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Solar Dome Technology and Transformative Learning: Empowering JATAM and PKK Communities for Sustainable Aloe Vera-Based Business Growth

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Abstract

The abundant aloe vera plants in Argomulyo, Sedayu, Bantul, DIY have not been managed optimally, both for health and improving economic status. Therefore, the Community Service Team from Universitas Ahmad Dahlan (UAD) and Universitas Jenderal Achmad Yani Yogyakarta (UNJAYA) carried out a community empowerment program to improve aloe vera management and develop product innovations in order to foster entrepreneurial interest in improving the economic level of the community. The goal of PKM is to increase community capacity in managing aloe vera cultivation sustainably, introduce post-harvest processing technology with a solar dome, and encourage the strengthening of the local economy through training and mentoring activities. The method used is an Asset-Based Community Development (ABCD) approach through several activities, namely: participatory training which includes aloe vera cultivation techniques, post-harvest processing, product diversification, packaging, and marketing strategies. Participants in the activity consisted of the JATAM group, Argomulyo Village officials, and members of the Family Welfare Empowerment (PKK), most of whom were women and housewives. The results of the activity showed positive values. First, the community is able to better adopt aloe vera cultivation practices and utilize solar dome-based drying technology independently for a sustainable processing process. In addition, the knowledge and participation of the community, especially women who are members of the PKK, have also increased. Entrepreneurial activities based on herbal products also increased by 35%. This program produces a variety of processed aloe vera products with better packaging and a more modern and targeted marketing strategy. Thus, the integration of community training and the application of appropriate technology can strengthen local economic resilience and become a more transformative model for rural community empowerment because it is based on sustainable local potential.

Keywords: *Aloe vera; automated post-harvest; asset-based community development; IoT*

INTRODUCTION

Indonesia has advantageous environmental conditions for aloe vera cultivation because of its tropical climate and nutrient-rich soil. These conditions give a great chance of opportunities for the development of aloe vera based products to support community economic. This tropical plant is scientifically proven to have a high content of beneficial nutrients for health (Ebrahim et al.,

2020; Haristy et al., 2021; Swaraj, 2024). Therefore, in the beauty and health industry, they are generally used as a main ingredient (Wasiullah et al., 2022; Witaszczyk & Klimowicz, 2023). However, in the rural society aloe vera are only used for simple home remedies (Swaraj, 2024). One of the villages that has abundant aloe vera is Argomulyo. It is one of the villages in Sedayu District in Bantul Regency, which covers an area of 953 hectares and has a population of 13,460 people in 4,777 households. It has great potential in natural resources including Aloe vera where it was planted and grow abundantly due to the fertile land and suitable climate. Unfortunatly, this potential has not been optimally utilized by the local community, as most residents lack the knowledge and skills to cultivate, process, and market aloe vera based products. Such abundant Aloe vera has not been optimally utilized moreover in health and economic aspects by Sedayu community. They remain largely unutilized to support the improvement of community welfare, so the economic added value of this commodity has not been optimized.

Building on this idea, Jatam is a farmer community located in Sedayu, was founded on January 14, 2024, with the vision of actively contributing to increasing farmers' income and welfare. Its members come from various professions: farmers, entrepreneurs, housewives, teachers, and lecturers. It has carried out various activities: organic fertilizer-making training, planting yellow kepok bananas, food processing training based on Aloe vera, and product bazaars. Aloe vera planting target for the entire 1600 m² area is planned to be completed in the end of August 2025. Despite these progressive plans, the fact is that Jatam still faces obstacles in various aspects, including agricultural technology innovation to cultivate Aloe vera, modern cultivation strategies, post-harvest processing, product diversification, and marketing. Although some previous parties have provided guided, Jatam still needs sustainable mentoring programs in cultivating Aloe vera.

