

Optimization of The Vegetable Agricultural Sector as A Superior Product Based on Community Empowerment in Kopeng Village, Semarang Regency

R Benny Riyanto¹, Hary Suswanto², Bara Yudhistira³, Sucihatningsih Dian Wisika Prajanti¹, Widya Hary Cahyati¹, Sunyoto¹, Isti Hidayah¹

Universitas Negeri Semarang

Universitas Negeri Malang

Universitas Sebelas Maret

e-mail: *widyahary27@mail.unnes.ac.id

Abstrak

Kopeng Village, Semarang Regency, has an agricultural area of approximately 275 hectares, most of which is used for horticultural cultivation. The main commodities produced include cabbage, carrots, potatoes, and green beans, with production reaching thousands of tons per year. However, this sector still faces various obstacles that hinder agricultural optimization. One major challenge is market price fluctuations due to dependence on middlemen. This dependence on middlemen prevents farmers from having strong bargaining power in setting the selling price of their crops. Based on the problems presented, the solutions offered in this community service partnership program is appropriate technology. The implementation of Appropriate Technology (TTG) in the form of a potato chipper machine in Kopeng Village is an innovative solution to increase the efficiency of potato chip production, a leading processed product. This machine is designed to help business owners speed up the potato chip cutting process to a uniform size, resulting in slices that are more consistent in thickness and quality. The advantages of using a potato chipper machine compared to manual methods include increased productivity and labor efficiency, allowing for greater market demand in a shorter timeframe. Furthermore, product quality standards are better maintained because uniform potato slices affect the final product during the frying process, creating a crispy texture and improved flavor. this activity fostered confidence in the community's ability to process their own agricultural produce into marketable products. The direct impact are participants gained real-world experience processing vegetables into ready-to-eat products, awareness of the importance of quality standards increased, for example, in maintaining the cleanliness of tools and materials, participants began to envision opportunities for small, home-based businesses (home industries), and a two-way knowledge transfer occurred: the community service team provided technical knowledge, while participants shared local experiences on recipes and processing methods. After the socialization, training, and hands-on practice phase, the activity continues with the mentoring and community empowerment phase. This phase is crucial because it ensures that the skills acquired by the community are not limited to the training activities but can be truly applied and developed sustainably in their daily lives.

Kata kunci— Optimization, Appropriate Technology, Vegetable Agricultural Sector

Abstract

Desa Kopeng, Kabupaten Semarang, memiliki lahan pertanian seluas kurang lebih 275 hektar, sebagian besar digunakan untuk budidaya hortikultura. Komoditas utama yang diproduksi meliputi kubis, wortel, kentang, dan buncis, dengan produksi mencapai ribuan ton per tahun. Namun, sektor ini masih menghadapi berbagai kendala yang menghambat optimalisasi pertanian. Salah satu tantangan utama adalah fluktuasi harga pasar akibat ketergantungan pada perantara. Ketergantungan pada perantara ini mencegah petani memiliki daya tawar yang

kuat dalam menentukan harga jual hasil panen mereka. Berdasarkan permasalahan yang ada, solusi yang ditawarkan dalam program kemitraan pengabdian masyarakat ini adalah teknologi tepat guna. Implementasi Teknologi Tepat Guna (TTG) berupa mesin pemotong kentang di Desa Kopeng merupakan solusi inovatif untuk meningkatkan efisiensi produksi keripik kentang, produk olahan unggulan. Mesin ini dirancang untuk membantu pemilik usaha mempercepat proses pemotongan keripik kentang hingga ukuran yang seragam, menghasilkan irisan yang lebih konsisten ketebalan dan kualitasnya. Keuntungan menggunakan mesin pemotong kentang dibandingkan metode manual antara lain peningkatan produktivitas dan efisiensi tenaga kerja, sehingga memungkinkan peningkatan permintaan pasar dalam jangka waktu yang lebih singkat. Selain itu, standar kualitas produk lebih terjaga karena irisan kentang yang seragam memengaruhi produk akhir selama proses penggorengan, menciptakan tekstur renyah dan rasa yang lebih baik. Kegiatan ini menumbuhkan kepercayaan diri masyarakat dalam kemampuan mereka untuk mengolah hasil pertanian mereka sendiri menjadi produk yang dapat dipasarkan. Dampak langsungnya adalah peserta memperoleh pengalaman nyata mengolah sayuran menjadi produk siap makan, kesadaran akan pentingnya standar kualitas meningkat, misalnya, dalam menjaga kebersihan alat dan bahan, peserta mulai membayangkan peluang untuk usaha kecil berbasis rumah (industri rumahan), dan terjadi transfer pengetahuan dua arah: tim layanan masyarakat memberikan pengetahuan teknis, sementara peserta berbagi pengalaman lokal tentang resep dan metode pengolahan. Setelah fase sosialisasi, pelatihan, dan praktik langsung, kegiatan dilanjutkan dengan fase pendampingan dan pemberdayaan masyarakat. Fase ini sangat penting karena memastikan bahwa keterampilan yang diperoleh masyarakat tidak terbatas pada kegiatan pelatihan tetapi dapat benar-benar diterapkan dan dikembangkan secara berkelanjutan dalam kehidupan sehari-hari mereka.

