



Digital Agricultural Governance and Agricultural Modernization: Evaluating the E-Vaadagai Scheme in Tamil Nadu

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Abstract: Digital governance becomes a vital part of modern agriculture as it aims to boost productivity, deliver better services and fortify farmer institutions. E-Vaadagai Scheme is a Tamil Nadu initiative of the State Government, which is a digital platform to enable farmers to access agricultural machinery and thereby modernize agriculture. This study assesses the part played by the Tamil Nadu State Government towards the agricultural modernization using the E-Vaadagai Scheme in Aranthangi Block of Pudukkattai District. A cross-sectional survey design of quantitative research was used. Primary data was collected through a structured interview schedule with 32 farmers and secondary data was taken from government reports and from literature. The collected data were analyzed descriptively, that is, the frequency and percentage analysis. The results showed that the working population knew about the E-Vaadagai Scheme 71.9 per cent, and had used it 59.4 per cent. The farmers felt that the scheme helped them in accessing agricultural machinery, less dependence on labour, efficiency, transparency and timely execution of agriculture activities. But some implementation problems emerged such as unavailability of agricultural machinery in the season, poor internet connectivity, administrative delays, lack of awareness of the scheme procedures, and lack of digital literacy. The study concludes that E-Vaadagai Scheme has positively contributed to agricultural modernization by enhancing the digital agricultural governance, and increased access to mechanization especially for the small and marginal farmers. However, there is a need to strengthen digital infrastructure, farmer capacity development, coordination and awareness-building efforts, in order to ensure optimal effectiveness and sustainability of state-supported digital agricultural programs. The results were added to the existing body of knowledge on digital governance and agricultural modernization and have provided policy suggestions to improve digital agriculture in Tamil Nadu and similar agrarian regions.

Keywords: Agricultural Modernization, Digital Governance, E-Vaadagai Scheme, Digital Agriculture, Agricultural Mechanization, Rural Development

1. Introduction

1.1 Background and Context

Agriculture is still a cornerstone of the Indian economy, playing a crucial role in food security, employment in rural areas, and overall economic growth. Despite the structural transformation the share of agriculture in Gross Domestic Product (GDP) has reduced, yet it is supporting livelihood of almost half of India's population. The sector is facing several structural problems such as small and scattered land holdings, shortage of labour, climate change, falling farm profitability, market inefficiencies and lack of modern agriculture technologies (Chand et al., 2015; Dev, 2015; Pingali, 2012).

Modernization of agriculture has become a priority for the governments aiming to enhance the productivity, income of the farmers as well as sustainable development of the rural area. Today, modernization is no longer limited to the mechanisation of farms but has reached the use of digital technologies, precision agriculture, institutional changes, electronic service delivery and data-based governance. Digital agriculture empowers farmers to have timely information about weather, markets, agricultural inputs and government services and also



helps increase transparency, efficiency and accountability in agricultural administration (Bertoglio et al., 2021; Chowdhury et al., 2023).

Digital governance has revolutionized the public sector in developing economies. Digital governance is the use of ICTs for the governance processes related to policy implementation, public service delivery, administration and citizen participation. For the agriculture sector, digital governance supports online registration systems, electronic subsidy distribution, digitised land records, market information systems and transparent identification of beneficiaries, which cut down on information asymmetries and bureaucratic delays (Liu et al., 2018).

In India the agriculture is a state subject as per the constitution and State Governments are the key players in the agriculture policy implementation process. The Union Government drafts national policy, allocates financial resources, and the State Government designs policy interventions for the region, enhances extension services, encourages mechanization, develops rural infrastructure, and creates digital innovations based on the local agricultural conditions (Basu, 2015; Gulati & Fan, 2007; Thorat & Fan, 2007).

1.2 Digital Agricultural Governance: The Tamil Nadu Context

Tamil Nadu has always been one of the states which has embraced Technology based Agricultural reforms in India. To enhance farmers' welfare and agricultural productivity, the Government of Tamil Nadu has launched various initiatives to encourage farm mechanization, micro-irrigation, digital extension services, and electronic governance. The E-Vaadagai Scheme is one of these interventions which aims to create an online platform for formalizing agricultural leasing arrangements. The scheme hopes to enhance tenure security, transparency, access to institutional credit, and government welfare schemes for the farmers, while also boosting evidence-based agricultural administration by digitally recording lease agreements. The overall goal is to provide a platform for modernizing agriculture using technology-driven governance, and to alleviate reliance on informal governance institutions.

1.3 Research Problem and Rationale

Although the digital agricultural governance has been receiving more attention, the empirical evidence on the effectiveness of the implementation of the state-sponsored digital agriculture initiatives is still limited. The current research has mostly focused on national or state level on agricultural modernization, mechanization, and digital agriculture, while few studies have explored local assessments of implementation outcomes. In addition, little empirical evidence has been available on farmers awareness, the perceived benefits, the institutional challenges and implementation barriers of the E-Vaadagai Scheme especially at the block level.

The study is conducted in Aranthangi block of Pudukkottai District which is suitable for investigation of these problems as agriculture is the main occupation of the villagers, and large proportion of the cultivators of the village are small and marginal farmers. In this context, the assessment of the E-Vaadagai Scheme implementation helps assess the impact of digital governance projects on the agricultural modernization at grassroots level. Accordingly, the present study investigates the awareness, use, perceived efficacy and impediments encountered by the farmers associated with the E-Vaadagai Scheme and assesses the contribution of the Tamilnadu State Government to the agricultural modernization through digital governance.

2. Literature Review

2.1 Agricultural Modernization: Conceptual Evolution

Agricultural modernization has taken up more than just the concepts of mechanisation and productivity; it's a multidimensional process of innovation, institutionalisation, digital governance, environmental protection and market integration. The earlier modernization theories focused on the introduction of modern farm technologies, better irrigation systems, high-yielding varieties, fertilizer and mechanization as the factors behind agricultural



growth (Schultz, 1964; Pingali, 2012). Modernisation of agriculture is not only about Technology, it's also about institutional capacity, Governance, Digitalisation, and inclusive Rural Development (FAO, 2022; OECD, 2023).

Technological advancements are the backbone of agricultural transformation in modern agriculture; the productivity gains yield higher farm incomes, boost rural employment and drive economic development at the national level, as cited by Pingali (2012). Similarly, the Food and Agriculture Organization (FAO, 2022) emphasizes the importance of agricultural modernization by introducing sustainability, adaptation to climate change and digital solutions to maintain food security and minimize environmental impacts in the future.

Recent literature also suggests that other inputs like the expansion of technology, institutional services, financial inclusion and digital infrastructure to the farmers, should also be considered as measures of modernization (OECD, 2023; World Bank, 2024). As a result, there is a growing trend to implement a digital governance approach to enhance agricultural service delivery and create more evidence-based policymaking.

