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Development and user validation of a web-based financial decision-support system for coconut and arecanut plantation enterprises

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Abstract

Digital tools are increasingly used in agriculture to widen access to information and support farm-level decision-making, yet most agricultural applications concentrate on crop production, weather, markets and advisory services, leaving financial planning for long-duration plantation enterprises comparatively underserved. Coconut and arecanut plantations involve substantial establishment costs, recurring maintenance expenditure and delayed returns, all of which make financial assessment a critical part of investment planning. This study reports the development and user validation of a web-based financial decision-support system for coconut and arecanut growers, built using a Design and Development Research approach with an iterative development cycle. Development proceeded through requirement identification, data-input design, database development, financial-model construction, mobile-application integration, web-portal deployment, user-access configuration, functional testing and release. Google Forms handled structured data collection, Google Sheets served as the database and financial-processing environment, AppSheet supported mobile access, and WordPress hosted the web portal. The financial module computed total investment, annual maintenance cost, income, Return on Investment, Net Present Value, Internal Rate of Return, Benefit-Cost Ratio, Discounted Cash Flow and Payback Period, and an automated recommendation module translated these indicators into a feasibility judgement. Fifty respondents evaluated the system using a structured five-point rating scale, and their responses were examined through frequency and percentage analysis, mean scores, ranking, perception classification and reliability testing. Helping users make better decisions received the highest usefulness score (mean 3.72), followed by useful investment suggestions (3.68) and reduced calculation errors (3.61). Cost estimation was the most preferred feature (90% of respondents), followed by risk analysis (52%), financial budget planning (44%) and investment comparison (44%). Every respondent preferred Tamil as the access language, and 86 per cent expressed positive willingness to use the system, although overall acceptability was predominantly medium (70%). The findings show that agricultural financial models can be meaningfully integrated with cloud-based and low-code technologies to produce a working decision-support application, while also indicating that further refinement and larger-scale field validation are needed before wider deployment.

Keywords: Web-based system, ICT, digital agriculture, financial decision support, coconut; arecanut, plantation management, AppSheet; user validation

1. Introduction

Information and communication technologies now occupy a visible place in modern agriculture. Websites, mobile applications and cloud-based platforms increasingly supply farmers with information on production practices, weather, markets and farm management. The value of such systems, however, rests less on the sheer availability of information than on whether the underlying technology is built around a decision that users actually face. Financial planning is one such decision. Farmers establishing perennial plantations must commit to expenditure and returns that unfold over many years. Establishing a plantation calls for investment in land preparation, planting material, irrigation, fertilisers, labour and other inputs, while returns are deferred until the crop reaches bearing age. This investment pattern sets coconut and arecanut apart from short-duration crops and gives their financial planning a distinct character.

Financial indicators such as Net Present Value (NPV),

Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), Discounted Cash Flow (DCF), Return on Investment (ROI) and Payback Period are well suited to assessing the feasibility of such investments, but applying them requires several inputs and a sequence of interdependent calculations. A digital system can ease this burden by letting users enter the required information once and receive the computed results automatically. A review of the literature on enterprise budgeting, agricultural decision-support systems, farm management information systems, web applications and digital agriculture points to a gap: plantation-specific financial planning has rarely been integrated with a user-oriented digital platform. The present study addresses this gap from two complementary directions. From an agricultural economics standpoint, it applies established investment-appraisal methods to coconut and arecanut plantations. From an ICT standpoint, it builds a connected digital system through which data can be entered, stored,

processed and presented back to the user. The intent was not to devise a new financial formula or a sophisticated algorithm, but to translate existing financial-planning procedures into a practical, web-based workflow using accessible cloud and low-code technologies.

1.1 Objectives

The study was undertaken to develop and validate a web-based financial decision-support system for coconut and arecanut plantation enterprises. Specifically, it sought to identify the information and functional requirements of the system, develop its database and financial-computation modules, design and integrate the web and mobile interfaces, test system functionality, and assess user perception, feature preference, willingness to use and overall acceptability.

2. Materials and Methods

2.1 Research design

The study adopted a Design and Development Research (DDR) approach combined with an iterative development process, a choice suited to a study that involved building a functional digital product and then testing, refining and validating it with users. Development proceeded through requirement analysis, database development, system design, financial-model development, web-application development, testing, user evaluation, deployment and documentation, with each component built and tested before being connected to the next rather than attempting the entire application in a single stage.

