# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter will present the methodology that will guide the execution of this study, which aims to design a context-aware Decision Support System (DSS) for farmers. The methodology will include the research design, the target population, sample design and sampling techniques, data collection instruments and procedures, data analysis methods, data presentation techniques, and ethical considerations. It will serve as the foundation for ensuring that the research process is methodical, reliable, and suitable for generating useful results.

A context-aware DSS integrates environmental and situational data with intelligent processing to support farmers in making informed decisions. Developing such a system requires a deep understanding of the end-users’ needs, the constraints they face, and the opportunities available within their context. Therefore, a robust methodology will be essential to collect, interpret, and present data that accurately reflects the realities of the agricultural sector—particularly among smallholder farmers, who are often marginalized in digital transformation efforts.

The study will adopt a mixed-methods approach, incorporating both quantitative and qualitative methods. This approach will be instrumental in capturing the breadth and depth of information required for system development. Quantitative data will support the measurement of agricultural patterns, digital adoption levels, and system requirements, while qualitative data will offer a narrative understanding of farmers' experiences, constraints, and technology interaction. Through triangulation, this mixed-method approach will enhance the validity, accuracy, and credibility of the research findings.

## 3.2 Research Design

The research design is the overall strategy that will be employed to integrate the different components of the study in a coherent and logical manner. This study will employ a mixed-methods research design, which will combine both descriptive quantitative analysis and exploratory qualitative inquiry. This hybrid approach will be used because it will provide a comprehensive picture of the current state of agricultural decision-making, technology usage, and the feasibility of deploying a DSS that adapts to contextual variables.

The quantitative component will involve collecting numerical data through structured questionnaires. This data will be essential for identifying trends in agricultural practices, levels of digital literacy, mobile phone penetration, and types of information farmers frequently seek. Statistical analysis of this data will help quantify needs and highlight gaps that the system can address.

The qualitative component, on the other hand, will involve interviews and field observations aimed at exploring attitudes, behaviors, and expectations that cannot be captured through closed-ended questions. This data will be critical in understanding the human factors influencing the adoption of DSS, such as trust in technology, cultural perceptions, local knowledge systems, and information-sharing dynamics.

The design will also incorporate a descriptive survey method to evaluate the current state of technological infrastructure, digital engagement, and agricultural support systems in rural communities. This method will facilitate data collection from a large and geographically dispersed population within a relatively short timeframe, making it ideal for exploratory studies.

## 3.3 Target Population

The target population of this study will consist of individuals and professionals directly involved in agricultural decision-making, particularly those who stand to benefit from an intelligent support system. This will include smallholder farmers, agricultural extension officers, and ICT professionals working on agricultural technology initiatives.

Smallholder farmers will form the core of the population under study. They are often the most affected by unpredictable weather patterns, fluctuating market conditions, and a lack of access to timely, context-specific information. These farmers frequently rely on traditional knowledge, which, while valuable, may not always align with contemporary environmental and economic challenges. Their feedback will be essential in identifying what kind of information the DSS should provide and how it should be delivered.

Agricultural extension officers serve as intermediaries between farmers and institutional knowledge. Their inclusion in the study will ensure that the system design aligns with best agricultural practices and complies with government and institutional frameworks. They will provide insights into the type of data that is useful in decision-making and the challenges they face when disseminating this information.

ICT professionals—particularly those involved in developing agricultural apps, mobile platforms, or cloud-based decision tools—will offer technical insights into how a context-aware DSS can be architected, integrated, and scaled. Their input will help refine the system’s functional requirements and ensure that the DSS is both user-friendly and technically feasible within the rural infrastructure constraints.

## 3.4 Sample Design and Sampling Techniques

The study will use a non-probability purposive sampling technique to select participants from the target population. This technique will be chosen because it allows for the selection of individuals who are best placed to provide rich, relevant, and practical data for the study. The criteria for participant selection will include experience in farming or agricultural support, willingness to participate, and exposure to digital technologies such as mobile phones or farm-related apps.

The sample size will consist of 100 participants, distributed as follows:

- 80 smallholder farmers: These will be selected from three counties known for high agricultural activity. Care will be taken to ensure a balance in terms of gender, age, crop type, and level of education. Farmers with more than three years of experience will be prioritized.

- 10 agricultural extension officers: These will be drawn from both public and private sector agricultural programs. They will be selected based on their involvement in community outreach and knowledge transfer.

- 10 ICT professionals: These will be selected from companies or institutions engaged in agricultural innovation, particularly those that have previously developed decision-making or data analytics tools for rural areas.

This sample design will allow the research to benefit from a wide spectrum of experiences, ensuring that the DSS reflects the multifaceted nature of modern farming and the different user requirements involved.

## 3.5 Data Collection Methods

To ensure the credibility of the research, a combination of primary and secondary data collection methods will be used.

Primary Data Collection

1. Structured Questionnaires: These will be administered to smallholder farmers. The questionnaires will contain closed-ended and multiple-choice questions focused on farming practices, decision-making challenges, and the use of technology in farming. To ensure clarity, the questionnaires will be translated into local languages and pre-tested in a pilot study.

2. Semi-structured Interviews: These will be conducted with agricultural extension officers and ICT professionals. The interviews will allow for open-ended responses, providing deeper insights into challenges, potential benefits, and design expectations for the DSS.

3. Field Observations: On-site visits will be conducted to observe farming environments, types of technology in use, network coverage, and access to power and mobile devices. Observations will be guided by a checklist and will be used to validate data obtained from other sources.

Secondary Data Collection

Secondary data will be gathered from:

- Government agricultural reports  
- Scientific publications and journals  
- Previous studies on DSS and precision agriculture  
- National census and agricultural survey data  
- Agricultural NGO reports and datasets

These sources will help establish a contextual background and reinforce the data gathered from primary research.

## 3.6 Data Analysis Methods

After collection, the data will undergo rigorous analysis using both quantitative and qualitative techniques.

Quantitative data from the questionnaires will be coded and analyzed using SPSS. Descriptive statistics—such as frequencies, means, and standard deviations—will be calculated to identify major patterns. Inferential statistics such as chi-square tests or correlation coefficients may be used to assess relationships between variables like education level and adoption of technology.

Qualitative data from interviews and observations will be analyzed using thematic analysis. The process will involve transcription, coding of text, categorization of themes, and interpretation. Emerging patterns such as "lack of trust in mobile applications" or "need for localized weather data" will be carefully noted and discussed. NVivo software may be used to assist in organizing and analyzing large volumes of text.

Data triangulation—comparing data from multiple sources—will be applied to validate findings and improve the depth of analysis. This will allow for both breadth and nuance in interpreting the research outcomes.

## 3.7 Data Presentation Methods

Findings will be presented in a combination of visual and textual formats to ensure effective communication of insights to different audiences.

- Tables and charts will be used to present statistical findings, such as the percentage of farmers using mobile phones for farming information.  
- Bar graphs and pie charts will be employed to show distributions and trends, including preferred information delivery formats.  
- Narrative summaries will describe qualitative findings and will be supported by direct quotes from participants, highlighting their personal experiences and contextual insights.

Where applicable, maps and infographics may also be used to display regional disparities in technology usage or farming patterns. This presentation strategy will make the results accessible to policymakers, developers, and community stakeholders alike.