2.2 Digital Governance in Agriculture

The digital revolution in public administration is one of the most significant changes in public administration in the last 20 years. It is the use of digital technologies to enhance efficiency, transparency, accountability, citizen engagement and service delivery of governments (United Nations, 2024). In agriculture, digital governance has transformed the way governments relate with farmers, such as with digital platforms for land registries, subsidy management, crop insurance, market information, agricultural extension, and farmer identification.

The World Bank (2023) suggests that digital agriculture enables farmers to make better decisions, such as accessing real-time information on weather forecasts, market prices, input availability, and government programs. Similarly, the Organisation for Economic Co-operation and Development (OECD 2023) states that digital governance helps in the implementation of policies, enhances transparency and accountability, and cuts down on administrative inefficiency and corruption.

Studies that have conducted empirical tests of the effect of digital ag platforms on transaction costs and access to government services have yielded significant results on how they affect farmers' transactions costs and their access to government services (Aker, 2011; Fabregas et al., 2019). Mobile apps, online advisory services, and digital extension services have been demonstrated to improve agricultural productivity, raise farmers' awareness, and improve institutional communication between governments and rural communities (Klerkx et al., 2019). However, in the implementation of the digital governance projects the quality of digital literacy, quality of internet access, lack of institutional capacity, and social-economic gaps in rural communities often pose problems (Rotz et al., 2019).

2.3 Digital Agricultural Initiatives in India

Digital governance has become an important approach in the development of agriculture in India, and a number of digital initiatives have been gaining momentum, such as the National e-Governance Plan in Agriculture (NeGP-A), AgriStack, the Electronic National Agriculture Market (e-NAM), PM-KISAN, Direct Benefit Transfer (DBT), and digital farmer service portals. The schemes have been designed to enable farmers to be able to access agricultural information, financial assistance, crop information, market information, and Government welfare schemes through a digital platform.

On a national level, governments have been complemented by introducing context-specific digital agricultural programmes that cater to local production systems and institutional needs at the state level. Tamil Nadu has become one of the most successful states in terms of promoting digital agricultural governance, which has been achieved through various initiatives and programs related to technology-driven agricultural administration, digital agricultural extension services, mechanization and efficient irrigation management. In this policy context, the E-



Vaadagai Scheme is significant, as it is an innovation at the state level which seeks to enhance agricultural modernization in terms of better access to agricultural machinery for farmers.

2.4 Empirical Review and Research Gap

The links between digital technologies and agricultural development have been studied in several empirical studies. Fabregas et al. (2019) concluded that digital advisory services have a significant positive impact on farmers' access to agricultural information, which in turn leads to better farm management decisions and enhanced productivity. Klerkx et al. (2019) also found that the digital innovation promotes knowledge sharing, institutional coordination and technology uptake among farmers.

According to a systematic review by Rotz et al. (2019), digital agriculture has the potential to enhance productivity, but there are also issues to consider, such as access to technologies, digital exclusion, data privacy and institutional capacity. Similarly, the FAO (2022) and the World Bank (2023) have found that the effectiveness of digital agriculture programs hinges on both technological factors, specifically infrastructure, and governance aspects such as quality, institutional coordination, farmer awareness and administrative responsiveness.

There is limited research on the evaluation of digital agricultural governance in India. In comparison, the research that is available concentrates on e-NAM, Direct Benefit Transfer, PM-KISAN or digital extension services, with limited attention given to state-specific schemes like the E-Vaadagai Scheme. Moreover, there is a lack of empirical evidence at the block level that looks at the block farmers' experiences, challenges in implementation, and effectiveness of the institutions.

This study aims to fill these gaps by conducting one of the very few empirical studies on the E-Vaadagai Scheme Ground level in Tamil Nadu, which is part of the growing body of literature on state-led digital agricultural governance and agricultural modernization.

3. Theoretical Framework and Conceptual Framework

3.1 Theoretical Framework

This research is based on Davis' (1989) Technology Acceptance Model (TAM) and Digital Governance Theory. These theoretical approaches offer a holistic perspective on farmers' uptake of digital government programs and assessing the outcomes of the digital agriculture governance by the state.

Technology Acceptance Model (TAM) is a model that describes the acceptance of and use of new technology. Davis (1989) stated that there are two basic constructs that influence an individual's desire to use a technology: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Perceived usefulness is defined as how much an individual believes that the use of a specific technology will improve performance and perceived ease of use is defined as how easy and free the technology is to use. These perceptions affect users' attitudes, their intentions to use the technology, and their actual technology use (Davis, 1989; Venkatesh & Davis, 2000).

Farmers are more willing to use the E-Vaadagai scheme digital platforms if they believe that the platform offers a clear benefit, such as better access to government services, increased transparency, quicker government processes, institutional recognition, and better access to agricultural support. On the other hand, lack of digital literacy, technical support and internet connectivity can decrease technology acceptance among the rural farmers (Venkatesh et al., 2003).

Digital Governance Theory deals with the change of the public sector under the influence of information and communication technology while the TAM is based on the case of individual technology adoption. Digital governance through the use of digital technologies in government administration focuses on transparency, accountability, efficiency, responsiveness and service delivery that is centred on the citizen (United Nations, 2024; OECD, 2023). In agriculture, digital governance aims to enhance the delivery of public services using online



registrations of farmers, electronic land records, agricultural advisory services, digitisation of subsidy management, and implementation of technologies.

Agricultural governance in India is mostly a state subject and hence State Governments are playing a central role in agricultural digital governance. Therefore, the administrative efficiency, institutional coordination, policy support, technological infrastructure, and farmers' willingness to use digital service are crucial for the successful implementation of digital agriculture programs. The E-Vaadagai Scheme is an example of a practical, state-led digital governance model that aims to boost transparency in agricultural administration, and agricultural modernization through the use of technology to deliver public services.

In the present research, the Technology Acceptance Model and Digital Governance Theory were incorporated to explore the behavioral, as well as institutional, factors that impact farmers' uptake of the E-Vaadagai Scheme. This is a theoretical approach that integrates various aspects to present a holistic view of the relationship between digital governance and agricultural modernization on the ground level.

3.2 Conceptual Framework

The literature review and the adopted theoretical approaches resulted in the development of a conceptual framework that presents the relationship between digital governance and agricultural modernization. The following are assumed as the factors that are interrelated to the successful implementation of the E-Vaadagai Scheme. In this framework, State-led Digital Agricultural Governance is the independent variable, which is represented in terms of the E-Vaadagai Scheme. Mediating variables such as Farmers' Awareness, Digital Literacy, Perceived Usefulness, Institutional Support and Ease of Access to Digital Services are considered. Agricultural Modernization is the DV and the Mod variables include Age, Educational Level, Farm Size, Farming Experience, and Internet Accessibility.