2.2 System development framework

Development spanned eight broad phases: requirement analysis, online-form development, database development, financial-model development, AppSheet application development, WordPress website development, system testing and validation, and deployment and documentation. The overall workflow ran from the user through Google Forms to the Google Sheets database, into the financial calculation module, on to the financial recommendation module, and out through AppSheet and WordPress back to the user. This architecture formed the backbone connecting agricultural financial analysis with web and mobile access.

2.3 Requirement analysis and input design

The first stage identified the information needed for plantation financial analysis, drawing on the financial characteristics of coconut and arecanut enterprises, a review of relevant literature, and consultation on plantation economics. The main requirements were plantation characteristics, establishment expenditure, annual maintenance expenditure, production, selling price, additional income and discount-rate assumptions. The input structure was deliberately designed so that users would never have to operate spreadsheet formulas directly; instead, information was collected through structured online forms.

2.4 Online data-entry module

Google Forms was used to build the online data-entry component, with separate forms prepared for coconut and arecanut plantations. Each form captured plantation, production, cost and financial information and fed directly into the Google Sheets database. Using a structured form in

this way simplified the interaction between the user and the underlying financial model, since the user supplied agricultural information rather than manipulating the spreadsheet itself. Google Sheets served as the central database. Responses submitted through Google Forms were transferred automatically into the spreadsheet and organised for financial processing, with separate worksheets maintained for coconut and arecanut. The database therefore functioned both as a storage environment and as the processing environment for the financial model, which removed the need to transfer information manually between data collection and calculation

Fig 1.1: Online data-entry module

Fig 1.2: Online data-entry module

2.6 Financial computation module

The financial computation module was built using spreadsheet formulas that calculated total initial investment, annual maintenance cost, gross annual income, net annual income, NPV, IRR, BCR, DCF and Payback Period automatically once the required inputs were entered. The IFERROR function was incorporated throughout to reduce errors arising from incomplete or inappropriate entries, and

the formulas were checked against sample datasets before the module was integrated with the rest of the system.

2.7 Financial recommendation module

A separate recommendation component interpreted the calculated financial indicators and generated a feasibility judgement, presented to the user as either financially feasible or financially not feasible according to the criteria built into the model. This component was designed to make the results easier to interpret for users unfamiliar with formal financial appraisal methods.

2.8 Mobile application development

The Google Sheets database was integrated with AppSheet to create a mobile-friendly application through which users could view submitted plantation records and the associated financial results on their smartphones. The mobile component was built as an extension of the web-based system rather than a stand-alone application, so information remained connected to the underlying database at all times.

2.9 Web portal development

WordPress was used to build the main web portal, which included Home, About, Coconut Financial Tool, Arecanut Financial Tool and Contact sections and embedded the Google Forms and AppSheet components. The portal thus served as the main presentation and access layer of the system, while Google Sheets and AppSheet handled processing and mobile functions behind it. The developed web platform.

2.10 User access and data management

Basic user-specific access control was built into the AppSheet component through email-based identification and user-specific record filtering, which restricted each user to their own records. This addressed basic data-access needs during development but should not be read as a comprehensive cyber security assessment.

Fig 2.1: User access and data management

Fig 2.2: User access and data management

2.11 System testing

Testing used sample plantation and financial data and covered functional operation, financial calculations, Google Form responses, Google Sheets processing, AppSheet synchronisation and website navigation. The aim was to confirm that the different components worked together correctly and produced the intended financial outputs before the system was put in front of users.

2.12 User validation

The system was evaluated by 50 respondents using an instrument covering computational accuracy, ease of use, interface design, navigation, information presentation, report quality, reliability, satisfaction and overall acceptability. Perception and evaluation items were rated on a structured five-point scale.

2.13 Statistical analysis

Frequency and percentage analysis summarised respondent characteristics and categorical responses. Mean scores were used to assess perceived usefulness, and ranking compared system attributes and preferred features. Perception and acceptability were classified into low, medium and high categories, and Cronbach's Alpha was used to examine the internal consistency of the evaluation instrument.

