

GPS-based Track and Trace Smart Farming Application to Increase Domestic Market Share for Melon Farmers

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ABSTRACT

Background. Millennial farmers, defined as those aged 18-55, have increased rapidly in number in North Aceh Regency, particularly in Lhoksukon Village, in 2023. These farmers face challenges in marketing their products and remotely monitoring their agricultural activities, such as water management and crop irrigation.

Purpose. The aim of this activity is to increase farmers' interest in agriculture, making millennial farmers more advanced and independent, and to achieve food security in Lancang Barat Village, Dewantara Sub-district, North Aceh.

Method. The activity involved workshops, training, counseling, and mentoring over a period of four months, focusing on the use of ASSA (Smart Shopp Agriculture Application) technology for distribution channels within the e-marketplace system. Data collection techniques included observation, interviews, and questionnaires to identify the problems faced by the farmers.

Results. The results showed a significant increase in farmers' digital technology use, with an 80% adoption rate of the ASSA application among the Geuthena farmer group. Additionally, there was a 30% increase in product sales in the first three months and faster product delivery times. The activity improved farmers' digital skills and optimized distribution channels.

Conclusion. This activity successfully enhanced farmers' digital literacy, optimized distribution channels, and contributed significantly to food security by enabling farmers to reach a broader market and sell their products directly to consumers.

KEYWORDS

Market Share, Melon Farmers, Smart Farming, Track and Trace GPS

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INTRODUCTION

Dewantara is one of the subdistricts located in the North Aceh Regency. Based on data from the North Aceh BPS in 2022, there are 15 villages in Dewantara Subdistrict, one of which is Lancang Barat Village (Mohammad & Dey, 2025). This village is located 54.9 km from the capital of North Aceh Regency, Lhoksukon, and 12.7 km from Malikussaleh University Campus (K. A. Singh dkk., 2025). This village has soil conditions that contain high organic matter and sandy loam soil types (Montalvo dkk., 2025). It is located on the coast, and the people of Lancang Barat Village, who work as farmers, have chosen melons as their main crop (Z. Ali dkk., 2025). However, the distribution and marketing system for melon crops is still not profitable for



melon crops is still not profitable for farmers because it still involves third parties or agents (middlemen), meaning that farmers do not have direct access to distributors, wholesalers and modern markets (M. Singh dkk., 2025). This has an impact on reducing farmers' income and turnover.



Figure 1. Condition of melon farmland in Lancang Barat Village, Dewantara Subdistrict, North Aceh.

During the field survey conducted by the proposing team, melon production in Lancang Barat Village was around 8 tonnes per harvest, with a land area of 1,200 square metres and melon farmers having mastered melon cultivation techniques (N. Singh dkk., 2025). The North Aceh Government hopes that this large amount will serve as an example or pilot project for other villages to adopt the melon cultivation techniques used by melon farmers in Lancang Barat Village (Abou-Mehdi-Hassani dkk., 2025). In observations conducted by the team proposing the issues occurring in Lancang Barat Village, melon farmers must increase productivity and distribution channel efficiency (Ulva, Fadhliani, dkk., 2023). With many competitors (melon farmers from other villages), melon farmers in Lancang Barat Village must create branding and modern marketing strategies (Ulva, Yulisda, dkk., 2024).



Figure 2. Melon sales in front of melon cultivation fields, still selling in the area around Lacang Barat Village, Dewantara District, North Aceh.

Lancang Barat Village has two community organisations, namely economic empowerment-based organisations consisting of fish farming groups, brick-making groups and melon farming groups. In the social and community sector (non-economic empowerment), there are PKK women's groups and youth groups (Imran & Li, 2025). The focus of this community service activity is the Geuthena Melon Farmers Group because this melon farming group has a track record of innovative melon cultivation techniques and maximum agricultural production (melons), and serves as a role model for melon farmers in other villages in North Aceh District.

