. The students get access to various things online with a single click. This caters for various needs of students' foreexample online text books, notes and articles. The students get admission, results related information from the websites. The World Wide Web can be considered as the main source for getting academic and research-based information and thus enabling users to test new methods online like conducting an analysis of the content of the websites.

### **Types of Websites**

The following are the types of websites;

According to (Desliyanah.S 2025), an educational website is a website designed to teach, inform and support learning. Acquiring technical literacy or knowing how to use it involves more than

just learning how to read; it also involves being able to use, access, and integrate technology on websites into the teaching and learning process. Although most people use the internet, not everyone is able to utilize its benefits fully, at least in the field of education. Therefore, in order to help students understand and not become disinterested in the process of learning, teachers need to possess additional skills. Thus, providing the internet and educational websites as resources for learning English will be beneficial for both educators and learners.

Dhingra, S et al., (2020) defines an e-commerce website is a website that allows people and businesses to buy and sell products or services over the internet. Most of the businesses rely on the online platform to reach its customers and provide them wide a wide range of goods and services. E-commerce refers to the buying and selling of goods over the internet. Online businesses are generally classified as Business-to-Business and Business-to Customer. An increasing number of customers buying online as well as the amount spent by them has motivated many businesses to operate online leading to high sales thus higher profits.

A News website is an online platform that posts current events, stories, articles, and reports.

(Vermeer et al., 2020), It acts like an online newspaper or magazine for covering political, business, entertainment, sports, technology, science, and many other areas. For democracy to work, people must be informed about pressing public issues and relevant topics. News media are considered to be some of the most vital channels for providing people with various and accurate information about political and public topics. News consumption has changed dramatically as people increasingly use the Internet as their primary news source because it avails a large amount of available information sources and channels, as well as more chances for interaction and co-creation among news consumers. Therefore, people find and access online news not only directly through the websites of news media organizations themselves but also through a large array of other pathways including search engines and social media.

A personal website is, generally, an internet page representing a person's identity, work, and interests developed to showcase their identity, work, and interests (Ciriminna & Pagliaro, 2023),. Personal websites are owned and managed by people in order to present their activities in different fields such as research, education, and societal service that comprises the academic profession. It is a website with its own domain and not a subdomain of another website.

Abundant websites provide free web space to create a personal website but using only their subdomain.

## 2.4 Requirements for Website Design

The website design requirements are the set of needs, objectives, and limitations that need to be realized and described before the website design and development are started. According to Singh et al., 2023,. In the digital era, the design and functionality of websites have become crucial in defining user experiences and influencing the success of businesses and organizations online. The growth of the web technologies has transformed the way web design is approached, resulting in the establishment of more sophisticated, user-friendly, and adaptable websites. One of the biggest revolutions in web design is HTML5, CSS3, and responsive design techniques. Requirements have types and these include; Functional requirements which describe what the website should do, specific features and functions it must have and these include: User authentication where users can register and create an account, users can log in and log out, users can reset forgotten passwords and Admins can manage user accounts and permissions. Content Management where admins can create, edit, delete, and publish content like text, images, and videos. E-commerce where products listed with images, prices, descriptions, shopping cart and checkout process, secure payment processing like pay pal, mobile payments, order confirmation and email receipts. Search Functionality where users can enter keywords to find specific content or information about the site.

However according to Beaird, J., Walker, A., & George, J. (2020). There are also non-functional requirements which well describe how a website performs and the requirements include; Performance where the website must be fast at loading and high responsiveness even when there is heavy traffic. Scalability where the website is able to handle increased user loads. Maintainability where the code of the website should be well structured and easy to update and maintain over time. Security where the website should have protection against unauthorized access and data breaches through measures like encryption and so on. Availability where it should be ready and available for use. Compatibility where the site must be able to work on various devices like desktops, mobile devices. Usability where a site should have an intuitive and consistent user interface that is easy to learn and use on different devices and browsers.

However, according to Lowe, D. 2020, there are also business requirements which explain the goals, purpose, and needs of the business or client that the website is meant to serve, and these include; goals and purpose which define the website's primary function for example e-commerce, target audience where you identify the ideal users, budget where you establish a realistic budget for the project for example costs for maintaining and marketing.