Along the same line, Argomulyo has an established community which is called as PKK. It is a family-based empowerment group/program consisting of women and housewifes. The activities that have been carried out are farming Aloe vera and selling some simple traditional snacks. PKK movement in Argumulyo is still small and weak, and it has not yet established a clear presence or strong existence, therefore Argumulyo authority tried to support by driving the family economy through cultivation and socio-cultural activities (Interview with the head of the village, July 20, 2025). However, the results have not been optimal yet. Sustainable mentoring should be undertaken in cultivating, processing, and packaging Aloe vera. Based on the data from Argomulyo Authority Medium-Term Development Plan for 2022-2028, the average education level of the community is still low. This will therefore automatically impact competitiveness and employment opportunities. The majority of the working-age population is self-employed, out of a total of 8,641 residents. This is because the availability of formal employment is very limited, contributing to the high unemployment rate. There are 211 people of working age who are recorded as unemployed, and the number of pre-prosperous families is still high.

Despite these developments owed by Jatam and PKK, several challenges persist. The problems faced by Argomulyo Authority are limited job opportunities and high unemployment. On the one hand, the global market is paying attention to the consumption of Aloe vera for health and as a functional food ingredient (Javed, 2014). This opportunity could actually be seized by Jatam and PKK under the coordination of Argomulyo Authority. Unfortunately, various fundamental issues related to both raw materials and processing remain unresolved. The cultivation being carried out is not yet running at its maximum potential. The care and maintenance of Aloe vera is still done resulting in low technological literacy, low selling price, and economic unrealibility. The lack of innovation in managing Aloe vera and limited access to global markets are real problems. Therefore, innovation in agricultural technology needs to be implemented so that cultivation can be more effective and quality is improved.

Three substantial problems are highlighted: production, management, and marketing. Production is one of the priority problems that lacks innovative technology. Jatam farmers need technological assistance related to irrigating Aloe vera cultivation. Another problem is technology for peeling the leaves and drying the leaf mucilage, which will be used to make various processed products. The methods used so far are still conventional and take a long time, with low quantity and quality. Management is the second problem as its organizational structure and management systems are still not well-organized. Therefore, Jatam and PKK need a comprehensive training in post-harvest management to strengthen the institutional foundation and improve professionalism in the management. An intensive training is needed to improve members' capacity and skills in the field of marketing. The training should cover digital marketing strategies across various marketplace platforms, as well as strengthening offline marketing. One planned effort to strengthen offline marketing is to transform into Aloe Vera Village, a local branding area that can become the flagship identity for Jatam's agricultural products (Yildiz & Scharaldi, 2015). The other problems faced by them is production. PKK faces challenges in the production aspect, particularly regarding the sub-optimal utilization. Although farming activities are already in place, Aloe vera produced is not yet processed into value-added products due to the limited skills of the members in processing and packaging. Additionally, production facilities are still limited, so the potential of Aloe vera has not been fully utilized to increase family income.

The application of modern technology and transformative learning for training and mentoring activities has proven to be successful and has resulted in improving the community's economy in some other fields. Some research and community empowerment activities show that the capacity of the community to manage local potential becomes more productive and sustainable. Solar dome-based drying technology has been developed as one of the alternative technologies that can help improve the efficiency of the drying process and maintain the quality of the products produced to be more hygienic. On the other hand, the approach of community empowerment which fully involves self-transformation and active community participation, such as the development of entrepreneurial skills, has been proven to be able to increase the economic independence of village communities.

Based on these conditions, community service programs need to be carried out with an emphasis on changing mindsets so that they are open and able to carry out training results in a sustainable manner, especially after activities. The community should not only focus on acquiring new knowledge but also be able to utilize local potential to the maximum and be more innovative through the application of appropriate technology. This program is implemented by applying the Asset-Based Community Development (ABCD) approach with an emphasis on the utilization of assets and potentials that have been willingly owned. Through this approach, the community is encouraged to develop the potential of aloe vera into herbal products that have economic added value through cultivation training activities, post-harvest processing using solar dome technology, product diversification, packaging, and marketing strategies.

This service activity helps increase the capacity of the village community in managing the potential of aloe vera to be more productive, and even introduce more modern, efficient and sustainable processing technology. In addition, this activity also encourages the growth of local potential-based entrepreneurship that involves the active participation of the community, especially women's groups that are members of the Family Welfare Empowerment (PKK). Based on this description, the purpose of this community service activity is to empower the people of Argomulyo Village through training and application of solar dome technology in aloe vera processing to increase the added value of products and encourage the development of entrepreneurship based on local potential in a sustainable manner.