Based on these issues, the PkM team planned an appropriate technology to support the 'digital economy' in the form of a mobile application system to monitor melon distribution channels using the GPS Track and Trace concept (Ulva, Abdullah, dkk., 2023). This system will provide a solution

for melon farmers to increase production and expand their modern market reach throughout North Aceh Regency (Kallenberg dkk., 2025). An information system is a collection of elements that are interconnected and form accurate information (Patel dkk., 2025). Technological developments play an important role in the development of industry and agriculture, as they facilitate and streamline activities (Anastasiou dkk., 2025). A system that provides a real-time overview of distribution channels can improve operational efficiency, improve distribution channel management, and increase customer satisfaction (customer behaviour) (Ulva, Yulisda, dkk., 2023a). The GPS track and trace facility in this distribution chain system provides real-time visibility for farmers, distributors, retailers and consumers, thereby increasing customer confidence by providing direct information on product origin and delivery status (Natsir dkk., 2025). Cities equipped with GPS tracking and monitoring systems have a great deal of potential for good and transparent governance since this technology enables governments to gather and evaluate data in real-time on public goods, capital distribution, and mobility (Ulva, Kurniawati, dkk., 2023). Thus, the use of appropriate technology in the melon distribution system, using GPS tracking and tracing techniques, has become a driving force in expanding market share, maintaining product quality, and facilitating closer ties between farmers and consumers (Ulva, Andriani, dkk., 2024).

The main objective of this community service activity is to create appropriate technology based on the digital economy, namely a mobile GPS-based track and trace distribution system application, which will improve delivery transparency by enabling real-time location tracking (Bayar dkk., 2025). This system will also improve distribution channel management as farmers can optimise the selling value of their harvests (Karagiannis dkk., 2025). With GPS tracking and tracing, farmers can track the products they are shipping and analyse traffic to determine the most efficient route recommendations to maintain melon quality, reduce delivery times and fuel costs.

The primary objective of this community service initiative is to bridge the gap in agricultural logistics by implementing appropriate technology rooted in the digital economy (Marchegiani dkk., 2025). By developing a mobile GPS-based track and trace distribution application, the project aims to revolutionize delivery transparency through real-time location monitoring (Hassoun dkk., 2025). This digital intervention is specifically designed to enhance distribution channel management, empowering farmers to safeguard the market value of their harvests (Shahab dkk., 2025). By transitioning from traditional methods to a data-driven tracking system, the program fosters a more accountable and professional supply chain environment for local agricultural products.

Beyond simple transparency, this technology serves as a critical tool for operational optimization and quality preservation (Rezaee Danesh, 2025). Through the integrated GPS tracking and tracing features, farmers can monitor their products in transit and perform detailed traffic analysis to identify the most efficient route recommendations. This strategic routing is essential for maintaining the freshness and quality of melons, while simultaneously reducing delivery durations and minimizing fuel expenses. Ultimately, the adoption of this tracking system provides farmers with a competitive edge, ensuring that their high-quality yields reach consumers in peak condition while maximizing their overall profit margins.

RESEARCH METHODOLOGY

The implementation method in this community service activity is divided into three stages by the proposing team, namely the preparation stage, the implementation stage, and the guidance stage (Awal dkk., 2025). The division into these stages aims to facilitate the proponents in finding the most optimal method to be applied in this community service activity (Moe dkk., 2025). The implementation method to be applied in this activity is divided into two aspects of the problem,

namely the marketing aspect and the distribution channel management aspect (Güneş & Hasegawa, 2025). The activity schedule is shown in Table 1.