3. Results

3.1 Development of the integrated web-based system

The study produced a functional digital financial-planning system that integrates online data collection, cloud-based database management, financial computation, decision recommendation, mobile access and web presentation. Development proceeded through successive stages rather than as an isolated website-development exercise, and the final system links Google Forms, Google Sheets, spreadsheet-based financial calculations, AppSheet and WordPress into a single workflow. The system therefore comprises both a front-end user interface and an underlying data-processing and financial-analysis structure, and the study's principal contribution lies in integrating these components into one coherent agricultural decision-support

workflow. The developed web platforms for coconut and arecanut financial planning are presented through two dedicated websites, namely Coconutplanner.wordpress.com for coconut-based financial planning and arecanutfinancialplanner.wordpress.com for arecanut-based financial planning. These platforms are designed to support farmers and stakeholders in assessing the financial feasibility, profitability, and economic viability of coconut and arecanut cultivation.



Fig 3: Front page of developed web platform for Coconut



Fig 4: Front page of developed web platform for arecanut

3.2 Web interface and data-entry experience

The web portal is the user's initial point of access. From there, users navigate to the relevant plantation module and supply the required information through the online form. The crop-specific forms were built around plantation, cost, production and financial variables, and submitted information transferred automatically into the database, confirming that the system was designed as a user-oriented application rather than a direct spreadsheet interface.

3.3 Database and financial processing

The Google Sheets environment functioned as the central database and financial-processing layer: submitted data were stored and organised automatically, after which the financial formulas generated the required indicators. Separating the user-input interface from the calculation environment removed the need for users to perform any financial calculations by hand.

3.4 Financial analysis and decision output

The system generated the core indicators needed for plantation investment appraisal — total investment, maintenance cost, gross and net income, NPV, IRR, BCR, DCF and Payback Period — and the recommendation component converted these results into an easily interpretable feasibility statement. The financial output therefore served two purposes at once: presenting the numerical results and offering a simplified interpretation of what they meant.



Fig 5: Financial analysis and decision output of Coconut Crop



Fig 6: Financial analysis and decision output of Arecanut Crop

3.5 Mobile application integration

The AppSheet component let users access their stored plantation records and financial results through smartphones, extending the system's reach beyond the desktop web interface and allowing users to engage with their financial information on devices they already owned and used regularly.

3.6 Web portal development

The WordPress portal hosted the coconut and arecanut financial-planning tools and provided a single, centralised point of access to the different components of the application, so that the final system combined a browser-based interface

with cloud-based processing and mobile access.

3.7 Functional integration

The completed system successfully brought together Google Forms for data collection, Google Sheets for database management, spreadsheet formulas for financial analysis, AppSheet for mobile application development, and WordPress for web deployment. The result is an integrated online financial planning platform for coconut and arecanut plantation enterprises.

3.8 Sample financial report

The system also generates a sample financial report summarising investment cost, annual returns, financial indicators and the recommendation, giving users a more permanent record of the analysis that can support documentation and financial planning discussions.

3.9 User characteristics

The 50 respondents who took part in the validation were predominantly farmers, along with a smaller number of entrepreneurs. All respondents reported using smartphones and mobile applications, and a substantial share were already familiar with agricultural mobile applications a characteristic worth noting given that the system was specifically designed for web and mobile access.

3.10 Perceived usefulness

Helping users make better decisions received the highest mean score (3.72), followed by providing useful investment suggestions (3.68) and reducing calculation errors (3.61); trust in digital financial tools scored 3.57.

Table 1: Perceived usefulness of the developed system

Attribute	Mean score	Rank
Helps users make better decisions	3.72	I
Provides useful investment suggestions	3.68	II
Reduces calculation errors	3.61	III
Trust in digital financial tools	3.57	IV
Encourages investment in agriculture	3.52	V
Would recommend to others	3.49	VI
Useful for financial planning	3.44	VII
User-friendly interface	3.40	VIII
Would use this tool regularly	3.35	IX
Mobile accessibility is important	3.28	X

These results suggest that users weighed the system's decision-support function more heavily than its technical or interface characteristics.

3.11 Overall perception

Sixty-eight per cent of respondents fell into the medium perception category, with 16 per cent each in the low and high categories.

