Original article

Support for the commercial management of small-scale agricultural producers supported by a low-tech application

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Abstract

This article describes a research project that provides support in the management and control of small-scale farm panel farmer's business and input control through a low-tech mobile application, whose methodology is oriented towards an adoption strategy, and its development follows the unified rational methodology known as RUP by its English acronym Rational Unified Process. The research was carried out using the case study modality with an exploratory-descriptive scope, framed in the use of information technologies (IT), and was based on two conditions of the agricultural producer who is engaged in the extraction and processing of pan cane juice in a small-scale rural productive environment: (1) the need to manage their agricultural activity and (2) no access to the internet. The application does not require installation from the Appstore, works asynchronously (it does not require server access except for backup), and has been used by producers who are looking to replace the traditional notebook with the App, bringing with it the benefits such as finding the required information faster and generating discipline of using IT in users who previously resisted its use.

Keywords: Small agricultural producer; Mobile application; Commercial management.

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Apoyo en la gestión comercial del productor agrícola de pequeña escala soportado en un aplicativo de baja escala tecnológica

Resumen

Este artículo describe un proyecto de investigación en el que se contempla el apoyo en la gestión comercial y control de insumos del productor agrícola panelero de pequeña escala por medio de una aplicación móvil de baja escala tecnológica, cuya metodología está orientada hacia una estrategia de adopción y su desarrollo sigue la metodología racional unificada conocida como RUP por su sigla en inglés Rational Unified Process. La investigación fue realizada mediante la modalidad de caso de estudio con un alcance exploratorio-descriptivo, enmarcada en el uso de tecnologías de la información (TI) y partió de dos condiciones del productor agrícola que se dedica a la extracción y procesamiento de jugos de caña panelera en un entorno rural de pequeña escala productiva: (1) la necesidad de gestión de su actividad agrícola y (2) el nulo acceso a internet. La aplicación no requiere instalación desde la Appstore, funciona de manera asíncrona (no requiere de acceso a servidor excepto para hacer backup) y ha sido usada por productores en quienes se busca que reemplacen la tradicional libreta de apuntes, por la App, trayendo consigo beneficios como el encontrar más rápido la información requerida y generar disciplina de usar TI en usuarios que antes se resistían a su uso.

Palabras clave: Productor agrícola de pequeña escala; Aplicación móvil; Gestión comercial.

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1. Introduction

The commercial management of small-scale agricultural producers, known as peasants, needs support. This project targets explicitly those involved in extracting and processing cane juice for panela in a rural setting, but the beneficiaries of the generated application extend to any peasant needing to manage their productive agricultural activities, typically without Internet access.

The development of the application began with system analysis and identification of producer characteristics, leading to a proposed scope that includes recording and later searching for input purchase activities and production dispatches, along with report generation and featuring voice recognition for data entry.

According to the users' conditions, the complexity level of technology must be reduced concerning IT; the focus is not on acquiring the latest technology but on providing support for their activities using low-tech mobile devices instead.

Key points must include:

1. Engaging in input purchases and agricultural product sales requires managing supplier-related information from commercial relationships, customers, orders, and collections.
2. Trade occurs with neighbors or nearby communities, necessitating mobility for purchasing inputs or selling agricultural products.
3. Access to low-tech mobile technology is essential (low-end phones capable of installing and running applications).

Rural Family Businesses (Self-sufficiency, infrastructure, social ties)

A peasant's farm is considered a rural family business, necessitating long-term social relationships with stakeholders. This aspect is evidenced by Acquaah (2011), who states that external management relationships improve performance and provide sustainability through alliances between consumers and producers in food supply activities.

Sustainable development for peasants involves understanding their characteristics, managing their businesses effectively, and continuously learning about them. Farmers' perspectives indicate that self-sufficiency indicators are interconnected; their capacity development goes beyond improving knowledge and skills for inclusive participation in government or regional authority programs, especially in decision-making processes (Ndlela y Worth, 2021).

