

## Training on Golden Apple Snail–Based Pilus Snack Production to Support Food Security and Local Entrepreneurship in Yoka Village, Jayapura City

Suriani Surbakti, Lalu Panji Imam Agamawan, Baiq Amarwati Tartillah \*

Faculty of Mathematic and Natural Science, Cenderawasih University, Indonesia

Email: [b.a.tartillah@fmipa.uncen.ac.id](mailto:b.a.tartillah@fmipa.uncen.ac.id)

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### ABSTRACT

The golden apple snail (*Pomacea canaliculata*) is an invasive species that damages rice fields and aquatic ecosystems in Sentani Lake, Papua, Indonesia. Its uncontrolled population threatens local agriculture and biodiversity while remaining an underutilized food resource. This community service project aimed to reduce snail abundance and empower local residents by transforming the pest into a nutritious product. A training program was held on 15 May 2025 in Yoka Village, Jayapura City, involving 13 women participants. The activity included preparation, counselling on ecological impact and nutritional value, hands-on pilus-making practice, mentoring, and evaluation. Before training, all participants recognized golden apple snails only as basic dishes such as grilled or stewed meat. Afterward, every participant could identify at least one new processed product, particularly pilus, followed by cireng, tofu meatballs, and otak-otak, and all successfully produced pilus snacks. The program enhanced practical skills, introduced new microenterprise opportunities, and demonstrated an ecologically sustainable way to control pest populations. This approach offers a replicable model for integrating food innovation, nutrition improvement, and rural entrepreneurship in regions facing invasive species challenges.

**Keywords:** golden apple snail, pilus snack, food security, community empowerment, invasive species utilization



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## INTRODUCTION

Food security remains a persistent challenge globally and nationally, with projections indicating that the number of people vulnerable to hunger will continue to rise toward 2050 [1]. Papua Province is among Indonesia's most food-insecure regions, where undernutrition persists despite abundant natural resources and long-standing traditions of local food consumption [2]–[4]. This vulnerability is particularly evident in peri-lake communities such as Yoka Village, located near Sentani Lake, where dependence on purchased foods has increased, dietary diversity remains limited, and ecological pressures affect local livelihoods. Communities in this area still rely heavily on conventional protein sources while overlooking alternative nutrient-rich ingredients available in their surroundings.

At the same time, the invasion of golden apple snails (*Pomacea canaliculata*) has intensified across Indonesia, including Papua, causing severe damage to rice fields and freshwater ecosystems [1], [5]. The species is recognized as one of Southeast Asia's most destructive rice pests due to its rapid reproduction and high adaptability [1], [2]. Conventional control measures have not succeeded in reducing its population effectively. Paradoxically, this invasive species is highly nutritious, with documented protein, mineral, and vitamin contents that make it suitable as a local food source [6]–[8]. Several regions in Indonesia have transformed golden snails into satay, stew, meat floss (*abon*), and soy sauce with acceptable sensory qualities [9]–[11]. This idea, *utilizing invasive species as food*, known as *invasivorism*, has been promoted as an ecological and nutritional opportunity [12], [13].

However, despite such innovations elsewhere, Papua has not yet adopted keong mas for human food processing. In communities around Sentani Lake, the snail remains seen solely as a pest rather than a resource [1], [14]. No structured training has been conducted to introduce its culinary potential, resulting in a significant gap. This gap is particularly relevant for Yoka Village, where women play a central role in household nutrition, informal processing activities, and small-scale economic contributions. Introducing processing technologies such as pilus production could diversify local diets, reduce dependence on purchased snacks, and create new microenterprise opportunities.

From a theoretical perspective, the initiative aligns with community empowerment principles, particularly the *participatory approach* in which beneficiaries are directly involved in learning and practice-based activities [15], [16]. Empowerment models emphasize *women-led microenterprise development*, recognizing women as key agents in strengthening local economies through value-added food production [17], [18]. Moreover, transforming locally abundant but underutilized species supports *livelihood diversification*, a strategy widely recommended to enhance community resilience and income stability in rural settings [13], [17].