Keywords— *Optimalisasi, Teknologi Tepat Guna, Sektor Pertanian Sayuran*

1. INTRODUCTION

Kopeng Village, Semarang Regency, has an agricultural area of approximately 275 hectares, most of which is used for horticultural cultivation. The main commodities produced include cabbage, carrots, potatoes, and green beans, with production reaching thousands of tons per year (Pabidang *et al.*, 2020). However, this sector still faces various obstacles that hinder agricultural optimization. One major challenge is market price fluctuations due to dependence on middlemen. During peak harvest times, vegetable prices can drop drastically, with cabbage prices reaching Rp1,000/kg, far below production costs. This dependence on middlemen prevents farmers from having strong bargaining power in setting the selling price of their crops (Marpaung *et al.*, 2023).

Furthermore, limited implementation of Appropriate Technology (TTG) is a major obstacle to increasing the competitiveness of agricultural products. Most farmers still use conventional methods in post-harvest processing (Wirandhani *et al.*, 2021). The lack of wrapping and chopping equipment means agricultural products have a short shelf life and struggle to compete with products from other regions. For example, without proper packaging technology, more than 20% of vegetable harvests are damaged before reaching the market. This results in significant potential losses for farmers, especially those who rely on sales outside the region (Fadilah & Setiawan, 2023; Musaid *et al.*, 2019). Another challenge is the lack of

diversification of processed products. Most crops are sold fresh, resulting in very low added value (Umroh, 2020; Syahri *et al.*, 2024). However, with simple technology such as shredding tools and proper frying methods, vegetables can be processed into vegetable chips or other products with higher economic value. Unfortunately, to date, not many farmers have received training in agricultural product processing. Based on survey data from local farmer groups, only 15% of farmers have participated in product diversification training, leaving the majority dependent on selling fresh produce (Wibowo & Nugraha, 2016).

Besides product innovation, the high rate of crop damage is also a major issue. Limited storage and packaging infrastructure causes vegetables to wilt and spoil more quickly (Abidin *et al.*, 2023; Kurniawan *et al.*, 2020). For example, during distribution to regional markets such as Semarang and Yogyakarta, approximately 10-15% of vegetable products experience quality loss, resulting in lower selling prices. This highlights the need for improved wrapping and storage technology to extend product shelf life (Perdana *et al.*, 2022; Yudha *et al.*, 2022). Lack of access to training and education for farmers further exacerbates this situation. Most farmers lack skills in product processing and digital marketing strategies (Rahmiyati & Rachmawati, 2024; Fadilah *et al.*, 2022). Based on data from the Kopeng Village farmer group, only 10% of farmers understand digital marketing, leaving them dependent on traditional markets. Without adequate training, opportunities to

improve farmer welfare through innovation and technology are difficult to realize (Marpaung *et al.*, 2023).

Lack of understanding of quality standards and product certification is also a major obstacle for entrepreneurs in Kopeng Village in developing processed vegetable-based products (Pabidang, 2020). Many farmers and agricultural product processors are unfamiliar with the requirements set by certification bodies such as the Home Industry Food Certification (PIRT), as well as the product quality standards required by modern markets, such as supermarkets and large retail chains (Yudha *et al.*, 2022). As a result, even though their products have significant potential, they struggle to penetrate broader markets because they do not meet the food safety, hygiene, and consumption standards stipulated in national regulations (Mawardi *et al.*, 2019; effendi, 2023).