The lack of social infrastructure to support small-scale farmers becomes critical as they face challenges engaging in multi-activity work, securing reliable labor, and building relationships with consumers and peers for short-term profits and long-term social capital (Keri *et al.*, 2021). Additionally, peasants must invest in activities that foster social ties to gain a competitive advantage in commercializing their products since their activities often occur in areas with weak demand (Akinhola-Adéchian *et al.*, 2021).

Conditioning Factors for Rural Family Businesses

Among the conditioning factors rural family businesses face is the trade-off between economic opportunities arising from expanding organic food markets and political principles at their core (Pizarro-Muñoz *et al.*, 2021). Access to local input markets or products is influenced by the distance from their cultivation sites (To-The y Nguyen-Anh, 2021); thus, profitability may vary based on scale, location, and choice of direct or intermediary channels (Bauman *et al.*, 2018). Social relationships are recognized as crucial for achieving competitive advantages and performance in small-scale farms (Akinhola-Adéchian *et al.*, 2021).

ICT in Marketing for Rural Family Businesses

Examples of IT supporting rural marketing were reviewed, revealing objectives such as:

1. Understanding peasants' intentions to use new technologies for agricultural data collection is essential for promoting IT usage (Beza *et al.*, 2018). Even though they have advanced technology, the author states it is necessary to dimmish its scale so that peasants can access it.
2. Promoting marketing channels to consumers taking advantage of the growing demand driven by food security interests (Lee *et al.*, 2020).
3. Demonstrating investment needs in technology, transport, and storage facilities—a financial challenge for small-scale farmers competing nationally or in regional markets (Gyeltshen y Osathanunkul, 2018).
4. Seeking participation in direct and intermediary marketing channels while identifying key operational factors influencing farmers' financial performance—these channels must enable farms of any sales volume scale to be financially viable (Bauman *et al.*, 2018).
5. Providing evidence that greater access to IT enhances market efficiency for agricultural consumption (Aker y Ksoll, 2016).

Regarding mobile technology as an IT alternative, its considerable expansion in developing countries is noted:

1. In Colombia, an agricultural research center under the Ministry of Agriculture has a program based on a free service data system to advise members of a national farmers' organization (Jiménez *et al*., 2019).
2. In Ecuador, the Regional Autonomous University of the Andes proposed a rural administrative management project prioritizing associativity as a foundation for community management adaptation; this associativity has strengthened through mobile phone usage among peasants who recognize data collection's importance for agricultural development (Galarza-Villalba *et al*., 2020).
3. In Africa, user acceptance of new technology has gained significant interest; efforts have been made to promote mobile phone usage while reducing the digital divide (Kabbiri *et al*., 2018). For example, widespread mobile coverage growth in sub-Saharan Africa offers new potential for increasing rural households' access to public and private information transfers (Aker & Ksoll, 2016). In Ethiopia, acceptance of SMS technology among peasants was explored to provide agriculture-related information (Beza *et al*., 2018), seeking fair pricing through new techniques and online market utilization (Abishek *et al*., 2016).

Proposal

Considering the described situation, a software application was proposed to support small-scale agricultural producers' commercial activities to aid decision-making by facilitating input entry, storage, organization, searching, and retrieval of information while including value-added features like reminders and consolidated activity reports.

The application promotes the use of ICT in agriculture and aligns with the Sustainable Development Goals (SDGs) 8 and 12 of the United Nations (UN, 2021). Goal 8 promotes decent work and economic growth, precisely target 8.2: to achieve higher levels of economic productivity through diversification, technological modernization, and innovation, focusing on sectors with high added value and intensive labor use. Goal 12 promotes responsible production and consumption, mainly target 12. a: to assist developing countries in strengthening their scientific and technological capacity to move towards more sustainable consumption and production patterns that lead to sustainability. In order to achieve these objectives, there must be community capacity for the responsible use of inputs that prevent their depletion or exceed their renewal capacity, as Viglizzo (2014) mentioned.