Table 2: Overall perception

Perception	Frequency	Percentage
Low	8	16.00
Medium	34	68.00
High	8	16.00
Total	50	100.00

The predominance of medium perception indicates that the system was viewed positively overall, while also leaving clear room for improvement.

3.12 Preferred features

Cost estimation was the most preferred feature, selected by 90 per cent of respondents, followed by risk analysis (52%) and financial budget planning and investment comparison (44% each).

Table 3: Preferred system features

Feature	Frequency	Percentage
Cost estimation	45	90.00
Risk analysis	26	52.00
Financial budget planning	22	44.00
Investment comparison	22	44.00
Profit calculation	20	40.00

This pattern indicates that users placed particular value on being able to estimate an enterprise's financial requirements before committing to an investment decision.

3.13 Language preference

All 50 respondents selected Tamil as their preferred access language.

Table 4: Preferred language

Language	Frequency	Percentage
English	0	0.00
Tamil	50	100.00
Bilingual	0	0.00
Total	50	100.00

This finding underscores the importance of local-language design when digital financial tools are aimed at agricultural users.

3.14 Willingness to use

Thirty-nine respondents (78%) indicated they would probably use the system and four (8%) said they definitely would, while seven (14%) remained unsure — an overall positive willingness of 86 per cent.

Table 5: Willingness to use the system

Response	Frequency	Percentage
Definitely Yes	4	8.00
Probably Yes	39	78.00
Not Sure	7	14.00
Probably No	0	0.00
Definitely No	0	0.00
Total	50	100.00

This result points to positive initial willingness, though it should not be read as evidence of sustained, long-term adoption.

3.15 Overall acceptability

Seventy per cent of respondents fell into the medium acceptability category, 22 per cent into the low category and 8 per cent into the high category.

Table 6: Overall acceptability

Acceptability	Frequency	Percentage
Low	11	22.00
Medium	35	70.00
High	4	8.00
Total	50	100.00

This finding suggests that the application has genuine potential but is still at a stage where further refinement and field validation are warranted.

4. Discussion

The central contribution of this study lies in integrating web technologies with agricultural financial decision support. The financial indicators used in the system are well-established investment-appraisal methods; the development contribution was to embed these methods in a connected digital workflow accessible through a web portal and mobile application. The work shows that an agricultural decision-support application can be built with accessible cloud and low-code technologies: Google Forms supplied the data-entry layer, Google Sheets the database and financial-processing environment, AppSheet mobile access, and WordPress the web presentation layer. A key design feature is the separation between user interaction and financial computation users enter plantation information through structured forms rather than manipulating financial formulas directly, while the underlying spreadsheet performs the calculations and returns the results. The web portal then brings these components together into a single access environment, which is what distinguishes the system from a conventional farm-budgeting spreadsheet: the user interacts primarily with a web or mobile interface while the calculations run in the background.

This approach also has relevance for agricultural institutions and student projects, where a custom software-development environment is not always available. Cloud and low-code platforms offer an alternative route for building and testing functional prototypes before investing in more elaborate software architecture. The user evaluation supports the system's practical orientation. Its highest usefulness score was for helping users make better decisions, suggesting that users judged the technology chiefly by the decision it could support rather than by the software platform itself. The strong preference for cost estimation selected by 90 per cent of respondents is similarly telling; it suggests that expenditure information is what users consider most important when planning a plantation investment, while the second-ranked preference for risk analysis points to an area where the system's treatment of uncertainty could be strengthened.

The unanimous preference for Tamil is also worth dwelling on. Financial planning involves concepts that can be difficult to communicate through a purely technical interface, and local-language access should therefore be treated as a core design requirement for user-oriented agricultural ICT, not an optional add-on. The results nonetheless call for a cautious reading. Most respondents expressed positive willingness to use the system, yet overall acceptability was predominantly medium rather than high. Taken together, these findings offer evidence of initial usefulness and adoption potential rather than proof of sustained adoption or measurable economic impact.