Problems with online and offline marketing remain a challenge for farmers and agricultural businesses in Kopeng Village. In offline marketing, limited distribution networks and access to modern markets mean farmers remain dependent on middlemen who often purchase their crops at low prices. Furthermore, the lack of direct promotional strategies, such as product exhibitions or collaborations with modern retailers, makes it difficult for agricultural products to compete with those from other regions. Meanwhile, in online marketing, many agricultural businesses lack the skills to utilize digital platforms like e-commerce and social media. This lack of understanding of digital marketing strategies, such as optimizing visual content and product descriptions, contributes to low product appeal. Kopeng Village, Semarang Regency is a program partner in this community service, while the Vegetable Farmers Group in Kopeng Village is the target partner.

Based on the description presented, the identified problems faced by partners are production aspects and management aspects. The vegetable farming sector in Kopeng Village faces various production constraints, particularly related to the lack of post-harvest facilities that meet modern marketing standards. One major challenge is the lack of hygienic and durable wrapping equipment for vegetable products. To market products to large supermarkets, vegetables must be properly packaged to maintain freshness and meet modern market hygiene standards. However, currently, the majority of farmers in Kopeng Village still use simple packaging methods using ordinary plastic or even no packaging at all, accelerating the decline in product quality before it reaches consumers. As a result, many products are

rejected by supermarkets for not meeting proper packaging standards. Furthermore, limited production facilities for diversification of processed products are a major obstacle to increasing the added value of agricultural products. One potential product is potato chips and other vegetables, which have a large market and more stable selling prices than fresh produce. However, to date, farmers lack the necessary equipment for chip production, such as choppers, spinners, pans, and specialized stoves. This technological unpreparedness limits the scale of production and the quality of the processed products. Without adequate equipment, the production process is still carried out manually with low efficiency, making it difficult for farmers to compete with other chip producers.

The majority of farmers and business owners in Kopeng Village lack experience in processing vegetables, especially potatoes, into high-quality chips. Limitations in cutting, drying, frying techniques, and the selection of additional ingredients result in inconsistent production results in terms of taste, crispiness, and shelf life. Without adequate skills, processed products tend to go stale or have a less stable flavor, making them difficult to compete in the market. Another problem is the lack of skills in product processing and diversification innovation. Despite the significant potential for producing potato and other vegetable chips, most farmers lack experience in producing delicious and long-lasting chips. This results in suboptimal quality of processed products, both in terms of taste, texture, and shelf life. Without training in production techniques, flavor standards, and attractive packaging, processed vegetable-based products from Kopeng Village will struggle to compete in the broader market.

In addition to challenges related to production factors, farmers and business owners in Kopeng Village also face obstacles in business management and product marketing, particularly in meeting supermarket standards and developing vegetable-based processed products. One major problem is a lack of understanding of the quality standards and product certification required to penetrate the modern retail market. Large supermarkets typically have strict requirements regarding cleanliness, size, and food safety standards, which farmers and producers in the village do not fully understand. Lack of understanding of these aspects often leads to product rejection, even if the quality is still considered good. Without assistance in quality standards and supply chain management, farmers struggle to improve the competitiveness of their products in the modern

market. In addition to product quality, a lack of skills in production management is a major challenge to agricultural business development in Kopeng Village. Many farmers still rely on traditional methods of production management without thorough planning related to resource efficiency, cost control, and inventory management. This lack of understanding of effective production techniques results in low productivity and uncontrolled increases in operational costs.

2. METHOD

Based on the problems presented, the solutions offered in this community service partnership program is appropriate technology. The implementation of Appropriate Technology (TTG) in the form of a potato chipper machine in Kopeng Village is an innovative solution to increase the efficiency of potato chip production, a leading processed product (Wibawanto *et al.*, 2023; Aulia & Wasesa, 2024). This machine is designed to help business owners speed up the potato chip cutting process to a uniform size, resulting in slices that are more consistent in thickness and quality. The advantages of using a potato chipper machine compared to manual methods include increased productivity and labor efficiency, allowing for greater market demand in a shorter timeframe (Yuliawan *et al.*, 2025). Furthermore, product quality standards are better maintained because uniform potato slices affect the final product during the frying process, creating a crispy texture and improved flavor (Muhsin & Ahmad, 2017).