The application aligns with the positions expressed by Gyeltshen and Osathanunkul (2018) regarding the importance of linking farmers to the market. An example is the mobile software Logihfrutic developed by Bermeo-Andrade and González-Bañales (2021), which supports small producers in managing their vegetable and fruit crops. Both sources agree that there is a need to broaden the understanding of the benefits of ICT in farmers' routines and adhere to the premise that ICT can be used to promote their activities. Direct marketing schemes for food have emerged

as an ecological and economic supply method, allowing for a closer relationship between producers and consumers (Preiss *et al*., 2017).

A small-scale agricultural producer, known as a farmer, is defined as a person with established knowledge and practices for producing raw materials and food linked to the land and integrated with the nature and territory of rural areas (Fonseca-Carreño *et al.*, 2020). This individual engages in commercial activities such as selling their products or purchasing inputs, and their commercial management could benefit from the adoption of ICT tools to obtain information that supports decision-making (Erumban & De Jong, 2006). According to Daza-Martínez *et al.* (2017), this should aim to generate changes in how processes are carried out, and according to Cobo (2007), to achieve this, it is necessary to mitigate resistance to change caused by user culture.

The application is developed in RAD Studio, a programming environment for cross-platform applications with flexible Windows, Linux, Mac, and Android services, compatible with various database managers and Delphi or C++ (Mitsik *et al*., 2017).

2. Methodology

This work incorporates two methodologies for its development, which are:

1. An exploratory-descriptive methodology was used to understand the community that will benefit from the application through participation and observation of the system (Hernández-Sampieri & Mendoza-Torres, 2018). This aligns with what Somers and Stapleton (2014) express regarding the appropriation of ICT as a challenge that is addressed by designing strategies that provide benefits to users and that must go beyond mere adoption, as it should help organize the system's operation.
2. For the implementation of the application, the Rational Unified Process (RUP) methodology was utilized, which is iterative and incremental; it is iterative because it allows for repeating the cycle of the four phases multiple times and incremental. After all, in each iteration, the scope of workflows is increased. Its execution must include documentation and best practices such as version control of the code and clarity regarding aspects that, according to Jacobson *et al*. (2000), must be fulfilled: determination of objectives and scope, user analysis, quality criteria, content design, and usability analysis of the prototype. According to Carrizo and Moller (2018), the quality criteria are availability, performance, modifiability, and security.

Considering the two methodologies used, the design did not start from the task of collecting needs because the user cannot define them a priori. Instead, it began with visits to users to understand field operations. That is, the application includes guidelines expressed by Sheikh *et al*. (2014) and Bermeo-Andrade and González-Bañales (2021) regarding the need to focus on the

users' profiles and the characteristics of the farms they manage. Therefore, elements that are typically overlooked and complicated adoption must be considered. Some characteristics identified among producers are:

- They vary in digital competencies.
- They are older and have a low level of traditional education.
- They have limited access to infrastructure.
- They use outdated technology.
- They require quality content, such as good written, visual, and auditory communication.
- They rely on traditional marketing networks and thus participate in direct and intermediate markets in a low-demand environment.

Some necessary features of the application are:

- It must adapt to low-cost mobile phones and even to rural communities without internet connectivity.
- It should ensure that mobile actions support small producers on a low technological scale, making it easily transferable.
- It should not store unnecessary information or require unnecessary records.

After clarifying these points and considering the development methodology, the phases followed according to RUP have the following purposes:

- Analysis: Define requirements, entities, and process structure, which were identified by evaluating various possibilities presented by producers.
- Design: Determine architecture and construct models.
- Construction: Program the application.
- Transition: Use the application realistically to identify and improve weaknesses.

From this process, it was determined that the scope of the first version should involve the commercial activities of the farm, represented in a notebook that producers use to keep track of their upcoming production deliveries and necessary input purchases.