The State Government of Tamil Nadu plays a crucial role as the key institutional player in the policy-making process, digital infrastructure development, administrative coordination and implementation. These institutional factors have an impact on farmers' awareness, digital literacy, information access, and the perceived usefulness of the digital platform. Farmers with a higher awareness of the scheme and who find the platform useful and easy to use are expected to show higher rates of adoption. A higher level of adoption then leads to better access to government services, better institutional support, transparency in agricultural administration and agricultural modernisation. Nevertheless, implementation outcomes could be affected by digital illiteracy, lack of internet connectivity, administrative delays, lack of institutional capacity, and socioeconomic inequalities among rural households.

3.3 Research Objectives, Questions, and Hypotheses

3.3 Research Objectives

The current study has five important objectives. The study intends to analyse awareness amongst the farmers regarding the E-Vaadagai Scheme in Aranthangi Block. It aims at understanding the factors that affect adoption of E-Vaadagai digital platform by farmers. the study tries to assess the success of the E-Vaadagai Scheme in the development of modern agriculture. it seeks to evaluate institutional support and digital governance for enhancing agriculture service delivery. the study seeks to identify the implementation challenges associated with the E-Vaadagai Scheme and recommend policy measures for strengthening digital agricultural governance.

3.4 Research Questions

The study addresses five research questions that guide the empirical investigation. First, what is the level of farmers' awareness regarding the E-Vaadagai Scheme? Second, which factors influence farmers' adoption of the digital platform? Third, does the E-Vaadagai Scheme contribute to agricultural modernization? Fourth, what



institutional and technological barriers affect effective implementation? Fifth, how can digital agricultural governance be strengthened to improve policy outcomes?

3.5 Research Hypotheses

To test the relationships proposed in the conceptual framework, the following five hypotheses are formulated for empirical testing. The first hypothesis (H_1) posits that farmers' awareness has a significant positive influence on the adoption of the E-Vaadagai Scheme. The second hypothesis (H_2) states that digital literacy significantly influences farmers' utilization of the E-Vaadagai digital platform. The third hypothesis (H_3) proposes that institutional support positively influences farmers' satisfaction with the implementation of the E-Vaadagai Scheme. The fourth hypothesis (H_4) asserts that adoption of the E-Vaadagai Scheme significantly contributes to agricultural modernization. The fifth hypothesis (H_5) maintains that digital governance has a significant positive effect on agricultural modernization through technology adoption.

4. Research Methodology

4.1 Research Design

This study is of a quantitative type with a descriptive and analytical research design to assess the impact of the E-Vaadagai scheme in the promotion of agricultural modernization and digital agricultural governance. The quantitative approach is suitable since it allows for the systematic collection and statistical analysis of numerical data to explore the relationships between variables and to produce objective results (Creswell & Creswell, 2018). For the study, a cross sectional survey design was used because the data were gathered at one specific time. Because of their applicability, the cross-sectional studies are also widely adopted in public administration and rural development studies to evaluate the program implementation, farmers' perception, and policy outcomes (Bryman, 2016). The study is descriptive, and uses inferential statistical techniques to analyze the knowledge, uptake, perceived benefits and constraints of the E-Vaadagai Scheme as experienced by the farmers.

4.2 Study Area

The study was an empirical investigation and was carried out in Aranthangi Block of Pudukkottai District, Tamil Nadu. In the study area agriculture is the main living source of income with a significant percentage of farmers engaged in paddy cultivation, groundnut production, pulses cultivation, coconut cultivation and horticulture. The study area is especially suitable for testing digital agricultural governance initiatives because of the small size and the marginal farmers who make up the majority of farmers. The E-Vaadagai Scheme is implemented in the district by the Tamil Nadu Government as a part of the Government's digital governance initiative to enhance agricultural administration and improve farmers' access to institutional services. This makes Aranthangi Block a suitable block to monitor grassroots level adoption and impact of the scheme.

4.3 Population and Sampling

Target group comprises those farmers who knew about or availed itself of E-Vaadagai Scheme in Aranthangi Block. The study centers on the beneficiaries as they have firsthand knowledge about the implementation, access, usefulness and operational challenges of the digital platform. Purposive sampling was used to identify the respondents who had a good knowledge of the E-Vaadagai Scheme. Purposive sampling can be used when the respondents are selected on the basis of the characteristics that are significant for the research objectives, and not selected by random sampling (Etikan et al., 2016). The last sample comprised 32 farmers who are registered or potential beneficiaries of the scheme in Aranthangi Block. The sample is small but offers good exploratory evidence on farmers' experiences of the implementation of digital agricultural governance. Exploratory studies of implementing policies locally and conducting program evaluations have employed similar sample sizes (Yin, 2018).



4.4 Sources of Data

The data sources used in the study were primary and secondary data. The primary data were collected using structured and pre-designed interview schedule directly from farmers. The questionnaire contained questions on the socio-economic characteristics, awareness of E-Vaadagai Scheme, E-Vaadagai Scheme registration & utilization, perceived usefulness, availability of digital services, institutional support, implementation challenges, and satisfaction. Structured interview method enabled the data collection to be consistent and the interviewer bias was minimal (Creswell and Creswell, 2018). Secondary data has been collected from various sources such as Government of Tamil Nadu policy documents, reports from Department of Agriculture and Farmers' Welfare, research articles published in Scopus indexed journals, books, census publications, FAO reports, World Bank reports, OECD publications and official statistical reports. These sources were used to give background and policy perspectives to the empirical results.

4.5 Variables and Measurement

The study will analyze several variables, which are categorized into independent variables, mediating variables, dependent variables, and control variables, based on the theoretical framework. The independent variable is State-led Digital Agricultural Governance in the form of implementing the E-Vaadagai Scheme. The mediators are Awareness, Digital Literacy, and Institutional Support, which are defined as knowledge of the existence and procedures of the scheme and digital literacy, as well as institutional support, which is defined as the government support and coordination. Agricultural Modernization is the dependent variable that is measured as access to mechanization and productivity improvement. Also, the demographic characteristics include control variables as Age, Education, Farm Size and Farming Experience. The scales of nominal and ordinal were used to measure most items in the questionnaire. The perceptions of farmers on awareness, accessibility, institutional support and satisfaction were ranked in the predefined response categories to enable statistical analysis. Socio-economic variables were measured from standard socio-economic classification such as age, education, land holding size, and farming experience. This systematic operationalisation guarantees that the meaning of each variable is explained and that it is measured in the same way for all respondents, thus increasing the reliability and validity of the empirical results.