In addition to increasing production capacity, the use of a potato chipper machine also has a positive impact on reducing raw material waste. Manual cutting often results in uneven slices, potentially increasing the amount of unusable material scraps (Zulha, 2018; Khusna *et al.*, 2017). With a shredding machine, the level of cut uniformity is higher, thus minimizing the amount of potato waste and optimizing the availability of raw materials. This technology also supports hygiene aspects in production, as the use of the machine can reduce direct hand contact, ultimately improving product hygiene standards (Umroh, 2020). With better quality and more efficient production, potato chips from Kopeng Village will be more competitive in the modern market, both locally and nationally (Effendi, 2023). The implementation of Appropriate Technology (TTG) in the form of a frying machine in Kopeng Village aims to improve the efficiency and quality of potato chip production, a leading vegetable-based product (Heryadi *et al.*,

2022). The traditional frying process often results in products with uneven levels of doneness, high oil consumption, and longer production times. With the availability of more modern frying equipment, business owners can produce chips with better quality, brighter colors, and lower oil content (Waluyo *et al.*, 2024). This not only increases product competitiveness in the market but also makes the product healthier and more desirable to consumers who are more selective about food quality (Djayasinga *et al.*, 2021).

The use of a spinner machine (cooking oil drainer) in Kopeng Village is an effective solution for improving the quality of potato chips by reducing excess oil content, which can cause the product to quickly go rancid and become less crispy. This technology allows the oil that adheres to the chips after frying to be maximally drained, resulting in a healthier, more durable product that is more attractive to the modern market (Mindarta *et al.*, 2024). In addition to improving quality, the spinner machine also helps reduce production costs by saving on cooking oil, which is one of the largest cost components in the food processing industry. The drained oil can be reused in subsequent production processes, making it more efficient and environmentally friendly (Witjaksono *et al.*, 2023). However, the successful implementation of this technology requires technical training for business owners so they can operate and maintain the machine properly, including adjusting the rotation speed according to product characteristics. With support from various parties, the use of the TTG spinner machine is expected to increase the competitiveness of potato chip products from Kopeng Village, enabling them to penetrate wider markets, both locally and nationally.

The use of a wrapping machine for vegetables sold in supermarkets is an important solution for increasing the attractiveness, hygiene, and durability of vegetable products from Kopeng Village (Aulia & Wasesa, 2024). This machine allows for neat and hygienic packaging of vegetables with plastic wrap, thus protecting the product from dust and dirt contamination, and extending its shelf life by reducing water evaporation. Furthermore, with a more attractive and professional appearance, vegetables packaged with this wrapping machine are more readily accepted by modern markets, especially supermarkets and large retailers that require high hygiene standards. Not only does this machine increase the selling value of the product, but it also helps farmers meet the quality and aesthetic requirements imposed by large

distribution networks. However, for optimal implementation of the wrapping machine, business owners need to understand the correct packaging techniques, including selecting food-safe plastics and proper storage methods to maintain the quality of the vegetables.

Based on the problems, solutions, and output targets of the community service activities, it is necessary to implement them with systematic, integrated, and sustainable steps for the Community Service Partnership partners. Several methods will be implemented, including (Ponidi *et al.*, 2022): a) Socialization. The initial stage is socialization. This socialization is provided to partners. This socialization is carried out so that all parties involved have a shared vision, mission, concept, and goals for implementing this community service and empowerment program. This socialization is expected to serve as a medium and forum for community service providers, partners, and students involved to share a common Framework of Reference (TOR). B) Training. Throughout the activities, partners will be equipped with knowledge, insight, and skills relevant to the problems, desired solutions, and output targets. Training will include areas of production and management. In terms of production, partners will be provided with an understanding of how to optimize production processes using Appropriate Technology (TTG), such as potato shredders, fryers, oil spinners, and wrapping machines. In addition, partners will be provided with training on how to use and operate these machines. Training on all aspects is provided by the joint service team to support the achievement of the Key Performance Indicators (IKU) set by the government. In terms of management, partners will be provided with insight, training, and intensive mentoring on product diversification using vegetables as raw materials, as well as on improving human resource capacity and competency. These efforts are crucial to ensure partners are able to optimally utilize the various potentials of the agricultural sector, particularly vegetables. c) Mentoring and Evaluation. After implementing technology and innovation, mentoring is the next step. This step serves as a form of control to ensure partners can operate and utilize the technology and innovation provided. Mentoring is carried out intensively and will be evaluated periodically by the implementation team. d) Program Sustainability. After implementing technology and innovation, mentoring is the next step. This stage serves as a form of control to ensure partners can

operate and utilize the technology and innovations provided. Intensive mentoring is provided and will be periodically evaluated by the implementation team..