## **2.5 Advantages of using websites to farmers**

Accessibility to educational webpages and equal access to information are the main considerations as students of the higher education level obtain crucial learning related information, do their academic work, and fulfil administration related tasks through the Internet on-line (Kvaszingerné, C, P. 2018). However, the concept of webpage accessibility should deserve priority not only because of its ability to help the vulnerable, but several abled students who commute and learn can get access to educational information or texts only through the Internet. Most part-time students have full-time jobs and a bigger percentage of adult learners can be considered atypical learners, as they get involved in individual, organizational-prepared, or other web-based knowledge acquisition sites. All of the abovementioned groups rely on webpages to obtain learning-related information, data bases and functions on demand at any time. Furthermore, most vulnerable students can only gain access to essential information and services via the Internet. Although the disabled do not occupy a bigger portion of society, or that of the student population of higher education, the lack of accessibility options fully excludes them from the possibility of learning. The importance of accessible or obstacle-free webpages is emphasized by several international studies and research results.

According to Amuko et al. (2023), Enhanced Price Transparency and Farmer Bargaining Power are the very improvements in price transparency that bolster the bargaining power of farmers. In most rural areas in Uganda, for example, cotton farmers rely on informal sources for market information, normally from middlemen or brokers. These middlemen often take advantage of such a situation by offering prices lower than the prevailing ones in the market. When real-time data on crop prices in various regions is available to farmers, this places them at a better vantage point to negotiate better prices for their crops. Through online listing, farmers check on the prevailing trends of the day and are able to avoid selling in a panic, time sales more strategically, and ultimately obtain better returns. This transparency cuts down on exploitation and leads to a

fairer agriculture value chain. In addition, when this information is channeled through a trusted platform, farmers begin to sell directly to buyers or cooperatives who eliminate intermediate exploitation, thus enhancing the shares of the final sale price to be obtained by farmers.

**Expanded Market Access and More Income Opportunities.** The other key importance that a web-based listing platform would have for farmers is a widened access to markets beyond the local or regional area. A large number of cotton farmers in Gulu and other districts face difficulties in reaching these faraway or urban markets due to a lack of contacts, transport structures, or knowledge about demand in those markets. Such a digital platform would allow them to advertise produce to a wider clientele, including national buyers, exporters, and textile manufacturers. They thus achieve better visibility for their crops and attract improved offers. Farmers can post their available quantities, quality, and price expectations to get matched with buyers who might be out of their usual catchment areas. The wider access reduces risks of local market saturation and a crash in prices at harvest time. It also opens opportunities for contract farming or long-term trade relationships with more income predictability. The overall impact of the platform serves as a bridge that connects rural farmers to diversified markets for significant rural development and poverty reduction.

The capability and flexibility to extend the conversion rate can be enhanced by optimizing the website and applying data mining techniques based on users' interaction criteria on the website. Data mining can also allow attaining website objectives such as e-commerce goals and lead generation goals. In this research, users' interactions within the websites are captured. Customer profiles can be updated systematically by analyzing consumer's behavior, such as websites they visited and left from, how long they stayed on the website and which pages they browsed. Customers visit websites and leave behind important information about their behaviour. A study on consumer behaviour is to raise business performance through an analysis of past and present and target prospective consumers and their behaviour. However, the companies are working tirelessly to keep their competitive position to acquire good revenue. Many small to medium scale online businesses depend on free web analytic tools such as Google Analytics, Woopra, Clicky, Site Catalyst, Web trends and other API items to understand their web marketing campaigns and strategic business decisions.

## 2.6 Challenges of using websites to farmers

The major constraints facing farmers relate to a lack of adequate technology and required skills. Rural farmers are either unable to access these tech services or do not have the basic training in using them for farming purposes (Saidu et al., 2017). This situation has been exacerbated by a lack of appropriate educational support from the government. This situation persists because farmers simply lack reliable information that would lead to finding solutions to these problems. Basic infrastructural issues pose a significant hindrance. Some of the issues which farmers face include unreliable power and blackouts, and the cost of buying computers and their software is just too high for the average rural individual. Beyond the infrastructural level, the technology itself represents an issue. Constraints include high costs, a lack of familiarity (awareness), and difficulty in getting new systems to work with one another. As per, the views of Namoun, A., et al, 2021, July.