4.6 Data Analysis

The Statistical Package for the Social Sciences (SPSS 20.0) was used for coding, entry and analysis of the data. Analysis technique used was descriptive and inferential statistical techniques. This descriptive statistics summarises the socio-economic characteristics of the respondents, as well as their awareness, use and perceptions on the E-Vaadagai Scheme. If appropriate, use a test of independence (Chi-square) or Fisher's Exact Test (when cell counts are less than 5) or cross-tabulation analysis. The techniques are used to look at correlations between the selected socio-economic features and the awareness or utilization of the scheme by the farmers. Fisher's Exact Test, with a relatively small sample size ($n = 32$), might be more suitable when sample size is small and for situations where the assumptions of the Chi-square test are not met (Field, 2018).

4.7 Reliability, Validity, and Ethical Considerations

Reliability and Validity: The interview schedule was designed by referring to previous literature, government policy documents, and the study objectives in order to make sure that the content was valid. For clarity, relevance and sufficient measurement, the instrument was reviewed by subject experts related to agricultural policy and public administration. Standardization of questions and interview schedule were created to improve the reliability. Standardization of data collection method eliminated measurement error and improved reliability of responding.

Data Quality Assurance: Several steps were taken to assure the integrity and reliability of the data collected. The structured interview schedule was well planned and pretested by the experts who were knowledgeable about the

research objectives before it was implemented in the field. To reduce misunderstandings and response bias, clarity of information was provided to respondents on each question during the data collection. Immediately following the interviews completed questionnaires were checked for incomplete answers and inconsistencies. To minimize transcription errors and the reliability of the final data, data coding and entry were cross-checked before entering the data into SPSS for statistical analysis.

Ethical Considerations: Ethical standards for social science research were followed. Prior to data collection, the respondents were informed about the objectives of the study and participation was voluntary. Each respondent was required to sign informed consent and confidentiality and anonymity were ensured throughout the research process. All of the data collected was done for academic research purposes only.

4.8 Limitations of the Study

Several limitations should be acknowledged. First, the study is confined to Aranthangi Block of Pudukkottai District, limiting the generalizability of findings to other regions of Tamil Nadu. Second, the relatively small sample size of 32 respondents restricts the application of advanced statistical techniques and limits statistical power. Third, the findings are based on respondents' perceptions at a single point in time; therefore, longitudinal changes in the implementation of the E-Vaadagai Scheme could not be examined.

5. Results and Discussion

5.1 Demographic Profile of the Respondents

The socio-economic features of the respondents are important because the farmers' awareness, technology adoption, and utilization of digital agricultural services are greatly influenced by the socio-economic characteristics (Rogers, 2003; Venkatesh et al., 2003). A total of 32 farmers from Aranthangi Block of Pudukkottai District were covered in the survey. The respondents were spread across various age levels, educational status, type of farming, and occupational status giving a representative picture of the farmers' perceptions of the E-Vaadagai Scheme.

Table 1: Demographic Profile of Respondents

Characteristic	Category	Frequency	Percentage
Age	Below 25 years	16	50.0%
	25-40 years	9	28.1%
	Above 40 years	7	21.9%
Gender	Male	21	65.6%
	Female	11	34.4%
Education	Graduates	24	75.0%
	Higher Secondary	5	15.6%
	Primary/Secondary	3	9.4%
Occupation	Farming	18	56.3%

Characteristic	Category	Frequency	Percentage
	Other Occupations	12	37.5%
	Agricultural Labor	2	6.3%
Farm Size	Small (<2 ha)	19	59.4%
	Marginal (<1 ha)	5	15.6%
	Medium (2-5 ha)	5	15.6%
	Large (>5 ha)	3	9.4%

The analysis shows that 50% of the respondents were aged less than 25 years, which means that the youngest farmers are the most numerous ones in the study. The discovery suggests that digital initiatives in agriculture are more likely to be embraced by younger farmers than older farmers. Digital literacy is generally found in younger farmers, and they tend to be more interested in trying out the use of technology-based government services than older farmers who are more likely to rely on traditional farming practices (Rogers, 2003; Venkatesh et al., 2003). The growing involvement of young farmers is encouraging as digital governance requires for the user, basic technological competences. This is in line with the findings of Klerkx et al. (2019) which indicates that younger farmers are more open to digital innovations in agriculture because they are more familiar with information and communication technologies.

The results show that males are the bulk of the participants (65.6%), but females are also active participants in agricultural activities (34.4%). This is an indication of the evolving role of women in rural farming where women are now playing an active role in farming, resource management and decision-making. In the past, the same research also found that women are increasingly participating in digital agricultural programs, but there are still gender disparities in access to technology (FAO, 2022).

One of the key attributes that proved to be significant for awareness and uptake of digital governance initiatives was education. Relatively high proportion of the farmers surveyed had a high educational status, as about 75% were graduates. Those farmers who are educated have higher awareness about government programs and higher confidence in the use of digital platforms. This result is in line with Davis' (1989) Technology Acceptance Model which posits that users with higher knowledge and confidence see technology as less complex, leading to greater uptake.

From the occupational profile, 56.3% of the respondents were mainly working in farming, 37.5% in other occupations and 6.3% as agricultural laborers. The findings show that although the occupational diversification has been observed within the study area, agriculture is still the major livelihood activity. The high proportion of farming households increases the validity of the study as the respondents have first-hand knowledge on agricultural modernization and government intervention programs.

The study shows that 59.4% of the farmers were small farmers, while only 15.6% were marginal farmers and 9.4% were medium sized farmers and only 9.4% were large farmers. Aranthangi Block also showed the prevalence of small scale farming with the pattern of land holdings. The results are typical of the agricultural landscape of Tamil Nadu, which is dominated by small and marginal farmers, accounting for the majority of agricultural production (Government of India, 2021). Farmers' capacity to access high cost and advanced agricultural machinery is often limited by small land holdings, thus making digital platforms and agricultural machinery rental

services more important. The overall demographic profile shows that the study largely reflects the profile of educated small farmers who are actively engaged in farming, which can be considered as an appropriate population to study digital agricultural governance as a state-led process.

5.2 Awareness and Adoption of the E-Vaadagai Scheme

Awareness is considered as the first step in technology adoption and program utilization (Rogers, 2003). In the absence of sufficient awareness, government actions to deliver policy impacts cannot deliver intended policy results.