5. Contribution of the Study

This study makes three connected contributions. At the technical level, it demonstrates how online data collection, cloud database management, automated financial processing, mobile application development and web deployment can be integrated into a single agricultural decision-support workflow. At the agricultural economics level, it embeds established financial-appraisal methods in a digital platform designed specifically for coconut and arecanut plantation enterprises. At the user level, it provides preliminary evidence on perceived usefulness, preferred features, language requirements, willingness to use and overall acceptability. The interdisciplinary character of the work is itself a notable feature: the study is neither purely a web-development exercise nor purely an agricultural economics study, but derives its value from connecting the two.

6. Practical Implications

The system can serve as a supporting tool in agricultural extension programmes concerned with plantation investment and financial planning, with extension personnel able to use it to demonstrate how changes in cost, yield and price assumptions affect financial feasibility. It may also have value in agricultural education by showing how enterprise budgeting and financial appraisal can be translated into a working digital application. For developers of digital agriculture tools, the study demonstrates that relatively accessible technologies are sufficient to build a credible agricultural decision-support prototype. The strong preference for cost estimation and risk analysis suggests that future versions should prioritise deepening these features rather than simply adding more technical functions.

7. Limitations

This study has several limitations. The user validation involved only 50 respondents, so the results offer preliminary rather than population-level evidence. No long-term adoption study was conducted, and the reported 86 per cent willingness to use reflects stated intention rather than actual continued use. The study also did not measure whether the system changed investment behaviour, raised farm profitability or reduced financial losses; establishing such effects would require a separate impact evaluation. Technical testing was functional in nature and did not include comprehensive performance benchmarking, independent cybersecurity auditing, or comparison against a custom-built software architecture. The financial results generated by the system remain dependent on the quality of the assumptions and data entered by users. Finally, the application was developed specifically for coconut and arecanut, and extending it to other crops would require crop-specific financial models and additional validation.

8. Future Scope

Future work should focus on improving the user interface, simplifying data entry, strengthening local-language support, and expanding the system's sensitivity and risk-analysis components. The financial database could be updated periodically to reflect current input costs, labour charges, yields and market prices, and the system could be extended to other plantation and horticultural enterprises once appropriate crop-specific financial parameters are developed.

From an ICT perspective, future versions could examine stronger authentication, database architecture, scalability, performance under larger numbers of users, and more comprehensive data-security mechanisms. The most important next step, however, is field-level evaluation: a larger study involving farmers with varying levels of digital literacy could compare decisions made with and without the system and assess whether it produces measurable improvements in financial planning.

9. Conclusion

This study developed and validated a web-based financial decision-support system for coconut and arecanut plantation enterprises by integrating agricultural financial analysis with cloud, mobile, and web technologies. The system combines online data collection, cloud-based database management, automated financial calculations, investment recommendations, mobile accessibility, and a WordPress-based web portal. The successful implementation of user interfaces, database components, financial analysis outputs, and mobile and web screens demonstrates that the study produced a working digital prototype rather than a purely conceptual model.

The financial analysis module included widely accepted investment appraisal indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), Discounted Cash Flow (DCF), Return on Investment (ROI), and Payback Period. User evaluation results showed that decision-making support was considered the most useful aspect of the system, while cost estimation emerged as the most preferred feature. All respondents preferred Tamil as the language of access, and 86% indicated a willingness to use the system. Although the overall level of acceptability was mostly moderate, the findings suggest encouraging potential for future adoption.

Overall, the study shows that agricultural economics can be effectively integrated with web-based and low-code technologies to support financial decision-making in plantation enterprises. The developed system should currently be viewed as a functional prototype with promising user acceptance rather than a fully established farmer advisory platform. Further large-scale field evaluation, technical improvements, and assessment under real-world farming conditions are necessary before wider deployment can be recommended.

Author Contributions

R. Ravikumar: conceptualisation, research design, methodology, agricultural financial modelling, supervision, interpretation of results and manuscript preparation. Durgadevi S., Liya Fathima, Monisha K., Muthuvel M. and Varshini T.: requirement analysis, data-entry design, database preparation, system development, application integration, testing, user validation, data analysis and project documentation. The authorship order reflects R. Ravikumar's role as corresponding and supervising author, with the undergraduate co-authors recognised for their development, testing and validation contributions.

Conflict of Interest

The authors declare that they have no conflict of interest.

Data Availability

The data generated during the user validation are available from the corresponding author subject to institutional and respondent-related considerations.

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