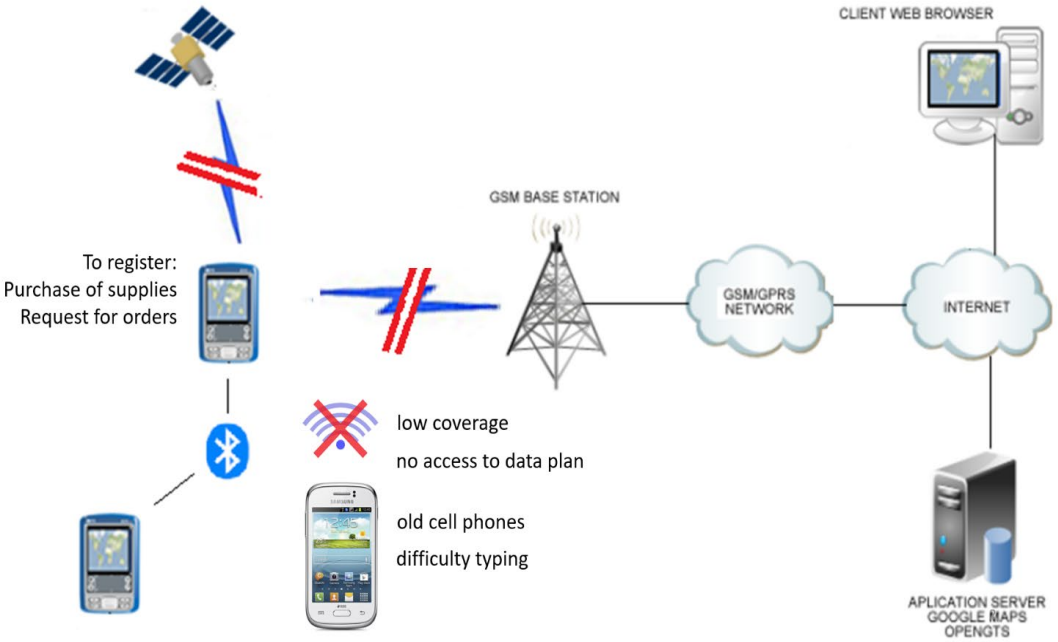
3. Findings

Given the described circumstances and the proposed solution, the result is the proposal of an ICT tool in the form of a mobile app called Agrolibreta (the name is derived from the traditional notebook that producers use to record information about these two events, but it eliminates the difficulty of searching for or consolidating information). This app is aligned with

the conditions explained for small producers and their production system, where operational conditions are as illustrated in Figure 1, specifically:

- It does not require an internet connection, although it can export and import backup copies the user can utilize when internet access is available.
- It requires Bluetooth for installation on a neighbor's device.
- If option one is not used, data will not be sent to any server. Thus, it includes an option to export to CSV to save in a file and migrate when necessary.
- The usage of each mobile device will be personal and independent.

Figure 1. Conditions Based on User Characteristics.



Source: own elaboration.

The application has only two user profiles: the administrator and the farmer (with the administrator serving only as support and being the contact that farmers can contact if they encounter any issues with backup). Its first version requires functionalities such as registering orders and purchases (which can be done via voice) and consulting them (via text). Figure 2 presents an example of the application divided into five parts, which are:

- Option to select the event: order or purchase.
- Option to activate the microphone so that the application can transcribe the received text.
- Button to register: When used, a calendar activates to select the date of the activity.
- Option to enter filter options.
- List of records corresponding to the applied filter.