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To solve the identified problems, PKM of UAD and UNJAYA have set the purposes of this community engagement into three sustainability programs, they are:

1. To change the community mindset and improve knowledge on aloevera productions and marketing after the program conducted by PKM team.
2. To introduce modern technology to Jatam and PKK community and help them in supporting the efficiency and quality of Aloe vera products.
3. To strengthen Jatam and PKK community's economy through the development of aloe vera-based businesses.

METHODS

Asset-Based Community Development (ABCD method) was applied to emphasize the development and utilization of local assets. It is the most appropriate method to apply because it served as the foundation for creating sustainable social and economic change. Kretzmann & McKnight (2023) conceived this approach, based on building communities inside out, which emphasizes that community development should start from the strengths and resources already possessed, not from its shortcomings. This approach is believed to be most relevant to this context because it involves three main partners to achieve synergy between the production sector, social empowerment, and community education (Qiaoyu et al., 2024). Through this approach, research and service activities are directed toward utilizing existing human resources, social, economic, and natural resource assets in partner villages, as well as strengthening collaboration between partners in a participatory manner.

There are 5 steps adopted in implementing ABCD approach (Russell, 2022). *First*, discovery (*asset and needs identification*) aims to identify the potential and assets. Data were collected through field observation and interviews. *Second*, dream (*formulating shared hopes and vision*) refers to identifying results. UAD and UNJAYA as the community engagement team and partners have formulated a shared vision regarding the development of aloe vera and the improvement of agricultural equipment quality, as well as strategies for women's empowerment and community education. *Third*, participatory dialogue was applied at this stage to build collective awareness and a sense of ownership toward the program. *Fourth*, design (program planning and innovative solutions) of programs has been done based on the strategic role of each partner: Jatam has a function for cultivating agricultural tools such as a solar dome for aloe vera cultivation needs. PKK's funtion is for training on Aloe vera-based product processing, entrepreneurship mentoring, and strengthening marketing networks. Argomulyo Authority has to organize for educational, socialization, and community-based training activities using transformative learning. *Fifth*, define and destiny (implementation, mentoring, and sustainability) were implemented over one year. Activities which had been done include workshops, technical assistance, and results monitoring. Data from the activity results were collected through participatory observation, and reflective interviews to assess program effectiveness. Data analysis was conducted using qualitative descriptive analysis to identify changes in thinking, and synergy among partners. Justification of the condition and expected results aims to understand the improvement of the programs served to the three partners (Cunningham et al., 2022). The steps in implementing *ABCD* approach is presented in the following figure 1.

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Figure 1. Steps in implementing the ABCD approach

A total of prticipant involved in the community service activity were 38 representing key community groups in Argomulyo Village. The participant group comprised representatives from the JATAM group ($n = 15$), Argomulyo Village officials ($n = 3$), members of the Family Welfare Empowerment / PKK ($n = 10$), and members of the Women Farmers Group / KWT ($n = 10$). While 38 core participants are actively involved in various activities that have been prepared, some of the 56 members participate regularly during the operational phase alone, for example assisting in the cultivation and cultivation of aloe vera, collection of post-harvest yields, and voluntary commercial sales activities.

Demographically, the majority of participants were female which were almost 85%. Mostly they were housewives, alongside local governance staff and farmers. Participants ranged in age from 30 to 65 years, with a mean age of 43.5 years. Regarding the educational background, participants demonstrated diverse levels of formal education, ranging across primary education (20%), secondary education / senior high school (55%), and tertiary education / bachelor's degree (25%). Detailed information regarding the number of participants and their demographic characteristics are presented in Table 1.