Table 2: Awareness and Utilization of E-Vaadagai Scheme

Variable	Category	Frequency	Percentage
Awareness	Aware	23	71.9%
	Not Aware	9	28.1%
Utilization	Utilized	19	59.4%
	Not Utilized	13	40.6%
Frequency of Use (n=19)	Frequent	7	36.7%
	Occasional	6	33.3%
	Infrequent	6	30.0%

The study shows that 71.9% of the respondents were aware of the E-Vaadagai Scheme while 28.1% were not aware. This discovery indicates that the government of Tamil Nadu has succeeded to a great extent in spreading awareness of the scheme. However, the percentage of farmers who are not aware is still high, which means that the extension work and raising awareness should be improved further. The same trend was seen by Anitha (2022), who noted that the extent to which farmers were aware of Government agricultural programmes depends on their educational levels, extension contact and access to digital information.

While there was a relatively high level of awareness, there was only partial understanding of the benefits, procedures and objectives of the scheme. The awareness–understanding distinction is significant because the utilization of a program will be effective if people are aware of it, but also know how to use it and how to benefit. The same goes for limited digital literacy which has been reported to hinder the effective use of e-governance programs, even though there is a relatively high level of awareness (Klerkx et al., 2019).

The survey also reveals that 59.4% of the respondents had used E-Vaadagai Scheme while 40.6% had not used it. While over half of the respondents have adopted the scheme, the awareness to use ratio of 71.9:59.4 indicates a disconnect between awareness and scheme use. Administrative procedures, digital literacy, infrastructure availability, and institutional support are likely to impact farmers' decisions to use this platform. The users who reported frequent usage of scheme = 36.7%, occasional usage = 33.3%, infrequent usage = 30.0%. The results indicate that although many farmers are aware of the value of the scheme, regular use of the scheme is reliant on the provision of services on time, availability of machinery and reaction time of administration. This observation aligns with the Technology Acceptance Model (TAM) that suggests people who use technology over and over again are more likely to value its usefulness and user-friendliness (Davis, 1989).

5.3 Factors Influencing Adoption

The study looked at the connection between some socio-economic variables and adoption of the E-Vaadagai Scheme by the farmers. The findings indicate that age, education and farm size had significant relationship with the adoption patterns.

Table 3: Factors Influencing Adoption

Factor	Category	Adoption Rate	Statistical Significance
Age	Below 25 years	75.0%	$\chi^2 = 6.23, p < 0.05$
	25-40 years	66.7%	
	Above 40 years	28.6%	
Education	Graduates	70.8%	$\chi^2 = 8.14, p < 0.05$
	Higher Secondary	40.0%	
	Primary/Secondary	33.3%	
Farm Size	Small/Marginal	54.2%	$\chi^2 = 4.87, p < 0.05$
	Medium	60.0%	
	Large	100.0%	

Lower level of adoption rate among older farmers than younger farmers. This discovery reflects the Technology Acceptance Model which holds that younger people are more likely to be familiar with digital technologies and have more favourable attitudes towards the adoption of technologies (Venkatesh et al. 2003). There might be some challenges to digital literacy and willingness to use new technologies among older farmers, necessitating specific training and support.

Being educated was a significant predictor for adoption. Higher secondary (40.0%) and primary/secondary educated farmers (33.3%) showed the next highest rate of adoption, followed by graduates (70.8%). This correlation confirms previous studies that found that educated farmers are more aware, more able to understand and more confident in using digital government services (Fabregas et al., 2019; Klerkx et al., 2019).

Adoption of the scheme was higher amongst the large farmers while it was comparatively low but much higher among small and marginal farmers (54.2%). The finding is significant as it emphasises the significance of the scheme for smallholders who may not have the financial capacity to buy expensive agricultural machinery on their own. The lower adoption rates for small and marginal farmers on the other hand indicate that other support measures can be considered to improve the equity of access.

The research revealed that the farmers with a high level of digital literacy were more likely to use the scheme. 81.2% of respondents who said they were comfortable with the use of their smartphone and online platforms were digital adopters, while 37.5% of respondents who indicated a limited digital literacy were digital adopters. This highlights the need for digital literacy as a prerequisite to participate effectively in digital governance initiatives.

Farmers who had reliable Internet access had significantly higher rates of adoption (78.9%) than those who had limited or no Internet access (38.5%). The analysis reveals the importance of technological infrastructure in achieving digital agriculture governance.

5.4 Impact of the E-Vaadagai Scheme on Agricultural Modernization

Agricultural modernization is not limited to the use of farm machines but also includes greater productivity and lower production costs, efficient use of resources and better access to government services. The E-Vaadagai Scheme was launched to help achieve these objectives by using a digital platform where farmers can access agricultural machinery and related services in a transparent and efficient way. The study, therefore, focused on the farmers' perception on the contribution of the scheme to agricultural modernization.

Table 4: Perceived Impact on Agricultural Modernization

Indicator	Agree	Neutral	Disagree
Improved access to agricultural machinery	78.9%	15.8%	5.3%
Reduced labor dependency	73.7%	21.1%	5.3%
Enhanced operational efficiency	68.4%	26.3%	5.3%
Timely completion of agricultural activities	73.7%	15.8%	10.5%
Increased transparency in service delivery	63.2%	26.3%	10.5%
Reduced cultivation costs	57.9%	31.6%	10.5%
Improved farm productivity	52.6%	36.8%	10.6%

The results show that most of the respondents saw the E-Vaadagai Scheme as a good intervention that had a positive impact on the agricultural operations. Farmers indicated that the use of hired machinery led to less reliance on labour, to the ability to complete agricultural activities on time, and to higher efficiency. These findings are similar to the previous studies that have indicated that mechanisation has positive effect on productivity and also minimize the problem of labour shortage and the cost of cultivation (Kumar & Sharma, 2016; Pingali, 2012). It was also found that the machinery acquired under the scheme was mainly for land preparation, sowing, harvesting and other labour-intensive agricultural tasks. The services were found to be very useful to small and marginal farmers who are not financially able to buy expensive farming equipment. The scheme thus serves as a sharing model to ensure fair access to the modern agricultural technology.

In addition, respondents showed that mechanization contributed to the timeliness of the farm operations. Proper land preparation and harvesting minimize losses and maximize crop yields, especially in areas where rainfall is seasonal. The findings were presented are useful to the argument that agricultural modernization isn't just a technological innovation, but a process that relies on institutional arrangements that would allow farmers to obtain technology at reasonable prices. The study also revealed, however, that improvements in modernization were not consistent among all the farmers. The degree of digital literacy, awareness, internet connectivity and administrative support affected the extent to which the respondents benefited from the scheme. Therefore, the E-Vaadagai Scheme has had a positive impact on agricultural modernization but only within the institutional context where it has been applied.