The following tools are creditable as they inspect a broad range of areas like speed, SEO, and security. However, the deep dive shows that each of them has critical faults, most of which are either ignoring or misunderstanding usability. If website testing tools do not place a focus on real usability, then it is likely many agricultural websites will have poor designs that confuse or frustrate farmers. The site might be technically sound-good speed, security-but functionally useless to a farmer finding market prices or weather data. Farmers are generally non-technical users of information. Any given agricultural website built with such testing tool insights would already be too complex for the average farmer to understand and find their way around. Accessibility issues affect farmers of varying needs, including older farmers who may have poor vision or motor skills, those with low digital literacy, and those on older, slower mobile devices which struggle with sites that are not well-coded.

If a major e-commerce site fails on accessibility, an agricultural website likely fails even worse. That the discovery of contrast errors are the most common barrier means that many farming websites likely have text that is hard to read against the background-a major frustration for any user, especially those in bright, outdoor environments looking at a small screen. The fact that the ability to "perceive" information is the most neglected area (83.1%) suggests that agricultural websites are likely failing to clearly and simply present vital information like market prices, weather alerts, or government forms, making it nearly impossible for a farmer to get what they

need. Areas Where Farmers Can Apply Websites Websites have become vital instruments of improving agricultural communication and marketing through which farmers could communicate with diverse stakeholders like buyers, suppliers, and agricultural extension workers (Ramavhale et al., 2024). Website use enhances timely sharing of information, visibility of products, and knowledge exchange that are valuable in achieving growth and innovation in agriculture. The following are areas where farmers can apply websites in agriculture. According to Muhanguzi & Ngubiri, 2022, websites, among other ICT tools, have facilitated ways through which smallholder farmers get better marketing information, compare prices, and find more profitable outlets for their agricultural products. Websites provide an avenue where farmers can display and sell their produce directly to consumers and wholesalers, thereby removing the middlemen who take advantage of farmers through unfair pricing of farm products.

Muhanguzi and Ngubiri add that access to online marketplaces enables farmers to adjust supply according to demand trends, reducing wastes and increasing profitability. For instance, a vegetable farmer may quickly learn which products are in higher demand in nearby towns, plan harvests in accordance with such demands, and negotiate directly with buyers to raise income margins. According to Ajambo et al. (2023), digital agricultural platforms enhance inclusion through connecting farmers to both local and international markets, thus enabling them to create long-term business relationships, especially in high-value crops like g-nuts and simsim. Websites enable farmers to create profiles, showcase their products, and get in contact with exporters and traders. Ajambo and colleagues further note that market analytics and trade trends are also provided by these platforms and allow the farmer to make informed decisions based on production and sales.

Integrating social media into agricultural websites, on the other hand, allows farmers of remote areas to promote their products and reach wider markets beyond physical boundaries. Weather forecasts, rainfall predictions, and soil moisture data from reliable agricultural websites form a core component of climate-smart agriculture. Farmers are assured of excellent planning in the planting season and harvesting and effectiveness in minimizing risks while increasing productivity through these online services (Turyasingura & Chavula, 2022). According to Turyasingura and Chavula, farm-specific guidance will be availed by combining local sensor data with online forecasting. For example, a maize farmer can determine the perfect day for



planting after taking into consideration rainfall forecasts and soil moisture levels, and thus avoid crop failure and ensure a consistent production cycle for both subsistence and commercial farming. According to (Mirembe, D.P, 2023), websites have increased access to agricultural training materials, research papers, and tutorials on such issues as pest control and modern methods of farming. This online resource informs farmers and enables them to put into practice new technologies for productivity enhancement and sustainability.

Mirembe further argues that the interactive online courses and webinars encourage experimentation with new techniques and varieties of crops. For instance, a farmer who wishes to try organic farming can learn composting techniques or integrated pest management online, which decreases dependency on expensive chemicals, improving soil health while bridging the knowledge gap between the smallholder and commercial farmer. Websites come in to form online communities of farmers sharing challenges, experiences, and success stories that help promote peer learning and collaboration amongst themselves. Social media and the web reduce feelings of isolation among farmers and enhance innovation. Additionally, the websites allow farmers to discuss common problems-for example, pest outbreaks or market fluctuations-and share their solutions and strategies. Through discussions on various forums and expert advice, websites create a dynamic ecosystem of continuous learning and mutual support which helps strengthen farming communities' resilience and competitiveness.



## SECTION THREE

### RESEARCH METHODOLOGY

#### 3.0 Project Methods.

This section shows the methods of research, research design or approach to research, target population and sample, sampling technique, project development process, methods of data collection, project constraints, and ethical considerations.