Table 1. Demographic Profile of Program Participants ($N = 38$)

Demographic Characteristic	Category	Frequency (n)	Percentage (%)
Educational Background	Primary Education (SD/SMP)	8	21.1%
	Secondary Education (SMA/SMK)	21	55.3%
	Tertiary Education (Bachelor's/Diploma)	9	23.6%
Age Statistics	Range: 30–65 years	Mean Age (M): 43.5 years	—

The recruitment of participants was conducted through a community-based, participatory, and needs-oriented approach, which involved JATAM, PKK, and KWT communities as the primary target groups. Initial coordination and consultation with community representatives were the main processs of recruitment to identify potential participants whose interests, needs, and activities which were relevant to the development of sustainable aloe vera-based businesses. Participants were selected based on their willingness to engage in the program, their interest in developing entrepreneurial skills, their availability to participate in the training and mentoring sessions, and their potential to contribute to community-based business development. The process of recruitment also considered inclusive representation from both JATAM and PKK members to ensure equitable participation and strengthen collaboration between the two community groups.

The participants were actively involved directly in the activities. They participated in interactive discussions, trainings, and conducted evaluations after the activities ended. Active

community involvement was seen during the program, not just limited to training sessions. Participants were directly involved in identifying local resources and business opportunities for aloe vera, they also participated in hands-on training on the use and workings of Solar Dome Technology, learning sustainable aloe vera processing techniques, and developing value-added aloe vera-based products. In addition, they engaged in collaborative discussions, practical demonstrations, product development, and mentoring activities that focused on improving product quality, exploring market opportunities, and strengthening entrepreneurial capacity. Through Transformative Learning, participants were also encouraged to get used to critically reflecting on existing practices, exchanging experiences, developing new perspectives on sustainable resource utilization, and translating the knowledge gained into practical business initiatives. This approach places the JATAM and PKK communities not only as beneficiaries but also as active partners and co-creators in developing sustainable and community-based aloe vera-based business growth. In addition to participant profiles, program implementation and community engagement are structured in a clear timeline and work operations. With a total duration of three months (8 months), the program is systematically divided into three main phases: preparation, implementation, and evaluation of activities (table 2).

Table 2. Implementation Timeline and Phase Breakdown (8 months /32 Weeks)

Phase	Timeframe	Core Activities & Objectives	Target Deliverables
Preparation	Weeks 1–2	• Initial field assessment • Stakeholder coordination • Material development	Field assessment report, finalized workshop materials
Implementation	Weeks 3–20	• Workshop modules • Hands-on training sessions • Active mentoring	Skills acquisition, participant interactive engagement
Evaluation & Follow-up	Weeks 21–32	• Post-activity assessment • Feedback collection & data analysis • Sustainability planning & reporting	Final evaluation dataset, community service report

To evaluate how changes in participant mindset, critical thinking, and institutional synergy among the collaboration partners, the data obtained were analyzed using a qualitative descriptive approach. In addition, comparative justification between the initial baseline conditions and the expected outcomes was carried out to thoroughly assess the improvement and effectiveness of the community engagement programs implemented in the three target partner groups (Cunningham et al., 2022).

RESULTS AND DISCUSSION

This section reports the results of PKM programs implementation and the impact on the quality of performance of Jatam and PKK community. The activity results were analyzed based on three main program objectives: shifting community mindsets on aloe vera production, introducing modern processing technology, and strengthening the local economy through aloe vera businesses. In general, the results of the activity showed that there was a positive increase in processing skills, understanding of nutrition, product quality, marketing creativity, and business readiness of both the Jatam and PKK groups. These findings show that the use of Aloe vera plants not only helps food security, but also has the potential to increase the nutritional value of products and open up opportunities to strengthen the community's economy. Each finding is presented in the following paragraphs.

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The change of community mindset, knowledge, and skills for sustainable aloe vera cultivation

The mentoring activities carried out over 24 weeks have shown encouraging results. The members of Jatam and PKK who had participated in the training program showed their productive behavior. Overall, their capacity in managing Aloe vera have significantly increased. The training, designed as a comprehensive workshop focusing on utilizing the potential of Aloe vera, was able to encourage them to innovate various Aloe vera processed products that are nutritious and have high economic value. During the cultivation and processing stage, PKK members received training on techniques for processing Aloe vera into healthy drinks and traditional foods. They also received guidance on how to maintain cleanliness to meet hygiene standards in production. After that, advanced training was designing interesting packaging techniques. The women are trained on how to package aloe vera products that have been professionally and modernly produced. Additionally, they are also constantly reminded to remain consistent in paying attention to the nutritional content, the nutrients in Aloe vera. The training provided not only equips the mothers with technical skills but also opens up a new understanding of the importance of quality, hygiene, and nutritional value in every product they will create