Table 1. Methods for Implementing Community Service Activities

No	Activities	Aspects	Methods
Preparation			
1	Identification of problems faced by melon farmers and identification of the potential of melon farmers in Lancang Barat Village.	Marketing and distribution channel management.	Lectures, discussions, observations and surveys
2	Analysis of distribution data, marketing segmentation and mapping of the current distribution of melons in North Aceh Regency	Marketing and Distribution Channel Management	Survey Analysis
3	Development and design of a mobile-based distribution channel application that offers several services, such as: <ul style="list-style-type: none"> a. Marketplace services and connectivity with mobile-based delivery applications and web-based distribution channel management using GPS track and trace methods b. Pre-Order facility service for ordering melons before harvest c. Special service for regular customers and bulk purchases d. Consumer feedback service e. Education/news service 	Marketing and Distribution Channel Management	DesignS
4	System testing	Marketing and Management	Implementation and evaluation
Implementation			
5	Workshop and demonstration on application usage	Marketing and Distribution Channel Management	Socialisation
6	Technical training on how to use applications that focus on features supporting marketing activities to expand market share.	Marketing	Training
7	Technical training for partners on the direct use of distribution channel applications with GPS tracking and tracing methods	Marketing	Training
8	Technical guidance for partners on the basics of business management and marketing techniques to increase revenue generation	Distribution Management	Training
9	Management guidance on maximising the use of application data to detect distribution channels	Distribution Management	Education

	and identify changes in consumer behaviour		
10	Information session on digital marketing strategies	Marketing	Education
	Outreach to partners in an effort to enhance partnership cooperation with stakeholders, distributors and transport services to expand market share	Marketing	Education
11			
	Coaching		
12	Conducting field visits and periodic reviews of application usage, as well as receiving suggestions from partners	Marketing and Distribution Management	Monitoring and Evaluation
	Reviewing distribution and sales activities through the distribution channel application system with GPS tracking and tracing, and identifying issues in the development of distribution channel services.	Distribution Management	Monitoring and Evaluation
13			
12	Providing technical support for troubleshooting and updating application features so that they can function to improve marketing and optimally support distribution channels.	Marketing and Distribution Management	Technical Support
13	Creating a digital forum for melon farmers to share information, experiences, marketing strategies and distribution channel optimisation.		Online Discussion Forum
14	Establishing a community of melon farmers for collaboration and exchange of agricultural technology, as well as market share improvement and distribution channel optimisation.	Marketing and Distribution Management	Community Development

In order for this community service activity to run smoothly, partners participate in ensuring the success of this programme by providing a location for training and outreach activities, as well as internet access. To ensure that the application can be used continuously by partners, they participate in the following activities: Partners actively participate in every training and outreach session organised by the proposing team, partners provide feedback on the distribution channel application that has been implemented, so that the proposing team can identify the strengths and weaknesses of the available features and develop features according to the partners' needs, partners are willing to use the latest digital technology in the marketing and distribution of their agricultural products (melons).

RESULT AND DISCUSSION

In analysing the existing conditions of partners, the PkM team evaluated the initial conditions of melon farmers prior to the implementation of the GPS track and trace technology-based marketplace application. The results of this analysis covered aspects of distribution, marketing, and technology adoption that had already been implemented by melon farmers. In terms of marketing,

most farmers still rely on conventional methods such as direct sales at local markets or cooperation with large traders in certain areas. Farmers generally do not have adequate access to wider markets, either at the regional or national level (Zhao & Chen, 2023). The lack of information about market demand and current market prices is a major obstacle to increasing sales volume.