#### 3.1 Research Design.

The research design refers to the plan and structure that details how the research study is to be conducted. It analyses how data will be collected and analyzed in order to answer the research questions. It helps students in the organization of ideas, selection of appropriate methods, and ensures validity and reliability of the results. It ensures that the research problem is effectively addressed. It provides a clear plan from the beginning to the end of the research process.

For this research, the artefact will be a web-based Market Information and produce listing system for Smallholder farmers in Northern Uganda, particularly in the district of Gulu. The research design should provide guidelines that help in the development of the web-based system through which smallholder farmers will be aided to access market prices, list their produce, and connect with buyers while eliminating middle men and increasing profits and sales. This is so that at the end, the product will not only be functional but will also directly address the challenges farmers face in accessing reliable and fair markets.

#### 3.2 A Table illustrating the Research Design Methodology.

Design Science Methodology	Research Objective to be addressed	Application in the study	Expected Results
1. Problem Identification.	To investigate the market access challenges faced by smallholder cereal farmers in Northern Uganda.	Interviews and surveys with farmers and extension workers in Gulu.	Comprehensive problem statement and justification of research relevance for farmers' livelihoods and food systems.
2. Define Objectives of the	To establish system	Co-create	Documented system

solution.	objectives based on identified gaps and translating farmers 'needs into system requirements.	requirements with farmers groups and market stakeholders and prioritize features based on farmers' digital literacy.	requirements specification, clear objectives aligned with farmers' context.
3. Design and Development	To choose suitable system architecture and technology for user interface and developing a prototype.	Prototype of the web-based platform with modules for produce listing, market price updates, buyer-seller interaction and admin dashboard for market officers.	Working prototype of the system, technical design documentation.
4. Demonstration	To deploy system prototype in real world settings, training selected farmers and traders to showcase functionalities like posting produce, checking price and contracting buyers.	Pilot test with farmer cooperatives and traders in Gulu central market, live demonstration sessions supported by extension officers.	Operational prototype tested with actual users, initial evidence of problem-solving capability.
5.Evaluation	To collect feedback via surveys, interviews and focus groups, conduct performance testing compare with existing market information approaches.	Field evaluation with a sample of like 10 farmers and 10 traders, feedback gathered on ease of use, trustworthiness and usefulness of the system.	Evaluation report highlighting strengths, weaknesses and recommendations for improvements and scaling.

6.Communiacion	To document research findings and methodology, sharing outcomes with farmer groups.	Presenting results at Gulu university, farmer associations and district agricultural offices.	Knowledge transfer to stakeholders, policy and practical recommendations.
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**1. Problem Identification and Motivation:** A clear understanding of the real-world challenge being addressed, wherein access to market information is a major constraint for smallholder farmers in Northern Uganda, while price exploitation by middlemen and a lack of listing and selling platforms remain major challenges. The identification of the exact problems forms a strong basis for this design process.

**2. Define Objectives of a Solution.** At this stage, specific objectives of the project should be defined and put down. Major objectives for the study have been identified, and these include giving timely and transparent market prices; enabling farmers to list their produce online, connecting buyers directly with farmers, and offering an easy-to-use interface that is accessible on even basic internet-enabled devices.

**3. Design and Development:** The actual creation of the artifact, which will be a prototype of a web-based application, is done at this stage. Technologies that will be used in order to build the system include HTML, CSS, PHP, JavaScript, and MySQL. The prototype of the system will include modules for Farmer Registration, Product Listing, Market Price Viewing, and Buyer-Farmer Communication.

**4. Demonstration:** After the development of the prototype, demonstrations will be carried out among selected farmers and stakeholders in the target districts. This step allows users to interact with the system, test usability of the various features, and identify the usability gaps.

**5. Evaluation:** The system will be evaluated based on user feedback and performance metrics such as loading time, data accuracy, as well as usability criteria including ease of use, navigation, and responsiveness. This helps to establish whether the artefact addressed the challenges identified in stage 1 effectively.

**6. Communication:** The research findings, design process, and final solution will be documented in the form of an academic project report and possibly shared with local agricultural authorities or farmer cooperatives for practical application. This makes sure the contributions of the project are clearly articulated and that any lessons learned can be transferred to future deployments for similar agricultural environments.

### 3.3 Sampling Design

Sampling, according to Makwana et al., (2023), is the process of selecting a sample of the population from an individual or a large group of people for a certain type of research objective.