Based on these considerations, the present project introduced a practical training program for women in Yoka Village to process golden apple snails into *pilus keong mas*, a crispy, shelf-stable snack that aligns with local consumption preferences. The training covered cleaning, preparation, seasoning, frying, and basic packaging, guided through participatory demonstration methods [15], [17]. This initiative is the first documented effort in Papua to integrate invasive species management, nutrition improvement, and women's entrepreneurship in a single activity.

The contribution of this study is to offer a replicable model for transforming an invasive pest into a valuable local food product, strengthening food security, reducing ecological pressure, and empowering women to develop sustainable microenterprises. By addressing both environmental and socio-economic dimensions, this project responds to urgent community needs while filling a clear gap in local innovation and capacity-building efforts.

## METHOD

The methodological approach combined participatory training, practical demonstration, and mentoring to ensure effective knowledge transfer and skill development among the participants. This approach was selected because participatory methods have been shown to enhance community engagement, improve retention of knowledge, and empower local stakeholders in similar food technology and entrepreneurship programs [15]–[17]. The hands-on, practice-oriented design was essential to demonstrate the feasibility of converting *Pomacea canaliculata*, an invasive pest, into a high-protein snack, thereby linking ecological pest control with community-based food security initiatives.

### Participants and Location

As seen in Figure 1, the community service activity was conducted on May 15, 2025, at Yoka Village, Heram District, Jayapura City, Papua Province. Thirteen (13) women participated in the program, selected purposively from local households based on their roles in daily food preparation and their interest in small-scale entrepreneurship. Women were targeted because they are central actors in household nutrition and commonly manage home-based food production and informal microbusinesses in Papua, making them the most appropriate group for culinary empowerment activities. Their involvement is consistent with women-led microenterprise approaches, which highlight women's strong potential to drive household income diversification and adopt new food-processing innovations.

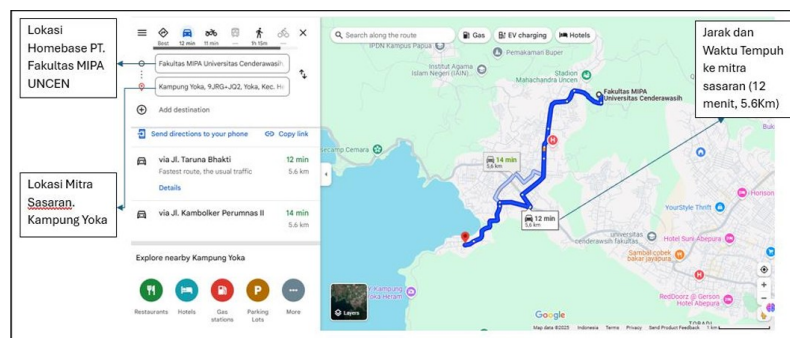


Figure 1. Area training based in Yoka Billage, heram District, Jayapura City

## Training Procedures

The program was implemented in five sequential stages:

1. Preparation: Coordination with the village head, obtaining formal permission, preparing the venue, procuring golden snails, ingredients, and cooking equipment.
2. Counselling and Demonstration: Presentation on the ecological impact of golden snails, their nutritional value, and potential as food products, followed by a step-by-step demonstration of pilus production.
3. Hands-On Practice: Participants directly processed snails, washing, boiling, removing viscera, drying, grinding, mixing with flour and spices, shaping, and frying pilus snacks.
4. Mentoring: Ongoing guidance during practice, ensuring participants could replicate the process independently, including advice on food safety and hygiene.
5. Evaluation: Collection of participant feedback through discussion and observation of skill acquisition, as well as informal knowledge checks to validate understanding.

## Data Collection and Analysis

Quantitative data on knowledge change were collected using pre- and post-training surveys regarding participants' awareness of golden snail processing methods. Qualitative data were gathered through direct observation and group discussion, enabling triangulation of results for improved validity. Responses were summarized into percentages and visualized through bar charts to illustrate knowledge gain and idea generation for new products. The combination of multiple data sources increased the reliability of findings by corroborating evidence from different perspectives.