3. RESULT AND DISCUSSION

The initial stages of the community service program began with a program socialization held at the Kopeng Village Hall. Representatives from farmer groups, food processing businesses, village officials, community leaders, and student mentors attended the event. More than 30 participants attended, including vegetable farmers, housewives active in MSMEs, and village youth interested in entrepreneurship. The socialization event was opened by the Kopeng Village Head, who delivered a welcoming speech and expressed his appreciation for the community service initiative. He emphasized the importance of university support in increasing community capacity, particularly in horticultural agriculture, which has long been a key component of Kopeng Village. This welcome also demonstrated the village government's full support for the program's smooth implementation.



Figure 1. Documentation of Program Socialization by the Community Service Team

The socialization took place in an interactive atmosphere. After the presentations, participants were given the opportunity to share their responses, experiences, and challenges they faced in the field. Some of the issues that emerged included: 1) Farmers complained about the frequent decline in crop prices due to dependence on middlemen; 2) Housewives expressed limited knowledge in processing crops into processed products; 3) Village youth highlighted the importance of digital marketing to enable processed products to penetrate a wider market. This discussion served as an important tool for concretely identifying partners' needs. The community service team recorded participants' input and used it as a basis for developing strategies for the next phase of training and mentoring.

In terms of participation, the socialization demonstrated the community's enthusiasm for the program. This was evident in their active participation in asking questions, sharing experiences, and offering ideas. Several participants even expressed interest in trying to process their crops into simple processed products, provided they were provided with adequate technical assistance.

In addition to presentations and discussions, the community service team also showcased examples of processed vegetable products from other regions for inspiration. For example, modernly packaged vegetable chips have entered the retail market, as well as processed carrot products with significant added value. This opened the participants' eyes to the potential of processed products from Kopeng Village if managed properly. The socialization session concluded with a joint commitment session between the community service team, the village government, and the partner community. This commitment was expressed in the community's willingness to actively participate in every stage of the activity, from training to product marketing. The community service team also emphasized that the program's success is measured not only by the success of the training but also by the sustainability of the community's businesses after the program ends.

Following the socialization phase, the activity continued with training on diversification of vegetable-based processed products. This training is the core of the community service program because it aims to improve community skills in processing agricultural products, which have previously only been sold fresh, into processed food products with added value. This training is aimed at: 1) Equipping the community with technical skills in processing vegetables into processed foods (chips, vegetable noodles, and vegetable-based cakes); 2) Providing an understanding of quality standards, hygiene, and good food processing techniques; 3) Encouraging innovation in local products that are competitive in the modern market; 4) Fostering an entrepreneurial spirit, especially among housewives and village youth.

The training consisted of 30 participants, the majority of whom were housewives and members of farmer groups. The training atmosphere was active and enthusiastic, as evidenced by the participants' involvement from the preparation of ingredients, through the cooking process, to the presentation of the products. The community service team divided the participants into small groups to provide everyone with hands-on practice opportunities. This method was chosen so that the training would not only be a demonstration but also a "learning-by-doing" approach, allowing participants to truly master new

skills. The training materials are divided into two main sections: 1) Theoretical Material (Introduction); 2) Practical Material.

In theoretical material (introduction), consist of an introduction to various types of vegetable-based processed products with high sales value, an explanation of the importance of cleanliness and hygiene standards in food processing, knowledge of ingredient composition, storage techniques, and production cost estimation, and discussion of simple strategies for marketing products (e.g., through social media or village fairs). In practical material (hands-on training), participants are trained directly in making several processed products, including potato and carrot chips, carrot and spinach noodles, and vegetable-based cakes. In potato and carrot chips section, they are taught techniques for thinly slicing, frying at a stable temperature, and draining the oil for crispy results. In carrot and spinach noodles, they are introduced to how to make dough with a mixture of vegetables to add nutritional value and attractive color. In vegetable-based cakes section, participants try making cakes and cookies with carrots as the main ingredient. In practice, the community service team emphasized standardizing the size of the pieces and adjusting the oil temperature, as these factors significantly affect product quality (crispy, long-lasting, and non-greasy).