The use of sampling has a variety of benefits and drawbacks. We might occasionally wonder, why is sampling necessary? The reason we employ sampling is because it would be extremely expensive and time-consuming to survey the entire population for a research study. Sampling is a critically important research method when there is a huge population. Due of this, we have separated it into two types which are Probability and nonprobability.

Probability sampling this is where every member of the population has a predetermined chance of being chosen for inclusion in the sample. In cases where the population exhibits a high degree of homogeneity, the likelihood of any given member being selected in a sample is significantly increased. In a scenario where a bag is filled with g-nuts, the likelihood of selecting each individual grain of g-nuts in a sample is considerably high.

Therefore, the collected sample will be indicative of the entire contents of the g-nuts bag. In the context of this study, the population is considered to be relatively homogeneous due to the fact that each member of the population is a potential respondent for the research and there are types in probability which include; simple random, systematic sample, stratified sample, cluster sample. Nonprobability sampling is a sampling technique in which the likelihood of each member of the population being selected for the sample is not known.

To investigate the problem of middle-men faced by cereal farmers in Northern Uganda, the researcher will exclusively seek out and conduct interviews with farmers who grow cereal crops like g-nuts and others. The act of choosing sample members based on their ease of accessibility is referred to as convenience sampling. The selection process involves choosing members who are readily available to the researcher. This sampling method utilizes the existing data without

imposing any additional criteria. This is a more prevalent practice in pilot testing. The study's participants or samples are chosen based on their ease of recruitment. Here we have snowball sampling and purposive sampling as some of the examples.

However, in conclusion: Sampling techniques are integral to research and data analysis in their ability to enable inferences about large populations using data from a small group. Every sampling technique, in simple random sampling, stratified sampling, cluster sampling, and systematic sampling, has advantages and disadvantages. In order for the best sampling strategy to be selected, each of these requires careful consideration of the goals of the study, the nature of the population under study, and the resources available. Proper techniques applied in the course of sampling enable researchers to enhance validity and reliability in their findings for improved development of knowledge on a wide range of spheres.

### **3.4 Sources of Project Data**

We will be gathering both primary and secondary data that will help us gain a complete understanding of the agricultural value chain in Northern Uganda. The main objective of this will be to clearly outline the problem of market access, its causes, and detail the functional and non-functional requirements of the proposed web-based market information and produce listing system. The collected data will ensure that the IT solution is user-centered, technologically viable, and responds to the major bottlenecks that face smallholder farmers.

The primary data will be directly collected from the key stakeholders in the local produce trade, offering up-to-date insights into what is occurring within market practices and the existing information system. This will comprise data collection through Focus Group Discussions (FGDs) and Semi-structured Interviews with farmers, which are the end-users, focusing on their ongoing price discovery, challenges in selling, desirable features of listings, and technological access. Capturing aggregated farmer needs and collective bargaining practices requires Key Informant Interviews (KIIs) conducted among the Cooperative and Village Savings & Loan (VSLA) Leaders.

Additionally, structured interviews with buyers and processors are very relevant for determining required grading standards, current processes followed in sourcing, and specific features required on the interface for the listing of produces. Data about the existing Information System will also be elicited from Internal Organizational Documents, such as forms used in registering farmers

and operational manuals. Secondary data will be obtained from the literature available to give context to the market, essential technical benchmarks, and necessary foundational knowledge.

In detail, this shall include Government and Policy Literature: for example, a review of relevant National Agricultural Policies and/or reports from MAAIF to contextualize the regulatory environment and market size; Academic and NGO Publications will review the benchmark for successful or failed MIS in the region, focusing on barriers to technological adoption; lastly, Industry and Trade Publications will help provide a base for historical and current spot prices of commodities nationally and internationally-a critical feature that will be used to design the core "market information" feature of the system.

### 3.5 Population, Sample Size, and Sampling Procedure

### 3.5 Target Population

Smallholder farmers play a crucial role in agricultural production and marketing in Uganda (Mirembe et al., 2023). The target population for this study comprises all registered smallholder farmers within selected districts of Northern Uganda who engage in agricultural production and marketing activities. According to district agricultural records and cooperative union data, the estimated total population of smallholder farmers across the study area is approximately 10,000 farmers. This population represents individuals who participate in crop cultivation, post-harvest handling, and market access activities relevant to the development of a web-based market information and produce listing system.