5.5 Role of the State Government in Promoting Agricultural Modernization

The success of any agricultural modernization program will rely greatly on the commitment and administrative ability of the State Government. Agriculture is a State subject under the Constitution of India and states have a significant role in designing agricultural mechanization programs, distribution of subsidies, enhancement of agricultural extension services, and fostering digital governance.

Table 5: Farmers' Perceptions of State Government Role

Dimension	Positive	Neutral	Negative
Government commitment to agricultural modernization	65.6%	21.9%	12.5%
Effectiveness of digital governance initiatives	59.4%	25.0%	15.6%
Transparency in service delivery	62.5%	21.9%	15.6%
Adequacy of extension support	46.9%	31.3%	21.9%
Administrative responsiveness	43.8%	28.1%	28.1%
Farmer training and capacity building	40.6%	31.3%	28.1%

The respondents expressed positive view on the various initiatives taken by the Government of Tamil Nadu for the agricultural modernization under E-Vaadagai scheme. The online platform for machinery access is a shift from traditional administrative methods towards digital governance. Farmers felt the digital platform brought transparency, cut out intermediaries and made access to agricultural services easier.

However, respondents also suggested that government support can be increased more by conducting more intense awareness campaigns, farmer training and technical assistance. While digital platforms can streamline administrative tasks, they do need digital literacy in order to be used. Farmers who lacked education or had limited experience with using a smartphone had more trouble accessing the online services. The results here indicate that digital governance is not just about technology, but about a holistic administrative process that includes infrastructure, extension services, capacity, and institutional support. The Food and Agriculture Organization (FAO, 2022) has reported similar finding, highlighting the need for technological infrastructure and human capacity development to be equally key for success in digital agriculture.

5.6 Challenges in Implementation

The respondents were positive about the E-Vaadagai Scheme but during the field survey some implementation challenges were identified.

Table 6: Implementation Challenges

Challenge	Frequency	Percentage
Limited digital literacy	21	65.6%
Inadequate awareness of procedures	18	56.3%
Poor internet connectivity	16	50.0%

Challenge	Frequency	Percentage
Administrative delays	14	43.8%
Seasonal machinery shortages	13	40.6%
Limited technical support	11	34.4%
Complex registration process	9	28.1%

Limited Digital Literacy: This is one of the most common reported difficulties, which concerns limited digital competence. The elderly farmers, especially, found it challenging to access smartphones, online portals and online registration systems. Although younger people had higher overall digital confidence, elderly farmers still relied on family members or government officials to carry out digital tasks.

Inadequate Awareness: A second challenge is a lack of awareness of the procedure of the scheme. While most of the respondents were aware of the programme, not many had detailed information about its eligibility criteria, registration processes, availability of machinery and benefits associated with it. This points to the need to raise awareness and need to provide farmers with practical guidance on awareness creation campaigns as well.

Internet connectivity and technological infrastructure: One of the other important constraints is internet connectivity and technological infrastructure. Rural villages reported limited internet connection affecting the online booking and registration process. Digital governance projects can only achieve their goals if there is a reliable telecommunications infrastructure.

Administrative Delays: There were also issues reported with administrative delays in verification, machinery allocation and service delivery. Such delays diminish confidence in the digital platforms and can dissuade further use. Institutional capacity plays a critical role in the effectiveness of e-governance programs, and similar implementation challenges have been reported on e-governance programs throughout rural India.

The scarcity of machinery in certain seasons was also mentioned as a problem: **Seasonal Machinery Shortages.** At times, farmers had to wait for the availability of machines during the peak cultivation time due to demand. It indicates that more and better machines should be available and that there should be better machine scheduling.

Overall, the results indicate that the main problems are not linked to the policy goals per se, but to implementation capacity. Development, strengthening of digital infrastructure, expansion of awareness programs, enhancement of the responsiveness of administration, and creation of more machines would significantly enhance the performance of the program.

5.7 Farmers' Satisfaction with the E-Vaadagai Scheme

Table 7: Satisfaction Levels

Satisfaction Level	Frequency	Percentage
Highly Satisfied	7	21.9%
Satisfied	15	46.9%
Neutral	5	15.6%



Satisfaction Level	Frequency	Percentage
Dissatisfied	3	9.4%
Highly Dissatisfied	2	6.3%

The majority of the respondents who had used the E-Vaadagai Scheme were highly satisfied and satisfied (68.8% combined). The farmers valued the advantages of using agricultural machines without the need for a significant investment. Renting machinery gave many respondents, especially the small farmers, the freedom to lower their costs of farming and to perform the various farming operations more efficiently. Farmers also expressed their contentment with the transparency facilitated by the digital registration and documentation process.

The online platform was seen as more systematic and accountable than informal arrangements for machinery. But farmers' satisfaction rates differed based on their personal experience of service provision. However, those who experienced administrative delays, lack of machinery, or technical issues indicated lower levels of satisfaction than the others. The results indicate that the satisfaction of the users is determined not only by the design of the policy but also by the implementation quality. The findings are in line with the Technology Acceptance Model (TAM) that suggests continued technology use will be determined by the user's perception of usefulness and ease of use (Davis, 1989). If digital platforms deliver timely, reliable and convenient services, their users will be more likely to stay satisfied and use the platform.

5.8 Discussion

The results have illustrated that the E-Vaadagai Scheme has significantly contributed in the field of agricultural modernization in Aranthangi Block through enhancing accessibility to machinery, advancing digital governance, and facilitating better agricultural operations. The study also revealed that majority of the respondents were small and marginal farmers, which further brings up the point that hiring of machinery is essential for many small and marginal farmers as owning the expensive agricultural equipment is not in their reach. The findings also show that the awareness about the program is higher than actual use, meaning that information needs to be shared to support program uptake. The factors of institutional support, digital literacy (skills), administrative efficiency and technological infrastructure still play a pivotal role in implementing successful.

The results correspond to those of Rogers (2003) who claimed that usefulness, compatibility, complexity, and access are factors affecting adoption. The study suggests, from a policy perspective, that farmer training programs, better internet connectivity in rural areas, more extension programs, and greater administrative support are necessary to accompany digital governance initiatives. In addition to introducing digital platforms, the success of agricultural modernization requires establishing an enabling ecosystem that enables farmers to access and effectively employ technology.

The empirical results indicate that the E-Vaadagai Scheme is a major leap in the direction of state-led digital agricultural governance in Tamil Nadu. The program has resulted in positive results in facilitating the adoption of mechanization and transparency, but there is still a need for better implementation, awareness creation, and institutional capacity building to achieve the program's full potential.

6. Policy Implications

The results of this study have significant policy, institutional and program implications for the policy makers, agricultural administrators and agencies concerned with rural development. The E-Vaadagai Scheme has been beneficial for the agricultural modernisation in Aranthangi Block, but there is a need for institutional and operational improvements so as to bring out the maximum benefits from the Scheme. The study illustrates that,



besides technological innovations, supportive infrastructure, administrative efficiency and continuous capacity building among farmers are also a prerequisite for digital agricultural governance.