## Data Collection and Analysis

To ensure validity, the procedures were standardized: the same facilitator delivered all sessions, and the same recipe and instructions were used throughout the demonstration. Reliability was strengthened through mentoring, which confirmed participants' ability to repeat the process without assistance. The use of pre/post surveys and observational cross-checks allowed for consistent evaluation of knowledge transfer and skill development. This systematic approach supports the reproducibility of the program and its adaptability to other communities facing similar ecological and food security challenges.

## RESULTS AND DISCUSSION

### Main Findings of the Present Study

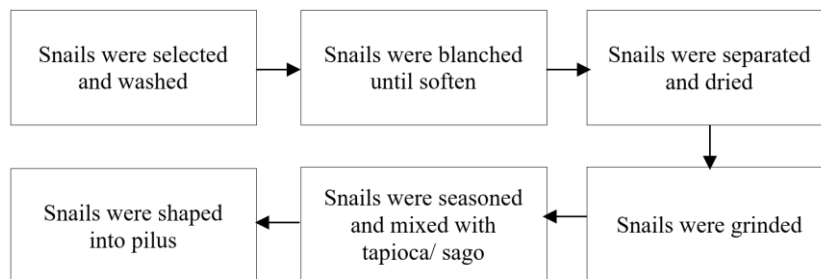
The training on golden apple snail-based pilus snacks was successfully conducted on 15 May 2025 in Yoka Village, Heram District, Jayapura City, involving 13 female participants. Although attendance reached only 65% of the initial target (20 participants), the active participation of those present compensated for the reduced turnout. During the sessions, participants engaged enthusiastically, asking about alternative seasoning options, shelf-life extension, and pricing strategies for small-scale sales. This level of engagement suggests that the participants recognized the economic potential of transforming *keong mas* from a nuisance pest into a valuable food source.

As seen in Table 1, The pre-training survey revealed that 100% of respondents only recognized golden apple snails as simple dishes such as grilled or stewed meat. Following the training, all participants (100%) could name at least one additional product derived from snails, most notably pilus, while 85% identified cireng, 55% mentioned tofu meatballs, and 45% recalled otak-otak as possible variants. These results were obtained through questionnaire given in Table 2. The hands-on practice confirmed skill acquisition: every participant successfully cleaned, processed, shaped, and fried pilus snacks. Informal feedback collected during the evaluation stage reflected participants' eagerness for

follow-up sessions that would cover packaging, marketing, and business licensing. These findings confirm that the training achieved its primary goal of enhancing local knowledge and skills for utilizing golden apple snails as a nutritious, value-added product. The quantitative elaboration of knowledge gain on Golden Snail-Based Snack variations (n=13) shown in Table 3 and Figure 2 below.

**Table 1. Attendance of Yoka Village Participants in the Golden Apple Snail Pilus Training**

No	Participant Name	Attendance Proof
1	Maria Yowei	✓
2	Debora Yongsu	✓
3	Yuliana Wally	✓
4	Elisabet Demetouw	✓
5	Theresia Ondikeleuw	✓
6	Natalia Hayo	✓
7	Veronika Samberpasi	✓
8	Regina Wanimbo	✓
9	Agnes Yoku	✓
10	Dorina Imbiri	✓
11	Selina Matuan	✓
12	Ruth Yembise	✓
13	Febe Hobong	✓



**Figure 2. Flowchart of pilus making process**

**Table 2.** Questionnaire Draft: Instruction: Please tick (✓) “Yes” if you agree/know, or “No” if you disagree/don’t know.