### 3.6 Sample Size Determination

Following Yamane (1967), in determining the number of respondents to be interviewed, the study applied Yamane's formula for sample size determination at a 95 percent confidence level with a margin of error of 5 percent:  $n = N / (1 + N(e)^2)$

Where:  $N = 10,000$ , the total population;  $e = 0.05$ , the level of precision.

Substituting the values:  $n = 10,000 / (1 + 10,000(0.05)^2) = 10,000 / (1 + 25) = 10,000 / 26 = 384.6$

The calculated sample size is 385 respondents. This sample size presents a representative and statistically reliable sample of the target population while ensuring feasibility during fieldwork.

### 3.7 Sampling Procedure

Multi-stage sampling improves the representative nature of studies dealing with large populations, such as smallholder farmers, as indicated by Ramavhale et al. (2024). In this regard, this study will adopt a multi-stage sampling technique in the selection of respondents.

First, districts in Northern Uganda, like Gulu, Lira, and Kitgum, will be purposively selected because of the high concentration of smallholder farmers and active participation in agricultural produce marketing. The approach guarantees that the study focuses on an area of relevance to ICT-based market information systems.

**Stage Two: Stratification by Sub-County or Cooperative** In each of the selected districts, sub-counties or farmer cooperatives are to act as strata to ensure representation of the different farming communities and differing levels of ICT exposure.

**Stage Three: Proportionate Allocation and Simple Random Sampling** The total sample of 385 farmers will be divided proportionately between these strata, based on the number of farmers in each stratum. All the respondents within each stratum are then selected through simple random sampling from lists of cooperative membership or local farmer registrations to eliminate any potential bias and ensure equal chances for all to be selected.

**Stage Four: Replacement and Verification** In the event of non-response or unavailability, replacement shall be done based on a pre-determined random reserve list. Supervisors will verify at least 10% of interviews through callbacks or spot checks to maintain the quality and consistency of data.

### 3.8 Rationale for the Sampling Strategy

As indicated by Ramavhale et al., the combination of purposive, stratified, and random sampling ensures both representativeness and practical feasibility. The purposive selection captures areas most relevant to the study objectives. Stratified sampling enhances coverage of diverse groups and farming conditions, while simple random selection ensures that every farmer within a stratum will have an equal chance of being included. Using Yamane's formula guarantees that

the sample size is scientifically determined and appropriate for the total population, minimizing any kind of sampling error or bias.

### **3.9 System analysis and design approaches**

System analysis and design are very crucial stages in the development of any web-based platform. The system analysis and design allow it to meet the user's needs, achieve organizational goals, and be workable in the real world. When developing a web-based platform, for instance, for education accessibility, market information, or e-commerce optimization, analysis and design allow for the identification of user requirements, specifying the functionalities of the system, and designing architecture that is both usable and sustainable. This process involves understanding the current problems, proposing feasible solutions, modeling the system components, and developing the best technologies and frameworks to run the system. The system analysis phase includes gathering requirements and understanding the problems that the proposed web-based platform aims to solve.

Therefore, the system analysis process must include a thorough needs assessment of different user groups like students with disabilities, part-time learners, and adult learners. The interviews, surveys, and observation methods will help to cover functional and non-functional requirements. Functional requirements which describe what the website should do, specific features and functions it must have and these include: User authentication where users can register and create an account, users can log in and log out, users can reset forgotten passwords and Admins can manage user accounts and permissions.

Content Management-admins have the power to create, edit, delete, and publish text, images, and video content. E-commerce-products are listed with images, prices, descriptions among others. There are also non-functional requirements that describe how a website performs; the requirements include: Performance-the website shall be fast in loading and high responsiveness even when heavy traffic is experienced. Scalability-the website has to be able to handle increased user loads.

Maintainability: where the code of a website should be well-structured and easy to update and maintain over time. Security: where the website should offer protection against unauthorized access, breaches of data through measures like encryption, etc. Availability: where it is ready and available for use. Compatibility: The site will have to work on different devices, such as



desktops and mobile devices. Usability: A site should have an intuitive and consistent user interface that is easy to learn and use on various devices in different browsers.

On the other hand, the system analysis should, according to Lowe, D. (2020), focus on identifying the challenges faced by farmers in accessing transparent market information and widening their market access. Here, some of the problem domains include a lack of price transparency, few buyer connections, and reliance on intermediaries. A deep analysis involves critical scrutiny of the existing flows of information, sources of data, and user interaction in the prevailing ecosystem of markets. The system should, therefore, allow viewing of real-time price information by farmers, posting of produce, and direct connections to buyers.