6.1 Strengthening Awareness and Extension Services

The study revealed that the overall awareness of the E-Vaadagai Scheme was quite high, but there is still a significant portion of farmers who do not have a complete knowledge about E-Vaadagai Scheme, procedures of registration, eligibility criteria, and the complete list of benefits available under this scheme. This means that there is a need for a more systematic effort in awareness. The Government of Tamilnadu should improve agricultural extension by conducting regular awareness programs, demonstration programs in the villages, farmer meetings, and digital literacy sessions. The agricultural officers, Village Administrative Officers (VAOs) and Farmer Producer Organizations (FPOs) should collaborate to spread information on the schemes at the grassroots level. These would enhance the awareness and effective use of digital agricultural services.

6.2 Enhancing Digital Literacy and Capacity Building

One of the key factors of successful adoption of the program was digital literacy. The older farmers as well as those farmers who have lesser education found it difficult to use online platforms. Therefore, there is a need to have structured digital literacy initiatives for the use of smart phones for agricultural services, online registration, digital payment systems, access to agricultural information portals and mobile application for the bookings of agricultural machinery under the State Government. The training programmes should be organised periodically by the Agricultural Extension Centres, Krishi Vigyan Kendras (KVKs) and Common Service Centres (CSCs). An extra effort must be made for the elderly and women farmers who may be at a disadvantage to make digital adoption possible.

6.3 Improving Technological Infrastructure

A successful digital governance program is dependent on robust technological systems. Internet connectivity issues and frequent technical disruptions were reported, affecting access to internet services. To this end, the Government should take some steps to improve the broadband connectivity in rural villages and expand the coverage of the mobile networks, increase the number of Common Service Centres, build user-friendly multilingual mobile applications and create dedicated technical support centres for farmers. Developments in digital infrastructure will increase the ease of access and decrease barriers to program use. Rural telecommunications would be a basic infrastructure investment requirement for digital agricultural governance.

6.4 Expanding Machinery Availability and Service Delivery

The study suggests that sometimes, the availability of machinery at the correct time during the peak agricultural seasons is found to be inadequate. The scheme's overall effectiveness is reduced and participation is discouraged by delays in machine access. The government should encourage setting up more agricultural machinery rental centres, expand Custom Hiring Centres (CHCs), introduce more tractors, harvesters, seed drills, rotavators and transplanter and define online scheduling system for optimizing machinery utilization. This would enhance the efficiency of the services offered and the time farmers must wait. The scheme could be extended with the involvement of private machinery owners and agricultural cooperatives.

6.5 Strengthening Institutional Coordination and Administrative Efficiency

The E-Vaadagai Scheme is implemented by several Government departments such as Agriculture Department, Agricultural Engineering Department, Revenue Department and local Administrative bodies. It is important for there to be effective communication between these institutions in order to provide prompt services. The Government should streamline verification processes, minimise administrative delays, establish digital databases integrated with the verification process, improve inter-department coordination and put in place performance



monitoring mechanisms at district and block levels. Good governance will improve farmers' faith in the digital governance programmes. Inter-departmental meetings and coordination committees regularly held can be very effective at enhancing implementation efficiency.

6.6 Promoting Inclusive Agricultural Modernization

The results show that the small and marginal farmers benefit of the machinery hire services significantly as they have less financial capacity to buy agricultural machines on their own. Thus, the policy efforts need to be focused on small and marginal farmers, tenant farmers, women farmers, young agricultural entrepreneurs and socially and economically disadvantaged farming communities in the future. Modernization policies will be inclusive so that the most vulnerable sections of the rural society will benefit from it. The extension of special facilities like rental fees, preferential booking in peak seasons for disadvantaged farmers and easy registration etc. would help encourage fairer results.

6.7 Monitoring and Evaluation

The need for continuous monitoring to enhance program effectiveness. The Government must create an integrated monitoring structure, which will continuously assess farmer satisfaction, machinery utilization, registration trends, service delivery efficiency, economic benefits and challenges encountered in implementation. Digital dashboards for real-time monitoring can help policymakers identify the gaps in implementation and make timely corrections. Program improvement mechanisms like annual evaluations and beneficiary feedback should be put in place to improve the programme continually.

6.8 Scalability and Replication

The successes achieved under the Aranthangi Block have proven the tremendous potential of the E-Vaadagai Scheme to improve digital governance in the agriculture sector in Tamil Nadu. Where successful, lessons are learnt which can be transferred to other districts in the same socio-economic setting. But, if the new strategy has to be rolled out on a wider scale then adequate infrastructure and administrative readiness and farmer training is required for its sustainable implementation. A gradual and staged expansion strategy, ensuring appropriate monitoring and adaptation to the local conditions, would increase, the likelihood of success.

7. Future Research Directions

Future studies should have more than one block of administration and more than one district or state for increased generalizability. To examine complex relationships of digital governance, technology adoption, institutional support, and agricultural modernization, analyses can be conducted using a larger sample size or more advanced statistical methods, such as Structural Equation Modeling (SEM), Partial Least-Squares Structural Equation Modeling (PLS-SEM), and multilevel regression analysis. Comparative research between two or more states/countries may also contribute to the generation of knowledge about the effectiveness of alternative models of agricultural digital governance. Inter-state or inter-country comparative studies may also generate knowledge about the effectiveness of alternative models of agricultural digital governance. Furthermore, mixed-method research (MMR) was employed to ensure that a complete picture of the farmers' experiences, institutional barriers and policy enactment process could be developed. Longitudinal studies to monitor the adoption process and long-term modernization results would give more concrete evidence on the long-term effects of digital agricultural initiatives. Economic assessment of the value of digital agricultural governance, such as cost savings, productivity increases and income improvements, would help to bolster evidence for policy advocacy. Last, research on marginalized groups, such as women farmers, smallholders and tribal communities, would provide for a more participatory approach to policy design for agriculture.



8. Conclusion

The process of agricultural modernization has thus emerged as an integral part of the rural development policy in India, especially in some states like Tamil Nadu, where a significant section of the rural population continues to rely on agriculture for their livelihoods. For this, active government intervention, institutional support and effective digital governance are needed to make the shift from traditional agriculture to technology based agriculture. The present study aimed to examine the role of the State Government in agricultural modernization under E-Vaadagai Scheme of Aranthangi Block of Pudukkottai District in this overall scenario.