Before the program was implemented, the conditions of partners' potential mainly for Aloe vera cultivation and marketing have not yet maximized. Coordination and management were still limited, and there was no innovation in Aloe vera cultivation technology. Even women's involvement in the local economy was still very simple and limited. Through the implementation of ABCD approach in answering the PKM goals, some progresses have been gradually achieved. Figure 2 depicts the solution proposed to solve the identified problems.

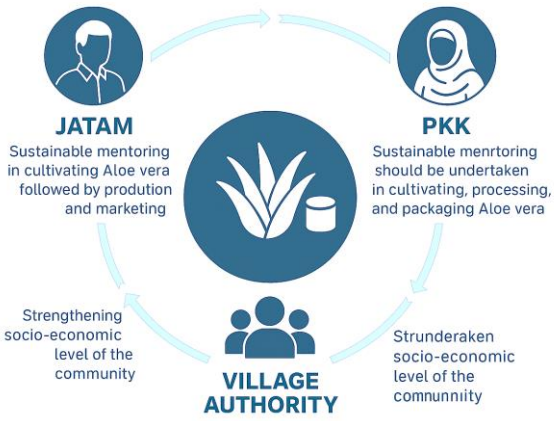


Figure 2. Conceptual Model of Agriculture

There is a change in participants' mindset and an increase in understanding of management skills, understanding aloe vera nutrition, product quality, creativity in sales and readiness to run a business. The average score in the range of 7-8 out among 38 participants. They admitted that the training and mentoring program had a positive impact on building their capacity and independence. The results of these findings also showed that the program that had been provided not only contribute to the aspect of food security, but can also increase the nutritional intake of processed Aloe vera products. In fact, this program can open up opportunities to increase economic value for the community, especially those who were previously not working. After the program, now they find their own motivation to work by managing Aloe vera plants that were previously only wild plants.

Tabel 1. The community mindset, knowledge, and skills (N=38)

No	Aspects	Improvemnet Description	Mean Score
1.	Skill Management	Participants showed improved their ability to process Aloe vera-based products through hands-on practice during the training.	7.6
2.	Nutritious Understanding	Participants better understand the nutritional content and health benefits of processed Aloe vera products.	7.8
3.	Product Quality	The resulting products show improvements in terms of cleanliness, texture, and processing standards.	7.5
4.	Marketing Creativity	Participants began to develop marketing ideas such as more attractive packaging and simple promotional strategies.	7.4
5.	Bussiness Readiness	Participants showed initial readiness to develop small businesses based on Aloe vera products.	7.7

Although still simple, PKK members have shown better ability in managing, processing, and sustainably marketing Aloe vera products. Activities such as mentoring can encourage a change in their perspective, for example, from simply processing raw materials to having the courage to dream of becoming creative and innovative local entrepreneurs with an international market. The mindset transformation of the women participants is evident in the increased interest in entrepreneurship and active participation in all mentoring activities. courage to take initiative, and the ability to identify new economic opportunities based on village potential.

Tabel 2. The change of community mindset, knowledge, and skills (N=38)

No	Aspects	Description Indicators	N	Score Phase I	Score Phase II
1	Skill Management	Enhance of processing Aloe vera product	38	7.6	78
2	Nutritious Understanding	Better graps of Aloevera nutritious	38	7.8	80
3	Product Quality	Improve cleanliness, texture, and standart	38	7.5	80
4	Marketing Creativity	Developing attractive of packaging and strategies	38	7.4	73
5	Business Readiness	Initial preparadness for small bussiness venture	38	7.7	97

As seen in table 2, the results of the activities show good improvement across all indicators. The participants achieved better improvemnet. The 5 aspects, that are Skill Management, Nutritious Understanding, Marketing Creativity, marketing creativity, and business readiness are well mastered by the participants.