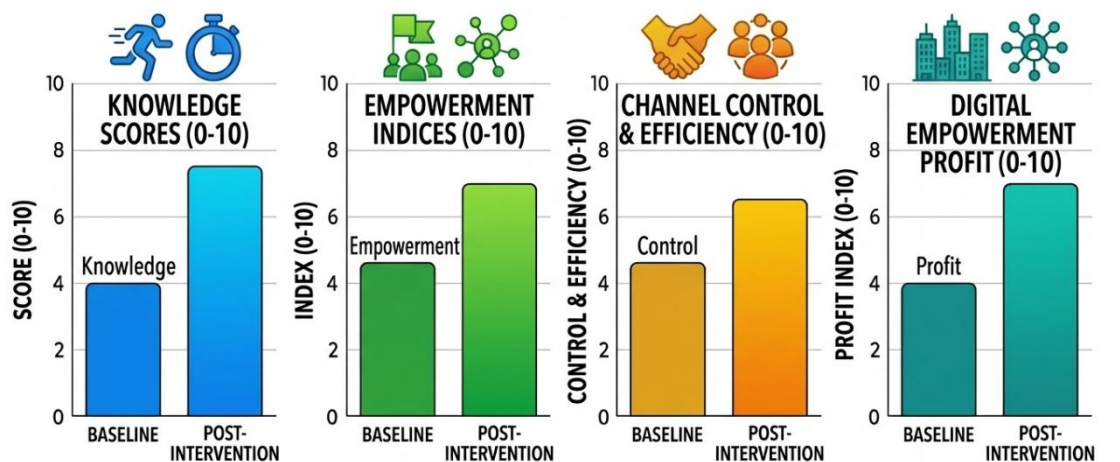


Figure 3. Simplified Melon Farmer Outcomes and Distribution Channels

Farmers are also not yet accustomed to using digital platforms to market their products directly to end consumers. As for the distribution channel, the distribution of melons from farmers to consumers was previously carried out through several intermediaries, such as middlemen or collectors (Wahyuni dkk., 2023). This distribution system tended to be inefficient, as the products often suffered a decline in quality due to long transit times or suboptimal handling processes. In addition, farmers had little control over selling prices, as prices were generally determined by intermediaries. This resulted in low profit margins for farmers, even though market demand for melons was quite high. Therefore, PkM activities are divided into several aspects of activity.

This analysis shows that before using marketplace applications with GPS tracking, partners faced various challenges, such as a lack of transparency, low efficiency, and an inability to address distribution issues in real time. Implementing applications with GPS track and trace features can overcome many of these problems, providing better visibility and control in the supply chain. Based on an analysis of the situation and the main problems faced by partners, the solutions offered by the proposing team to partners are as follows: (1). Transferring technology, namely a user-friendly mobile-based GPS track and trace distribution system application to partners, (2). Providing education on changes in the selling prices of agricultural products through a system to partners, (3). Providing education on how to use the mobile-based distribution system application to partners, (4). Providing knowledge through training on operating techniques for viewing and using the MAP function in the application and services on the system to partners, (5). Providing knowledge in the form of knowledge transfer about the operating standards of the mobile-based distribution channel system to partners, (6). Providing training to the Geuthena Farmer Group through education on the operating techniques of the control and monitoring management of the distribution channel system.



Figure 4. Training for the Geuthena Farmer Group on the Use of Marketplace Applications with GPS Track and Trace Features

The training session for the Geuthena Farmer Group marks a pivotal shift toward digital literacy and logistical autonomy within the local agricultural sector. By focusing on the integrated use of marketplace applications featuring GPS Track and Trace capabilities, this workshop equips millennial farmers with the technical proficiency to manage their own distribution channels. This hands-on training ensures that participants can move beyond theoretical knowledge to practical application, enabling them to monitor real-time shipments and optimize delivery routes for their harvests. As a result, this capacity-building initiative serves as the primary engine for reducing reliance on middlemen, thereby ensuring higher profit margins and the long-term sustainability of the Geuthena group's digital economic transition.



Figure 5. Data analysis and roadmap development with the North Aceh Agriculture Office

Based on the data analysis and meetings held with the Agriculture Office, the North Aceh Regency Government, and the Lancang Barat Village Administration, the local authorities at the district, sub-district, and village levels expressed their readiness to support the implementation of the Marketplace Application specifically for the Geuthena Farmer Group and more broadly across North Aceh Regency. Following this commitment, the proposing team proceeded to design the Marketplace Application by developing a business model that is clear, practical, and easy for stakeholders to apply.

Technological innovations and products continue to push the boundaries of what is possible in various sectors. With technological developments, new products will continue to change our daily

lives and help us face global challenges such as climate change, health, and education. These innovations are an important pillar in building a more sustainable and efficient future.