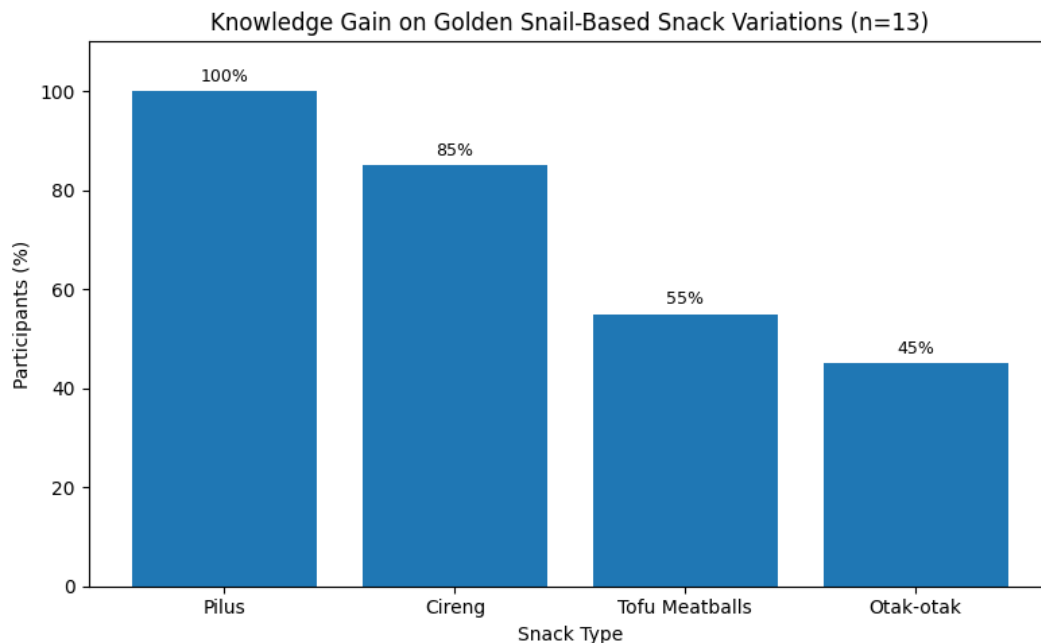
No	Statement	Yes	No
1	I only know golden apple snails ( <i>Pomacea canaliculata</i> ) as a simple dish (grilled/stewed).		
2	I know that golden apple snails can be processed into pilus snacks.		
3	I know that golden apple snails can be processed into cireng.		
4	I know that golden apple snails can be processed into tofu meatballs.		
5	I know that golden apple snails can be processed into otak-otak.		
6	I am confident in independently practicing the pilus-making process.		
7	I intend to continue producing golden snail-based snacks at home.		

**Table 3.** Pre–Post Training Knowledge and Skills on Golden Apple Snail Utilization (n = 13)

No	Indicator	Pre-Training (n, %)	Post-Training (n, %)	Change (pp)
1	Knew golden apple snail only as a simple dish (grilled/stewed)	13 (100%)	0 (0%)	–100
2	Knew <b>pilus</b> as a snack made from golden apple snail	0 (0%)	13 (100%)	+100
3	Knew <b>cireng</b> made from golden apple snail	0 (0%)	11 (84.6%)	≈+85
4	Knew <b>tofu meatballs</b> made from golden apple snail	0 (0%)	7 (53.8%)	≈+55
5	Knew <b>otak-otak</b> made from golden apple snail	0 (0%)	6 (46.2%)	≈+45
6	Able to independently practice pilus production (complete steps: boiling–shaping–frying)	0 (0%)	13 (100%)	+100
7	Intention to continue production at home after training (household business intention)	3 (23.1%)	10 (76.9%)	+53.8

*Note:* Data were collected through short pre-training and post-training questionnaires. Indicators were binary coded (0 = unaware/unable, 1 = aware/able) and summarized as counts (n) and percentages (%). Percentages were rounded for n = 13.

As seen in Figure 3, *Short interpretation:* Knowledge shifted entirely from only knowing golden apple snails as a basic dish to recognizing multiple processed snacks. Pilus awareness reached 100%, followed by cireng (~85%), tofu meatballs (~55%), and otak-otak (~45%). Practical pilus-making skills improved to 100%, and intention to continue production increased from 23.1% to 76.9%, indicating strong potential for local microenterprise development.