Table 3. The differences among the aspects (N= 38)

Subjek (N)	Skor Fase I (X1)	Skor Fase II (X2)	Perbedaan (D=X2−X1)
38	7.6	78	+70.4
38	7.8	80	+72.2
38	7.5	80	+72.5
38	7.4	73	+65.6
38	7.7	97	+89.3

PKM program mainly helps participants in producing a variety of aloe vera products with better packaging and a more modern as well as targeted marketing strategy. The integration of community training and the application of appropriate technology can strengthen local economic

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resilience and become a more transformative model of village community empowerment because it is based on sustainable local potential

Training and couching how to use the technology to improve Aloe vera-based products

The main purpose of the training is to train how to use the technology of solar dome for post-harvest processing and IoT for watering the plants. With the efford, the quality of the Aloe vera palnts can be improved. This effort was carried out through several participatory training activities designed to increase the knowledge of the community and acquire adequate skills so that cultivation practices become more effective. The program emphasizes on understanding more modern planting techniques by applying solar dome, and IoT for sustainable plant maintenance. Through this capacity increase, the community was able to optimize the abundant local potential of Aloe vera so that it can increase the productivity and sustainability of the cultivation of these plants.

Automation Technology Transfer of Solar Dome for Post-Harvest Processing

In improving the process of Aloe vera cultivation, automation technology, Internet of Things (IoT)-based automated drying and extraction tool were provided to achieve sustainability. IoT aims to assist in the drying process, while connecting an automatic temperature and humidity monitoring system to maintain best quality (Ma'arij & Yudhana, 2023; Yudhana et al., 2018, 2023). The technology and innovation have been built in Jatam's Aloe vera field aiming to support the suitability of the work volume and producing a large quantity of Aloe vera. It provides a drying equipment and for locking the temperature between 40°C and 80°C inside the dryer was provided in the Aloe vera field.



Figure 3. Automation technology & Internet of Things (IoT)

Figure 3 and 4 show the technology that have been served in the Aloe vera field to help the best cultivation process. Figure 3 shows an IoT-based Watering and Nutrient Feeding Automation System for aloe vera plantations. The system works in an integrated manner from data collection to processes in the field. The first groove is soil sensors (Soil Moisture and DHT) which detect environmental parameters such as temperature conditions, soil and air moisture, and soil pH. Then the next process is to send the data to the local control device (IoT Edge Device). After that, the data is forwarded through the Gateway using the MQTT/RES protocol to the Cloud Server so that it can be processed by Machine Learning. Thus, it will result in accurate watering predictions or decisions. The results of the decision are then sent back to the Edge device so that it can activate the water pump automatically either for watering through sprinklers or for temporary nutrient

distribution throughout the data or land. Furthermore, the control status can still be monitored in real-time through laptops or smartphones participants or JATAM members.



Figure 4. Internet of Things (IoT)-based automated drying and extraction Tool

The implementation of the programs and automation technology by developing an IoT and automated drying as well as extraction tool for Aloe vera (Yudhana et al., 2019, 2021) has been succesfully implemented. The installation of IoT can support the cultivation of Aloe vera to become more fertile. Because of the solid cooperation between the implementing team, relevant partners, and the active participation of the participants, the installed equipment can be operated optimally. The program's achievements show positive results. Both in terms of increased understanding, community involvement, and the sustainability impact that is beginning to be seen.

The technology that has been provided and taught to JATAM members has successfully increased their knowledge. Even based on interview results, they are also ready to build "Kampung Lidah Buaya" or Aloe Vera Village (AVV) as a form of program sustainability. The head of Jatam stated that "*Jatam is ready to implement a modern and sustainable Aloe vera cultivation program." Where AVV is designed not only as a center for developing healthy herbal products, but also as a prototype of an Independent Tourism Village that utilizes the potential of Aloe vera as an asset for community health, economy, and education*". Through the training provided by CST, JATAM, they admitted that they are confident to run the model of an integrated agricultural education, with modern Aloe vera cultivation techniques and automated post-harvest processes as the foundation for sustainable innovation development.