Therefore, system analysts need to design workflows with the help of data flow diagrams, use case diagrams, and entity-relationship models that represent how information moves through the system. The analytical process ensures that all functional requirements-like listing produce, accessing price trends, or communicating with buyers-are mapped accurately against the system components. Once this analysis is done, the translation of requirements into a description of the system structure and behavior undergoes the system design phase. This design process includes architectural design, interface design, and database design.

The system components interact through an architectural design that describes whether the platform architecture will be a client-server, three-tier, or cloud-based architecture. For the web-based marketplace, a three-tier architecture is considered ideal. The architecture ensures the platform is scalable, maintainable, and secure, as well as supports a seamless user experience. The interface design focuses on usability and accessibility. Web accessibility principles, such as providing alternative text for images, enabling keyboard navigation, and ensuring high color contrast, should be integrated into the interface to help all groups of users-for example, farmers.

The database design element involves the organization of data storage to achieve efficiency and reliability. In a web-based produce listing platform, for example, the database should deal with records of farmers, products, buyers, price listings, and transaction histories. Second, the system design strategy should adhere to object-oriented design methods where the system is perceived as comprising interacting objects that integrate data and behavior. Designers visualize the logical

structure along with the dynamic behavior of the system by using UML diagrams such as class diagrams, sequence diagrams, and activity diagrams.

This would also promote modularity, reusability, and easier platform maintenance. Further, iterative design methodologies such as Agile or RAD can be used for incremental testing with ongoing user feedback and flexible adaptation to changing requirements. For instance, prototypes of web interfaces or dashboards can be tested with farmers in order to refine usability and ensure the final system will meet user expectations. As indicated by Vatskel, V. et al (2023), hardware requirements define the physical parts of the agricultural system-the devices and sensors that collect data and execute control actions. These include sensors, crucial for collecting real-time environmental and crop data: soil moisture sensors used for measuring water content in soil, temperature and humidity sensors for monitoring environmental conditions, pH sensors that check acidity or alkalinity of the soil, among others.

The brains of the system are microcontrollers or microprocessors, processing sensor data and controlling actuators. Examples include Arduino, popular for small, low-cost, easy-to-program systems. Actuators-these are devices that perform actions based on control signals. Examples include water pumps for irrigation. Power Supply-Reliable energy sources are crucial, especially in remote areas. Example: Solar panels and batteries form a sustainable power solution.

According to Lowe, D. (2020), software requirements control the operation of the hardware, process data, and present it in a useful form for decision-making, and these include; system software or firmware embedded programs written in C/C++, Python, or Micro Python, Application Software, which is used in analyzing data, visualization, and user control, Cloud and IOT Platforms, which are used for remote data collection and automation, Artificial Intelligence (AI) and Machine Learning Optional, advanced agricultural systems use this for crop disease detection using image recognition (Tensor Flow, OpenCV), Operating Systems, such as Raspberry Pi OS (Linux-based), for running full-scale systems and also Windows or Linux for server or desktop data analysis software.

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## APPENDICESAPPENDIX 1: PROJECT BUDGET

Resource Category	Description	Quantity	Unit Cost (UGX)	Total Cost (UGX)
Software tools		1	Free	Free
Hosting &Deployment	Cloud application hosting	1	100,000/month	200,000
	Domain registration	1	60,000	60,000
Hardware components	Laptops for development	3	Provided	0
	Internet data bundles	3 months	50,000/month	150,000
Human Resources	System developers (team)	3	0	0
	Technical supervisor consultations	3 sessions	30,000/session	60,000
Data Collection	Printing questionnaires	50 copies	500/copy	25000
	Pens and stationery	Lump sum	1000	5000
Meetings and Logistics	Transport to the school site	4 visits	60,000/visit	60,000
	Refreshments during	2 sessions	20,000/session	40,000
Miscellaneous	Contingency (5%)	-	-	340,000

Estimated Total Budget: UGX 340,000

## APPENDDDIX 2: DATA COLLECTION TOOLS

It is an interview guide from some people and our Supervisor. It helps in understanding the challenges faced by small holder farmers in northern district of Gulu.

## APPENDIX:3 CHATT CHART

(August 18th to late November)