**Figure 3. Percentage Of Participants (N = 13) Who Could Name New Snack Products From Golden Apple Snails After Training. Pilus Awareness Reached 100%, Cireng 85%, Tofu Meatballs 55%, And Otak-Otak 45%.**

### Comparison with Other studies

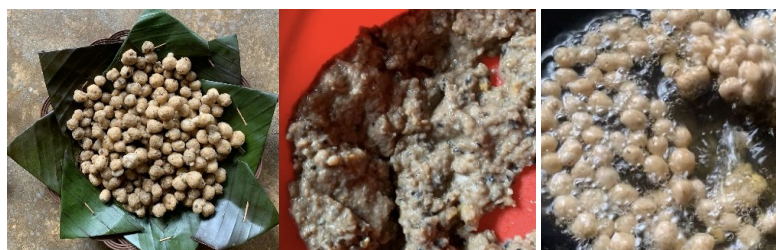
These findings are consistent with earlier studies on community empowerment through food innovation. Anggoro Putranto [6] reported similar knowledge and skill gains when Bengkulu villagers were trained to produce snail meat floss (*abon*), while Hendambo [19] demonstrated that golden snail

satay and stew dishes were widely accepted by consumers in Jayapura, supporting the potential of snail-based food in the same region. Rosida [11] confirmed that golden snail soy sauce possesses desirable chemical and sensory characteristics, highlighting the species' versatility as a food ingredient. Moreover, nutritional studies by Pratama and Andriani [20] and Yao [8] reaffirm the high protein content and feed potential of golden snails, while Ghosh [12] advocated farming *Pomacea canaliculata* as a "mini-livestock" to address protein shortages.

The participatory approach employed in this program parallels the methods of Maulana [17] and Indriyani [15], who observed significant improvements in knowledge retention and entrepreneurial readiness when using hands-on training for rural communities. Unlike many previous initiatives, however, this program applies these methods in Papua, where prior utilization of golden snails for human food has been limited [1], [14]. As seen in Figure 4 and Figure 5, this geographic and cultural context adds novelty, as it demonstrates the potential for invasive species utilization in a region historically overlooked in food innovation efforts.



**Figure 4. The Snails Were Cleaned, Blanched For 5 Minutes, Grinded, Mixed With Tapioca And Shaped**



**Figure 5. Pilus Batter, Fried And Become Pilus**

### **Implication and Explanation of Findings**

The program demonstrates that the utilization of invasive species can function as a dual-purpose intervention, supporting both ecological pest control and local food security. Skills acquisition was evident, as all participants independently completed each processing step, from snail preparation to pilus frying, indicating strong short-term competency development. Harvesting golden apple snails for processing also provides ecological co-benefits by reducing populations that threaten rice fields and freshwater ecosystems around Sentani Lake [5], [14]. Nutritionally, pilus enriched with snail protein offers an affordable, locally available option for communities facing chronic food insecurity [2].



Beyond technical skills, participants showed clear adoption intention, with several expressing readiness to continue production at home. Their engagement reflects early-stage enterprise readiness, supported by emerging ideas for product variation and interest in commercialization. These findings align with evidence that community-based, participatory training can improve entrepreneurial capacity, particularly when paired with packaging innovation [21], digital marketing exposure [17], and structured mentoring [15], [22]. Because the training model uses standardized recipes, hands-on demonstration, and shared learning, it can be replicated in similar Papuan communities, contributing to broader efforts to optimize local resources and integrate indigenous foods into local food systems [13].

### 3.1. Limitation and Recommendations

Limitations include lower-than-target attendance and the absence of long-term follow-up. Longitudinal monitoring is needed to measure sustained adoption, sales, and ecological impact. Strengthening policy support is also essential. Village and municipal governments could integrate keong mas processing into local food-security programs, facilitate access to packaging and safety certification, or assist in forming women-led microenterprises. Embedding this activity within local economic development strategies would reinforce its long-term impact and help transform invasive species utilization into a viable livelihood pathway for Yoka Village and surrounding communities.



**Figure 6.** Documentation With Participants

## CONCLUSION

The training on golden apple snail–based pilus snacks in Yoka Village successfully achieved its objectives of enhancing community knowledge, improving practical food-processing skills, and demonstrating the economic potential of utilizing an invasive species. By converting keong mas, a major agricultural and ecological pest, into a high-protein snack, the program provided an innovative, sustainable approach to pest management while addressing local food insecurity.

The initiative’s success underscores the value of participatory, hands-on community service programs that integrate ecological solutions with economic empowerment. Beyond reducing snail populations and improving household nutrition, this activity offers a replicable model for rural entrepreneurship and food innovation in Papua and other regions facing similar challenges.

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