In order to realize the promotion of sustainable and innovative product development, AVV is expected to give contribution to improve community welfare through the production of high-quality functional foods and herbal products. In addition, AVV is also expected to support the government's program, MBG (Free Nutritious Meals Program) that are healthy, nutritious, and safe for consumption. By implementing IoT technology and automated post-harvest processing systems, Aloe vera cultivation becomes more efficient, environmentally friendly, and aligned with the principles of sustainable agriculture. Through the implementation IoT in Jatam community, AVV is also predicted to support the achievement of Sustainable Development Goals (SDGs) such as poverty eradication, food and nutrition security, quality education, decent work, and responsible consumption and production (Rulandari, 2021).

Strengthening Jatam and PKK' economy development through Aloe vera-based businesses

Consistent improvements have confirmed that Aloe vera product innovation not only strengthens food security and increases nutrient intake but also provides economic opportunities thru herbal products with economic value. Thus, transformative approach training can directly contribute to the optimization of sustainable Aloe vera cultivation at the community level.

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The educational programs based on transformative learning was conducted to enhance community knowledge and awareness of sustainable local economic development. Some programs promoted by Argomulyo authority were started from the training, problems faced by Argomulyo Authority in which limited job opportunities and high unemployment. The opportunities in seizing the global market paying attention to the consumption of Aloe vera for health and as a functional food ingredient were attempted to be utilised to their advantage. This opportunity could be seized by community under the coordination of Argomulyo Authority. Some fundamental issues related to both raw materials and processing were intensively discussed then followed by some basic strategies to do modern marketing.

Having joined the workshops, the local women community then tried to plant Aloe vera around their houses and running at its maximum potential. The care and maintenance of Aloe vera was done with proposed technology. The innovation in managing Aloe vera and good access to global markets can be solved. Agricultural technology was implemented so that cultivation can be more effective and of higher quality. Some educational programs conducted to support collective awareness is depicted in the following figures.



Figure 3. Workshops for supporting collective awareness

From the programs, some good results have been achieved in terms of community mindset. Many members showed willingness to change, and were comfortable with the new methods swhich will help them be more effective. They can do modern planting and selling with a broader target market. The mindset has moved them from being subsistence-oriented by increasing economic value. Additionally, the habit of reflecting on failures and continuous evaluation of cultivation practices have helped them to improve. This education has supported their awareness of local potential and market opportunities. Therefore, the transformative thinking approach has brought self-awareness and breaking free from old, unproductive patterns. The following figures show some independent activities done by the local women community.



Figure 4. Independent activities done by the local women community

The program of activities has made a significant contribution to achieving the university's Key Performance Indicators (KPIs), specifically regarding lecturers and students in community

empowerment and the downstreaming of research results. This activity aligns with the government's Asta Cita vision, which emphasizes food and herbal sovereignty, improving the quality of life, and strengthening the competitiveness of local products based on aloe vera cultivation.



Figure 8. A group of women are making hearlty drinking from Aloe vera

Through a transformative learning approach, this program empowers farmers and surrounding communities to not only master technical skills but also to support a transformation in thinking and developing creative, critical, and adaptive mindsets toward technology. The training activities were conducted in a participatory and reflective manner, integrating expertise from the fields of technology, agriculture, education, and economics to build a productive community ecosystem. This integration supports the achievement of SDGs, mainly to reduce poverty eradication, and nutrition security, quality education, decent work, and responsible consumption and production. Additionally, the activity's results also position Argomulyo as a model for independent tourism villages based on technological innovation and local wisdom.



Figure 5. Aloe vera products made by the community

The collaborative accompaniment and empowerment activities carried out by Jatam, PKK, and the Argomulyo Village Government using ABCD method are beginning to show that they can bring about socio-economic change. The main problems, namely the limited job opportunities and high unemployment rate, will gradually be overcome through the optimization of aloe vera cultivation and innovation in production, packaging, and marketing.