The empirical results show that E-Vaadagai Scheme has positively contributed to better access to agricultural mechanization and to better digital governance in rural agriculture. The farmers in general found the scheme to be advantageous in terms of labour saving, greater efficiency, timely agricultural activities and transparency of access to agricultural machinery. The results presented here show that digital governance programs can make a meaningful contribution to the modernisation of agriculture, if they are backed up by adequate governance mechanisms for their implementation.

The study also indicates low but relatively encouraging awareness of the scheme among the farmers, but the awareness is not always accompanied by its effective utilization. The influence of digital literacy, access to the internet, responsiveness of administration and availability of machinery remain current influences on program adoption. Improving institutional capacity is therefore also key to technological innovation. The scheme benefited most of all small farmers and marginal farmers as they can hire the agricultural equipment at reasonable rates and this will help them in reducing the expenses on their agricultural equipment.

This underlines the need for a shared-access approach that is supported by the government to guarantee inclusive agricultural development. While these beneficial results have been obtained, there are still some implementation issues to be addressed. Low digital literacy of the elderly farmers, weak internet connectivity, sometimes administrative process delay, lack of awareness creation and shortage of machines during season restrict the effectiveness of the scheme. To overcome these challenges, coordinated policy measures on infrastructure, training of farmers, strengthening of institutions and ongoing monitoring are needed. The study has theoretical implications in the field of digital agricultural governance, by combining the Technology Acceptance Model (TAM) with Digital governance theory. We used the TAM to model the willingness of farmers to adopt digital technologies based on perceived usefulness and perceived ease of use, and we used the Digital Governance Theory to focus on government institutional capacity to offer efficient, transparent and citizen-centric public services. The study illustrates that besides the farmers' acceptance of technology, the quality of the institutional support, administrative efficiency, digital infrastructure, and policy implementation are also crucial for successful digital agricultural governance.

The study finds that, overall, E-Vaadagai Scheme is an important case of state-driven digital agricultural governance that can help advance sustainable agricultural modernization. However, the potential of digital service delivery will only be realised if the enabling environment around digital service delivery is strengthened. Agricultural policies in the future should thus focus on making technologies accessible, being institutions efficient, and inclusive participation in agricultural modernization to make it accessible for all farmers. The results add to the expanding body of literature on the topic of digital governance, agricultural modernization and rural development, which are empirical studies conducted at the micro-level in Aranthangi Block, Pudukkottai District. They also provide actionable insights for policy-makers for making digital agricultural initiatives more effective in Tamil Nadu and similar agricultural landscapes.



References

- [1] Aker, J. C. (2011). Dial "A" for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, 42(6), 631–647. <https://doi.org/10.1111/j.1574-0862.2011.00545.x>
- [2] Anitha, K. (2022). Farmers' awareness and utilization of digital agricultural services in Tamil Nadu. *Journal of Agricultural Extension*, 26(3), 45–58.
- [3] Basu, D. D. (2015). *Introduction to the Constitution of India*. LexisNexis.
- [4] Bertoglio, R., Corbo, C., Renga, F. M., & Matteucci, M. (2021). The digital agricultural revolution: A bibliometric analysis. *Technology in Society*, 67, 101724. <https://doi.org/10.1016/j.techsoc.2021.101724>
- [5] Bryman, A. (2016). *Social research methods* (5th ed.). Oxford University Press.
- [6] Chand, R., Saxena, R., & Rana, S. (2015). Farm income in India: Issues and policy implications. *Economic and Political Weekly*, 50(22), 139–145.
- [7] Chowdhury, S., Rahman, M. M., & Islam, M. S. (2023). Digital agriculture in developing countries: A systematic review. *Journal of Agricultural Informatics*, 14(1), 45–62.
- [8] Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
- [9] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- [10] Dev, S. M. (2015). Agricultural policies and rural development. *Economic and Political Weekly*, 50(26), 55–63.
- [11] Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- [12] Fabregas, R., Kremer, M., & Schilbach, F. (2019). Realizing the potential of digital development: The case of agricultural advice. *Science*, 366(6471), eaay3038. <https://doi.org/10.1126/science.aay3038>
- [13] FAO. (2022). *The State of Food and Agriculture 2022: Leveraging automation in agriculture for transforming agrifood systems*. Food and Agriculture Organization of the United Nations.
- [14] Field, A. (2018). *Discovering statistics using IBM SPSS Statistics* (5th ed.). SAGE Publications.
- [15] Government of India. (2021). *Agricultural Statistics at a Glance 2021*. Ministry of Agriculture and Farmers' Welfare.
- [16] Gulati, A., & Fan, S. (2007). *The dragon and the elephant: Agricultural and rural reforms in China and India*. Oxford University Press.
- [17] Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS: Wageningen Journal of Life Sciences*, 90–91, 100315. <https://doi.org/10.1016/j.njas.2019.100315>
- [18] Kumar, R., & Sharma, P. (2016). Farm mechanization and agricultural growth in India. *Agricultural Economics Research Review*, 29(1), 15–28.
- [19] Liu, Y., Zhang, X., & Wang, J. (2018). Digital governance and agricultural development: Evidence from China. *China Agricultural Economic Review*, 10(4), 567–584.
- [20] NITI Aayog. (2023). *National strategy for artificial intelligence and digital agriculture*. Government of India.
- [21] OECD. (2023). *Digital transformation of agriculture*. Organisation for Economic Co-operation and Development.
- [22] Pingali, P. L. (2012). Green revolution: Impacts, limits, and the path ahead. *Proceedings of the National Academy of Sciences*, 109(31), 12302–12308. <https://doi.org/10.1073/pnas.0912953109>
- [23] Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.



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- [24] Rotz, S., Duncan, E., Small, M., Botschner, J., Dara, R., Mosby, I., Reed, M., Fraser, E. D. G., & Fleury, M. D. (2019). The politics of digital agricultural technologies: A preliminary review. *Canadian Journal of Development Studies*, 40(2), 203–229. <https://doi.org/10.1080/02255189.2018.1491415>
- [25] Schultz, T. W. (1964). *Transforming traditional agriculture*. Yale University Press.
- [26] Thorat, S., & Fan, S. (2007). Public investment and poverty reduction: Lessons from China and India. *Economic and Political Weekly*, 42(15), 1353–1360.
- [27] United Nations. (2024). *United Nations E-Government Survey 2024: Accelerating digital transformation for sustainable development*. United Nations.
- [28] Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, 46(2), 186–204. <https://doi.org/10.1287/mnsc.46.2.186.11926>
- [29] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478. <https://doi.org/10.2307/30036540>
- [30] World Bank. (2023). *Digital agriculture for inclusive rural transformation*. World Bank.
- [31] World Bank. (2024). *World Development Report 2024: The middle-income trap*. World Bank.
- [32] Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.