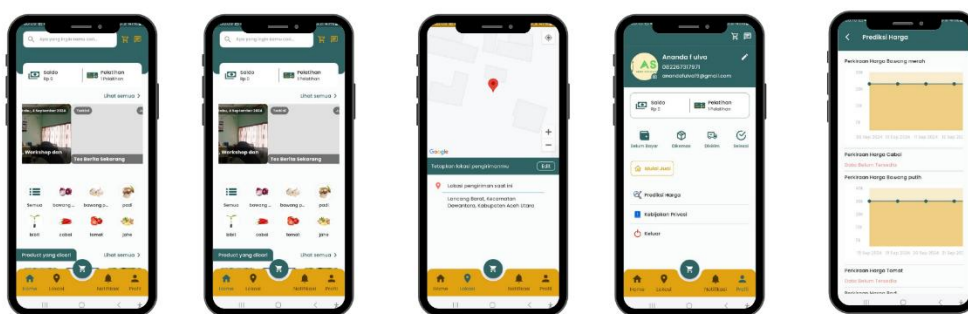


Figure 6. Smart Farming-based Marketplace Application Display

The adoption of marketplace-based technologies with GPS Track and Trace features provides considerable value to the agriculture, logistics, and trade sectors (A. Ali dkk., 2023). This system enables users to verify the full journey of products from farm origin to final delivery thereby strengthening consumer trust, ensuring ethical and sustainable handling, and enhancing transparency within the supply chain. Such visibility also improves the credibility and market reputation of farmers and small producers.

GPS tracking and tracing enables distributors, collectors, and farmers to monitor the location of products in real time. This feature can be integrated with delivery route systems, allowing for more optimal distribution arrangements (Ulva, Yulisda, dkk., 2023b). With delivery route optimisation, delivery times can be reduced and transport costs cut, which ultimately lowers product prices in the market. This benefits all parties, from farmers who can reduce their operational costs to consumers who get fresh products at affordable prices.

The mentoring programme using the ASSA marketplace application has increased farmers' sales by 30 percent, reduced production costs by 10 percent, and accelerated product delivery. To sustain the programme, continuous training, strategic collaboration, feature development, and alignment with key SDGs will be strengthened

CONCLUSION

Millennial farmer assistance activities for monitoring distribution channels using the ASSA marketplace application have resulted in a 30% increase in product sales in the first three months of using the ASSA application, a 10% reduction in production costs, and faster product delivery times, so that products are fresher when they reach consumers. This PkM activity addresses the issues faced by millennial farmers in Lhoksukon District, where prior to this initiative, declining product sales led to unstable farmer incomes and high production costs due to multiple distribution channels to consumers via middlemen or brokers. The methods applied to achieve the results were highly effective, as they involved not only training activities but also five months of mentoring for millennial farmers to ensure effectiveness. To enhance the impact of this PkM activity and ensure positive outcomes, it is recommended to improve access to technology, develop better logistics infrastructure, provide incentives from the North Aceh Regency Government to the Geuthena farmer group in Lancang Barat Village, Dewantara District, which has adopted sustainable agricultural practices, and for the North Aceh Regency Government to establish regulations supporting the development of the ASSA marketplace application.

The implementation of the ASSA marketplace application has yielded transformative results for millennial farmers in Lhoksukon District, effectively dismantling the traditional barriers of inefficient distribution. By bypassing high-cost middlemen and brokers, the program achieved a remarkable 30% increase in sales within the first quarter alongside a 10% reduction in production costs, directly stabilizing farmer incomes. These quantitative gains were made possible through a rigorous five-month mentoring period, ensuring that technological adoption was paired with practical mastery. Moving forward, the long-term sustainability of these gains depends on institutional support;

specifically, the integration of better logistics infrastructure and the formalization of local government regulations in North Aceh to protect and incentivize these digital agricultural advancements.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; Investigation.

Author 3: Other contribution; Resources; Visualization; Writing - original draft.

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