A transformative thinking is urgently needed to support the transition of local communities in order to achieve sustainable aloe vera cultivation. Changes in thinking support the process of awareness regarding the importance of modern and sustainable agricultural processing. Meanwhile, through various trainings, community members, especially women from PKK and KWT, acquire basic and operational skills. This capacity-building approach is supported by the results of innovative research on aloe vera conducted by Martínez-Burgos et al., (2022). He

highlighted the development of the global patent and technology landscape of aloe vera in the pharmaceutical and agricultural sectors. In addition, the participants' education on the use of processing by-products is in line with the latest findings on the valorization of Aloe barbadensis Semerel et al., (2023) which shows that converting plant residues into value-added goods minimizes environmental impacts while maximizing resource efficiency. Technical training on the extraction and application of Aloevera functional gels is further strengthened by Rigueto et al., (2026), who emphasizes that the training of smallholders in the extraction of aloe vera gel for edible layers improves the plant's post-harvest usability and shelf life.

The introduction and knowledge transfer of Solar Dome dryer automation received a positive response from the participants. Because with Solar Dome, the drying of raw materials will be more sterile and avoid bacteria and erratic weather, thus avoiding nutrient degradation. The application of solar drying mechanisms is in accordance with Semerel et al. (2023) which identifies solar drying as an advanced and environmentally friendly solution to overcome the challenges of traditional drying in the open air. Utilizing Solar Dome technology for sustainable post-harvest purposes can ensure product quality retention and moisture control in dry products (Sadekla et al., 2025). Specifically for medicinal plants, Eapen et al., (2025) notes that modern drying systems such as indirect solar technology dramatically reduce drying time while protecting the thermosensitive bioactive compounds in aloe vera gel. In addition, a comparative analysis by Anato et al., (2026) confirms that solar tunneling and indirect solar drying offer a much more hygienic, energy-efficient, and fast alternative to traditional solar drying, directly increasing the attractiveness of the product.

Programs to strengthen value-added and commercialize Aloe vera-based products have proven to have a real economic impact on partners. This program involves members of the JATAM, PKK, and Women Farmers Group (KWT), which mostly consists of housewives and women farmers. Through the development of selling value products, partners not only gain improved skills in product processing and diversification, but they also have the opportunity to expand market access, increase income, and strengthen family economic independence. The results of this activity program are in line with research conducted by Mbelebele et al., (2024), which show that technical training, market access, and extension consulting services can help in increasing profits and cultivation of high-value crops among smallholders, where women make up a large proportion of the workforce. In addition, the active involvement of women in selecting, and executing post-harvest technology is in line with Wiley's research (2026c). Their study establishes that involving women in the design of post-harvest technologies reduces the labor burden, and increases community-based household income, tailored training, and structured market relationships to ensure the long-term sustainability of the company.

CONCLUSION

This community service program successfully addressed the local economic challenges in Argomulyo Village by integrating agricultural technology, community-based mentoring, and transformative thinking. Involving 32 participants, mostly women from PKK and KWT groups, the program strengthened practical skills in sustainable Aloe vera cultivation, gel extraction, product diversification, and environmentally friendly waste management. The application of Solar Dome technology also provided a more hygienic, energy-efficient, and effective alternative for post-harvest drying, supporting better product quality and processing efficiency.

Furthermore, beyond technical improvements, the integration of transformative thinking encouraged participants to shift from subsistence-oriented practices toward more productive, reflective, innovative, and entrepreneurial mindsets. Through product innovation and modern marketing strategies, members of JATAM and PKK began recognizing the economic potential of

Aloe vera and opportunities to create value-added products. Overall, combining technological innovation, women's empowerment, and the Asset-Based Community Development (ABCD) approach has laid a foundation for sustainable entrepreneurship, improved community well-being, and stronger local economic resilience.

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AI Disclosure

Generative Artificial Intelligence (AI) and AI-assisted technologies were used solely to improve the readability and organization of the manuscript. All outputs generated through these tools were carefully reviewed, edited, and validated by the author to ensure accuracy, completeness, and alignment with the study's original content. The author assumes full responsibility and accountability for the integrity of the work, including its analysis, interpretation, and conclusions. AI tools were not used for data generation, data analysis, or as a substitute for scholarly judgment, and are not listed as authors or co-authors of this study.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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