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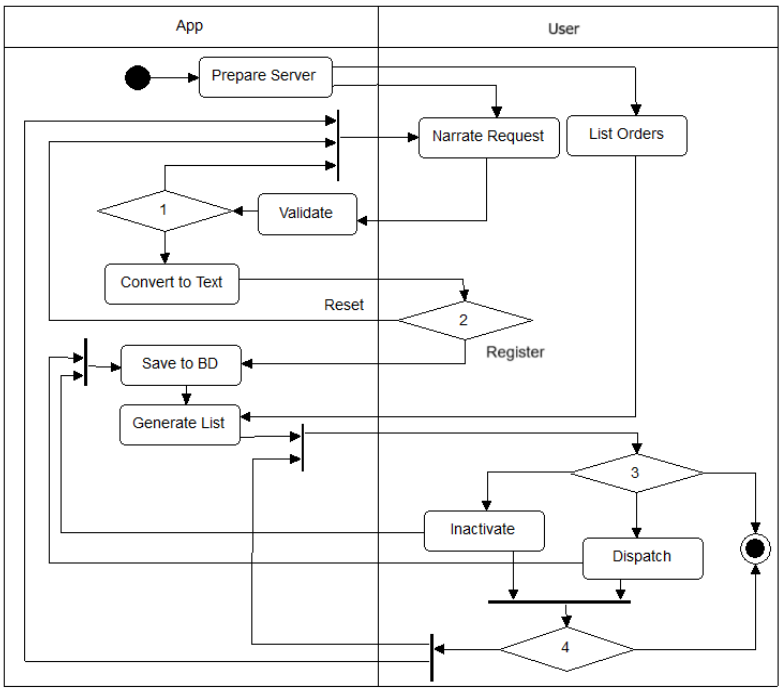
Figure 2. Agrolibreta Interface for purchases and orders.

Source: own elaboration, screen capture from the mobile phone.

Figure 3 presents the activity diagram for registering orders, a process similar to registering purchases. Note the importance of voice registration and its validation, which generates text for recording and later consulting according to the previous steps.

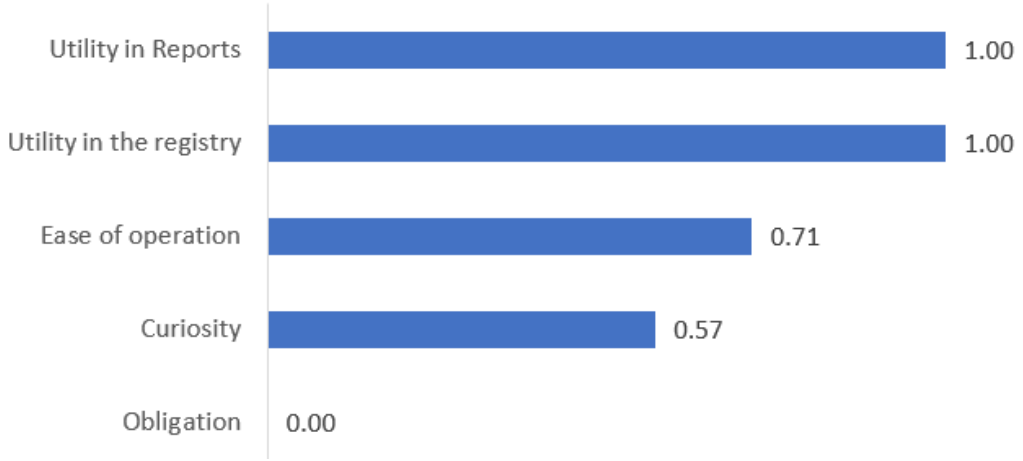
Figure 3. Activities Diagrams to record orders.



Source: own elaboration.

The tests conducted so far and usage by beneficiaries allow us to affirm that farmers now identify the application as the successor to the notebook where they used to jot down reminders for orders they received and dispatched and input purchases they needed to make based on those orders. A follow-up survey was conducted with them, adapted from the proposal by Gómez-Prada *et al.* (2020), to measure technology acceptance and appropriation. The survey seeks to understand their perceptions regarding the usefulness of functionalities, ease of operation, and curiosity. Figure 4 shows that 100% of the surveyed farmers find the reports and the recording of purchases and orders applicable, 71% consider it easy to use, and 57% started using it out of curiosity. Future versions aim to replicate development advantages offered by the Rad Studio environment by adding PUSH notifications and REST services, facilitating the sending of reminders, and managing cloud backups.