Participants' processed products were displayed at the end of the activity. Several products were quite satisfactory, both in terms of taste and appearance. For example: Savory and crunchy carrot chips, although some adjustments were needed to adjust the doneness. Vegetable noodles with attractive colors (orange from carrots, green from spinach) that children loved. A carrot-based cake with a soft texture that was a favorite among other participants. These products were then displayed together, allowing participants to share feedback. This opportunity provided a collective learning opportunity and boosted participants' self-confidence.

The next stage after the theoretical presentation and training demonstration is hands-on training involving all participants. This method was chosen because experience shows that food processing skills are more quickly mastered when the community is actively involved in every stage of production. Purpose of Hands-on Training are to provide participants with the opportunity to apply the theoretical material presented, to test participants' technical skills, from ingredient preparation to the final product, to cultivate precision, patience, and the ability to maintain hygienic standards in processing, and to foster self-confidence and independence in

attempting to produce processed foods independently at home.

The practical work was conducted in the village hall using simple, readily available equipment, such as a large frying pan, oil strainer, knife, and cutting board. The community service team guided the participants in small groups, rotating them to provide hands-on experience. The practical steps included: 1) Material Preparation – Participants cleaned and prepared vegetables (potatoes, carrots, and spinach). Emphasis was placed on hygienic washing techniques, including the use of clean water and the selection of suitable ingredients; 2) Chopping Process – Participants attempted to chop the vegetables manually. This demonstrated a wide range of skills; some participants still produced uneven slices. The team then provided simple tips for thinner, neater slices, as preparation for using the chopping machine, which would be provided in the next stage; 3) Frying – Participants took turns frying the vegetables in a large frying pan. The main challenge was adjusting the oil temperature and frying time to ensure crispy, non-greasy results. The community service team emphasized the importance of patience when frying, as too high a temperature will result in burnt chips, while too low a temperature will result in soggy chips; 4) Draining – After frying, the products were drained using a manual strainer. The team explained that using a spinner (oil drainer) would result in drier, longer-lasting, and healthier products. Although the spinner wasn't used yet, participants understood its importance after experiencing the relatively oily, hand-made products; 5) Presentation and Evaluation – The chips, noodles, and vegetable cakes were presented together. Participants tasted each other and provided feedback on taste, texture, and appearance. This process served as a collaborative evaluation platform, encouraging participants to be more critical of product quality.



Figure 2. Vegetable-Based Processed Product Diversification Training

The workshop was lively and energetic. The housewives were enthusiastic while frying the chips, and some even brought family recipes to try under the team's guidance. Village youth helped with the stove burner, while student assistants documented the activity and assisted with logistics. Some interesting moments captured in the documentation are the mothers jokingly offered feedback when the chip pieces were different sizes, the children in attendance tried their mothers' homemade carrot noodles, and participants posed for photos while proudly displaying their creations. Despite using simple equipment, the resulting product was quite good. The chips were crispy and savory, although the doneness still needed improvement. The vegetable noodles had attractive natural colors (orange and green), making them more appealing to children. The carrot cake made by another group had a mild sweetness and was a hit with the participants.



Figure 3. Training Participants Show Practical Results

4. CONCLUSION

This activity fostered confidence in the community's ability to process their own agricultural produce into marketable products. The direct impact are participants gained real-world experience processing vegetables into ready-to-eat products, awareness of the importance of quality standards increased, for example, in maintaining the cleanliness of tools and materials, participants began to envision opportunities for small, home-based businesses (home industries), and a two-way knowledge transfer occurred: the community service team provided technical knowledge, while participants shared local experiences on recipes and processing methods. After the socialization, training, and hands-on practice phase, the activity continues with the mentoring and

community empowerment phase. This phase is crucial because it ensures that the skills acquired by the community are not limited to the training activities but can be truly applied and developed sustainably in their daily lives.

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