Figure 4. Measurement of Utility, Ease of Use, and Reason for using Agrolibreta.



Source: own elaboration.

4. Conclusions

The sessions to promote the application's adoption show consistency with the results of other studies directed at small-scale agricultural producers to support commercial strategies. Authors such as Acquaah (2011), Slamet *et al.* (2017), and Kabbiri *et al.* (2018) express the necessity of generating networks with community leaders, involving younger farmers with higher education levels, and integrating packaging equipment and storage facilities into their systems. Additionally, Kabbiri *et al.* (2018) highlight the importance of interacting with beneficiaries to understand their limitations, a principle that the methodology followed, demonstrating its utility through the feedback provided by farmers.

The application for the commercial management of small-scale farmers aligns with the views expressed by Lundström and Lindblom (2018), Erumban and De Jong (2006), and Daza-Martínez et al. (2017) regarding the need to manage the information arising from agricultural

processes to improve productive and economic outcomes, as well as the quality of life for their inhabitants. The latter of these three authors is particularly relevant as it pertains to the strategic plan of the Santander department in Colombia, where the application is currently being used. This purpose aligns with the Sustainable Development Goals (SDGs) 8 and 12 mentioned in this document (UN, 2021).

Efforts should be made to increase rural households' access to ICT and their capacity to utilize it, a goal to which Agrolibreta contributes by incorporating ICT, the likelihood of selling crop production is enhanced, as suggested by Aker and Ksoll (2016), who also emphasize the need to address other aspects with ICT to improve farmers' well-being, such as access to health care, education, and improved infrastructure.

Finally, to provide applications that promote the use of ICT and strengthen economic productivity through diversification, as well as enhancing technological capacity to move towards more sustainable consumption and production modes, modernization, and innovation, it is observed that it is essential to:

- Support the generation of information for purchases and marketing by small-scale producers, as expressed by Lee *et al.* (2020). Additionally, direct marketing channels with consumers of agricultural products should be promoted, increasing commitments that traverse social movements to coordinate complementary market strategies for managing small agricultural production systems (Pizarro-Muñoz *et al.*, 2021).
- Generate self-sufficiency and improve the sustainability of livelihoods among small producers (Ndlela & Worth, 2021).
- Mitigate misunderstandings about rural systems (Acquaah, 2011) and the benefits of ICT in farmers' financial routines.
- Seek to strengthen alliances between consumers and producers that generate solidarity and sustainable food supply chains, allowing for stable marketing of products at fair prices for farmers (Preiss *et al.*, 2017). It is hoped that this development will resemble examples of platforms for marketing agricultural products directly from farms to consumers or retailers, providing advantages to farmers and consumers or retailers for buying and selling (Abishek *et al.*, 2016), ideally involving only one intermediary known in the research application region (Santander department in Colombia) as "el cacharrero," who plays a role similar to a pollinator by bringing products from suppliers to consumers or like the Agrocraft application described by Gómez-Prada *et al*. (2016), which regulated future supply based on demand projected by organizations consuming large volumes of fresh agricultural products.

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Authors' Contribution statement

Urbano Eliécer Gómez-Prada: Conceptualization, Formal Analysis, Methodology, research, Software Implementation, Writing (Original Draft), Writing (revision of the draft and revision/correction); Marco Antonio Villamizar-Araque: Conceptualization, Formal Analysis, research, Methodology, Project Administration, Writing (revision of the draft and revision/correction); Ariel René Carreño-Oléjua: Conceptualization, research, Writing (Review and Editing/Editing); Brayan Danilo Ortiz-Hernández: Conceptualization, research, Writing (revision of the draft and revision/correction).

Conflict of interest

The authors declare that they have no conflict of interest in the writing or publication of this article.

Ethical implications

The authors have no ethical implications to declare in the writing and publication of this article.

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